

Winter crop variety sowing guide 2019

NSW DPI MANAGEMENT GUIDE



Peter Matthews and Don McCaffery



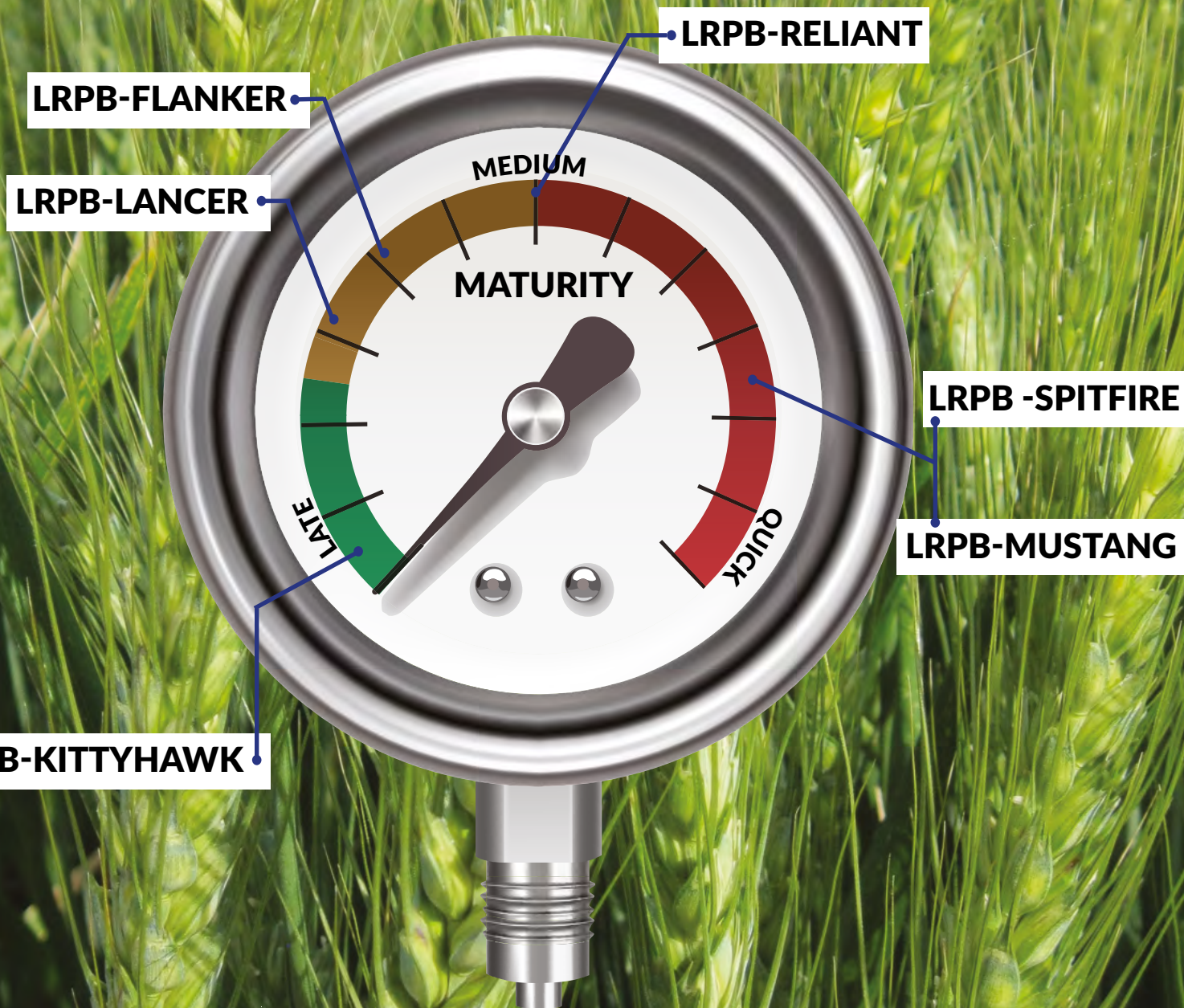
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Winter crop variety sowing guide 2019



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Introduction

Welcome to the 2019 edition of the *Winter crop variety sowing guide*, published each year by the NSW Department of Primary Industries (NSW DPI). The aim of this guide is to help grain growers and their advisers make better cropping decisions and higher profits from winter crops.

Profit depends on choosing the most suitable variety for each paddock and sowing time, optimising tactical crop management to achieve the chosen variety's yield potential, and matching the end product of both variety choice and management to available markets. This guide is updated annually with new variety and technical information, based on the latest research and development results from both NSW DPI and industry programs.

Cropping decisions can also be influenced by the complexities of modern technology, fluctuating markets and the vagaries of seasonal conditions, notwithstanding the impact of climate change on weather patterns in more recent times. These factors all contribute to the winter crop producer's need for careful planning and management to optimise productivity and profitability.

Profitable winter crop growing demands a higher production per unit area at a lower cost per unit of production. This can be achieved by increasing grain yields through adopting new or improved technology, including variety choice and management options. The goal is not higher total production, but greater productivity from the resources invested in crop production, along with total sustainability of the farm business. Carefully consider the range of information contained in this guide, how it can be applied to your farm business, and consult your local agronomist or farm adviser for more specific advice.

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ISSN 1328-9535
jn 15138

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Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (March 2019). However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the appropriate officer of NSW Department of Industry or the user's independent adviser.

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Acknowledgments

We gratefully acknowledge the Grains Research and Development Corporation (GRDC) for the financial support of the many research, extension and industry based projects from which information has been gathered for this publication. Yield and disease data for this publication is sourced from the National Variety Testing (NVT) program which is a GRDC initiative.

Wheat Quality Australia, GrainCorp, Grain Trade Australia, Pulse Australia and Barley Australia provide valuable assistance on the subjects of grain quality assessment, receival standards and marketing.

This publication is a companion to *Weed control in winter crops and Insect and mite control in field crops*, both publications are available on the NSW DPI website at www.dpi.nsw.gov.au

Front cover main photo and grain picture insets: courtesy of **Lupins for Life**, Drew families, Brocklesby NSW. Inset image: header unloading, Rohan Brill, NSW DPI.

Plant Breeder's Rights

Throughout this guide, varieties protected under Plant Breeder's Rights (PBR) legislation are signified by the symbol [Ⓟ]

Plant Breeder's Rights are exclusive commercial rights to a registered variety. In relation to propagating material of the registered variety, the breeder has exclusive rights to:

- a** produce or reproduce the material;
 - b** condition the material for the purpose of propagation (conditioning includes cleaning, coating, sorting, packaging and grading);
 - c** offer the material for sale;
 - d** sell the material;
 - e** import the material;
 - f** export the material; and
 - g** stock the material for any of the purposes described in (a) to (f).
- In most instances the breeder will licence these rights to a selected seed company (the licensee).

Exceptions to breeder's rights are the rights of farmers to save seed for sowing future commercial crops. However harvested material derived from farm saved seed will be subject to the End Point Royalty (EPR) applying to that variety.

Where EPRs apply, growers will be required to enter into arrangements with the breeder or licensee whereby royalties are paid on delivery of the grain. Some varieties may have a Seed Royalty (SR) paid on purchase of seed rather than an EPR.

Royalties collected are used to support ongoing research and the breeding of new and improved varieties.



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Interpreting variety trial results

The National Variety Trial (NVT) data presented in the *Winter crop variety sowing guide* are long-term multi-environment trial (MET) results. These results are currently the most accurate and reliable means of interpreting variety performance across sites and years. Within the limitations of the printed guide's format, results are presented for the main cereal types (wheat, barley, triticale and oats) on both a separate yearly regional mean basis (2014, 2015, 2016, 2017 and 2018) and on a combined regional mean basis that has been presented in previous editions of the guide. For crop types with a smaller number of testing sites (canola and pulse crops), MET's are presented only on a combined regional mean basis. The yearly regional mean values presented in the guide have been extracted from the NVT database and values are only shown for a variety when the variety was present at sites in that year. For consistency, the data has been extracted at the default values of accuracy and VAF filters, which are ≥ 0.8 and $\geq 50\%$ respectively within the 'Long term yield reporter' web tool. Users can change these, depending on their risk acceptance, under the 'Advanced' tab on the web tool. Definitions of the filters 'Accuracy' and 'VAF' can be found within the web tool. The regional mean yields shown in the guide are average varietal performances across trial locations within each year or region. This averaging can mask the variety by environment interaction; that is, the ability of a variety to yield differently at each location across seasons (years). For growers and agronomists wishing to further interrogate the NVT results on a varieties performance across the state, go to the **NVT site** (www.nvtonline.com.au). On the website, locate the 'Long term yield reporter'. This web tool gives users the ability to view data in yield based groupings and/or seasonal outcome across states, regions or selected trials down to a single site level.

The individual trial results for 2018 can also be located by using the interactive map on the NVT website home page and selecting the site of interest.



Highlights and changes 2019

Cereal diseases

Rusts: The dry season in 2018 kept cereal rust levels low across NSW, but there was a localised late outbreak of stem rust in southern Queensland barley crops. The dry summer and early autumn conditions in 2019 will lead to low stripe rust pressure early in the season, with stripe rust building up only if good winter and early spring rainfall permits successive infection cycles. The new stripe rust pathotype detected in 2017 did not cause problems in 2018 due to the drought; it has continued to spread north reaching the Dubbo region. Currently grown wheat varieties have been screened for the new pathotype and resistance ratings are shown in the variety characteristics and reactions to diseases table for wheat on [Table 13 on page 20](#). Growers and agronomists are urged to actively monitor crops throughout the season for any signs of stripe rust or any other rust. If rust is found, samples should be collected and submitted to the National Cereal Rust Survey (see [Managing grazing cereals on page 73](#)) before applying fungicide to the crop.

Barley yellow dwarf virus (BYDV) and Wheat streak mosaic virus (WSMV): BYDV and WSMV were observed at very low levels in south-eastern NSW in 2018. With the dry autumn conditions in 2019, growers are advised to treat any early-sown cereals with a registered insecticidal seed dressing to reduce aphid feeding and BYDV spread. Early sown cereal crops will be a target for aphid and wheat curl mite activity when migrating from perennial grass pastures or weeds.

Crown rot: Dry conditions in 2018 were conducive to the expression of crown rot throughout much of NSW. The dry summer and autumn of 2019 have also slowed stubble breakdown, so inoculum levels are expected to be high in infected cereal paddocks, not only those grown in 2018 but potentially also in stubble remaining from 2017, or even 2016 crops. Growers are urged to test for crown rot inoculum levels in paddocks before sowing using the PreDicta® B test, particularly if considering sowing durum crops, which are very susceptible to infection.

Smuts in cereals: With the increased areas sown to more loose-smut-susceptible barley types such as Hindmarsh[Ⓢ], LaTrobe[Ⓢ], Rosalind[Ⓢ] and Spartacus CL[Ⓢ], growers are encouraged to ensure all sowing seed is treated with an effective seed dressing and all seed is checked as free from visibly smut-infected grain. Both feed and malt barley have a **nil tolerance** for smut-contaminated grain.

Insect pests

Russian wheat aphid: Russian wheat aphid (RWA) was initially found in South Australia and Victoria in 2016, and was subsequently found in NSW and Tasmania. In spring 2018, RWA has been newly detected around Cowra, Forbes, Condobolin and as far north as Coonamble, Coonabarabran and the Liverpool Plains. Grain growers and agronomists across NSW are urged to regularly monitor cereal paddocks for signs of RWA in order to manage infestations.

New varieties with limited data available

The *Winter crop variety sowing guide* contains information on commercially available crop varieties that may be suited to NSW, it does not include all varieties available and may not include outclassed varieties, interstate released varieties or niche market varieties. Consult either the owners or commercial licensees of new varieties for further information. Further yield performance data is available from the NVT site (www.nvtonline.com.au) on varieties included and tested in the NVT trials across NSW.

When considering a new variety, compare the yield, grain quality and disease resistances of the new variety with the currently grown varieties.

Varietal changes

Wheat. Two new winter wheat varieties were released in the 2018 season, DS Bennett[Ⓢ] and Illabo[Ⓢ]. Five new spring wheat varieties will be available for the 2019 season: DS Tull[Ⓢ], LG Gold[Ⓢ], Razor CL PLUS[Ⓢ], Sunprime[Ⓢ] and Vixen[Ⓢ]. One new soft wheat variety, LRPB Oryx[Ⓢ], was released and is a replacement variety for LRPB Impala[Ⓢ] in dryland and supplementary irrigation soft wheat systems.

The variety characteristics and reactions to diseases table for wheat on [Table 13 on page 20](#) lists the maximum quality classification of varieties at the time of publishing.

Some newer varieties might not have a final classification for all NSW regions pending further sample testing.

Barley. Check before growing any new malt barley variety, that local segregation is available for that variety, or short-term on-farm storage might be required before delivery to a buyer. RGT Planet[®] is now an accredited malt barley variety. In NSW, there will be limited availability of Banks[®] and Topstart[®] for 2019; both will be deliverable as feed only. A new acid-tolerant barley, Buff[®], was released in Western Australia, which may have adaptation to NSW acid soil conditions.

Canola. There are 10 new releases for 2019.

There are no new conventional varieties. The winter-type canola SF Brazzil has been withdrawn.

Hyola[®] 550TT, InVigor T 3510, Pioneer 45T03 (TT) and SF Spark TT are four new TT hybrids. ATR-Gem and Pioneer 45T01 (TT) have been withdrawn.

Pioneer[®] 45Y93 (CL) is a new CLEARFIELD[®] hybrid. Archer has been withdrawn.

InVigor R 4020P is a new Roundup Ready[®] hybrid with the PodGuard trait. DG 460RR and GT-41 have been withdrawn.

Hyola[®] 410XX is a new TruFlex[®] Roundup Ready[®] Technology hybrid.

Hyola[®] 580CT is a new dual herbicide-tolerant hybrid combining CLEARFIELD[®] and triazine tolerance.

Hyola[®] 530XT is a new dual herbicide-tolerant hybrid combining TruFlex[®] Roundup Ready[®] Technology and triazine tolerance.

Improvements have been made to [Table 44 on page 79](#) based on recent research. The state has been divided into seven broad regions and suggested sowing times are shown for 'slow', 'mid' and fast phenology (speed to flowering from sowing earlier than 15 April) varieties. Phenology ratings of varieties are shown in [Table 45 on page 86](#).

Chickpea. There are no new chickpea variety releases for NSW in 2019, although PBA Drummond[®] is a new variety for growing areas in central Qld. PBA Drummond[®] has had very limited testing in northern NSW, but is potentially suited to north-western areas where Kyabra[®] has been grown, and in paddocks with a low Phytophthora risk.

Drought conditions in winter/early spring 2018 across most of NSW meant disease incidence (*Ascochyta*, *Phytophthora*, *Sclerotinia* and *Botrytis*) was low overall in 2018 and followed dry conditions in 2017. Isolated cases of *Ascochyta* infection in 2018 crops were in paddocks that had grown chickpea in 2016 or 2017, highlighting that this disease should never be underestimated and the disease management strategy outline on [page 100](#) should be followed every year.

Faba bean. PBA Nanu[®], PBA Bendoc[®] and PBA Marne[®] are three new faba bean varieties for 2019. PBA[®] Nanu[®] is released for northern NSW. It is higher yielding than PBA[®] Warda in the north west and has similar disease resistance. Seed is slightly larger than PBA[®] Warda. PBA Bendoc[®] is adapted to southern NSW, but has had limited testing to date. It is the first imidazolinone-tolerant faba bean variety. There is an existing permit (PER 14726, expiry 30/09/2019) for imazamox and a further permit is being sought for 2019. PBA Marne[®] is adapted to southern NSW shorter-season environments. In dryland testing it is slightly higher yielding than PBA Samira[®] and has a similar seed size.

The dry season in 2018 kept disease pressure very low, suggesting that inoculum levels should also be low. Inoculum load and seasonal conditions dictate disease infection and pressure, so sticking to recommended and proven strategies is advised. The bean aphid (*Megoura crassicauda*) was again found at the Liverpool Plains Field Station in 2018.

The aphid has not been found in commercial crops, but growers and advisers should report any suspicious aphid activity.

Field pea. There are no new field pea varieties for 2019. PBA Butler[®] was released in late 2017. It is a Kasper[®] seed type variety that has performed similar or better than PBA Oura[®] in southern NSW. It is mid-late flowering with early-mid maturity. It performs best in medium-to long-season climates. Bacterial blight outbreaks were widespread in 2018 due to severe frosts in some districts. The dry conditions in 2018 kept other diseases at low levels. PBA Butler[®], PBA Oura[®] and PBA Percy[®] all have good resistance to bacterial blight.

Lupin. There are no new lupin releases for 2019. The narrow-leaf lupin PBA Bateman[®] and the albus lupin Murringo[®] were released in late 2017. Restrictions following anthracnose detection in southern NSW in 2016 have been lifted as there were no detections in 2018.

Lupins are increasingly being used as a double-break grain crop in the year before canola in central and southern NSW. Growers need to be aware of the potential for *Sclerotinia* to infect lupin, providing an extra source of disease inoculum for the following canola crop.



Wheat

Variety choice

Varieties are tested across NSW before being included in the *Winter crop variety sowing guide*. However, varietal performance varies from year to year due to seasonal conditions and many other factors. Use varieties yielding consistently well over several years that offer the best combination of yield potential, grain quality and disease resistance.

To ensure high yields select varieties by considering:

- grain quality to attract premium payments
- good disease resistance
- maturity suited to sowing time
- strong seedling vigour
- resistance to lodging and shattering
- tolerance to herbicides
- tolerance to soil acidity
- tolerance to pre-harvest sprouting
- good threshing ability
- tolerance to frost.

Varieties for each receival zone

Varieties are considered according to their suitability for the two receival zones in NSW: northern and south-eastern. The major purpose of this division is for the environmental growing season differences on grain quality, transport and marketing arrangements. This facilitates deliveries by quality grade, maximising grower returns.

Growers can grow the varieties of their choice regardless of classification zone and deliver them to selected clients on a negotiated basis. If a variety is to be accepted into its classification grade, it must be taken to a receival site where that grade is segregated. Certain quality standards must be met before the variety will be accepted.

Segregation is a separate issue from variety approvals. Varieties are commonly suited to a range of end uses such as pan bread, steam bread or noodles, whereas others have specific uses such as biscuits or pasta, depending on their quality.

Sow on time

Varieties differ in the time they take from sowing to flowering. Late sown (quicker maturing) varieties take fewer days to flower than early-sown (late maturing) varieties. Some varieties sown too early will flower in late winter. Avoid this as it can result in crops flowering in late winter, when frosts can cause damage leading to a reduced yield and which can also affect grain quality. Varieties sown too late have little chance of reaching their yield potential because flowering and grain filling occur under hot, dry, stressful conditions.

Sowing time is a management compromise between having the crop flowering soon after the last heavy frost, but early enough to allow adequate grain fill before the onset of moisture stress and heat in spring.

Yield drops 4–7% with each week of delay in sowing after the optimum time for a specific variety.

If varieties are sown within the optimum sowing period, they can produce their highest yields, but the best sowing date varies with topography and variety. Locally, sowing dates might need to be extended (earlier or later) depending upon local climatic conditions and soil types.

Conservation tillage techniques (no till, minimum till) as well as using moisture-seeking sowing tynes can enable varieties to be sown on time.

Frost damage is a major consideration and the risk cannot be eliminated entirely; therefore, the potential for higher yields from earlier sowings needs to be balanced against the risk of frost damage at flowering.

CROP MANAGEMENT

Profitable yields result from good management, of which variety choice is only a minor part. To reach their full potential, varieties must be grown in a rotation that minimises the risks from diseases and weeds, and maximises soil fertility and soil moisture storage.

TIPS AND TRICKS

1. Sow at least two different varieties each year. This spreads the risk of frost and disease damage.
2. Sowing towards the earliest part of the recommended sowing window usually results in higher yields.

High quality seed for Australian farmers...



Full list of varieties available in 2019

Wheat

Sunmax	Flanker
Suntime	Sunprime - NEW
Lancer	Reliant
Coolah	Mustang

Durum Wheat

DBA Lillaroï	DBA Bindaroï
--------------	--------------

Barley

RGT Planet	GrangeR
Spartacus CL	Compass

Oats

Drover	Taipan
Comet	

Chickpeas

PBA Seamer	PBA Monarch
PBA HatTrick	

Faba Beans

PBA Nasma	PBA Warda
PBA Nanu - NEW	



There are two ways of doing this:

1. In areas where the risk of frost is high, sow later than the suggested optimum sowing period. As a rule of thumb, three days difference at planting makes one day difference at heading.
2. Change varieties. Use maturity differences to have the crop flowering at a time when frost risk is acceptable.

Since rain for sowing is often erratic, varieties must be carefully chosen to achieve this balance.

Sowing rates and plant populations

High yields are possible from a wide range of sowing rates because wheat compensates by changing the number of tillers and the size of the head – the number of grains per head in response to the prevailing environment, including weather, fertility and plant competition.

Aim to establish a target number of plants. To achieve this, target a population for the environment and the seasonal conditions. Adjust sowing rates to compensate for:

- sowing date – higher with later sowings
- seed germination
- seed size
- seedling vigour differences
- seedbed conditions
- conservation tillage techniques (no-till, minimum till)
- double cropping
- soil fertility
- soil type
- field losses – see the following explanation.

Field losses: Under normal conditions, expect to lose up to 20% of seed sown in addition to germination losses. Adjust sowing rates to suit sowing conditions.

Press wheels improve establishment under dry or marginal moisture conditions.

Where herbicide resistance is suspected, higher sowing rates can assist with competition against weeds.

Calculating sowing rates

The following formula can be used to calculate sowing rates, taking into account:

- target plant density (plants per m²)
- germination percentage (90% = 90 in the formula)
- seed size (1000 seed weight in grams)
- establishment – usually 80%, unless sowing into adverse conditions (80% = 80 in the formula).

Tip – 1000 seed weight:

- count out 200 seeds
- weigh to at least one decimal point of a gram
- multiply weight in grams by five.

Example

1000 seed weight (grams)		target plant population (plants/m ²)		establishment percentage × germination percentage	
.....35.....	×	.....140.....	× 100 ÷	..... 80..... ×90.....	= your sowing rate .....68..... kg/ha

Your calculation

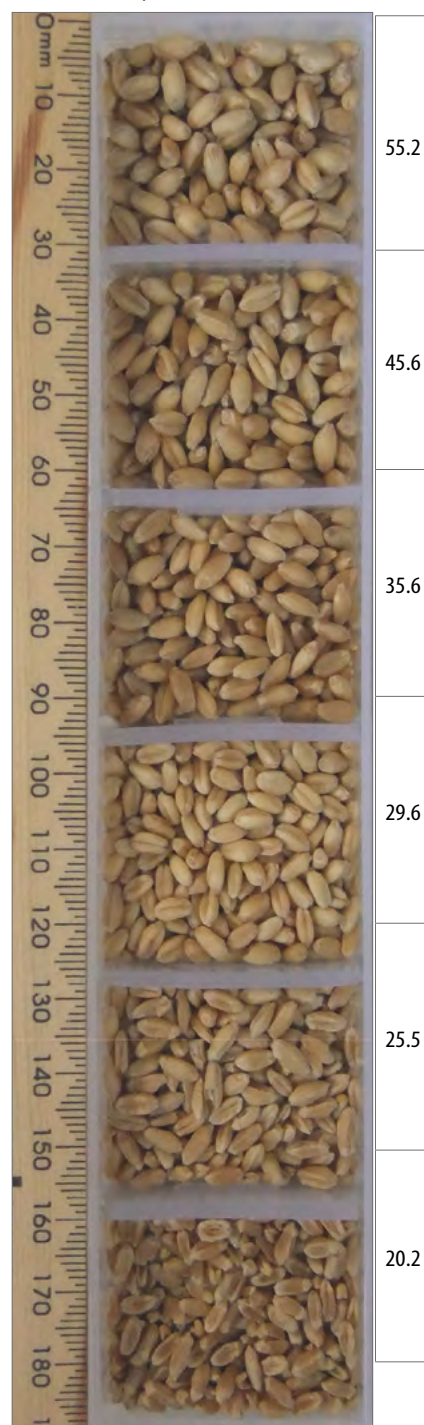
1000 seed weight (grams)		target plant population (plants/m ²)		establishment percentage × germination percentage	
.....	×	.....	× 100 ÷	..... × .....	= your sowing rate kg/ha

Table 1. Wheat sowing rates (kg/ha) for various plant populations (plants/m²) and 1000 seed weight (grams) for different rainfall region in NSW.

1000 seed weight (grams)	Target wheat plant population for grain only crops (plants/m ²) #													
	Rainfall													
	Low					Medium					High and irrigation			
	50	60	70	80	90	100	110	120	130	140	150	160	170	180
20	14	17	19	22	25	28	31	33	36	39	42	44	47	50
22	15	18	21	24	28	31	34	37	40	43	46	49	52	55
24	17	20	23	27	30	33	37	40	43	47	50	53	57	60
26	18	22	25	29	33	36	40	43	47	51	54	58	61	65
28	19	23	27	31	35	39	43	47	51	54	58	62	66	70
30	21	25	29	33	38	42	46	50	54	58	63	67	71	75
32	22	27	31	36	40	44	49	53	58	62	67	71	76	80
34	24	28	33	38	43	47	52	57	61	66	71	76	80	85
36	25	30	35	40	45	50	55	60	65	70	75	80	85	90
38	26	32	37	42	48	53	58	63	69	74	79	84	90	95
40	28	33	39	44	50	56	61	67	72	78	83	89	94	100
42	29	35	41	47	53	58	64	70	76	82	88	93	99	105
44	31	37	43	49	55	61	67	73	79	86	92	98	104	110
46	32	38	45	51	58	64	70	77	83	89	96	102	109	115
48	33	40	47	53	60	67	73	80	87	93	100	107	113	120
50	35	42	49	56	63	69	76	83	90	97	104	111	118	125
52	36	43	51	58	65	72	79	87	94	101	108	116	123	130
54	38	45	53	60	68	75	83	90	98	105	113	120	128	135
56	39	47	54	62	70	78	86	93	101	109	117	124	132	140
58	40	48	56	64	73	81	89	97	105	113	121	129	137	145
60	42	50	58	67	75	83	92	100	108	117	125	133	142	150

Seeding rates (kg/ha) calculated on a 90% germination and 80% establishment basis.

1000 seed weights (grams) of pictured wheat seed samples



Wheat

Nutrition

A balance of nutrients is essential for profitable yields. Fertiliser is commonly needed to add phosphorus and nitrogen, which are essential nutrients. The lack of other essential plant nutrients can also limit production in some situations. Growers should soil test before sowing, or if a deficiency is observed in crop, take plant tissue samples and have them tested. Consult your agronomist on interpreting soil or plant tissue test results.

Knowing a crop's nutrient demand is essential in determining nutrient requirements. Soil testing and nutrient audits help to match nutrient supply to crop demand.

Weed management in winter crops

Herbicide resistance in weeds is a problem that continues to become more widespread through NSW, and of which growers need to be aware. It is the biggest threat to cropping-system sustainability. However, this problem can be managed by having good crop and pasture rotations, by rotating herbicide groups and by combining both chemical and non-chemical methods of weed control. Further information on weed control strategies is in the management guide *Weed control in winter crops*.

GO TO PAGE

Weed control in winter crops (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Suggested sowing times

Aim to sow grain-only crops in the earlier part of the optimum period. The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock. Sowing windows for specific varieties varies across the regions and the tables are provided as a guide. Sowing decisions should be made according to the relative maturity of each variety.

USEFUL RESOURCES

NVT website (www.nvtonline.com.au).

Northern NSW – Varieties

Yield performance experiments from 2014–2018.

The yield results presented are NVT 'Production Value' multi environment trial (MET) data shown on a yearly regional group mean and regional mean basis from 2014–2018. Further results can be found on the **NVT website**.

Table 2. Long season varieties (North): Compared with EGA_Wedgetail = 100%

Variety	North east						
	Yearly group mean					Regional mean	Number of trials
	2013	2014	2015	2016	2017	2018	
% EGA_Wedgetail (t/ha)	3.05	2.56	3.35	5.35	–	–	3.65
DS Bennett■	–	–	–	108	–	–	103
EGA_Wedgetail■	100	100	100	100	–	–	100
Illabo■	–	–	–	112	–	–	112
Longsword■	–	–	–	119	–	–	123
LRPB Kittyhawk■	–	113	108	104	–	–	106
Mackellar■	99	80	91	91	–	–	90
Manning■	87	51	81	75	–	–	73
Naparoo■	105	64	64	101	–	–	85
RGT Accroc■	–	75	98	104	–	–	97
Sunlamb	–	115	114	92	–	–	105

■ Winter wheat

Table 3. Early season variety trial results Northern NSW (sown before 15 May): Compared with EGA_Gregory = 100%

Variety	North east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	3.97	4.21	5.14	3.58	2.47	4.06	
Coolah	106	102	107	111	106	106	20
Cutlass	—	—	—	112	104	105	5
DS Bennett■	—	—	—	57	102	92	3
DS Faraday	—	101	100	98	99	100	15
EGA_Gregory	100	100	100	100	100	100	20
EGA_Wedgetail■	77	81	97	58	92	84	20
Illabo■	—	—	—	65	88	89	5
Kiora	97	93	101	101	—	98	17
Longsword■	—	—	—	72	—	93	2
LRPB Flanker	105	104	105	107	104	105	20
LRPB Gauntlet	101	102	94	106	90	99	20
LRPB Gazelle*	93	83	101	—	—	95	15
LRPB Kittyhawk■	—	81	95	58	89	83	15
LRPB Lancer	103	101	98	111	94	101	20
Mitch	106	101	106	112	104	105	20
Strzelecki	91	92	95	—	—	92	15
Sunlamb	—	85	98	57	94	86	15
Sunmax	—	90	105	84	105	96	15
Suntime	96	94	98	98	96	96	20
Sunvale	96	96	92	101	89	94	20
Sunzell	88	90	94	81	93	90	20
Feed wheats							
RGT Zanzibar	—	—	111	74	102	98	10
Tungsten	—	—	93	102	—	94	7

■ Winter wheat

* Soft/biscuit wheat variety.

Table 4. Early season variety trial results Northern NSW (sown before 15 May):
Compared with EGA_Gregory = 100% (continued)

Variety	North west						Number of trials
	Yearly group mean					Regional mean	
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	3.25	4.27	4.88	2.16	1.87	3.44	
Coolah	104	104	108	113	106	107	29
Cutlass	—	—	—	114	105	106	10
DS Faraday	—	100	101	96	100	100	23
EGA_Gregory	100	100	100	100	100	100	29
EGA_Wedgetail■	85	73	96	57	100	83	29
Illabo■	—	—	—	57	—	87	6
Longsword ■	—	—	—	59	—	91	6
LRPB Flanker	103	105	105	107	104	105	29
LRPB Gauntlet	97	102	98	100	91	99	29
LRPB Gazelle*	98	86	98	—	—	98	19
LRPB Kittyhawk■	—	73	95	57	97	82	23
LRPB Lancer	99	102	102	108	95	102	29
Mitch	103	103	108	114	105	106	29
Strzelecki	94	89	94	—	—	92	19
Sunlamb	—	76	97	55	—	84	19
Sunmax	—	87	102	90	108	96	23
Suntime	96	94	99	100	98	97	29
Sunvale	95	96	94	99	90	95	29
Sunzell	92	87	93	81	96	90	29
Feed wheats							
Tungsten	—	—	94	105	—	96	13

■ Winter wheat

* Soft/biscuit wheat variety.

Wheat

Sunmax[Ⓢ]

The best early break wheat option in the North.



- Long season maturity, best suited to mid to late April plantings
- APH quality classification in the Northern Zone
- Out-yields other early sowing options Sunbri, Sunbrook and Sunzell[Ⓢ]
- Excellent stem and stripe rust resistance
- Tolerance to root lesion nematode (P. thornei)

www.agtbreeding.com.au for more information.

Table 5. Main season variety trial results Northern NSW (sown after 14 May):
Compared with EGA_Gregory = 100%

Variety	North east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	4.23	3.70	5.03	3.47	1.98	3.83	
Beckom	—	110	103	115	106	108	19
Condo	111	111	100	110	97	106	24
Coolah	—	—	105	105	106	104	13
DS Faraday	—	103	—	103	102	103	13
EGA_Gregory	100	100	100	100	100	100	24
EGA Wylie	97	98	89	—	—	94	17
Elmore CL Plus	97	100	100	100	100	99	24
Janz	—	98	—	—	—	97	6
Livingston	105	105	95	107	95	101	24
LRPB Crusader	107	103	93	99	86	99	24
LRPB Dart	100	100	90	101	89	96	24
LRPB Flanker	105	105	105	104	104	105	24
LRPB Gauntlet	102	101	95	102	95	99	24
LRPB Impala*	99	103	106	100	102	103	24
LRPB Mustang	—	—	99	115	103	106	13
LRPB Oryx*	—	104	104	100	—	103	12
LRPB Reliant	111	110	102	113	104	107	24
LRPB Spitfire	101	101	93	101	90	97	24
Mitch	101	104	109	100	103	104	19
Scepter	—	—	—	112	105	115	7
Sunguard	100	101	97	—	—	99	17
Sunmate	102	107	—	109	99	102	18
Sunprime	—	—	—	109	102	103	7
Suntop	105	108	101	108	100	104	24
Sunvale	92	95	93	94	93	94	24
Wallup	105	105	95	105	94	101	24

Variety	North west						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	3.65	3.25	5.04	1.85	1.80	3.39	
Beckom	—	112	104	117	100	107	23
Condo	104	110	100	114	92	104	29
Coolah	—	—	107	110	103	104	17
DS Faraday	—	103	—	102	101	102	15
EGA_Gregory	100	100	100	100	100	100	29
EGA Wylie	95	98	89	—	—	93	20
Elmore CL Plus	98	99	101	107	101	100	29
Janz	—	93	—	—	—	99	6
Livingston	98	104	95	109	90	99	29
LRPB Crusader	97	101	92	96	87	95	29
LRPB Dart	92	96	91	99	87	93	29
LRPB Flanker	105	106	105	107	103	105	29
LRPB Gauntlet	97	100	95	98	94	97	29
LRPB Impala*	101	100	107	111	104	104	29
LRPB Mustang	—	—	100	118	99	106	17
LRPB Oryx*	—	—	105	109	—	104	14
LRPB Reliant	107	115	101	115	99	107	29
LRPB Spitfire	95	98	93	101	87	95	29
Mitch	—	99	110	111	100	106	23
Scepter	—	—	—	122	104	114	9
Sunguard	98	100	98	—	—	99	20
Sunmate	100	105	—	116	91	102	21
Sunprime	—	—	—	115	98	103	9
Suntop	102	106	102	113	93	103	29
Sunvale	93	91	94	95	91	93	29
Wallup	98	104	96	107	91	99	29

* Soft/biscuit wheat variety.

Suggested sowing times – Northern

Aim to sow grain-only crops in the earlier part of the optimum period. The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock. Sowing windows for specific varieties varies across the regions and the tables are provided as a guide. Sowing decisions should be made according to the relative maturity of each variety.

Table 6. Suggested sowing times Northern NSW

		March				April				May				June				July		
Variety	Weeks	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Slopes																				
Mackellar■, Manning■, RGT Accroc■	>	★	★	★	★	★	★	★	★	<										
DS Bennett■		>	★	★	★	★	★	★	★	★	<									
EGA_Wedgetail■, Illabo■, Kittyhawk■, Naparoo■		>	>	★	★	★	★	★	★	★	<									
Sunlamb					>	★	★	★	★	<										
Longsword■					>	★	★	★	★	★	<									
Sunbrook, Sunmax						>	★	★	★	<	<									
Kiora, Lancer, Suntime, Sunzell, Tungsten							>	★	★	★	★	<								
Coolah, DS Faraday, EGA_Gregory, Flanker, Gazelle, Mitch, RGT Zanzibar								>	★	★	★	<								
Beckom, EGA_Burke, EGA_Wylie, Sunvale									>	★	★	★	<							
Elmore CL PLUS, Impala, Janz, Oryx, Reliant, Sunguard, Suntop, Wallup										>	★	★	★	★	<					
Baxter											>	★	★	★	★	<	<			
B53, Condo, Crusader, LG Gold, Livingston, Mustang, Spitfire, Sunmate, Sunprime												>	★	★	★	★	<	<		
Dart													>	★	★	★	★	<	<	
Plains																				
EGA_Wedgetail■, Illabo■, Kittyhawk■, Longsword■, Naparoo■, Sunlamb					>	★	★	★	★	<										
Sunbrook						>	★	★	★	<	<									
Sunmax							>	★	★	★	<									
Kiora, Sunbri, Suntime, Sunzell, Tungsten							>	>	★	★	★	★	<	<						
Coolah, DS Faraday, EGA_Gregory, Flanker, Gazelle, Lancer, Mitch									>	★	★	★	<							
Beckom, EGA_Burke, EGA_Wylie, Gauntlet, Sunvale										>	★	★	★	<						
Elmore CL PLUS, Impala, Janz, Oryx, Reliant, Sunguard, Suntop, Wallup										>	★	★	★	★	<	<				
Baxter											>	★	★	★	★	<	<			
B53, Condo, Crusader, Emu Rock, LG Gold, Livingston, Mustang, Spitfire, Sunmate, Sunprime												>	★	★	★	★	<			
Dart													>	★	★	★	★	<		

> Earlier than ideal, but acceptable.

★ Optimum sowing time.

< Later than ideal, but acceptable.

■ Winter wheat sowing window can be extended earlier, provided crops are grazed to delay reproductive development.

Note: For durum suggested sowing times see Table 19. Suggested sowing times, Durum wheat varieties on page 35.

Sunprime[®]

The new late planting APH wheat option to complete your cropping program.



- New release, available for 2019 plantings
- Fast maturity, well suited to late May and June plantings
- Higher yielding* alternative to Spitfire[®]
- APH quality classification in the Northern Zone
- Good root lesion nematode (P. thornei) tolerance

*Sunprime[®] 7% higher yielding than Spitfire[®]: Grain yield as % of the average of northern NSW/QLD main season National Variety Trial (NVT) Multi-Environment Trial (MET) analysis (2014-2018). www.agtbreeding.com.au for more information.

Southern NSW – Varieties

Yield performance experiments from 2014–2018.

The yield results presented are NVT 'Production Value' multi environment trial (MET) data shown on a yearly regional group mean and regional mean basis from 2014–2018. Further results can be found on the [NVT website](http://www.nvtonline.com.au) (www.nvtonline.com.au).

Table 7. Long season varieties (southern): Compared with EGA_Wedgetail = 100%

Variety	South east							Number of trials
	Yearly group mean						Regional mean	
	2013	2014	2015	2016	2017	2018		
% EGA_Wedgetail (t/ha)	3.48	3.38	4.91	5.77	4.16	5.31	4.52	
DS Bennett■	–	–	–	115	115	109	110	8
EGA_Wedgetail■	100	100	100	100	100	100	100	19
Illabo■	–	–	–	93	98	89	103	8
Longsword■	–	–	–	88	95	94	92	8
LRPB Kittyhawk■	–	102	102	96	99	96	99	17
Mackellar■	101	118	101	107	–	–	107	15
Manning■	95	122	96	104	115	118	106	19
Naparoo■	92	86	93	111	91	100	97	19
RGT Accroc■	–	107	107	123	120	113	115	17
Sunlamb	–	91	100	103	101	101	100	17

■ Winter wheat

Table 8. Early season variety trial results (sown before 15 May): Compared with EGA_Gregory = 100%

Variety	South east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	3.37	4.86	5.65	4.65	2.73	4.51	
Coolah	110	105	111	108	109	109	21
Cutlass	–	105	114	108	111	110	16
DS Bennet■	–	–	120	112	109	111	10
DS Darwin	105	102	99	96	100	101	21
DS Faraday	–	102	100	101	100	101	16
DS Pascal	107	91	111	100	105	103	21
EGA_Gregory	100	100	100	100	100	100	21
EGA_Wedgetail■	96	91	106	97	97	98	21
Estoc	108	–	–	–	–	103	5
Illabo■	–	–	111	101	103	106	10
Kiora	108	97	109	101	105	104	21
Longsword■	–	–	108	102	103	107	10
LRPB Flanker	105	105	105	106	105	105	21
LRPB Gauntlet	104	101	97	94	99	99	21
LRPB Gazelle*	103	87	109	–	–	100	17
LRPB Kittyhawk■	–	90	104	95	96	97	16
LRPB Lancer	109	102	104	99	104	104	21
LRPB Trojan	117	110	113	110	113	112	21
Strzelecki	94	92	96	–	–	94	17
Sunlamb	–	94	104	98	96	98	16
Sunmax	–	96	109	105	–	103	14
Suntime	102	96	103	97	100	100	21
Sunvale	99	94	95	90	95	95	21
Sunzell	93	92	95	–	–	93	17
Feed wheats							
RGT Zanzibar	–	–	123	116	114	116	10

Table 9. Early season variety trial results (sown before 15 May): Compared with EGA_Gregory = 100% (continued)

Variety	South west#						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	4.20	3.59	5.10	4.87	6.61	4.54	
Coolah	107	108	113	107	106	109	26
Cutlass	—	110	117	108	107	111	19
DS Bennett■	—	—	125	102	99	106	12
DS Darwin	101	104	102	100	104	102	26
DS Faraday	—	101	101	100	101	100	19
DS Pascal	105	100	116	103	99	106	21
EGA_Gregory	100	100	100	100	100	100	26
EGA_Wedgetail■	93	89	110	95	93	97	26
Estoc	106	105	107	—	—	106	21
Illabo■	—	—	118	99	101	104	12
Kiora	104	103	112	103	102	106	26
Longsword■	—	—	115	99	104	105	12
LRPB Flanker	103	105	105	104	104	104	26
LRPB Gauntlet	101	103	100	99	—	101	24
LRPB Gazelle*	106	97	111	—	—	104	21
LRPB Kittyhawk■	—	89	109	94	93	97	19
LRPB Lancer	105	106	108	103	105	106	26
LRPB Trojan	110	115	116	109	111	113	26
Strzelecki	96	92	96	—	—	95	20
Sunlamb	—	89	106	94	93	96	19
Sunmax	—	97	110	102	—	102	17
Suntime	101	99	105	100	99	101	26
Sunvale	99	98	97	97	99	98	26
Sunzell	94	91	96	—	—	94	21
Feed wheats							
RGT Zanzibar	—	—	130	107	106	113	12

Includes irrigated trials

■ Winter wheat

* Soft/biscuit wheat variety.

Wheat

Illabo[Ⓢ]

The highest yielding
EGA Wedgetail[Ⓢ] alternative
for southern NSW.

Illabo[Ⓢ]

101%

EGA Wedgetail[Ⓢ]

94%

Kittyhawk[Ⓢ]

94%

Grain yield expressed as % of the average of southern NSW early sown National Variety Trial (NVT) Multi-Environment Trial (MET) analysis (2014-2018). www.agtbreeding.com.au for more information.

Table 10. Main season variety trial results – Southern (sown after 14 May):
Compared with EGA_Gregory = 100%

Variety	South east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	3.63	4.62	5.81	4.37	2.86	4.48	
Beckom	115	108	108	110	109	110	21
Chara	98	97	99	98	100	98	21
Condo	113	106	102	97	95	105	21
Coolah	–	–	103	105	102	104	10
Corack	111	105	100	102	105	104	21
DS Darwin	100	98	96	93	94	97	21
DS Faraday	–	101	99	99	98	100	15
DS Tull	–	–	101	98	94	100	10
EGA_Gregory	100	100	100	100	100	100	21
Elmore CL Plus	99	98	99	96	95	98	21
Emu Rock	103	100	96	96	100	99	21
Grenade CL Plus	93	94	91	91	95	92	21
Janz	–	97	–	–	–	95	5
Livingston	98	98	89	88	89	93	21
LRPB Cobra	109	103	106	101	96	105	21
LRPB Crusader	93	94	88	83	–	90	19
LRPB Dart	94	93	84	–	–	88	17
LRPB Flanker	104	102	106	104	101	104	21
LRPB Gauntlet	99	99	93	93	95	96	19
LRPB Impala*	99	98	101	101	101	100	21
LRPB Mustang	–	–	100	99	99	103	10
LRPB Oryx*	–	102	104	100	–	103	10
LRPB Reliant	105	104	98	98	99	101	21
LRPB Spitfire	95	95	90	88	91	92	21
LRPB Trojan	110	104	107	105	103	107	21
Mace	108	104	97	98	100	102	21
QAL2000*	94	94	102	–	–	98	8
QALBIS*	83	87	92	–	–	88	8
Razor CL PLUS	–	–	–	99	101	103	4
Scepter	–	107	105	109	112	108	15
Sunguard	100	98	96	–	–	97	17
Sunmate	98	98	–	–	–	95	11
Sunprime	–	–	–	99	100	102	4
Suntop	103	101	95	98	98	99	21
Sunvale	93	95	93	87	85	93	21
Vixen	–	–	–	112	115	111	4
Wallup	102	99	97	93	94	98	21
Yenda*	81	86	100	94	–	91	13
Feed wheats							
Tenfour	119	111	106	105	–	110	19

* Soft/biscuit wheat variety.

Table 11. Main season variety trial results – Southern (sown after 14 May):
Compared with EGA_Gregory = 100% (continued)

Variety	South west#						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% EGA_Gregory (t/ha)	4.05	3.14	5.05	4.53	4.32	4.16	
Beckom	113	121	112	110	108	113	28
Chara	99	107	104	102	102	103	28
Condo	109	116	105	100	104	107	28
Coolah	–	–	105	105	103	107	14
Corack	110	118	103	104	107	108	28
DS Darwin	103	112	102	100	102	104	23
DS Faraday	–	104	–	100	101	102	14
DS Tull	–	–	104	100	100	104	14
EGA_Gregory	100	100	100	100	100	100	28
Elmore CL Plus	103	106	103	99	100	103	28
Emu Rock	104	113	99	101	104	104	28
Grenade CL Plus	100	104	95	97	100	99	28
Janz	–	111	99	99	102	102	21
Livingston	101	109	94	97	100	100	28
LRPB Cobra	113	121	113	106	104	112	28
LRPB Crusader	95	104	93	93	–	96	24
LRPB Dart	97	109	91	–	–	97	21
LRPB Flanker	105	105	107	103	101	105	28
LRPB Gauntlet	101	107	96	99	–	100	24
LRPB Impala*	105	106	103	102	102	104	28
LRPB Mustang	–	–	103	101	104	106	14
LRPB Oryx*	–	110	107	102	102	107	14
LRPB Reliant	102	101	95	98	101	99	28
LRPB Spitfire	100	108	95	97	100	100	28
LRPB Trojan	111	117	112	106	105	111	28
Mace	111	120	101	104	106	108	28
QAL2000*	104	106	107	–	100	105	8
QALBIS*	94	94	96	–	–	95	6
Razor CL PLUS	–	–	–	102	105	105	7
Scepter	–	123	109	111	109	114	21
Sunguard	100	105	100	96	–	100	24
Sunmate	109	112	–	–	–	104	14
Sunprime	–	–	–	102	104	106	7
Suntop	108	114	99	104	103	105	28
Sunvale	96	98	97	93	96	96	28
Vixen	–	–	–	109	109	112	7
Wallup	101	112	103	100	102	104	28
Yenda*	98	96	107	98	95	100	9
Feed wheats							
Tenfour	120	127	110	108	–	115	24

Includes irrigated trials
* Soft/biscuit wheat variety.

Wheat

Coolah[Ⓛ]

The leading APH wheat variety
for the late April planting
window in NSW.



Coolah[Ⓛ]

107%

Flanker[Ⓛ]

104%

Lancer[Ⓛ]

103%

EGA Gregory[Ⓛ]

100%

Grain yield expressed as % of the average of NSW early sown National Variety Trial (NVT) Multi-Environment Trial (MET) analysis (2014-2018).
www.agtbreeding.com.au for more information.

NVT



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Suggested sowing times – Southern

Aim to sow grain-only crops in the earlier part of the optimum period. The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock. Sowing windows for specific varieties varies across the regions and the tables are provided as a guide. Sowing decisions should be made according to the relative maturity of each variety.

Table 12. Suggested sowing times southern NSW

Variety	Weeks	March				April				May				June				July		
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Slopes																				
Mackellar■, Manning■, RGT Accroc■		>	★	★	★	★	★	★	★	<										
DS Bennett■			>	★	★	★	★	★	★	★	<									
EGA_Wedgetail■, Illabo■, Kittyhawk■, Naparoo■, Rosella■			>		★	★	★	★	★	★	<									
Sunlamb					>	★	★	★	★	★	<									
Longsword■					>	★	★	★	★	★	<									
Sunmax						>	★	★	★	★	<									
Cutlass, DS_Pascal, Kiora, Sunzell, Suntime, Tungsten, Yenda							>	★	★	★	★	<								
Coolah, DS Faraday, EGA_Gregory, Flanker, Gazelle, Lancer, RGT Zanzibar								>	★	★	★	★	★	<						
Beckom, DS_Darwin, Estoc,, Sunguard, Suntop, Sunvale, Trojan									>	★	★	★	★	<						
Corack, DS Tull, Elmore CL PLUS, Grenade CL PLUS, Impala, Janz, Oryx, QALBis, QAL2000, Reliant, Scepter, Wallup										>	★	★	★	★	★	<				
B53, Condo, Crusader, Emu Rock, LG Gold, Livingston, Mustang, Razor CL Plus, Spitfire, Sunmate, Sunprime, Vixen											>	★	★	★	★	★	<			
Dart, Tenfour												>	★	★	★	★	★	<		
Plains																				
DS Bennett■				>	★	★	★	★	★	<	<									
EGA_Wedgetail■, Illabo■, Kittyhawk■, Sunlamb, Rosella■					>	★	★	★	★	★	<	<								
Longsword■					>	★	★	★	★	★	★	<								
Sunmax						>	★	★	★	★	<									
Cutlass, DS_Pascal, Kiora, Suntime, Tungsten, Yenda							>	★	★	★	★	★	<							
Coolah, DS Faraday, EGA_Gregory, Flanker, Gazelle, Lancer, Sunzell								>	★	★	★	★	★	<						
Beckom, DS_Darwin, Estoc, Gauntlet, Reliant, Scepter, Sunguard, Suntop, Sunvale, Trojan									>	★	★	★	★	<						
Cobra, Corack, DS Tull, Elmore CL PLUS, Grenade CL PLUS, Impala, Janz, Livingston, Mace, Oryx, QALBis, QAL2000, Wallup										>	★	★	★	★	<	<				
B53, Condo, Crusader, Emu Rock, LG Gold, Mustang, Razor CL Plus, Spitfire, Sunmate, Sunprime, Vixen										>	>	★	★	★	★	★	<			
Dart. Tenfour											>	>	★	★	★	★	★	<		

> Earlier than ideal, but acceptable. ■ Winter wheat sowing window can be extended earlier, provided crops are grazed to delay reproductive development.
 ★ Optimum sowing time.
 < Later than ideal, but acceptable.

Note: For durum suggested sowing times see Table 19. Suggested sowing times, Durum wheat varieties on page 35

Wheat

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Table 13. Varietal characteristics and reaction to diseases (page 1 of 3)

Maximum quality classification		Resistances and tolerances																				Year of release	
		Northern zone		South-eastern zone	Common root rot	Flag smut	Leaf rust	Stem rust	Stripe rust WA Yr 17–27 pathotype	Stripe rust new 239 Yr 33+ pathotype	Septoria tritici blotch	Yellow leaf spot	RLN <i>P. thornei</i> resistance	RLN <i>P. thornei</i> tolerance	RLN <i>P. neglectus</i> resistance	RLN <i>P. neglectus</i> tolerance	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance			Origin
Variety																							
Bread wheat																							
Beckom	AH	AH	S	MS–S	MR–MS	MS–S	MR–MS	MR–MS	MR–MS	MR–MS	MS–S	MS–S	MS–S	T–MT	S	MT–MI	R	MR–MS	MS–S	MR–MS	T–MT	AGT	2015
Chara	AH	APH	S 3	S	MS	S	MS	MR–MS	MS	MS	MS–S	MS–S	MR–MS	MT–MI	S–VS	–	R	MS–S	S	MR	I	DELWP Victoria	1998
Condo	AH	AH	S	MS–S	MS–S	S	MR–MS	MS–S	MS–S	MS–S	S	MS	MS	T–MT	S	MT 2	MR	MS	S	MR–MS	MT	AGT	2014
Coolah	APH	APH	MS–S	S	R	MR	MR	R–MR	R–MR	MS–S	MS–S	MS–S	MS	T–MT	MS–S	T–MT 3	S	S	S	MR–MS	MT	AGT	2016
Corack	APW	APW	S	MS	S 3	S–VS	MR	MS	MS	MS	S	MR–MS	MS–S	MI	MS–S	MT 3	R–MR	S	MS–S	MR	T–MT	AGT	2011
Cutlass	APH	AH	S	MS	MS	R	R–MR	MS	MR–MS	MS–S	MS–S	MS–S	MS–S	MI	MS–S	T–MT 3	MR	MS	S	MR–MS	MT	AGT	2015
DS Bennett	FEED	ASW	VS	S	S–VS	S	MR–MS	R	MS	MS–S	MR–MS	MR–MS	MS–S	–	S	–	S	S	–	–	Dow Seeds	2018	
DS Darwin	ASW	AH	S	MS–S	MR	S	MR–MS	MR	MR–MS	S	S	S	MS	MI	S	MI–I	MS–S	MS	–	–	Dow Seeds	2015	
DS Faraday	APH	FEED	S	S	R–MR	MR	MR	R–MR	R–MR	MS–S	MS–S	MS–S	MT	S	MT–MI 3	MS	MS–S	MS–S	–	–	Dow Seeds	2016	
DS Pascal	FEED	APW	S	MS	S	MS	MS	R–MR	R–MR	MS–S	MS–S	MS	I–VI	S	MT–MI	S	S	MS	–	–	Dow Seeds	2015	
DS Tull	FEED	APH	S	MS–S	R	MS–S	MR	MS	MR	MS–S	S	S	MI 3	S	MT 3	MS–S	MR–MS	–	–	Dow Seeds	2018		
EGA Burke	APH	AH	S	MS–S 1	MR	MS	MR	MS–S	–	S	MS–S	MS	MT	MS–S	MT–MI	–	R–MR 1	MS–S	S–VS	–	EGA	2006	
EGA Gregory	APH	APH	S	MS–S	MS–S	MR	MR	MR 6	MR–MS	MS–S	S	S	T–MT	S	MT	S	MS–S	S	MS	T	EGA	2004	
EGA Wedgetail	AH	APH	S	–	MR	MS–S	MR	MS	MS	MS–S	MS–S	MS–S	MI–I	S	MI–I 3	S	–	S	S	MR	T–MT	EGA	2002
Ellison	APH	APH	S–VS	S 1	R–MR	–	MR	MS	–	MS–S	MR–MS	S	I–VI	S	MI	–	MS 1	MR	MR	I	Uni Sydney	2003	
Elmore CL PLUS	AH	AH	S	S	MS–S	R–MR	MR	MR–MS	MR–MS	MS–S	S	S	MT–MI 3	S	T–MT 3	S	MS	MS–S	MS–S	MR–MS	I	AGT	2011
Emu Rock	APW	AH	MS–S	MS	MS	S–VS	MS	MR–MS	MR–MS	MS	MR–MS	S	I–VI	MS–S	MI 3	S	S	MS	–	MR	–	InterGrain	2011
Estoc	ASW	ASW	MS–S	MR–MS	MR–MS	S	MR	MR–MS	–	S–VS	S	S	I–VI	S	MT	MR	MS	MS	MS	MT	AGT	2010	
Gold	AH	AH	–	MS–S	–	S	S	MR	MR–MS	S	MS–S	S	–	S	–	–	MS	–	–	–	Elders	2018	
Grenade CL PLUS	APW	APW	S	MS	MR	S	MR	MR–MS	MR–MS	MR–MS	S	S	I–VI	MS–S	–	–	R	MS–S	MS	MR–MS	MT	AGT	2012
Illabo	FEED	APH	S 3	MS–S	R	S	MS	R–MR	R–MR	MS–S	MS	S	T–MT 3	S	VI 3	MS 3	MR–MS	MS 3	MR 3	MT 3	AGT	2018	
Janz	APH	APH	S	MR–MS	MR	MR	MR	MS	–	MS–S	MS–S	S	I	S–VS	MT–MI	S	S	S	MS	I	DAF Qld	1989	
Kiora	APH	APH	S	MS	MR–MS 3	MR–MS	MR	R–MR	R–MR	MS–S	MS–S	MR–MS	MT	S	MT–MI 3	MS	MS	S	MR	I	AGT	2014	
Livingston	AH	AH	S	S	R	MS–S	MR–MS	MR–MS	–	S	MS–S	MS	MT	VS	MI	S	MR–MS 1	–	MR–MS	I	AGT	2007	
LRPB Cobra	APW	AH	S	MS	S 2	MR	MR	MS–S	MS–S	MS–S	MR–MS	MS–S	MI	MS–S	MT–MI 3	MS	MS–S	S	R–MR	MT	LongReach	2011	
LRPB Crusader	APH	APH	S	MR–MS	MR	MS–S	R–MR	MS	–	S	MS	S	MI	S–VS	MI	MS	R–MR 1	S	MR	MT	LongReach	2007	
LRPB Dart	APH	APH	MS–S	MS	MS	S	MR	MR	–	S–VS	MS	MS	MI	MS–S	MI 3	S	MR–MS	S	R–MR	MT	LongReach	2012	
LRPB Flanker	APH	APH	MS–S	MS–S	R	MR	MR	R–MR	R–MR	MS–S	MS–S 3	MS–S	T–MT	S	MT 3	S	MS	S	MS	–	LongReach	2015	
LRPB Gauntlet	APH	AH	MS–S	MS–S	MS	MS–S	R–MR	MR–MS	–	MS–S	MS	MR	MT	S	MT–MI	MR–MS	MR–MS 1	MS–S	MR–MS	MT	LongReach	2011	
LRPB Kittyhawk	APH	APH	S–VS	S	R–MR	MS	MR–MS 3	R–MR	R–MR	MR–MS	MR–MS	S	I	MS–S 3	MT–MI 3	S	MR–MS	S	MR	MT–MI	LongReach	2016	
LRPB Lancer	APH	APH	MS–S	S	MS–S 3	R–MR	R	MR	MR	MS	MR–MS	MS	T–MT	S	MT–MI 3	S	MR–MS	S	MR	MI–I	LongReach	2013	
LRPB Mustang	APH	APH	MS–S	MS	R	S	MR–MS	R–MR	R–MR	S	MS–S	MS–S	MI 3	MS–S	MT–MI 3	MR	MS	–	MR 3	–	LongReach	2017	
LRPB Reliant	APH	AH	MS	MS–S	R	MR	R	MR	MR	R	MS–S	MS–S	T–MT	S–VS	MT–MI 3	MS–S	MS	S	MS	–	LongReach	2016	
LRPB Spitfire	APH	APH	MS	MS–S	MS–S	MS–S	MR	MR	MR	MR	MS–S	S	MS	MT–MI	MS–S	MT–MI	MS	S	MR–MS	MT–MI	LongReach	2010	
LRPB Trojan	ASW	APW	MS	MS	S–VS	MR	MR–MS	MR	MR–MS	MR	MS–S	MS–S	MI	MS–S	MT 3	MS	MS	S	MR–MS 3	MT–MI	LongReach	2013	
Mace	AH	AH	S	MS	S	MS–S	MR–MS	S–VS	S	S	MR–MS	MS	MT	MS	MI–I 3	MR–MS	MR–MS	MS–S	MR–MS	MT	AGT	2007	
Mitch	AH	APW	MS	MS	S 3	S	MR–MS	MR	MR	S	MS–S	MS–S	MT	S	T 3	S	MR–MS	–	MR–MS 3	MT–MI	AGT	2014	
Razor CL PLUS	FEED	ASW	S	MS–S	R–MR	S	MR–MS	MS	MS	MS	MR–MS	MR–MS	MI 3	S	MT 3	MR	MS	MS 3	MR	MT	AGT	2018	
Scepter	AH	AH	S	MS	MS–S	MS–S	MR–MS	MS–S	MS	MS	MR–MS	MR–MS	MT	S	MT–MI 3	MR–MS	MS	MS–S	MR	MT	AGT	2015	
Strzelecki	AH	AH	S	MR–MS 1	–	MR	MR–MS	MR	MR	MS–S	MS–S	S–VS	I	VS	MT–MI	–	MS 1	MS–S	MS	–	DAF Qld	2000	
Sungard	AH	AH	MS	MS–S	VS	MR	R	MR	R–MR	MS–S	MS–S	S	MT	S–VS	MT–MI	–	MS	MS–S	MS	I	AGT	2011	
Sunlamb	ASW	ASW	S	MS	S	MS	R–MR	MR–MS	R 3	MR	MR–MS	MS–S	MI	MS–S	I 3	MR	MS	–	MR–MS	MI	AGT	2015	
Sunmate	APH	AH	MS–S	MS	R–MR	MR–MS	MR–MS	MR–MS	MR 2	S	MS–S	MR–MS	T–MT	S	MT–MI 3	MR–MS	MS	S	MR 3	MT–MI	AGT	2014	
Summax	APH	APH	MS–S	MS–S	R–MR	MS–S	MR	R–MR	R–MR	MS–S	MS	MT–MI	S	T–MT 3	MR–MS	MR–MS	MS	–	MR–MS	T–MT	AGT	2016	

Table 13. Varietal characteristics and reaction to diseases (continued; page 2 of 3)

		Maximum quality classification	Resistances and tolerances																					
		Northern zone	South-eastern zone	Crown rot	Common root rot	Flag smut	Leaf rust	Stem rust	Stripe rust WA Yr 17-27 pathotype	Stripe rust new 239 Yr 33+ pathotype	Septoria tritici blotch	Yellow leaf spot	RLN <i>P. thornei</i> resistance 4	RLN <i>P. thornei</i> tolerance 5	RLN <i>P. neglectus</i> resistance 4	RLN <i>P. neglectus</i> tolerance 5	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance	Origin	Year of release	
Variety		APH	APH	MS-S 3	MS-S	MS 3	R-MR	MR-MS	R-MR	MR 3	S	MS-S	S	—	S	—	MS	MS	—	MR-MS	MT 3	AGT	2018	
		APH	APH	MS-S	S	MS	MS	MR-MS	R-MR	MR 3	MS-S	S	MR-MS	MT	S	MT-MI	MR-MS	MS	MS	MS-S	MT-T	AGT	2015	
		APH	APH	MS-S	MS	R	MR-MS	MR-MS	R-MR	MR 3	S	MS-S	MR-MS	T-MT	S	MT	S	MS-S	MT	MR-MS	MT	AGT	2012	
		APH	APH	MS-S	MS	—	S	R-MR	MR 6	—	MS-S	MS-S	MR-MS	MT-MI	S	MI	—	R-MR 1	S	S-VS	I	Uni-Sydney	1995	
		AH	APH	MS-S	MS-S	MS-S	MS	MR	MS	—	MS-S	MS-S	MR-MS	MT	MS	MI	—	S 1	—	MR-MS	T-MT	AGT	2006	
		FEED	AH	S	MS	S-VS	S-VS	MR-MS	MR-MS	MR-MS 3	S	MR-MS	MS	I-VI 3	MR-MS	MT 3	S	MS	—	—	—	InterGrain	2018	
		APH	APH	S	MS	S-VS	S-VS	MR-MS	MR-MS	MR-MS 3	S	MS-S	MR-MS	MT	MR-MS	MT	MR	MS-S	—	MR	I	AGT	2011	
		APH	APH	S	MS	S-VS	S-VS	MR-MS	MR-MS	MR-MS	S	MS-S	MR-MS	MT	MR-MS	MT	MR	MS	MR	MR	I	AGT	2011	
Feed wheat																								
BS3		FEED	FEED	MS	S	MR-MS 3	MS-S	MS-S	MR	MR 3	MS-S	MS	MS	T-MT	MS-S	MT-MI	S	MS	—	—	—	Elders	2015	
Buchanan		FEED	FEED	S	MS	MS	MR	MS	R-MR	R-MR 3	MS-S	MR-MS	MS	T-MT 3	MS-S	MT 3	MS	MS	—	—	—	Austgrains	2015	
Longsword		FEED	FEED	S	MS	MR-MS 3	MS-S	MR	MR	MR 3	MS-S	MR-MS	MR	MT 3	MR-MS	VI 3	MR-MS	MS	—	MR-MS 3	MT-T	AGT	2018	
Mackellar		FEED	FEED	—	—	—	S-VS 3	MR	R-MR	—	R-MR	MR-MS	MS	—	MS-S	—	S	—	S	—	—	CSIRO	2001	
Manning		FEED	FEED	VS	S-VS	R	MS	MR	R-MR	R-MR 3	MR-MS	MR-MS	S	—	MS-S	—	S	—	S	—	—	CSIRO	2013	
Naparoo		FEED	FEED	S	S	VS	R	R-MR	R	—	MS	MS	S	MI 3	S-VS	I 3	—	—	—	—	—	AGT	2007	
RGT Accroc		FEED	FEED	S-VS	S	S-VS	S	MS	R	R-MR 3	MS	MR-MS	MS-S	—	S	—	S	MR-MS	—	R-MR	—	Seedforce	2016	
RGT Zanibar		FEED	FEED	S	S	S-VS	S-VS	VS	R	R 3	S	MS	MS 3	MI 3	S	I-VI 3	MS-S	MR-MS	—	—	—	Seedforce	2017	
Tenfour		FEED	FEED	MS-S	MS	MR	S	S-VS	S-VS	S 3	S	MR-MS	S	I	MS	MT	MR-MS	MR-MS	—	MR	—	Elders	2015	
Tungsten		FEED	FEED	S	S	MR-M 3	MS	MS-S	R-MR	MR 3	MS-S	MS-S	S	MI-I	MS-S	MT-MI 3	MS	MR-MS	—	—	—	Elders	2017	

— Insufficient data

NYC No grain quality classification in NSW currently.

Crown rot and common root rot ratings come from screening in SARDI, SA (²) and DAF Qld (³). SARDI = South Australian Research and Development Institute; NSW DPI = NSW Department of Primary Industries; DAF Qld = Department of Agriculture and Fisheries, DELWP Victoria = Department of Environment, Land, Water and Planning Victoria.

¹ North

² South

³ Data relating to these varieties is based on limited testing and is to be considered provisional information.

⁴ RLN resistance — The root-lesion nematode (*P. thornei* & *P. neglectus*) resistance ratings that appear in this planting guide are national consensus ratings based on glasshouse and field data collected in the northern and south-eastern grain regions.

⁵ RLN tolerance — The root-lesion nematode (*P. thornei* & *P. neglectus*) tolerance ratings that appear in this planting guide are based on field data collected in the northern grain region rather than national consensus ratings.

Stripe rust

⁶ Varieties expected to respond to control measures if stripe rust begins early.

Resistances

R (Resistant) indicates a high level of resistance and grain yield is unlikely to be reduced.

R-MR (Resistant to Moderately resistant) indicates a high level of resistance and grain yield is unlikely to be reduced.

MR (Moderately resistant) indicates disease can develop in favourable conditions, some yield loss could occur. Early disease control can be important in some varieties.

MR-MS (Moderately resistant to Moderately susceptible) indicates disease can develop in favourable conditions, some yield loss could occur. Early disease control can be important in some varieties.

MS (Moderately susceptible) indicates disease might be conspicuous in favourable situations with moderate yield losses. Early disease control is important.

MS-S (Moderately susceptible to Susceptible) indicates disease might be conspicuous in favourable situations with moderate yield losses. Early disease control is important.

S (Susceptible) indicates high levels of disease can occur with substantial yield losses. Early disease control is essential.

S-VS (Susceptible to Very susceptible) indicates high levels of disease can occur with substantial yield losses. Early disease control is essential.

VS (Very susceptible) indicates high levels of disease can occur with substantial yield losses.

Tolerances

T (Tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.

T-MT (Tolerant to Moderately tolerant) high level of tolerance and grain yield is unlikely to be reduced.

MT (Moderately tolerant) indicates disease can develop in favourable conditions, some yield loss could occur.

MT-MI (Moderately tolerant to Moderately intolerant) indicates disease can develop in favourable conditions, some yield loss could occur.

MI (Moderately intolerant) indicates disease might be conspicuous in favourable situations with moderate yield losses.

MI-I (Moderately intolerant to Intolerant) indicates disease might be conspicuous in favourable situations with moderate yield losses.

I (Intolerant) indicates high levels of disease can occur with substantial yield losses.

VI (Very intolerant) indicates high levels of disease can occur with substantial yield losses.

Note: RLN or CCN tolerance indicates the ability of the variety to grow and yield in the presence of nematodes. Resistance refers to the ability of the variety to reduce nematode carryover.

Stripe rust ratings – what do they mean?

The pictures below show the varying levels of adult plant reaction to stripe rust.



Figure 1. Stripe rust ratings

Adult plant resistance – what does it mean?

Response to stripe rust is determined by the interaction of genes for resistance in a variety and genes for virulence in the pathogen population. The reaction of a wheat variety to stripe rust depends on two forms of resistance.

1. **Seedling genes**, effective from seedling emergence through to maturity, provided the matching virulence gene in the pathogen population is absent.
2. **Adult plant resistance (APR) genes**, which become effective at various growth stages, ranging from the fourth leaf stage through to full head emergence. APR will also be effective provided that matching virulence is not present in the pathogen.

Both seedling and APR genes, and combinations of both, provide varying levels of crop protection which can be influenced by environment (temperature, crop nutrition, management) and disease pressure.

Growers need to be aware that varieties which predominantly rely on APR for stripe rust protection might be more susceptible to stripe rust infection earlier in the season until the APR provides protection. Wheat varieties with APR can benefit from early stripe rust control by fertiliser, seed or foliar fungicides. If unsure speak to your local agronomist.

Table 13. Varietal characteristics and reaction to diseases (continued; page 3 of 3)

Variety	Maximum quality classification		Resistances and tolerances																		Year of release
	Northern zone	South-eastern zone	Flag smut	Leaf rust	Stem rust	Stripe rust WA Yr 17–27 pathotype	Stripe rust new 239 Yr 33+ pathotype	Septoria tritici blotch	Yellow leaf spot	RLN <i>P. thornei</i> resistance ⁴	RLN <i>P. thornei</i> tolerance ⁵	RLN <i>P. neglectus</i> resistance ⁴	RLN <i>P. neglectus</i> tolerance ⁵	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance	Origin		
Durum																					
Caparoi	ADR	ADR	R	R–MR	R–MR	MR	MR ³	MR–MS	MR	MR	T–MT	MS	MI	S	MS–S	MR	MR–MS	VI	TAM	2008	
DBA Aurora	ADR	VS	R	R–MR	R–MR	R–MR	R–MR ³	MR–MS	MR–MS	MR	MT	MR–MS	I–VI ³	MS	MS–S	–	–	–	DBA	2015	
DBA Bindaroi	ADR	FEED	R	MR	MR–MS	R–MR	R–MR ³	MS	MR–MS	MR	MT	MR–MS	MI ³	MS	MR–MS	–	–	–	DBA	2017	
DBA Lillaro	ADR	S–VS	R–MR	R–MR	R–MR	R–MR	R–MR ³	MR–MS	MR–MS	R–MR	MT	MR–MS	MI–I	–	MS	–	–	–	DBA	2014	
DBA Vittaro	ADR	S–VS	R	MR	MR	MR	MR ³	MS	MR–MS	MR	MI	MS	MI–I	S	MS–S	–	MR	–	DBA	2017	
EGA_Bellaroi	ADR	VS	R	MR–MS	MR	MR	–	MR–MS	MR–MS	MR	MT–MI	MS	MI–I	–	R–MR ¹	MS–S	MR	VI	TAM	2002	
Hypemo	ADR	FEED	R	R–MR	R–MR	MR	MR ³	MR–MS	MR–MS	R–MR	T–MT	MR	MT	S	MS	R	S–VS	VI	AGT	2008	
Jandaro	ADR	FEED	R–MR	MR	MR	MR	–	MR–MS	MR–MS	MR–MS	MT–MI	MR–MS	MI	MS	R–MR ¹	MR	MS–S	VI	TAM	2007	
Soft domestic																					
LRPB Gazelle	ASFT	S	S	MR	MR	MR	–	MS–S	MS–S	S	MI–I	S	MT	MS–S	MS–S	S	MR	–	LongReach	2012	
LRPB Impala	ASFT	MS–S	S	S–VS	MR	MR	MR ³	S–VS	MS–S	S	MI–I	S–VS	MT–MI	MS–S	MS	MS–S	MR–MS	MT–MI	LongReach	2011	
LRPB Oryx	ASFT	MS–S	VS	MR	MR	R–MR	R–MR ³	S–VS	MS–S	MS–S	I–VI	S	I ³	S	MS	–	–	–	LongReach	2018	
QAL2000	ASFT	S–VS	–	R	R–MR	VS	–	MR–MS	MS–S	MS	MT–MI	VS	MI	–	–	–	–	–	VAVCRC	2000	
QALBis	ASFT	S	MR–MS	–	R–MR	S–VS	–	–	MS–S	S	I–VI	VS	MI	–	S ¹	–	–	–	VAVCRC	2002	
Yenda	AGP	S	MR	–	R	S	–	MS	MR–MS	MS–S	MI–I	MR	MT–MI	MS	MR	–	R–MR	I	AGT	2006	

— Insufficient data

NYC No grain quality classification in NSW currently.

Crown rot and common root rot ratings come from screening in SARDI, SA (²) and DAF Qld (¹). SARDI = South Australian Research and Development Institute; NSW DPI = NSW Department of Primary Industries; DAF Qld = Department of Agriculture and Fisheries; DELWP Victoria = Department of Environment, Land, Water and Planning Victoria.

DBA Durum Breeding Australia
TAM NSW DPI Tamworth

¹ North

² South

³ Data relating to these varieties is based on limited testing and is to be considered provisional information.

⁴ RLN resistance – The root-lesion nematode (*P. thornei* & *P. neglectus*) resistance ratings that appear in this planting guide are national consensus ratings based on glasshouse and field data collected in the northern and south-eastern grain regions.

⁵ RLN tolerance – The root-lesion nematode (*P. thornei* & *P. neglectus*) tolerance ratings that appear in this planting guide are based on field data collected in the northern grain region rather than national consensus ratings.

Stripe rust

⁶ Varieties expected to respond to control measures if stripe rust begins early.

Resistances

R (Resistant) indicates a high level of resistance and grain yield is unlikely to be reduced.

R-MR (Resistant to Moderately resistant) indicates a high level of resistance and grain yield is unlikely to be reduced.

MR (Moderately resistant) indicates disease can develop in favourable conditions, (Moderately resistant) indicates disease control can be important in some varieties.

MR-MS (Moderately resistant to Moderately susceptible) indicates disease can develop in favourable conditions, some yield loss could occur. Early disease control can be important in some varieties.

MS (Moderately susceptible) indicates disease might be conspicuous in favourable situations with moderate yield losses. Early disease control is important.

MS-S (Moderately susceptible to Susceptible) indicates disease might be conspicuous in favourable situations with moderate yield losses. Early disease control is important.

S (Susceptible) indicates high levels of disease can occur with substantial yield losses. Early disease control is essential.

S-VS (Susceptible to Very susceptible) indicates high levels of disease can occur with substantial yield losses. Early disease control is essential.

VS (Very susceptible) indicates high levels of disease can occur with substantial yield losses.

Tolerances

T (Tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.

T-MT (Tolerant to Moderately tolerant) high level of tolerance and grain yield is unlikely to be reduced.

MT (Moderately tolerant) indicates disease can develop in favourable conditions, some yield loss could occur.

MT-MI (Moderately tolerant to Moderately intolerant) indicates disease can develop in favourable conditions, some yield loss could occur.

MI (Moderately intolerant) indicates disease might be conspicuous in favourable situations with moderate yield losses.

MI-I (Moderately intolerant to Intolerant) indicates disease might be conspicuous in favourable situations with moderate yield losses.

I (Intolerant) indicates high levels of disease can occur with substantial yield losses.

VI (Very intolerant) indicates high levels of disease can occur with substantial yield losses.

Note: RLN or CCN tolerance indicates the ability of the variety to grow and yield in the presence of nematodes. Resistance refers to the ability of the variety to reduce nematode carryover.

Varietal characteristics

* NB: Quality classifications are preliminary and subject to final review.

Aim to spread the overall risk by planning to sow at least one variety at each sowing opportunity. This depends upon suitable sowing rains. Disease reactions and ratings are in the suggested sowing time tables.

Refer to the chapter on [Durum on page 34](#) for notes on durum varieties.

Beckom[®]. Australian Hard quality in NSW. High-yielding mid maturity variety suited to sowing in early May. Broadly adapted variety throughout NSW. Short in height, BeckomA produces plants with moderate early vigour and straw strength, with good threshability. Moderate grain size; aluminium and boron tolerant. AGT.

Buchanan. No formal grain quality classification in NSW. Mid-late season variety, targeted for northern NSW and southern Queensland. Very limited yield performance data in NSW. Grown under production risk closed loop contract. Commercialised by Austgrains Pty Ltd.

Condo[®]. Australian Hard quality in NSW. Early maturity, adapted to low-medium rainfall areas of NSW. Maturity similar to Livingston[®]. Condo[®] has a tall plant type with medium straw strength. Moderately tolerant of acid soils. AGT.

Coolah[®]. Australian Prime Hard quality in NSW. It is a high yielding and more disease resistant alternative to its parent EGA_Gregory[®], adapted to range of environments across NSW. Suited to an end of April through to mid May sowing. It has good tolerance to acid soils, with improved lodging over EGA_Gregory[®]. Coolah[®] produces large and consistent grain size, resulting in low screenings loss and high test weight. AGT.

Corack[®]. Australian Premium White quality in NSW. An early-maturing Wyalkatchem derivative that has yielded well in low and medium rainfall environments and/or tight finishes to the growing season. It has high straw strength, good resistance to cereal cyst nematode and yellow leaf spot. Could be suitable for a wheat-on-wheat situation, low rainfall environments or late sowings. Highly tolerant to acid soils. AGT.

Cutlass[®]. Australian Prime Hard quality in northern NSW and Australian Hard in southern NSW. Replacement variety in south-western NSW for Yitpi. Similar maturity to Yitpi, with a flexible sowing window of mid April through to mid May. Improved disease resistance over Yitpi. AGT.

DS Darwin[®]. Australian Hard quality in southern NSW. It is an early-mid season wheat variety suited to early-mid May sowing. It has a compact plant type, with good straw strength and lodging resistance. It performs well under both irrigated and dryland conditions. It is susceptible to septoria tritici blotch and needs to be managed accordingly where *Septoria* is a problem. DS Darwin[®] has a good grain package and exhibits low screenings, a large seed size and good test weight. Moderately resistant to black point. Dow Seeds.

DS Faraday[®]. Australian Prime Hard quality in NSW. DS Faraday[®] is a main season variety with a maturity similar to EGA_Gregory[®] and has resistance to all three rusts. DS Faraday[®] has shown a yield improvement over EGA_Gregory[®] in northern NSW environments. DS Faraday[®] has improved tolerance over EGA_Gregory[®] to pre-harvest sprouting to manage the risk in a wet harvest periods. Dow Seeds.

DS Pascal[®]. Australian Premium White quality in southern NSW. It is an early season line, being 1–2 days quicker than Bolac[®], making it suitable for mid April through to early May sowing. Medium plant height, with good standability and high yield potential under irrigation. Exhibits pre-harvest sprouting tolerance. Dow Seeds.

EGA_Burke[®]. Australian Prime Hard quality in northern NSW and Australian Hard in southern NSW. Suitable for early-mid season sowings, with a maturity similar to Giles. Pacific Seeds.

EGA_Gregory[®]. Australian Prime Hard quality in NSW. Similar maturity, straw strength and height to Batavia and Strzelecki[®]. Pacific Seeds.

EGA_Wedgetail[®]. **Note – Winter wheats on page 29.** Australian Prime Hard quality in southern NSW and Australian Hard quality in northern NSW. Acid soils-tolerant, early sowing variety. Large grain size. Similar maturity and height to Rosella. Adapted to higher rainfall regions in southern and central NSW and the eastern part of the northern wheat belt. Seednet.

Elmore CL PLUS[®]. Australian Hard quality classification in NSW. A mid maturing variety with Clearfield® Plus technology, which provides tolerance to label rates of Intervix® herbicide. Check current herbicide registrations for registered product

rates and adhere to recommended plant growth stages for application timing. Has an adaptation pattern similar to Janz, providing an alternative strategy for in-crop weed control. AGT.

Emu Rock[®]. Australian Hard quality classification for southern NSW. Early season variety with broad adaptation. Produces large grain with good test weight and has a low susceptibility to screenings. Bred by InterGrain and marketed by Nuseed.

Estoc[®]. Australian Standard White quality in southern NSW. Mid to late season variety, 1–3 days earlier than Yitpi. AGT.

Grenade CL PLUS[®]. Australian Premium White quality in NSW. An early–mid maturing line, carrying Clearfield[®] Plus technology, which provides tolerance to label rates of Intervix[®] herbicide. Check current herbicide registrations for registered product rates and adhere to recommended plant growth stages for application timing. Grenade CL PLUS[®] combines the flexibility of improved weed management options through using Intervix[®] with high yield and cereal cyst nematode resistance. AGT.

Janz. Australian Prime Hard quality. Widely adapted main season variety. Moderate seedling vigour. Medium–strong straw strength, with good lodging and shattering resistance. Good milling quality.

Kiora[®]. Australian Hard quality in southern NSW and Australian Prime Hard in northern NSW. Medium–late maturity suited to early–mid-season sowings in medium–high rainfall areas. A possible replacement for Bolac[®] in medium–high rainfall environments. Susceptible to black point. AGT.

Livingston[®]. Australian Hard quality in NSW. Early maturing variety, later than H45 but earlier than Ventura[®] and Sunstate. Intolerant of acid soils. AGT.

LongReach Cobra[®]. Australian Hard quality in southern NSW. High yielding, early mid-season variety suited to both acid and alkaline soil types. Compact plant height, moderately resistant to lodging and has performed particularly well on irrigation and in high-production areas. Pacific Seeds.

LongReach Crusader[®]. Australian Prime Hard quality. Quick maturity, similar to Ventura[®] and H45. Strong straw with good lodging resistance. Pacific Seeds.

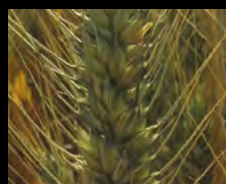
LongReach Dart[®]. Australian Prime Hard quality in NSW. Quick maturity suited to later plantings; slightly quicker than Ventura[®], LongReach Crusader[®] and H45. Suited to Queensland, NSW and NE Victoria. Late plantings can be a useful tool in herbicide resistance management. Good physical grain, milling and baking quality package. Lower tillering variety, with a long coleoptile and good early seedling vigour. Pacific Seeds.



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- Astute Triticale
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LongReach Flanker[®]. Australian Prime Hard milling quality in NSW. High yielding EGA_Gregory[®] type adapted to NSW where EGA_Gregory[®] is grown and has shown a 3–6% yield increase. Can be prone to crop lodging in high rainfall environments or under irrigation. Mid–late in maturity and has demonstrated a similar plasticity in maturity to EGA_Gregory[®]. Reliable grain package with good test weights and sound for screenings. Pacific Seeds.

LongReach Gauntlet[®]. Australian Prime Hard in northern NSW and Australian Hard quality in southern NSW. Main season maturity, similar to Janz and Lang. Fully awned. Medium length coleoptile with good early seedling vigour, short–medium plant height at maturity. Performs well in acid soils. Seednet.

LongReach Gazelle[®]. Biscuit wheat. Australian Soft quality in NSW. Mid–late season maturity, similar to QAL2000[®] and slightly quicker than Yenda[®]. Fully awned. Medium length coleoptile with good early seedling vigour, medium plant height at maturity and suited to high rainfall production areas and irrigation. Very susceptible to powdery mildew. Good soft wheat grain package with low screenings, low protein accumulation and good test weight. Pacific Seeds.

LongReach Impala[®]. Biscuit wheat. Australian Soft quality in NSW. Quick to main season maturity, similar to Lincoln[®] and Ventura[®]. Fully awned. Medium length coleoptile with good early seedling vigour, medium plant height at maturity. Good soft wheat grain package with low screenings, low protein accumulation and good test weight. Pacific Seeds.

LongReach Kittyhawk[®]. **Note – Winter wheats on page 29.** Australian Prime Hard milling quality in NSW. Similar maturity and planting window to EGA_Wedgetail[®]. Dual-purpose variety, suitable for grazing and grain recovery. Has improved stripe rust resistance and grain quality over EGA_Wedgetail[®]. Pacific Seeds.

LongReach Lancer[®]. Australian Prime Hard milling quality in NSW. A mid–late maturing variety, which is responsive to temperature, suited to early–mid season planting. Shorter canopy height than EGA_Gregory[®], with good resistance to lodging. Medium coleoptile length and has a medium plant height at maturity; improved lodging resistance over EGA_Gregory[®]. Stripe rust resistance based on adult plant resistance, rated moderately resistant. Pacific Seeds.

LongReach Mustang[®]. Australian Prime Hard quality in NSW. A high- yielding variety suited to NSW and QLD, with a reliable grain package similar to other prime hard main season varieties. Compact canopy with good straw strength maximises harvest efficiency and ease of stubble management. Good foliar disease resistance and useful root disease package. Maturity similar to LRPB Spitfire[®] with a significant yield improvement over other quicker prime hard varieties. Pacific Seeds.

LongReach Reliant[®]. Australian Prime Hard quality in northern NSW and Australian Hard quality in southern NSW. High yield potential, mid-season variety suited to the low–medium-yielding environments in NSW. Developed from a cross between EGA_Gregory[®] and LRPB Crusader[®]. Tillering ability similar to EGA_Gregory[®] and tightly packed heads like LRPB Crusader[®]. Reliable grain package with good grain size and test weight like EGA_Gregory[®]. Pacific Seeds.

LongReach Spitfire[®]. Australian Prime Hard quality in NSW. Early–mid season maturity, similar to Ventura[®] and Livingston[®]. Good soil disease control against crown rot and root lesion nematode (*P. thornei*). Good grain package with low screenings and high test weights. Long coleoptile and medium plant height. Performs well in acid soils. Pacific Seeds.

LongReach Trojan[®]. Australian Premium White in southern NSW. Mid–long-season maturity suited to the medium–high rain zone of southern Australia. Short–medium plant height at maturity with good straw strength. Moderately tolerant to boron. Pacific Seeds.

Mace[®]. Australian Hard quality in NSW. Has good foliar disease package apart from being susceptible–very susceptible to stripe rust and should only be grown where a full fungicide management program can be implemented. Has shown adaptation to south-western NSW. AGT.

Mitch[®]. Australian Hard quality in northern NSW and Australian Premium White in southern NSW. Mid–late maturing variety, suited to late April early May sowing in northern NSW. Similar height to EGA_Gregory[®], but has improved straw strength. It is moderately resistant to black point. AGT.

QALBis. Biscuit wheat. Australian Soft quality for NSW. Similar maturity to Sunstate. Austgrains International.

QAL2000. Biscuit wheat. Australian Soft quality. Similar maturity to Sunstate. Austgrains International.

Rosella. **Note – Winter wheats on page 29.** Australian Standard White/Noodle quality. Widely adapted with good seedling vigour. A useful dual-purpose grazing wheat. Strong straw, but with early sowing and higher soil fertility it can lodge when not grazed. Mid-season maturity once cold requirement is met.

Scepter[®]. Australian Hard quality classification in NSW. A higher yielding Mace[®] replacement, with improved stripe rust resistance over Mace[®]. Scepter[®] is rated moderately susceptible to susceptible to stripe rust so will still require a fungicide management program to maximise yields. A mid maturing variety, which is slightly later than Mace[®]. Boron tolerant and moderately tolerant to acid soils. AGT.

Sunguard[®]. Australian Hard quality classification in NSW. A main season Janz derivative; similar crown rot tolerance level to EGA_Wylie[®] with higher yield potential. AGT.

Sunlamb[®]. Australian Standard White quality in NSW. An awnless, long season spring wheat suited to early April plantings. Suited to grazing and grain recovery across NSW. Similar flowering time to EGA_Wedgetail[®], and a few days earlier than

Naparoo[®]. Moderately intolerant of acid soils. AGT.

Sunmate[®]. Australian Prime Hard quality in northern NSW and Australian Hard quality in southern NSW. An early-maturing variety similar to Spitfire[®]. Moderately tolerant–moderately intolerant of acid soils. AGT.

Sunmax[®]. Australian Prime Hard quality in NSW. It is a long-season spring wheat, slower in maturity than Sunzell[®], but quicker than the older variety Sunbrook, best suited to a mid–late April sowing. With its late maturity, avoid sowing outside its preferred sowing window as there is an increased risk of screenings. It has acid soils tolerance and improved lodging tolerance over EGA_Gregory[®]. AGT.

Suntime[®]. Australian Prime Hard quality in northern and southern NSW. Mid–late maturity variety, about 4–6 days quicker in flowering than Sunzell[®] and 5–10 days slower than EGA_Gregory[®]. Suited to northern NSW and an alternative to Sunzell[®], Lancer[®] and EGA_Gregory[®]. Moderately tolerant to acid soils. AGT.

Suntop[®]. Australian Prime Hard quality in NSW. A main season line that is well adapted to NSW, showing high and stable yields from low to high yield potential areas. It is quicker maturing than EGA_Gregory[®], similar in maturity to Janz. AGT.

Sunvale. Australian Prime Hard quality. Main season maturity. Medium straw strength. Moderately susceptible to common root rot. AGT.

Sunzell[®]. Australian Prime Hard quality for southern NSW and Australian Hard in northern NSW. Acid soils tolerant early sowing variety. Slightly longer season than Strzelecki[®]. AGT.

Wallup[®]. Australian Prime Hard quality classification in NSW. It has very good grain processing quality characteristics and high straw strength. Moderate coleoptile length. Best suited to medium yield potential environments, but has not performed as well in Mallee environments. It does not tolerate toxic levels of soil boron or acid soils. Intermediate resistance to pre-harvest sprouting and black point and expresses low levels of screenings. AGT.

Yenda[®]. Biscuit wheat. Australian Soft quality in southern NSW. Short stiff-strawed variety suitable for irrigation and high rainfall areas. Seednet.

The following are more recently released varieties with limited data available in NSW.

DS Bennett[®]. **Note – Winter wheats on page 29.** Australian Standard White quality in southern NSW. It is a high yielding winter wheat, with photoperiod sensitivity, which generally flowers 7–10 days later than EGA_Wedgetail[®]. The sowing window for DS Bennett[®] is from mid March until early May. Suited to both grazing and grain production, or straight grain production. DS Bennett[®] is a tall, awnless wheat suited to the high and medium rainfall zones of NSW. Dow Seeds.

DS Tull[®]. Australian Prime Hard quality in southern NSW. It is a high yielding main season wheat, with a maturity between Suntop[®] and LRPB Spitfire[®]. Ideally suited to plantings from May to early June. Compact plant type with medium to short height, with good early vigour and moderate tillering. Dow Seeds.

Illabo[®]. Note – Winter wheats on page 29. Australian Prime Hard quality in southern NSW. An EGA_Wedgetail[®] alternative suited to grazing and grain production, with higher grain yield potential. Mid winter maturity, Illabo[®] is 2–3 days quicker to maturity than EGA_Wedgetail[®]. Improved stripe rust and black point resistance over EGA_Wedgetail[®]. Tolerant of acid soils. AGT.

LG Gold. Australian Hard quality in NSW. LG Gold has early maturity, suited to late planting, observed to be four to five days earlier than Mace[®]. Developed by Edstar Genetics and commercialised by Elders.

LongReach Oryx[®]. Biscuit wheat. Australian Soft quality in NSW. Early-mid maturing variety, marginally quicker to mature than LRPB Impala[®], suited to main season planting in dryland and supplementary irrigation soft wheat systems. LRPB Oryx[®] has demonstrated reduced canopy heights over its parent LRPB Impala[®], improving harvest efficiencies and stubble management for growers. Improved leaf rust resistance over LRPB Impala[®]. Good soft wheat grain package with low screenings, low protein accumulation and good test weight. Pacific Seeds.

Razor CL PLUS[®]. Australian Standard White quality in southern NSW. High yielding early maturity variety tolerant to Clearfield[®] Intervix[®] herbicide, slightly quicker than its parent Mace[®], similar in maturity to Corack[®]. Check current herbicide registrations for registered product rates and adhere to recommended plant growth stages for application timing. Good physical grain package, with low screenings and high test weight. AGT.

Sunprime[®]. Australian Prime Hard quality in NSW. Early maturing variety, similar to LRPB Spitfire[®], Sunmate[®] and LRPB Mustang[®]. High yielding variety across NSW. Derived from a cross with EGA_Gregory[®], similar adaption across NSW, but with a quicker maturity and shorter plant height. Good physical grain package, including moderate to low screenings and high test weight. Good tolerance to RLN (*P. Thornei*). Moderately tolerant of acid soils. AGT.

Vixen[®]. Australian Hard quality classification in southern NSW. An early–mid maturity variety, similar in maturity to LRPB Spitfire[®]. Suited to sowing from the third week of May onwards in southern NSW. High yield potential, with strong physical grain characteristics. It has good grain size and produces low screenings. Vixen[®] has a short–moderate plant height, providing reduced stubble loads in high yielding environments. Bred and marketed by InterGrain.

Feed wheats

Longsword[®]. Winter wheat. White grained feed wheat. Longsword[®] is a winter type and requires vernalisation as with other winter wheats. It has Mace[®] as a parent and is relatively quick to mature once vernalisation requirements have been met. The quicker maturity makes it suitable for low-medium rainfall environments in which traditional longer season winter wheats would not normally be grown. Most suited to April sowings and can be grazed, given its winter growth habit. Good physical grain package with low screenings and high test weights. AGT.

Mackellar[®]. Awnless. Winter wheat. Red grained, dual-purpose feed wheat. Tolerant to pre-harvest sprouting. Average coleoptile length. Resistant to *Barley yellow dwarf virus*. Seednet.

Manning[®]. Awnless. Winter wheat. White grained feed wheat. Long season dual purpose grazing and grain variety, released to replace Mackellar. High yield potential in high rainfall or under irrigated production. Resistance to *Barley yellow dwarf virus*. Bred by CSIRO and commercialised by GrainSearch.

Naparoo[®]. Awnless. Winter wheat. Feed quality. Maturity similar to Marombi[®], slower than Whistler and EGA_Wedgetail[®]. Medium height with good straw strength. Consistently produces higher levels of dry matter than Marombi, but lower grain recovery. AGT.

RGT Accroc. Red winter wheat, feed grain quality, suited to the high rainfall zone. Suitable for sowing late February to early April for early grazing. Good standability. Maturity is 3–5 days earlier SF Adagio. Bred by RAGT, available via Seed Force Broadacre Commercial Partners.

RGT Zanzibar. Red winter wheat, feed grain quality, suited to the medium–high rainfall zone. Suitable for sowing late April to early May. Maturity is similar to Suntop[®] and EGA_Gregory[®]. Good standability. Under evaluation for grazing suitability. Bred by RAGT, available via Seed Force Broadacre Commercial Partners.

Tenfour. White grained early maturity feed wheat variety with high yield potential and wide adaptation. Good standability. Tenfour was developed by Edstar Genetics and commercialised by Elders.

Tungsten[®]. A medium–late maturing variety, similar to Yipti. Strong straw, with a plant height similar to Mace[®]. High protein grain with good test weight and low screenings, currently AH in Victoria and South Australia. Developed by Edstar Genetics, commercialised by Elders.

Note – Winter wheats

Winter wheats have the major advantage of adaptability to a wide range of sowing times. Winter habit delays maturity in early sowings, thus reducing the risk of frost damage. Maturity varies once cold requirement has been met. Winter wheats can be sown from February into April for grazing, depending on vernalisation (cold) requirement. See [Managing grazing cereals on page 73](#).

Acknowledgments

Variety characteristics and reaction to diseases table

RLN tolerance ratings are from the Queensland screening program coordinated by Jason Sheedy, Toowoomba, DAF Qld.

Disease scores courtesy of the various NVT national pathology screening projects throughout Australia. Lodging scores are combined ratings from the southern irrigated wheat project and Allan Peake's, CSIRO (northern irrigated wheat project).

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Table 14. Diseases and crop injury guide – wheat

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Foliar diseases				
Yellow spot <i>Pyrenophora tritici-repentis</i>	Tan coloured leaf lesions with a yellow border. Lesions eventually join, resulting in leaf death. Lesions usually randomly distributed along individual leaves and early in season are more concentrated on lower leaves in the canopy.	More severe in northern and central NSW, associated with retained wheat stubble. Can develop in all crops late in season after above average rainfall. Quite common early in the growing season.	Primary infection from ascospores from wheat stubble, which are airborne for a short distance. Secondary infection from conidia produced on infected leaves during season, which are airborne for longer distances.	Wheat stubble removal, crop rotation (avoid wheat-on-wheat). Resistant varieties. Foliar fungicides applied as a preventative before rain events as they have poor curative activity.
Septoria tritici blotch <i>Zymoseptoria tritici</i>	Leaf lesions with minute black spots; leaf death.	Once common in the south, in early-sown crops in wet springs; re-emerged as an issue in southern crops in 2016. Can occur in high rainfall regions.	Initially airborne spores, then rainsplashed spores within crop from infected leaves. Has a long latent period.	Resistant varieties. Seed and foliar fungicides. Fungicide resistance has developed in Victoria and Tasmania with some fungicides less effective. Resistant isolates were detected in southern NSW in 2016.
Septoria nodorum blotch <i>Phaeosphaeria nodorum</i>	Leaf blotches with minute grey–brown spots; leaf death. Glumes darken to brown to grey.	Uncommon. Develops late in season with above average mid–late spring rainfall and warm temperatures.	Initially airborne spores, rain-splashed spores within crop from infected leaves.	None required at present.
Ring spot <i>Drechslera campanulata</i>	Small (1–4 mm) spots with light centres and dark brown rims.	Southern and central areas; favoured by prolonged wet periods in late winter–early spring.	Spores spread from previously infected barley grass seed.	Reduce barley grass in previous season. Minor disease. Control not warranted.
Physiological black chaff (melanism or false black chaff) genetic disorder	Glumes, and sometimes stems just below the head, discoloured to brown–purple–black. Browning can also appear on stems in some varieties, which always extends downwards from a node.	Throughout the state. Develops in wet, humid springs.	This is a genetic disorder associated with the stem rust resistance gene Sr2 in some wheat varieties.	None. Is not a disease.
Stripe (yellow) rust <i>Puccinia striiformis</i> f.sp. <i>tritici</i>	Yellow powdery pustules, often in stripes on leaves.	Can develop from mid autumn onwards; favoured by cool (8–15 °C) moist weather. Plant infection can occur when night time temperatures are between 5–20 °C.	Airborne spores from living plants.	Resistant varieties; seed fungicide or in-furrow fungicides on starter fertiliser at sowing and/or foliar fungicides applied in-crop; control volunteer wheat and barley grass over summer–autumn period.
Leaf rust <i>Puccinia triticina</i>	Small, orange–brown powdery pustules on leaf.	Can develop from early spring; favoured by mild (15–22 °C) moist weather.	Airborne spores from living plants.	Resistant varieties; foliar fungicides; control volunteer wheat over summer–autumn period.
Stem rust <i>Puccinia graminis</i> f.sp. <i>tritici</i>	Redbrown, powdery, oblong pustules with tattered edges on leaf (both sides) and stem.	Can develop from mid spring to end of season, more severe in the north; favoured by warm (15–30 °C) humid weather.	Airborne spores from living plants.	Resistant varieties; foliar fungicides; control volunteer wheat and barley over summer–autumn period.
Powdery mildew <i>Blumeria graminis</i> f.sp. <i>tritici</i>	White to grey cottony fungal growth on leaf and leaf sheath; black resting bodies developing during the season.	Generally more prevalent in irrigated crops and usually more evident in winter and early spring. High nitrogen levels within a crop can favour development.	Spores blown from infected trash and infected plants.	Resistant varieties, seed or in-furrow fungicides at sowing or foliar fungicides in-crop. Note: fungicide resistance in barley powdery mildew has been recorded in Western Australia.
Virus diseases				
Barley yellow dwarf <i>Barley yellow dwarf virus</i> (BYDV) and <i>Cereal yellow dwarf virus</i> (CYDV)	Yellowing, infected plants have reduced height and reduced seed set.	Most common near perennial grass pastures and in early-sown crops.	Transmitted by aphids (oat, corn and rose grain) from infected grasses and cereals. Not seed-borne.	Resistant/tolerant varieties. Seed treatments to control early aphids in crop. In-crop aphid control.
Wheat streak mosaic <i>Wheat streak mosaic virus</i> (WSMV)	Light green streaks and blotches on leaves, stunted plants, reduced seed set.	Has occurred in wheat in southern irrigation areas, and in early-sown grazing wheat on the tablelands and slopes.	Transmitted by the wheat curl mite (WCM). Low level of seed transmission.	Generally no control required. In irrigation areas, spray out grasses in adjoining paddock four weeks before sowing wheat. Insecticides do not control WCM as they are protected within the curled leaf. Do not retain seed from infected crops for planting.
Takeall <i>Gaeumannomyces graminis</i> var. <i>tritici</i>	Blackened roots, stem bases and crown; stunting; 'white heads' and pinched grain.	More common in central and southern NSW, favoured by a wet winter and early spring, followed by dry weather.	Soil-borne on grass and cereal residues, mostly roots and crowns.	Crop rotation for one year free of hosts; some seed and in-furrow fungicides provide a level of suppression.
Crown rot <i>Fusarium pseudograminearum</i>	Brown stem bases, crown and sometimes roots go brown; 'white heads'; pinched grain.	More common in northern and western areas, favoured by a moist early season and dry finish. Becoming more common in the south with stubble retention adoption.	Stubble-borne on grass and cereal residues.	Crop rotation, preferably for 18 months to two years; grow more resistant varieties; grass weed control; balance inputs to available soil water. Inter-row sowing and avoid delayed sowing to minimise losses. Only grow susceptible varieties (e.g. durum) in low risk paddocks based on PreDicta B testing. Registered seed treatments have limited activity as a standalone management strategy.

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Common root rot <i>Bipolaris sorokiniana</i>	The root between the crown and seed (sub-crown internode) is always dark (brown to black); roots and sometimes the stem base are brown; plants have reduced tillering and biomass ('ill thrift').	Widespread throughout grain belt, often found in association with crown rot; scattered through the crop. Exacerbated by deep sowing. Infection favoured by warmer soil temperatures (20–30 °C)	As spores in soil, and on grass and cereal residues in soil. Sorghum and maize are also hosts.	Resistant varieties; crop rotation; optimise nutrition (especially phosphorus), be careful with sowing depth.
Rhizoctonia root rot <i>Rhizoctonia solani</i>	Patches of spindly, stunted plants with yellow erect leaves; 'spear point' root rot; plant death. Later infection of crown roots just seen as wavy appearance across crop.	Associated with minimum or reduced tillage; often aggravated by Group B herbicides.	As fungal threads in soil; soil-borne on residues of many grass, cereal and broadleaf plants.	Crop rotation, soil disturbance to 5–10 cm below sowing depth at or within 2–4 weeks before sowing; avoid Group B herbicides building up, which can cause root pruning. Some seed treatments provide suppression only. Liquid banding of some fungicides is also registered.
Eyespot <i>Tapesia yellundae</i>	Lodging, distinctive 'eyespot' with sharp bend in stem 3–5 cm above ground.	Southern and Central West Slopes, eastern Riverina; favoured by prolonged wet periods in late winter to mid spring.	Rain-splashed spores from crop or grass residue during winter.	Crop rotation (2-year break from cereals); fungicide at first node stage (Zadoks GS31).
Root lesion nematode <i>Pratylenchus thornei</i> <i>Pratylenchus neglectus</i>	Lower leaves yellow, reduced tillering, general ill thrift, restricted root system.	<i>P. thornei</i> more common in north. Crops differentially host each species, e.g. canola hosts <i>P. neglectus</i> but not <i>P. thornei</i> . Lower soil fertility and delayed sowing can exacerbate impacts.	Survive within old roots or as dormant nematodes in the soil. Nematodes can be spread between paddocks and regions through the movement of soil on machinery or in flood water.	Crop rotation but note different crops, differentially host the two nematode species, tolerant or resistant varieties, which again can differ for the two nematode species.
Smuts				
Flag smut <i>Urocystis agropyri</i>	Stunted plants with black, powdery streaks in leaves.	Most likely in early-sown crops (sown in warm soil).	Soil and seed-borne spores.	Resistant varieties, seed-applied fungicide.
Loose smut <i>Ustilago tritici</i>	Black powdery heads on diseased plants.	Statewide.	Airborne spores infect developing seeds at flowering.	Seed-applied fungicide.
Bunt <i>Tilletia laevis</i> ; <i>T. tritici</i>	Seed contains a black, foul-smelling mass of spores – affected grain is not accepted by buyers.	Now very rare, but present at low levels in many crops.	Spores on seed coat infect seedling before it emerges.	Seed-applied fungicide.
Grain conditions				
Head blight <i>Fusarium graminearum</i> ; other <i>Fusarium</i> spp.	Dying portions of head; white or pink, pinched grain; orange spore masses on head.	In wet springs with high humidity during flowering; more common in north. Durum wheat very susceptible. Overhead irrigation during flowering can provide conditions favourable for infection.	Stubble-borne on wheat, maize, sorghum, other grasses; wind-borne and rain-splashed spores. Note: basal infections from crown rot (<i>F. pseudograminearum</i>) can also cause low levels of head blight in wet seasons.	Crop rotation; avoid highly susceptible varieties especially durum; fungicides at flowering applied correctly to provide good coverage of heads.
Black point genetic disorder	Dark coloured areas on grain, particularly at embryo end, reducing appearance of grain products.	Favours moist weather during late stages of grain filling and ripening..	This is a physiological condition affecting some varieties of bread wheat and durum.	Resistant varieties.
Frost injury				
	1. Dark or split nodes, kinked stem. 2. Whole or partial head death. 3. Absence of seeds.	After severe frost at stem elongation. After frost during booting. After frost from heading to flowering.		Avoid early sowing of short season varieties. Avoid short sowing windows to spread risk.

Scoring 'Herbicide injury' – Crops under climatic or disease stress can show symptoms of injury after they are sprayed with herbicide. Refer to NSW DPI's *Weed control in winter crops*.

Coleoptile length of wheat varieties

Coleoptile length of wheat varieties is an important characteristic when selecting a variety to sow into difficult seedbed conditions. Coleoptile length will affect how deep you can sow a variety before plant emergence is reduced. Coleoptile length has been found to be influenced by several factors including variety, seed size, temperature, low soil moisture and certain seed fungicide dressings. Following are the results of wheat variety screening for coleoptile length as part of the National Variety Testing program, which is funded by GRDC.

Table 15. Predicted mean coleoptile length for durum wheat varieties at 21 NVT sites across Australia from 2010–2015

Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)
Caparoi	7.6	DBA_Vittaroi	7.5	Kalka	7.5	WID802	7.7
DBA_Aurora	7.6	EGA_Bellaroi	7.9	Saintly	7.4	Yawa	7.6
DBA_Bindaroi	7.6	Hyperno	7.8	Tamaroi	8.1	Check varieties	
DBA_Lillaroi	7.9	Jandaroi	7.1	Tjilkuri	7.7	Federation (long)	9.5
						Whistler (short)	6.0

Table 16. Predicted mean coleoptile length for early and long season wheat varieties at 20 NVT sites across Australia from 2008–2015

Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)
Beaufort	8.3	Estoc	7.0	RGT Accroc	6.6	Sunsoft 98	5.9
Bolac	5.7	Flanker	6.2	RGT Calabro	6.5	Suntime	6.2
Coolah	6.6	Forrest	6.1	Rosella	7.0	Sunzell	6.4
Cutlass	7.1	Gauntlet	6.6	Sentinel	6.3	Tennant	7.2
DS Darwin	5.6	Gazelle	5.8	SF Adagio	6.2	Trojan	6.9
DS Faraday	6.1	Kiora	6.5	SF Mosquito	6.7	Wylah	6.1
DS Pascal	5.8	Kittyhawk	6.3	SF Ovalo	9.0	Yenda	7.0
EGA_Bounty	6.3	Lancer	6.7	SF Scenario	6.7	Check varieties	
EGA_Burke	6.1	Mackellar	6.2	SQP Revenue	6.4	Federation (long)	9.5
EGA_Eaglehawk	6.4	Manning	5.8	Strzelecki	6.5	Whistler (short)	5.7
EGA_Gregory	6.3	Mitch	7.0	Sunbri	6.7		
EGA_Wedgetail	5.9	Naparoo	6.4	Sunlamb	6.3		
Einstein	5.8	Phantom	6.6	Sunmax	6.0		

Table 17. Predicted mean coleoptile length for main season wheat varieties at 55 NVT sites from 2008–2015

Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)	Variety	Predicted mean coleoptile length (cm)
Arrow	6.5	Diamondbird	6.6	Kord CL Plus	6.7	Sunguard	7.0
Axe	6.0	DS Darwin	5.6	Lincoln	6.1	Sunlin	6.7
B53	6.4	EGA_Gregory	6.4	Livingston	6.6	Sunmate	7.1
Barham	6.8	EGA_Hume	6.5	LRPB Oryx	6.0	Sunstate	6.4
Baxter	7.1	EGA_Kidman	6.4	Mace	6.9	Suntop	7.1
Beckom	6.4	EGA_Wills	6.8	Merinda	6.5	Sunvale	7.0
Buchanan	6.6	EGA_Wylie	6.9	Merlin	7.2	Sunvex	7.4
Chara	6.3	Ellison	7.0	QAL2000	7.2	Tenfour	6.6
Clearfield Janz	6.4	Elmore CL Plus	7.1	QALBIS	6.7	Tungsten	6.3
Cobra	6.6	Emu Rock	6.5	Reliant	6.6	Wallup	6.3
Condo	6.5	Grenade CL Plus	6.6	Scepter	6.6	Yitpi	7.8
Corack	6.8	Impala	5.7	Scout	7.3	Check varieties	
Correll	7.7	Jade	6.2	Shield	6.6	Federation (long)	9.8
Crusader	6.7	Janz	7.0	Spitfire	7.1	Whistler (short)	5.9
Dart	7.2	Justica CL Plus	6.7	Sunco	7.0		

Handy hints

Table 18. Typical values for characteristics

Grain	Typical values for key grain characteristics				
	Seeds/kg	Volumetric grain weight (kg/hL)	Bulk densities		Angle of repose°
			kg/m ³	t/m ³	
Barley	53,200	62	620	0.62	28
Canary seed	143,000	70	700	0.70	—
Canola	250,000	70	700	0.70	22
Cereal rye	40,000	71	710	0.71	26
Chickpea – desi	4,500	75	750	0.75	—
Chickpea – kabuli	2,100	75	750	0.75	—
Cowpea	5,000	76	760	0.76	—
Faba bean	2,000	75	750	0.75	—
Field pea	5,000	75	750	0.75	—
Grain sorghum	45,000	72	720	0.72	28
Linseed	150,000	73	730	0.73	20
Lupin – narrow-leaf	6,000	75	750	0.75	—
Lupin – albus	3,000	75	750	0.75	—
Maize	3,000	72	720	0.72	28
Millet	250,000	62	620	0.62	—
Mungbean	15,000	75	750	0.75	—
Navy bean	5,000	75	750	0.75	—
Oats	34,400	45	450	0.45	28
Pigeon pea	6,600	75	750	0.75	—
Rice – medium grain	35,700	56	560	0.56	31
Rice – long grain	40,000	56	560	0.56	31
Safflower	24,000	53	530	0.53	28
Soybean	5,500	75	750	0.75	27
Sunflower	17,300	40	400	0.40	30
Triticale	23,000	65	650	0.65	—
Vetch	14,000	75	750	0.75	—
Wheat	34,800	75	750	0.75	27

Note: The number of seeds/kg will vary according to variety and growing conditions. The bulk density and angle of repose varies according to variety, moisture content, quality and trash content of the grain.

To check grain bulk density, weigh 1 L of grain. This weight in kilograms is its density in tonnes per cubic metre.

Kath Cooper & Mike Elleway
Sherlock, South Australia

Specialists in non-PBR triticale varieties

Bulk or bagged seed available

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Durum

Durum wheat makes semolina upon milling, which is used to make pasta and similar products.

Durum wheat produces high yields and often attracts a price premium over bread wheat, giving growers in Prime Hard wheat or similar areas a useful alternative. Durum varieties should only be grown in high fertility soils where grain of 13% protein or above is consistently produced, and preferably following a weed-free fallow, broadleaf or sorghum crop to minimise the risk of crown rot.

Varieties

See [Table 13. Varietal characteristics and reaction to diseases on page 20](#) for additional information.

Caparoi[®]. ADR quality. A mid season maturity durum, with a maturity between EGA_Bellaroi[®] and Jandaroi[®]. It is a semi-dwarf durum variety with good yield potential in all regions. The grain quality is better than EGA_Bellaroi[®] and generally achieves lower grain protein content. Caparoi[®] has improved dough strength compared with EGA_Bellaroi[®], but is inferior to Jandaroi[®] for this trait. Caparoi[®] is superior to Jandaroi[®] for semolina yellowness. Moderately susceptible to root lesion nematode (*Pratylenchus thornei*) and very susceptible to crown rot. Adequate resistance to common root rot. Good shedding resistance. Marketed by Seednet.

DBA_Aurora[®]. ADR quality. A mid season maturity durum variety, released for the southern grains region. High yield potential, with yield levels similar to or better than Hyperno[®] in most NSW regions, so nitrogen management is important to obtain acceptable grain protein levels for delivery into durum quality grades, especially DR1. Higher levels of screenings can occur in some circumstances when compared with varieties such as DBA_Lillaro[®], Jandaroi[®] and Caparoi[®]. Avoid sowing DBA_Aurora[®] later than the suggested sowing window for your region, as grain quality and yield potential can be affected. It can lodge under irrigation or high yielding conditions. It is rated resistant–moderately resistant to root lesion nematodes (*P. thornei*) and very susceptible to crown rot. Bred by the Southern Program of Durum Breeding Australia (University of Adelaide). Marketed by SA Durum Growers Association.

DBA_Bindaroi[®]. ADR quality for northern NSW. Early–mid maturing durum wheat variety that is adapted to dryland production areas in NSW, with a higher yield potential than Caparoi[®]. DBA Bindaroi[®] has erect plant growth and is shorter in stature than Caparoi[®] with better straw strength. Grain, semolina and pasta making quality superior to Caparoi[®] with improved colour and brightness. Low screening variety, similar to Jandaroi[®]. Rated susceptible–very susceptible to crown rot. Bred by the Northern Program of Durum Breeding Australia (NSW Department of Primary Industries). Marketed by Seednet.

DBA_Lillaro[®]. ADR quality. An early–medium maturity variety, three days later to head emergence than Jandaroi[®], with a higher grain yield. Excellent durum quality with the largest grain size of the commercial varieties, low screenings, high test milling yield, and the improved semolina colour compared with current varieties. Adapted to the rain-fed durum production regions of NSW and is also suited to sowing later in the season. DBA_Lillaro[®] is not recommended for high-input irrigated systems without the appropriate agronomic management. Rated moderately resistant to root lesion nematode (*P. thornei*) and susceptible–very susceptible to crown rot. Bred by the Northern Program of Durum Breeding Australia (NSW Department of Primary Industries). Marketed by Seednet.

DBA_Vittaro[®]. ADR quality. An early–mid maturing durum variety that is suitable for high-input irrigated durum production systems and replaces EGA_Bellaroi[®]. DBA_Vittaro[®] is shorter in stature than either EGA_Bellaroi[®] or Caparoi[®], with superior straw strength. It is approximately seven days earlier to heading than EGA_Bellaroi[®]. Grain, semolina and pasta making quality are superior to EGA_Bellaroi[®].

Low screenings, similar to Jandaroi¹ and superior to EGA Bellaroi¹. Bred by the Northern Program of Durum Breeding Australia (NSW Department of Primary Industries). Marketed by Seednet.

EGA_Bellaroi¹. ADR quality. A mid season maturity durum variety. The grain yield is inferior to the newer-released varieties Caparoi¹, DBA_Bindaroi¹, DBA_Lillaroi¹, DBA_Vittaroi¹ and Jandaroi¹. The grain protein is consistently higher than other current commercial varieties. EGA_Bellaroi¹ makes good quality pasta, although somewhat dull and coloured deep yellow, but has poor dough strength. Moderately resistant to common root rot and very susceptible to crown rot. EGA_Bellaroi¹ has reduced crop lodging under high yield situations compared with most durum varieties and has now been outclassed by DBA_Vittaroi¹ for reduced crop lodging and grain yield in high yielding irrigated durum production systems. Marketed by Seednet.

Hyperno¹. ADR quality for northern NSW. A mid season maturity durum with excellent yield potential. Maturity is earlier than EGA_Bellaroi¹. It is resistant to stem rust and resistant–moderately resistant to leaf rust; susceptible–very susceptible to crown rot. It has a good level of sprouting and black point tolerance. It can produce higher screenings than other durum varieties in some circumstances. It can lodge under irrigation or high yielding conditions. Marketed by AGT.

Jandaroi¹. ADR quality for northern NSW. A quick maturity variety adapted to most durum producing regions and is suited to sowing later in the season. It has been shown to have improved weather tolerance at harvest compared with other varieties. Grain quality is superior to Caparoi¹ and EGA_Bellaroi¹, with much stronger dough properties but lower yellow pigment. An erect, semi-dwarf plant type. It is very prone to lodging under high yield conditions in southern NSW. It is moderately susceptible–susceptible to root lesion nematode, moderately resistant to black point and very susceptible to crown rot. Marketed by Seednet.

Table 19. Suggested sowing times, Durum wheat varieties

Variety	Weeks	April				May				June				July		
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Northern Slopes																
Caparoi, EGA_Bellaroi, Hyperno							>	★	★	★	★	★	<			
DBA_Aurora ¹						>	★	★	<							
DBA_Bindaroi ¹ , DBA_Vittaroi ¹							>	★	★	★	★	★	<			
DBA_Lillaroi ¹								>	★	★	★	★	★	<	<	<
Jandaroi								>	★	★	★	★	★	<	<	<
Northern Plains (Moree, Narrabri)																
Caparoi, EGA_Bellaroi, Hyperno								>	★	★	★	★	<			
DBA_Aurora ¹						>	★	★	<							
DBA_Bindaroi ¹ , DBA_Vittaroi ¹							>	★	★	★	★	★	<			
DBA_Lillaroi ¹									>	★	★	★	★	<	<	<
Jandaroi									>	★	★	★	★	<	<	<
Liverpool Plains																
Caparoi, EGA_Bellaroi, Hyperno									>	★	★	★	<			
DBA_Aurora ¹						>	★	★	★	<						
DBA_Bindaroi ¹ , DBA_Vittaroi ¹							>	★	★	★	★	★	★	<		
DBA_Lillaroi ¹									>	★	★	★	★	★	<	<
Jandaroi										>	★	★	★	★	<	<
South Western Plains (Griffith, Hillston)																
Caparoi, EGA_Bellaroi,							>	★	★	<						
DBA_Aurora ¹						>	★	★	★	<						
DBA_Bindaroi ¹ , DBA_Vittaroi ¹							>	★	★	★	★	<				
DBA_Lillaroi ¹								>	★	★	★	<				

Suggested sowing times – Aim to sow crops in the earlier part of the optimum period. The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock.

¹ New varieties – limited information available on the response to sowing time for these varieties.

> Earlier than ideal, but acceptable, some frost damage may occur.

★ Optimum sowing time.

< Later than ideal, but acceptable, yield might be reduced. DBA_Lillaroi and Jandaroi given their quicker maturities are suitable for double cropping following cotton.

Crop management

Seed

Use sound, true-to-type seed that is free of weed seeds, cracked grain, bread wheat and barley. Durum seed is significantly larger than bread wheat seed. Thousand grain weight should be determined and used to calculate a sowing rate based on target plant population. Target plant populations are similar to bread wheats (see [Calculating sowing rates on page 8](#)). Germination percentage should exceed 90%.

Sowing time

Best yields are obtained from sowing in mid May to the end of June, depending on variety and region. Frost can damage earlier sowings at flowering.

Sowing

Adjustments might be necessary for the larger seed size; increase the sowing rate if using seed with a reduced germination percentage, or sowing later into cold conditions or higher yield potential situations. Short coleoptile length should be considered when moisture seeking. Ensure seeders are clean of bread wheat and barley, in particular, before starting sowing.

Nutrition

A balance of nutrients is essential for profitable yields. Fertiliser is commonly needed to add the essential nutrients nitrogen and phosphorus. A lack of other essential plant nutrients (e.g. sulfur and zinc) can also limit production in some situations. Soil test and consider paddock history to determine nutritional requirements. Complete a nitrogen budget and consider variety selection to ensure that protein levels above 13% are achieved.

Crops usually tolerate low zinc (Zn) levels when grown on heavy, self-mulching black earths (pH_{Ca} 8–8.5). When grown in very wet, high phosphate soils for several weeks, zinc deficiency symptoms can appear.

If the soil is known to be low in zinc (soil and plant tissue tests are available), a 1% aqueous solution of zinc sulfate heptahydrate applied as a foliar spray 2–4 weeks after emergence ameliorates the deficiency. A range of zinc-fortified starter fertilisers are also available.

Diseases

Durum varieties generally have useful levels of resistance to all pathotypes (including the new virulent strains) of the three rusts, but are very susceptible to crown rot. They are also susceptible to Fusarium head blight, which is common in very wet seasons and in areas where durum is grown in close proximity to maize stubble. This disease is not commonly observed under irrigation in southern NSW when grown in rotation with maize, however, growers must be aware of the risks. Rotations and paddock selection are therefore important. Avoid wheat on wheat/barley situations due to the high crown rot risk and low nutrition. Nutrient management also needs to be considered if following cotton, as incorporated cotton trash ties up and immobilises a large amount of nutrients. Ensure good grass weed control as many grass species also host crown rot. Current varieties have useful tolerance to yellow spot.

Table 20. Durum – North east region – compared with Caparoi = 100%

Variety	North east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% Caparoi (t/ha)	3.23	3.53	5.18	2.89	2.09	3.52	
Caparoi	100	100	100	100	100	100	13
DBA_Aurora	110	104	107	112	111	108	13
DBA_Bindaroi	110	104	107	112	111	108	13
DBA_Lillaroi	102	95	106	102	104	101	14
DBA_Vittaroi	—	106	99	98	96	99	10
EGA_Bellaroi	90	93	97	79	88	92	13
Hyperno	112	96	103	109	—	105	11
Jandaroi	92	104	94	101	94	97	13

Table 21. Durum – North west region – compared with Caparoi = 100%

Variety	North west						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% Caparoi (t/ha)	1.49	2.75	4.43	1.77	—	2.60	
Caparoi	100	100	100	100	—	100	11
DBA_Aurora	106	104	112	115	—	110	11
DBA_Bindaroi	107	103	101	107	—	103	11
DBA_Lillaroi	102	103	94	106	—	99	11
DBA_Vittaroi	—	98	97	97	—	96	8
EGA_Bellaroi	85	92	96	79	—	90	11
Hyperno	116	104	105	110	—	108	11
Jandaroi	98	100	89	98	—	94	11

Table 22. Durum – South west region – compared with Caparoi = 100%

Variety	South west ^①						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% Caparoi (t/ha)	4.34	3.48	4.90	–	4.10	3.95	
Caparoi	100	100	100	–	100	100	12
DBA_Aurora	109	108	111	–	106	109	12
DBA_Bindaroi	101	100	101	–	101	101	12
DBA_Lillaroi	98	101	93	–	97	97	12
DBA_Vittaroi	–	104	96	–	98	99	9
EGA_Bellaroi	95	95	97	–	97	96	12
Hyperno	102	98	107	–	–	103	9
Jandaroi	94	97	88	–	94	93	12

^① Includes irrigated and dryland variety trials.

Yield results are a combined across sites analysis of NVT yield trials from 2014–2018.

The tables present NVT 'Production Value' MET (multi environment trials) data on a yearly region mean grouping and a regional mean basis.

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Barley

Paddock selection and nitrogen management are often the keys to producing malting quality barley.

Crop management

Sowing time

Sowing time determines the time a crop matures, and ideally flowering and grain fill should be in the cooler part of spring.

Sowing on time maximises the chances of achieving high yields and a malting grade. Sowing after the middle of June usually limits yield potential and results in smaller grain and higher protein, rendering the grain less likely to be accepted as malting.

Nutrition

Soil fertility and fertiliser management, with attention to nitrogen and phosphorus, is essential to optimise yield.

Grain protein below 10.5%, in combination with low yields, usually indicates nitrogen deficiency. Where the level of protein is consistently less than 10%, at least 50 kg/ha of nitrogen can normally be applied at sowing or up to the 5-leaf stage to increase yields whilst maintaining malting quality. High fertility paddocks usually produce grain too high in protein for malting grade. High rates of nitrogen can optimise feed grain yields.

Sowing depth

Pay close attention to sowing depth, particularly where direct-drilling is practised and for varieties with a short coleoptile. The ideal depth is 3–6 cm, but seed should always be sown into moist soil. If dry sowing is being considered target a sowing depth of 3–4 cm, particularly on a hardsetting or slumping soil, to avoid problems with crop emergence.

Irrigation

Barley does not tolerate waterlogging, so good paddock drainage and management are essential for high grain yields.

Sowing rates

Select seed carefully for large size and high germination percentage. A germination test can be conducted if in doubt. A suggested guide per hectare is:

- plains: 35–50 kg
- slopes: 45–60 kg
- tablelands and partial irrigation: 60–90 kg
- full irrigation: 70–110 kg
- grazing and grain: increase the above rates by 10–20 kg
- cover crops for pastures: 10–20 kg.

The lower rates should be used when there is limited subsoil moisture at sowing, and in drier areas. High sowing rates tend to decrease grain size and increase screenings.

Acid soils tolerance

No new acid tolerant barleys have been released in recent years for NSW. A new acid soil tolerant barley, Buff[®], was released in Western Australia in 2018, which might be adapted to NSW conditions. Limited yield data is available on Buff[®] in NSW. The older varieties Yambula and Tulla can tolerate high soil aluminium up to 10–15%. Most varieties tolerate high manganese levels very well.

GO TO PAGES

For disease prevalence see [Table 27. Disease and crop injury guide – barley on page 52.](#)

NVT website: www.nvtonline.com.au

GO TO PAGES

Formula for calculating sowing rates: [Calculating sowing rates on page 8](#)

Variety choice

When selecting a variety consider:

- Crop use. For grazing and grain recovery, feed grain, or malt grain production?
- Grazing value. When is feed most important? Dual-purpose varieties are most suitable.
- Grain:
 - For retention on farm?
 - For sale as feed grain?
 - For sale as human food?
 - For sale as a malting or food grade – for general delivery to malt segregations or under contract? Use only accredited malting or food grade varieties.

Management to achieve malting barley

Paddock selection

- Nitrogen status appropriate for expected yield.
- Soil pH_{Ca} not less than 5.0 or soil aluminium not more than 5%.
- Avoid soils prone to waterlogging.
- Rotation: ideally sow after a root-disease break crop.
- Avoid barley on barley. Barley can be sown after wheat if disease or seed contamination is not a problem.
- Avoid varietal contamination.

Variety choice

- Appropriate for the environment.
- To suit the sowing time.
- Availability of segregation.

Sowing time

- Too early increases the risk of frost damage.
- Too late will increase protein and screenings.

Sowing rate

- Too high can reduce grain size and increase lodging, especially under irrigation.
- Too low will reduce yield potential.

Seed treatment

- Use appropriate seed dressings to control smuts and foliar diseases.
- Note the effect of seed treatments on short-medium coleoptile length varieties, particularly in deep-sown situations.

Phosphorus

- Too low will limit yield and increase protein.

Nitrogen

- Too low will reduce yield and quality.
- Excessive nitrogen fertiliser can increase screenings and protein levels.

Timely weed control

- Weeds compete for nutrients and moisture.
- Reduce contamination.

Care with harvest

- Avoid skinning.
- Try to minimise weather damage effects.
- Avoid varietal contamination.
- Only use grain protectants registered for malting barley.

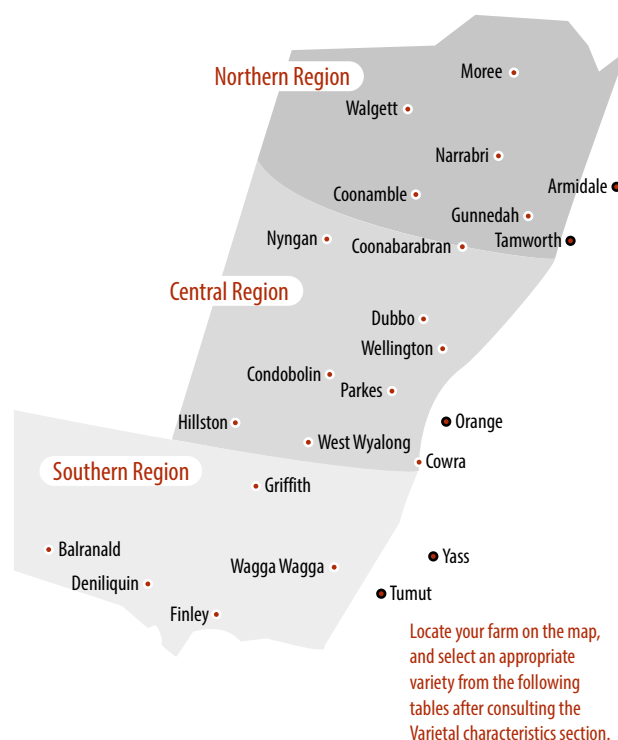


Figure 2. Map of NSW showing barley-growing zones

Variety selection

Varietal characteristics

The following is a list of barley varieties, including new releases for 2019. The variety descriptions should be read in conjunction with [Table 27. Disease and crop injury guide – barley on page 52](#).

There are a number of new specialist malt barley varieties becoming available on the Australian market, these are grown under contract to specific companies, for example SakuraStar[®]. Limited information is available on the performance of some of these new varieties, with limited testing in NVT (National Variety Trial) barley trials. Growers should seek as much information from the respective company on the variety's yield performance and disease resistance ratings and ensure grain contracts reflect any differences in yield or disease management for other, more locally adapted, barley varieties.

Information has been collated from breeding companies. Refer to [Table 25. Suggested sowing times on page 45](#) for suggested sowing times.

BARLEYmax[®]. A specialty barley for the human food market. Early–mid season maturity. Dark coloured, semi hulless seed with a shrunken endosperm.

Bass[®]. Malt. BaudinA replacement with excellent grain plumpness and high test weight, suited to medium–higher rainfall districts. Similar maturity to BaudinA. Moderately short variety with good straw strength and head retention. Bred and marketed by InterGrain.

Baudin[®]. Malt. Excellent malting quality. A GairdnerA replacement with earlier maturity (rated mid-season) and lower screenings. Adapted to medium rainfall areas. Short, with excellent straw strength and head retention. Very susceptible to powdery mildew and leaf rust. Released by the Department of Primary Industries and Regional Development (DPIRD). Seednet.

Buloke[®]. Malt. Excellent malting quality for the export market. Tall, early–mid season variety; flowering time similar to Schooner. Buloke[®] has a better grain size than Gairdner[®], but smaller than the benchmark variety Schooner. Buloke[®] exhibits sprouting tolerance, similar to Gairdner[®]. Can lodge under conditions favouring high yield and is susceptible to head loss. Bred by VIC DEPI. Seednet.

Commander[®]. Malt. A malting quality variety suitable for the domestic and Asian export markets. Mid season variety, with a maturity between Schooner and Gairdner[®]. Plump grain size compared with other malting varieties. High yield potential and lower grain protein than Schooner or Gairdner[®] when grown under the same conditions. Can lodge when sown early. Developed by the University of Adelaide. Seednet.

Compass[®]. Malt. Developed by the University of Adelaide as an early–mid season maturing variety option. It has a similar growth habit to Commander[®], but higher yield potential. In high-yielding situations it has shown to be prone to crop lodging. Compass[®] is earlier flowering compared with Commander[®] and similar in flowering time to Hindmarsh[®]. Compass has shown good physical grain quality, with plump grain, high retention and low screenings. Seednet.

Fathom[®]. Feed. Fathom[®] was developed using wild barley to improve stress tolerance and water use efficiency. It has a long coleoptile and shows particularly good early vigour and weed competitiveness. Early maturity, similar to Hindmarsh[®], best suited to lower and medium rainfall environments. Fathom[®] is a moderately tall variety, but shows good straw strength and has excellent grain plumpness with screenings levels lower than Hindmarsh[®]. Developed by the University of Adelaide. Seednet.

Flinders[®]. Malt. A medium–late maturing high-yielding barley variety, potentially offering yields greater than Baudin[®] or Gairdner[®]. It has a prostrate growth habit like Baudin[®], with maturity similar to Gairdner[®] and is suited to earlier sowing opportunities. Short coleoptile, so deep sowing should be avoided. Flinders[®] has good resistance to crop lodging and head loss. It offers a useful disease resistance package, in particular resistance to powdery mildew. Bred and marketed by InterGrain.

Gairdner[®]. Malt. Adapted to medium to higher rainfall areas (>400 mm). Mid–late season maturity and strong straw. Best sown early. It has a thin grain, producing significantly greater screenings losses relative to Schooner and is also around 1% lower in grain protein. Resistance to Barley yellow dwarf virus (BYDV). Developed by DPIRD. Heritage Seeds.

Granger[®]. Malt. A medium-late, high-yielding, broadly adapted barley with excellent malt extract, good diastatic power, and targeted for the domestic malting industry as a potential Gairdner[®] replacement. Performs better than Oxford under late planting conditions. Granger[®] is, on average, 10 cm taller than Baudin[®] and 3–4 cm taller than Gairdner[®], but with better lodging resistance; higher test weight; a potentially larger kernel size (2–4 grams/1000 grains); and lower screenings. Licensed to Heritage Seeds by Nickerson–Limagrain, UK.

Grout[®]. Feed. A quick-maturing variety with good grain size, suited to northern NSW and Qld. Matures up to two weeks earlier than Grimmer[®] from a mid May to mid June planting. Vigorous seedling with a high tillering ability and erect growth habit. Medium height with moderate standability, better than Grimmer[®] and similar to Mackay[®]. Leaf rust needs to be managed, rated as very susceptible. Seednet.

Hindmarsh[®]. Food. An erect, semi-dwarf variety that flowers earlier than Schooner, and is widely adapted to low and medium rainfall areas. Excellent yield potential, grain plumpness close to Schooner, and high test weight. Short coleoptile, so deep sowing should be avoided. It has been given a new classification of ‘food’, and can be segregated for human food and possibly used for Shochu (Japanese distilled spirit) and for malt production in some markets. Developed by Victorian DEPI. Seednet.

La Trobe[®]. Malt. La Trobe[®] is an early-maturing semi-dwarf variety with good yield potential in low-medium production environments. It has very similar growth habit and plant architecture to Hindmarsh[®]. It has excellent head retention, lodging resistance and good physical grain characteristics. Similar disease profile to Hindmarsh[®]. La Trobe[®] also possesses good pre-harvest sprouting tolerance. Bred and marketed by InterGrain.

Oxford. Feed. A medium-late-maturing variety similar to Gairdner[®]. High yield potential, with wide adaptation. Excellent head retention with above average test weight and excellent grain colour. Good straw strength and resistance to lodging. Resistant to powdery mildew and moderately resistant to leaf rust. Heritage Seeds.

RGT Planet[®]. Malt. Introduced European malt barley, which has shown a high yield potential in NSW. Mid season flowering, but maturity is flexible with a multi-environmental fit. Similar maturity to Commander[®]. Excellent standability. Bred by RAGT, and will be available via Seed Force Broadacre Agents.

Rosalind[®]. Feed. A broadly-adapted, high-yielding mid-season barley that has performed well across NSW. Maturity is later than La Trobe[®] and earlier than Buloke[®]. It has a short coleoptile length, moderate plant height and an erect growth habit. Good straw strength and head retention. High level of pre-harvest sprouting tolerance, with good physical grain package, grain plumpness similar to La Trobe[®]. Bred and marketed by InterGrain.

Schooner. Malt. Formerly a major central and southern malting variety, favoured for its reliability in maintaining grain size, although lower yielding than later releases. Can be prone to pre-harvest head loss.

Scope CL[®]. Malt. An imidazolinone-tolerant barley, which provides tolerance to label rates of Intervix[®] herbicide. Check current herbicide registrations for registered product rates and adhere to recommended plant growth stages for application timing. Tall, early-mid season variety, with a flowering time and head loss susceptibility similar to Buloke[®]. Developed by Agriculture Victoria Services and Seednet.

Shepherd[®]. Feed. It is slightly later maturing than Grout[®], but similar growth habit with erect vigorous early growth. Suited to medium rainfall areas of northern NSW and Qld. Seednet.

SouthernStar[®]. There is limited information on this variety’s performance in NSW. A potential boutique malting barley developed by Sapporo Breweries and the University of Adelaide. SouthernStar[®] is based on the variety Flagship[®] and incorporates a patented novel gene for improved beer quality. It has almost identical agronomic characteristics to Flagship[®] with good early vigour. SouthernStar[®] also has sensitivity to sprouting so timely harvest must be a priority. It is grown under production contracts with Barrett Burston Maltings and Cargill.

Spartacus CL[®]. Malt. A Clearfield barley suited for NSW; it is an early-maturing semi-dwarf barley with a maturity similar to La Trobe[®]. Spartacus CL[®] is a high-yielding barley where Clearfield technology can be used in-crop to control barley or brome grass. It is also ideal for following either Clearfield canola or wheat,

where herbicide plantback issues might be a concern. Check current herbicide registrations for registered product rates and adhere to recommended plant growth stages for application timing. Similar height and plant type to La Trobe[®]. Short coleoptile length. Moderately good straw strength and head retention, with a good physical grain quality. High level of pre-harvest sprouting tolerance. Bred and marketed by InterGrain.

SakuraStar[®]. There is limited information on this variety's performance in NSW. A potential new boutique malting barley developed by Sapporo Breweries and the University of Adelaide. Targeted to replace SouthernStar[®] as has improved pre-harvest sprouting tolerance. Superior grain size compared with SouthernStar[®] and is similar to Buloke[®]. Contract production only; can be grown under production contracts with Barrett Burston Maltings and Cargill.

Urambie[®]. Feed. It is best suited to grain and grazing situations. Two-row barley, adapted to early sowing, having early maturity combined with a cold requirement to initiate heading. Sowing window is early May to mid-June; earlier if grazed. Consistent yields across seasons, but low grain quality. Waratah Seeds.

Westminster[®]. Malt. A medium-late maturity variety similar to Gairdner[®], Westminster[®] has a high yield potential and performs well under high rainfall or irrigation. Medium-tall variety with good straw strength and improved head retention compared with Gairdner[®]. Introduced malt barley from Nickerson International Research, licensed to GrainSearch in Australia.

The following are more recently named or released varieties. Some lines might only have limited seed available in NSW for 2019.

Alestar[®]. A medium-long season barley, three days earlier than Commander[®] and five days earlier than Gairdner[®] and Oxford[®]. Under malt evaluation with Barley Australia. Good yield potential in medium- to high-yielding environments. Test weight, screenings and plumpness (retention) similar to Hindmarsh[®]; high grain colour (brightness); good straw quality with high resistance to lodging and straw breakage; excellent head retention. Bred by Limagrain UK, developed by Edstar Genetics in Australia. Commercialised by Elders.

Banks[®]. A later maturing variety suited to the medium-high rainfall areas of NSW, with an optimal sowing date of 25 April through to mid-May. Banks[®] has moderately good straw strength and a low head loss risk. It is currently undergoing malt accreditation with Barley Australia. Bred and marketed by InterGrain.

Biere[®]. Biere has a very fast maturity, being seven days early maturing then Hindmarsh[®] or La Trobe[®]. High seedling vigour. Low input line suited to late sowing situations (post May) and even early spring sowings. Limited commercial grain production will be supported in 2019 in selected regions as Barley Australia puts it through the malt accreditation process. GrainSearch.

Bottler[®]. A mid-season maturity variety, (-5 days compared with Gairdner[®]), with high yield potential. Suits medium and high rainfall zones, with potential for irrigation use. Limited production will be supported in selected regions in 2019 as it progresses through malt accreditation with Barley Australia. GrainSearch.

Buff[®]. An early maturing, white aleurone, acid soil tolerant variety and suited to the acid soil/high aluminium environments of Western Australia(WA). Buff[®] is broadly adapted in WA and offers moderately good grain plumpness and has good early vigour. Limited testing in NSW. It is currently undergoing malt accreditation with Barley Australia. Bred and marketed by InterGrain.

Maltstar[®]. A long season potential malting barley, similar to Commander[®]. Maltstar[®] is under malt evaluation with Barley Australia. Good yield potential in medium to high yielding environments. Has high test weight, low screenings and high grain colour (brightness). It has good straw quality with high resistance to lodging and straw breakage; excellent head retention. Bred by Limagrain UK, developed by Edstar Genetics in Australia. Commercialised by Elders.

Topstar[®]. Medium-long season variety; maturity similar to Commander[®] and three days earlier than Oxford; 10–15 cm taller than Baudin[®], with good straw quality and tolerance to lodging. Good test weight and low screenings. Developed by Edstar Genetics in Australia. Commercialised by Elders.

Northern NSW barley yield performance experiments from 2014–2018

The yield results presented are NVT 'Production Value' multi environment trial (MET) data shown on a yearly regional group mean and regional mean basis from 2014–2018. Further results are on the [NVT website](#).

Table 23. Northern NSW main season sown: Compared with Hindmarsh = 100%

Variety	North east						Number of trials
	Yearly group mean					Regional mean	
	2014	2015	2016	2017	2018		
% Hindmarsh (t/ha)	3.00	3.96	4.78	3.66	2.25	3.47	
Alestar	86	85	96	78	110	92	12
Banks	—	93	94	96	112	96	9
Bass♦	87	84	90	71	99	88	12
Baudin♦	83	77	84	—	—	86	8
Biere	—	98	92	84	96	93	9
Bottler	—	—	100	89	115	96	7
Buff	—	—	99	—	—	94	3
Buloke♦	89	89	87	—	—	89	8
Commander♦	92	93	87	87	112	93	12
Compass♦	104	106	95	107	110	103	12
Fathom	105	105	101	103	99	103	12
Flinders♦	85	84	93	74	101	89	12
Gairdner♦	71	70	—	67	98	75	9
Granger♦	87	89	97	—	—	94	8
Grout	87	91	91	99	100	93	12
Hindmarsh	100	100	100	100	100	100	12
LaTrobe♦	98	99	100	100	100	99	12
Maltstar	80	78	95	83	115	91	12
Oxford	77	78	103	64	121	92	12
RGT Planet♦	—	—	112	93	118	103	7
Rosalind	105	107	110	104	107	107	12
Schooner♦	84	87	—	—	—	87	3
Scope CL♦	90	88	84	79	92	87	12
Shepherd	83	90	89	85	109	91	12
Spartacus CL♦	99	102	104	98	95	101	12
Topstart	—	80	98	70	114	91	9
Urambie	75	76	—	—	—	86	5
Westminster♦	78	79	—	—	—	83	5

Variety	North west						Number of trials
	Yearly group mean					Regional mean	
	2014	2015	2016	2017	2018		
% Hindmarsh (t/ha)	3.53	3.79	4.21	2.14	2.58	3.37	
Alestar	98	90	93	90	104	94	19
Banks	—	96	92	100	109	97	15
Bass♦	99	88	91	86	96	92	19
Baudin♦	99	84	91	—	—	93	13
Biere	—	97	88	84	94	91	15
Bottler	—	—	93	95	108	96	10
Buff	—	—	93	—	—	93	4
Buloke♦	96	91	88	—	—	92	13
Commander♦	100	96	86	97	112	96	19
Compass♦	102	106	95	108	112	103	19
Fathom	102	104	101	102	101	102	19
Flinders♦	97	88	—	—	—	92	9
Gairdner♦	89	78	75	80	96	82	19
GrangeR♦	98	92	92	89	105	95	19
Grout	90	93	90	94	98	92	19
Hindmarsh	100	100	100	100	100	100	19
LaTrobe♦	98	99	99	99	99	99	19
Oxford	96	85	—	—	—	92	9
RGT Planet♦	—	—	104	101	109	101	10
Rosalind	103	105	106	104	105	105	19
Schooner♦	87	89	86	—	—	88	13
Scope CL	96	90	88	87	94	91	19
Shepherd	88	92	83	88	104	90	19
Spartacus CL♦	95	100	101	93	93	98	19
Topstart	95	86	91	85	104	91	19
Urambie	90	83	—	—	—	88	9

Note: *Accredited malt varieties.

For grazing and grain recovery consider Urambie.

For malting production, consider Buloke, Commander, Compass, La Trobe, Scope CL and Spartacus CL.

In more reliable rainfall regions also consider GrangeR and RGT Planet.

For food grade production, consider Hindmarsh.

For feed grain production only consider Fathom, Grout, Oxford, Rosalind, and Shepherd.

Southern NSW barley yield performance experiments from 2014–2018

The yield results presented are NVT 'Production Value' multi environment trial (MET) data shown on a yearly regional group mean and regional mean basis from 2014–2018. Further results are on the [NVT website](#).

Table 24. Southern NSW main season sown: Compared with Hindmarsh = 100%

Variety	South east						Number of trials
	Yearly group mean					Regional mean	
	2014	2015	2016	2017	2018		
% Hindmarsh (t/ha)	3.92	3.58	5.01	—	—	4.17	
Alestar	99	98	118	—	—	107	6
Banks	—	104	113	—	—	107	4
Bass♦	98	90	107	—	—	99	6
Baudin♦	94	90	106	—	—	98	6
Biere	—	82	93	—	—	91	4
Bottler	—	—	122	—	—	110	2
Buff	—	—	105	—	—	101	2
Buloke♦	93	93	101	—	—	96	6
Commander♦	91	96	103	—	—	97	6
Compass♦	100	100	96	—	—	98	6
Fathom	101	98	104	—	—	102	6
Flinders♦	96	89	106	—	—	98	6
Gairdner♦	89	78	95	—	—	88	6
Granger♦	100	95	116	—	—	105	6
Hindmarsh	100	100	100	—	—	100	6
LaTrobe♦	100	100	101	—	—	100	6
Maltstar	101	99	122	—	—	109	6
Oxford	98	96	125	—	—	108	6
RGT Planet♦	—	—	139	—	—	124	2
Rosalind	111	111	120	—	—	115	6
Schooner♦	84	77	81	—	—	81	6
Scope CL♦	93	90	100	—	—	95	6
Spartacus CL♦	99	102	100	—	—	100	6
Topstart	99	100	128	—	—	111	6
Urambie	93	93	—	—	—	99	4
Westminster♦	92	85	—	—	—	98	4

Variety	South west						Number of trials
	Yearly group mean					Regional mean	
	2014	2015	2016	2017	2018		
% Hindmarsh (t/ha)	3.93	3.31	5.52	3.43	1.64	3.97	
Alestar	90	88	109	87	77	96	15
Banks	—	98	108	96	91	101	11
Bass [♦]	90	88	103	89	78	94	15
Baudin [♦]	88	84	103	—	—	92	12
Biere	—	89	93	—	—	91	8
Bottler	—	—	112	88	76	98	7
Buff	—	—	105	98	89	98	7
Buloke [♦]	91	87	100	—	—	93	12
Commander [♦]	91	86	102	93	85	94	15
Compass [♦]	101	101	98	103	103	100	15
Fathom	98	97	104	100	91	100	15
Flinders [♦]	88	86	101	87	79	92	15
Gairdner [♦]	83	77	94	83	72	86	15
Granger [♦]	90	89	107	87	78	95	15
Hindmarsh	100	100	100	100	100	100	15
LaTrobe [♦]	99	99	101	100	98	100	15
Maltstar	90	89	112	88	—	97	14
Oxford	85	82	—	—	—	94	8
RGT Planet [♦]	—	—	123	94	82	108	7
Rosalind	104	108	112	101	99	108	15
Schooner [♦]	85	78	88	—	—	85	12
Scope CL [♦]	90	86	99	91	83	92	15
SpartacusCL [♦]	101	101	100	101	103	101	15
Topstart	87	85	—	82	—	95	10
Urambie	88	83	—	—	—	93	8

Note: * Accredited malt varieties.

For grazing and grain recovery consider Urambie. Urambie can be sown from mid–late March if grazed.

For malting production consider Buloke, Commander, Compass, La Trobe, Scope CL and Spartacus CL. In more reliable rainfall regions also consider GrangeR and RGT Planet.

For food grade production consider Hindmarsh.

For feed grain production only consider, Oxford, and Rosalind. In western areas, also consider Fathom.


Suggested sowing times

Aim to sow in the earlier part of the indicated optimum time to achieve maximum potential yield, particularly in western parts of the region. Selection of the actual date should allow for soil fertility and frost damage risk in particular paddocks.


Table 25. Suggested sowing times

Variety	Weeks	March				April				May				June				July		
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Northern region																				
Urambie●			>	★	★	★	★	★	★	★	★	★	<							
Banks▲, Gairdner, GrangeR, Maltstar▲, Navigator, Oxford, Westminster								>	★	★	★	★	<							
Bass, Baudin									>	★	★	★	★	★	<					
Alestar▲, Buloke, Commander, RGT Planet, Scope CL										>	★	★	★	★	★	<				
Buff▲, Compass, Hindmarsh, La Trobe, Rosalind, Spartacus CL										>	>	★	★	★	★	<				
Fathom , Grout, Shepherd											>	★	★	★	★	★	<			
Central region																				
Urambie●			>	★	★	★	★	★	★	★	★	★	<							
Banks▲, Bass, Gairdner, Oxford, Westminster								>	★	★	★	★	<							
Baudin, GrangeR									>	★	★	★	★	<	<					
Buloke, Commander, RGT Planet, Scope CL										>	★	★	★	★	<	<				
Compass, Rosalind											>	★	★	★	<	<				
Buff▲, Fathom, Grout, La Trobe, Hindmarsh, Shepherd, Spartacus CL											>	★	★	★	★	<	<			
Southern region																				
Urambie●			>	★	★	★	★	★	★	★	★	★	<							
Banks▲, Bass, Baudin, Flinders, Gairdner, GrangeR, Oxford, Westminster								>	>	★	★	★	★	★	★	<	<			
Buloke, Commander, RGT Planet, Scope CL											>	★	★	★	★	★	<			
Buff▲, Compass, Fathom, Hindmarsh, La Trobe, Rosalind, Shepherd, Spartacus CL											>	>	★	★	★	★	★	★	<	

- > Earlier than ideal, but acceptable.
- ★ Optimum sowing time.
- < Later than ideal but acceptable.
- Dual purpose varieties that can be grazed. Urambie can be sown from mid-late March, if grazed.
- ▲ Limited information available on performance in NSW.



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Diseases

Sound integrated management is the key to minimising losses from disease. Avoid sowing barley into barley stubble and carefully consider whether or not to sow barley into wheat stubble. An improved level of resistance to specific leaf diseases is available in some new barley varieties; this is the preferred management option if these varieties are suitable for your region.

Paddock management and crop rotation are preferred controls for root and crown rots. Seed dressings control smuts and delay the build-up of leaf scald and powdery mildew early in the season. A newer seed treatment is available (Systiva®), which appears to provide a good level of control against net blotches in barley up to the start of stem elongation (Z32). Under higher pressure and in conducive seasons, Systiva® needs to be backed up by applying a foliar fungicide around awn peep (Z49) in susceptible varieties.

Varying pathotypes of the main diseases – leaf rust, leaf scald and net blotches – occur in different regions across NSW and other barley-growing regions.

Growers should be aware that the variety's disease rating will depend on which pathotype(s) of a pathogen is present in their region.

For a number of varieties, you will see two distinct ratings. Growers are advised to show caution and monitor their crops carefully and be prepared, where feasible, to apply foliar fungicides to manage the leaf disease should the variety begin to show susceptibility and seasonal conditions are favourable for further disease development.

Leaf diseases

Rusts

Four rusts: stem rust, barley leaf rust, barley grass stripe rust and wheat stripe rust, can affect barley in NSW, with barley leaf rust the major concern.

Varieties such as Baudin[Ⓢ], Compass[Ⓢ], Grout[Ⓢ] and Navigator[Ⓢ] are very susceptible to leaf rust. Varieties that are rated very susceptible to leaf rust should be monitored carefully as they can build up leaf rust to damaging levels on other varieties, since many widely-grown varieties are rated as susceptible. Care should be taken to destroy volunteers of any susceptible or very susceptible barley variety over summer to limit leaf rust build-up early in the season.

Stem rust is not usually a problem on main season sowings. Stem rust infection occurs at higher temperatures and can develop on very late-sown susceptible varieties in some seasons.

Barley stripe rust is a major disease of barley in some overseas countries, but is not present in Australia. However, barley grass stripe rust and wheat stripe rust can develop to a small extent on some barley varieties, particularly if the diseases are severe on nearby barley grass or wheat. Barley stripe rust poses a significant threat to the Australian barley industry. Report any unusually severe infections of stripe rust on barley to your agronomist or NSW DPI plant pathologist and send samples to the Australian cereal rust survey, contact details can be found in [Industry information on page 67](#).

Net blotch

There are two forms: the spot form and the net form. Both forms survive on infected barley stubble, but the net form can also be seed-borne. It can be difficult to distinguish between the two forms and mixed infections are possible.

The spot form produces small, dark brown spots or blotches up to 10 mm long. Blotches are round-oval when small, becoming more straight-sided as they enlarge. Larger blotches are often surrounded by a yellow margin, particularly towards the leaf tip.

The net form also produces small, round-oval dark brown spots at first, but these elongate into dark brown streaks along the leaf, often giving a netted appearance. Severely affected leaves wither. Only the net form can infect grain, which can result in seed-borne infections if this seed is retained for sowing next season.

The spot form of net blotch is widespread as most varieties are susceptible. The net form has been less common in the southern region, because most of the major varieties have good levels of resistance, it can, however, be a major disease in northern NSW if susceptible varieties are grown.

It is advisable to use a seed treatment that will control the seed-borne stage of the net form of net blotch. Growers should be aware that the fungicide flutriafol, commonly applied as a fertiliser treatment, is not an effective control for either the net or spot form of net blotch. Planting seed retained from crops infected with the net form should be treated with an appropriate dressing. See [Table 71 on page 142](#) for details. Note that this only disinfects the seed and will not provide protection against infection from spores coming off infected barley stubble.

The new fungicide seed treatment Systiva® has been recently registered for use in barley, with trial results indicating that it appears to provide useful levels of early control against stubble-borne infections of both the net and spot forms of net blotch. The product is based on a Group 7 fungicide from the SDHI class and growers should be aware that this class of fungicide is considered to be vulnerable to resistance development and should not be repeatedly used.

Scald

This is the major leaf disease in the higher rainfall areas of central and southern NSW. In susceptible varieties it can reduce grain yield by more than 50%. Scald has high levels of genetic diversity, which enables it to rapidly overcome host resistance. Most current varieties are rated susceptible and should be closely monitored. To reduce the risk of scald developing, avoid sowing barley on barley stubble.

Fungicides applied to fertiliser or as a seed treatment provide useful early control. Fungicide sprays at growth stage Z31 and Z39 can provide an economic response in susceptible varieties with high-yield potential in seasons conducive to scald development.

Powdery mildew

Powdery mildew can occasionally be severe on seedlings and tillering barley in northern and central NSW; favoured by high humidity, but reduced with rainfall. High nitrogen levels in crops can also favour development. Foliar fungicides are often applied, but in many cases too late after powdery mildew infection has already damaged the crop. Growing resistant varieties is the best management strategy as the powdery mildew pathogen of barley has been found to have developed a level of resistance to some triazole fungicides in other states. Some seed treatments provide effective and economic control of powdery mildew at the seedling stage in areas where the disease frequently develops. See [Table 71 on page 142](#) for details.

PLS (physiological leaf spotting)

Under some circumstances, barley plants might develop various forms of leaf spots that are not caused by a pathogen. Spots can vary from tiny white/yellow flecks to dark brown or black blotches. These physiological leaf spots can be easily mistaken for diseases but, not being related to pathogens, applying fungicides is not warranted. Some varieties (e.g. GairdnerA and GrangeR) are more prone to developing physiological leaf spots than others, and growers are advised to consult their agronomist/adviser or NSW DPI pathologist if uncertain of the causes of leaf spotting.

Managing diseases with foliar fungicides

Foliar fungicides are often used as one component of disease management and can provide economic returns when applied correctly at the appropriate growth stage. Applying foliar fungicides should be an economic decision based on the following factors:

- accurate disease diagnosis
- yield potential
- potential loss (varietal susceptibility, growth stage, effect on yield and quality)
- appropriate application time
- cost of fungicide and application
- duration of control
- amount of disease present
- future disease development (weather)
- stock/harvest withholding periods.

With most diseases, application should aim to protect the flag-1 and flag-2 leaves in barley, which are the main contributors to yield. Losses from diseases in the vegetative stage are relatively small compared with infection of the adult plant. Consequently, in most cases, spraying at early growth stages is not worthwhile. In areas where severe powdery mildew infection frequently occurs on seedlings, an appropriate seed dressing generally provides better and more economic control than in-crop foliar fungicide application.

Control duration varies with the fungicide product and application rate; therefore, early sprays before stem elongation might require repeat applications to protect key leaves that were not emerged at this time of application.

Fungicide resistance has been documented in a number of barley foliar pathogens in Australia, such as powdery mildew and net blotch – net form (*Pyrenophora teres* f. *teres*). This means that repeated applications of the same fungicide group should be avoided and label instructions need to be followed.

Root and crown diseases

Barley is susceptible to the same root diseases (*Pythium*, rhizoctonia take-all, crown rot and common root rot) as wheat. With crown rot, yield losses are usually not as severe in barley as for wheat because of barley's earlier maturity, which provides an escape from late season stress that exacerbates disease expression. However, barley is very susceptible to crown rot infection and builds up inoculum levels within the rotation. Barley can still suffer significant yield loss from crown rot if moisture stress occurs during crop development. Barley varieties also differ in their susceptibility and yield loss from crown rot infection. As with wheat, crown rot control relies on adopting integrated management strategies, which includes effective rotations, stubble management, fallow moisture storage, grass weed control, sowing time, inter-row sowing and variety choice.

Smuts

Growers should be aware that varieties with a Hindmarsh background (Hindmarsh[Ⓛ], La Trobe[Ⓛ], Spartacus CL[Ⓛ] and Rosalind[Ⓛ]) are more susceptible to loose smut in barley. Over the past three seasons loose smut has built up in the more susceptible varieties where a seed fungicide has not been used or poorly applied. Both malting and feed barley receival standards have a zero tolerance for smuts. Grain appearance is damaged by smuts, making it less attractive for human and animal consumption. Control is readily achieved by using seed dressings at sowing. See [Table 71 on page 142](#) for details.

Treat all barley seed for sowing each year and ensure good coverage during the application process.

Using a seed dressing that will also control scald and powdery mildew is advisable.

Do not sow untreated seed retained from a crop where any smut was visible in heads during the season. Even low levels of infection within a paddock can result in significant carry-over of spores on grain that will infect the next barley crop, as the spores are dispersed when infected heads are harvested.

Black point

The darkening of the grain coat at the embryo (shoot) end can occur during wet periods from flowering to harvest. All varieties can be affected, depending on seasonal conditions. There are no known control measures as this is a physiological condition and not a disease.

Badly discoloured grain is unacceptable for malting, although affected seed is usually satisfactory for sowing.

Marketing

Barley may be freely traded on both the domestic and export market. Before adopting new barley varieties, look at what marketing options are available in your region. Not all new varieties will be accepted by the bigger grain receival sites, so alternative arrangements might need to be sought, or grain stored on farm, before delivery to an end user.

Take care not to over-thresh barley at harvest, which damages the grain. Ideally, markets seek malting barley with 10.5% protein.

Feed barley is traded through major traders and private merchants, or direct to domestic end-users such as stockfeed manufacturers, feed-lotters and other farmers. Prices tend to be lower around harvest time, and are usually higher during winter.

Barley is more difficult than most other cereals to store for more than three months because of its susceptibility to grain insect attack.

Grain insect treatment WARNING: Malting barley may only be treated with a limited number of grain protectants for insect control. Check with the end user before treatment to ensure a particular pesticide is acceptable. Refer to [Grain insects – options for control on page 139](#) for more details.

Current barley delivery standards are available from your local grain trader or from Grain Trade Australia (GTA).

Malting varieties

Malting barley varieties in Australia are accredited by Barley Australia and undergo rigorous testing to ensure they meet malting standards both for domestic and international markets. The Barley Australia website has a list of currently accredited varieties. Malting variety delivery will depend on segregations in your region and must meet the GTA quality standards/specifications for malt barley.

Food grade varieties

This is a new classification, which Barley Australia introduced in 2010. Barley varieties will need to meet all the physical quality parameters that apply to accredited malting barleys, such as protein, test weight, screenings and retention, before they can be accepted into food barley segregations.

Feed varieties

NSW Feed Barley No. 1: two-row varieties with white aleurone layer only.

Further reading

Barley Australia (<https://www.barleyaustralia.com.au/>)

GTA – Barley Trading Standards (<https://www.graintrade.org.au/>)

GRDC – Wheat & barley leaf symptoms: The back pocket guide (<https://grdc.com.au/resources-and-publications/all-publications/publications/2011/03/wheat-barley-leaf-symptoms-the-back-pocket-guide>)

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Table 26. Variety characteristics and reaction to diseases

Variety	Straw strength	Leaf scald	Net blotch net form	Net blotch spot form	Powdery mildew	Leaf rust	BGYR (stripe) rust	Crown rot	Common root rot	Cereal cyst nematode resistance	RLN <i>P. thomai</i> Resist-ance 5	RLN <i>P. thomai</i> Tolerance 6	RLN <i>P. neglectus</i> Resist-ance 5	RLN <i>P. neglectus</i> Tolerance 6	Issued by	Year registered
Alestar	–	S–VS	MR–MS & S	S	R–MR	MS	R	S	MS–S	R 2	MR	MT–MI 2	MR	I 2	Limagrain/Edstar/Elders	2017
Banks	–	MS–S	MR–MS	S	MR–MS & S	S	R 2	MS–S	MS–S	S	MR	T–MT 2	MR–MS	MI–I 2	InterGrain	2018
Bass 3	good	S–VS	MS–S	S	S	S–VS	R	S–VS	MS	S	MR–MS	MT 2	MS	I	InterGrain	2012
Baudin 3	good	S–VS	MR–MS & S	MS–S	VS	VS	R	S 2	S	S	MS–S	–	S	MI–I 2	DPIRD	2002
Biere	–	S	S	S	R	MS–S	MR 2	S	MS	S	MR–MS	–	MR	–	GrainSearch	2017
Bottler	–	S–VS	MS	S	R	MS–S	R–MR 2	S–VS	MS	–	R–MR	–	MS	T–MT 2	GrainSearch	2017
Buff	–	MS–S	MS	S	S	S–VS	R 2	S	MS–S	–	MR–MS	–	MR–MS	–	InterGrain	2018
Buloke 3	medium	S	MR 2	S 2	R–MR 2	S 2	R–MR 2	S–VS 2	MS 2	S 2	MS	–	MR–MS	–	DELWP Victoria	2004
Commander 3	medium	VS	MS–S	MS–S	MR–MS & S	S	R	S	MS–S	R	MR–MS	MT	MR–MS	MT–MI	University of Adelaide	2008
Compass 3	medium	S–VS	MR–MS	MS–S	MR–MS & S	VS	R	S	MS	R	MR	T–MT	MR–MS	T–MT	University of Adelaide	2013
Fathom	good	MR–MS	MS–S	MR	MR–MS & S	MS–S	R	S–VS	MS–S	R	MR	–	MR–MS	–	University of Adelaide	2012
Flinders 3	good	S–VS	MR–MS	S	R–MR	MR–MS	R	S–VS	MS	S	MR	–	MR–MS	–	InterGrain	2014
Gairdner 3	medium–good	VS	MR–MS	S	S–VS	S	R	S	MS–S	S	MS–S	I–VI	MR–MS	MI	DPIRD	1998
GrangeR 3	good	VS	MR–MS & S	S–VS	R–MR	MS–S	R	S–VS	S	R	MR–MS	MT–MI	MR–MS	MI–I 2	Heritage Seeds	2013
Grout	good	VS	MR–MS & S	S	R–MR	VS	R	S	S	–	MR–MS	MT	MS	MT	DAF Qld	2005
Hindmarsh 4	good	MR–MS & VS	MS	S–VS	MR–MS & S–VS	S	R	S	S	R	MR–MS	T–MT	MR–MS	MT–MI	DELWP Victoria	2006
La Trobe 3	good	MR–MS & VS	MS	S	MR–MS & S–VS	S	R	S–VS	S	R	MR–MS	MT	MR–MS	MT 2	InterGrain	2013
Maltstar	–	S–VS	S	S–VS	R–MR	MR–MS	R	S	MS–S	S	MR	MT–MI	MR–MS	I	Limagrain/Edstar/Elders	2017
Oxford	good	S–VS	MS–S	S	R	MS	R	S–VS	MS–S	S	MR	MI–I	MR	I–VI	Nickerson/Heritage Seeds	2009
RGT Planet 3	Very good	S	S	S–VS	R	MR–MS	MR 2	S	MS–S	R 2	MR	–	MR–MS	T–MT 2	RAGT/SeedForce	2017
Rosalind	good	S	MR	S–VS	MR–MS & S–VS	MR–MS	R	MS–S	S	R	MR	T 2	MR–MS	MT	InterGrain	2015
SakuraStar	–	VS	MS	MR–MS	MR–MS & S–VS	S	R 2	S	MS–S	R	MR	–	MR	MT–MI 2	Sapporo Breweries Ltd/The University of Adelaide	2018
Schooner 3	medium	S	MR–MS	MS–S	S–VS	S–VS	R	MS–S 2	S	VS	MR–MS	MT 2	MS	–	University of Adelaide	1983
Scope CL 3	medium	S–VS	MR–MS	MS–S	R–MR	S	R	S–VS	MS	S	MR–MS	MI	MR–MS	MI 2	DELWP Victoria	2010
Shepherd	good	S–VS	MR & S	S–VS	S	MS	R–MR	MS–S	MS–S	–	MS–S	MI	MR–MS	MI 2	DAF Qld/DPIRD	2008
Spartacus CL 3	medium–good	VS	MR & S	S–VS	MR–MS & S–VS	S	MR	S	MS	R	MR–MS	MI 2	MR–MS	–	InterGrain	2016
Topstart	–	S–VS	S–VS	S	R–MR	MR–MS	R	S–VS	MS–S	S	R–MR	MI	R–MR	I	Edstar/Elders	2018
Urambie 1	very good	MS	MR	S	MR–MS	S	R	VS 2	MS–S	–	MR	–	MR–MS	–	NSW DPI	2005
Westminster 3	good	MS	MS–S	S	R	MR–MS	R	S	MS–S	–	MS	I	MR–MS	I–VI	Nickerson/GrainSearch	2010

- insufficient data.
 - ① suitable for grazing and grain recovery.
 - ② provisional rating,
 - ③ may be accepted as malting. Accredited by Barley Australia.
 - ④ food grade.
- Where ratings are separated by ' & ' the first is correct for the majority of situations, but different pathotypes are known to exist and the latter rating reflects the response to these pathotypes.
- ⑤ **RLN Resistance ratings**
The root-lesion nematode (*P. thornei* and *P. neglectus*) resistance ratings that appear in this sowing guide are national consensus ratings based on glasshouse and field data collected from all Australian grain regions.
 - ⑥ **RLN Tolerance ratings**
The root-lesion nematode (*P. thornei* and *P. neglectus*) tolerance ratings that appear in this sowing guide are based on field data collected in the northern grain region rather than national consensus ratings.
- DPIRD = Department of Primary Industries and Regional Development;
NSW DPI = Department of Primary Industries; DAF Qld = Department of Agriculture and Fisheries, Queensland; DELWP Victoria = Department of Environment, Land, Water and Planning Victoria.

Resistances

R	(Resistant) indicates a high level of resistance; disease should not be seen and grain yield should not be affected.
R–MR	(Resistant to Moderately resistant) indicates a high level of resistance; very low levels of disease may be seen and grain yield should not be reduced.
MR	(Moderately resistant) indicates low levels of disease may develop in favourable conditions, some yield loss may occur but fungicide control unlikely to be economic.
MR–MS	(Moderately resistant to Moderately susceptible) indicates low to moderate levels of disease may develop in favourable conditions, some yield loss may occur. Fungicides may be economic.
MS	(Moderately susceptible) indicates moderate levels of disease may develop in favourable situations with moderate yield losses. Fungicide applications likely to be economic.
MS–S	(Moderately susceptible to Susceptible) indicates significant disease may develop in favourable situations with moderate yield losses. Fungicide application likely to be economic.
S	(Susceptible) indicates high levels of disease may occur with substantial yield losses. Fungicide applications should be budgeted.
S–VS	(Susceptible to Very susceptible) indicates high levels of disease may occur with substantial yield losses. Disease may require close monitoring and proactive fungicide control.
VS	(Very susceptible) indicates very high levels of disease may occur in favourable seasons with serious yield losses. Will require close monitoring and proactive fungicide control. Likely to develop some disease even when conditions less favourable.

Tolerances

VT	(Very tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.
T	(Tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.
T–MT	(Tolerant to Moderately tolerant) indicates disease may develop in favourable conditions, some yield loss may occur.
MT	(Moderately tolerant) indicates disease may develop in favourable conditions, some yield loss may occur.
MT–MI	(Moderately tolerant to Moderately intolerant) indicates disease may be conspicuous in favourable situations with moderate yield losses.
MI	(Moderately intolerant) indicates disease may be conspicuous in favourable situations with moderate yield losses.
MI–I	(Moderately intolerant to Intolerant) indicates high levels of disease may occur with substantial yield losses.
I	(Intolerant) indicates high levels of disease may occur with substantial yield losses.
VI	(Very intolerant) indicates high levels of disease may occur with substantial yield losses.

Table 27. Disease and crop injury guide – barley

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Foliar diseases				
Scald <i>Rhynchosporium commune</i>	‘Scalded’ patches with dark brown margins on leaf.	More common and severe in south, favoured by wet weather.	Rain-splashed spores from barley and barley grass residues and secondary infection from infected leaves during the season. Can be seed-borne.	Resistant varieties; rotation with non-host crops. Fertiliser, seed and foliar fungicides; avoid sowing into barley and barley grass residues. Clean seed.
Net blotch – net form <i>Pyrenophora teres f. teres</i>	First, as small elliptical dark brown spots that elongate into fine, dark brown streaks on the leaf blades giving a netted appearance. Severely affected leaves wither. It also infects heads.	Favoured by wet weather and early sowing.	Airborne spores from infected plants and stubble. Carried on seed.	Resistant varieties; rotation with non-host crops. Stubble removal. Clean seed. Fungicide seed treatments. Appropriate foliar fungicides.
Net blotch – spot form <i>Pyrenophora teres f. maculata</i>	Small, dark brown, round to oval spots or blotches up to 10 mm long becoming more straight-sided as they enlarge. Larger blotches are often surrounded by a yellow margin, particularly towards the leaf tip.	Favoured by wet weather and early sowing.	Airborne spores from infected plants and stubble.	Resistant varieties; rotation with non-host crops. Stubble removal. Fungicide seed treatments. Appropriate foliar fungicides.
Powdery mildew <i>Blumeria graminis f.sp. hordei</i>	White to grey cottony fungal growth on leaf and leaf sheath.	More common in north and south-western regions, more prevalent in winter and early spring.	Airborne spores from infected trash and infected plants.	Resistant varieties; seed and foliar fungicides.
Barley leaf rust <i>Puccinia hordei</i>	Very small pustules of orange-brown powdery spores on leaves and leaf sheaths.	Favoured by moist conditions and temperatures around 15–22 °C.	Airborne spores from living plants.	Resistant varieties; clean fallows; foliar fungicides to protect flag-1 to flag-2 leaves. Monitor very susceptible varieties regularly.
Stripe rust <i>Puccinia striiformis</i>	Pustules and stripes of yellow powdery spores on leaves.	Barley stripe rust is not present in Australia. However, some varieties can develop small amounts of barley grass stripe rust and wheat stripe rust. Promoted by cool nights (8–15 °C) with dews.	Airborne spores from living plants.	Rarely required. Resistant varieties, foliar fungicides not likely to be required.
Stem rust <i>Puccinia graminis f.sp. tritici</i>	Elongated pustules of dark brown spores on stems, leaves and awns.	Favoured by warm (15–30 °C) moist conditions. Only likely to be a problem in very late crops or where crops are in close proximity to other infected wheat and barley crops.	Airborne spores from living plants.	Clean fallows. Resistant barley varieties; control stem rust in other cereals (wheat, rye, triticale); foliar fungicides.
PLS (physiological leaf spotting)	Range from tiny white or yellow flecks to conspicuous dark brown to black spots and blotches on leaves.	Most prevalent under mild, moist growing conditions. Some genotypes are more susceptible. Grimmert often develops white flecking; Gairdner and GrangeR prone to brown blotching.	Not a pathogen. Note that some brown flecking might be a resistant reaction to other diseases and, in some regions, a reaction to adverse soil nutrient levels.	Avoid susceptible varieties. Confirm cause before considering fungicide application as they will provide no control of PLS because this is not a disease.
Sunblotch (physiological reaction to nutrient stress and sunlight)	Orange to dark brown spots more common on upper surface of leaf; leaf death.	Occurs sporadically. Conditions causing it yet to be defined.	Not a pathogen.	No practical control option.
Virus diseases				
Barley yellow dwarf <i>Barley yellow dwarf virus</i> (BYDV) or <i>Cereal yellow dwarf virus</i> (CYDV)	Yellowing, reduced height of infected plants, reduced seed set.	Most common near perennial grass pastures and in early-sown crops.	Transmitted by aphids (oat, corn and rose grain) from infected grasses and cereals. Not seed-borne.	Sow varieties with better resistance. Consider using an insecticide seed treatment (e.g. imidacloprid) to limit early infections from aphid vectors. Control insecticide application in-crop to control aphids at early growth stages if required.
Wheat streak mosaic <i>Wheat streak mosaic virus</i> (WSMV)	Light-green leaf streaks and blotches, stunted plants, reduced seed set.	Not yet observed in barley. Has occurred in wheat in southern irrigation areas and early-sown grazing wheat crops on the tablelands and slopes.	Transmitted by the wheat curl mite.	No control required.
Root and crown diseases				
Take all <i>Gaeumannomyces graminis</i> var. <i>tritici</i>	Blackened roots and crown, stunting, white heads, pinched grain.	More common in south, favoured by wet winter and early spring, then dry. Less severe on barley than on wheat.	Soil borne on grass and cereal residues.	Crop rotation to provide one year free of grass hosts. Some seed treatments provide a level of suppression.

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Rhizoctonia root rot <i>Rhizoctonia solani</i>	Patches of spindly, stunted plants with erect leaves; spear point root rot; plant death. Later infection of crown roots seen as a wavy appearance across the crop.	Associated with minimum or reduced tillage; often aggravated by Group B herbicides.	As fungal threads in soil; soil-borne on residues of many grass, cereal and broadleaf plants.	Crop rotation, soil disturbance to 5–10 cm below sowing depth at or within 2–4 weeks before sowing; avoid Group B herbicide build-up, which can cause root pruning. Some seed and fertiliser treatments provide suppression only. Liquid banding of some fungicides is also registered.
Crown rot <i>Fusarium pseudograminearum</i>	Browned stem bases, stunted or plant death if severe early infection, white heads not common in barley, pinched grain.	More common in northern and western areas, becoming common in the south, favoured by moisture/heat stress during grain filling.	Stubble-borne on grass and cereal residues.	Crop rotation. More resistant varieties. Grass weed control. Balance inputs to available soil water. Inter-row sowing and avoid delayed sowing to minimise losses.
Common root rot <i>Bipolaris sorokiniana</i>	The root between the crown and seed (sub-crown internode) is always dark; roots and sometimes the stem base are brown; white heads, pinched grain	Scattered through the crop. Plants can have reduced tillering and appear to have ill-thrift. Exacerbated by deep sowing. Infection favoured by warmer soil temperatures (20–30 °C).	Stubble-borne on grass and cereal residues; also survives as spores in the soil.	Resistant varieties; crop rotation; optimise nutrition; be careful with sowing depth.
Eyespot <i>Tapesia yallundae</i>	Lodging, eyespot with sharp bend in stem 3–5 cm above ground.	South and Central West Slopes, eastern Riverina. Less severe on barley than on wheat.	Rain-splashed spores from crop or grass residue during winter.	Crop rotation.
Smuts				
Loose smut <i>Ustilago tritici</i>	Black powdery heads on diseased plants; black lumps in harvested grain.	Statewide; presence can make grain unacceptable to maltsters. Certain varieties (Hindmash, La Trobe, Spartacus CL and Rosalind) appear more susceptible.	Airborne spores infect developing seeds at flowering.	Seed-applied fungicides. Treat seed every season.
Covered smut <i>Ustilago segetum</i> var. <i>hordei</i>	Ball of black powder replaces the seed.	Statewide, presence can make grain unacceptable to maltsters.	Spores on seed coat infect seedling before emergence.	Seed applied fungicides, resistant varieties.



Oats

Crop management

This widely adapted and reliable cereal is the major winter cereal grazing crop. It also offers rotational benefits where conditions are not suitable for broadleaf break crops. Oats can tolerate some cereal diseases such as take-all, crown rot and common root rot. Other benefits include its easy establishment and comparatively low cost compared with other grazing crops. Oats are a versatile crop in farming systems. They can adapt to acid soils, are used for hay, silage, pasture renovation and grazing-out, and are suitable for broadleaf weed control by in-crop herbicides.

Sowing

Except for very high tablelands areas, January and February sowings should be avoided. Hot conditions, soil temperatures consistently above 25 °C, and rapidly drying soils can cause patchy establishment.

Optimum sowing times are shown for each variety in the respective zones. Sowing later than recommended increases the risk of lower yields. In wet, acid soil conditions sow grain-only varieties at the earliest recommended time.

A sowing depth of 5 cm is ideal, but oats can be sown as deep as 7 cm if moisture seeking.

Nutrition

Apply fertiliser at above the normally recommended rates to crops used for grazing and grain, as they have a longer productive period than grain-only crops.

To achieve grain protein of 10% and above in high yielding varieties such as Mitika[®], avoid sowing into low fertility paddocks.

Sowing rates

High sowing rates give rapid growth rates and high forage yields. Use high rates where dense weed populations are expected, when conditions are likely to be wet during winter, in low pH soils, and/or in paddocks with low soil fertility, or if seed quality is substandard.

Seed size varies significantly between oat varieties and season, so it is important to know the 1000 seed weight of the selected variety to calculate the required sowing rate. The sowing rates shown should be used as a guide only and growers should calculate their own sowing rates based on the 1000 seed weight, target plant population and seed establishment percentage.

Higher tablelands/tablelands/slopes

- 80–120 kg/ha, grazing and grain
- 60–80 kg/ha, grain-only

Slopes/plains

- 60–80 kg/ha, grazing and grain
- 40–60 kg/ha, grain-only

Early-sown – grazing only

- 100–130 kg/ha

Irrigation

- 100–150 kg/ha, grazing and grain
- 80–120 kg/ha, grain-only

Hay production (Sowing rates are 30–50% higher than grain crops in the same region)

- 60–100 kg/ha dryland
- 80–140 kg/ha irrigated

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Formula for calculating sowing rates: [Calculating sowing rates on page 8](#)

Grazing

The ideal stage to start grazing is when plants are well anchored and the canopy has closed. Continuous grazing might be better for fattening stock than rotational grazing. Maintain adequate plant material to give continuous and quick regrowth, e.g. a minimum of 1000–1500 kg/ha of dry matter.

For the best recovery after grazing, do not graze below 5 cm for prostrate varieties, or below 10 cm for more erect types. The higher grazing height is particularly important with erect growing varieties; over-grazing greatly reduces the plant's ability to recover.

Financial returns from grazing can be based on:

- Changes in body weight throughout the grazing period. Weight gains of 1.2 kilograms per head per day for steers, and 200 grams per head per day for lambs are common.
- Stock value before and after grazing.
- Current agistment rates for stock.
- Hand feeding costs for the same period.

On the tablelands and slopes, grazing oats significantly reduces the grazing pressure on pastures and can often reduce the necessity for hand feeding during winter.

On the slopes and plains, grazing oats means lucerne pastures can be spelled in autumn.

Weeds

Planning in the previous season to prevent annual weeds, especially grass weeds, from setting seed by pasture cleaning, spray topping or early fallow, helps to reduce in-crop weeds and improves crop production.

Some post-sowing pre-emergent herbicides and early post-emergent herbicides will control annual ryegrass, but timing is critical. Broadleaf weeds can be effectively controlled with either early or late post-emergent herbicides, but again, timing is most important.

Higher sowing rates and narrow row spacings improve competition against weeds. Maintain crop canopy (bulk) to discourage weed recovery.

Diseases

Barley yellow dwarf virus (BYDV) is transmitted by aphids. Early-sown crops are more at risk. Sow tolerant varieties or be prepared to control aphids to prevent virus transmission. Imidacloprid is registered for use on cereal crops as a seed dressing to manage aphids and BYDV spread in cereal crops. See [Table 72. Cereal insecticide seed dressings for aphid and Barley yellow dwarf virus \(BYDV\) control 2019 on page 145](#) or available products.

Significant production losses can result from either stem or leaf rust. With the development of new pathotypes in some regions for stem rust, there are no remaining genetic resistances available in commercially grown varieties to fully protect crops. Leaf rust resistance levels in some varieties provide useful field tolerance to the disease. Monitor crops in season for these rusts. Rusts can be managed by selecting appropriate varieties for sowing, avoiding sowing later-maturing varieties and applying late irrigations, and adjusting grazing management (see [Managing grazing cereals on page 73](#)) or controlled by using foliar fungicides in the crop.

Insects

Earth mites and armyworm commonly affect crops. Earth mites can affect young crops, so monitor and control as necessary. They should be suppressed in the previous spring by applying an insect spray with the fallow weed control program.

Aphids are a major concern and in high numbers can cause feeding damage to establishing oat crops. The main issue with aphids is BYDV spread. Growers should treat their seed with an appropriate insecticidal seed dressing to reduce early aphid feeding and BYDV transmission.

Armyworms can cause severe damage to the ripening crop and should be monitored. Chewed leaf margins and/or oat spikelets on the ground are sure signs of armyworm presence. Always inspect the denser areas of the crop.

Producing quality grain

There are strong domestic and export markets with premium payments for oats with a high test weight (kg/hL) – see [Table 31. Oat varieties on page 60](#).

Producers aiming at milling markets should consider Bannister[Ⓢ], Durack[Ⓢ], Kowari[Ⓢ], Mitika[Ⓢ], Williams[Ⓢ], Wombat[Ⓢ] or Yallara[Ⓢ].

For high-quality feed grain oats for livestock, consider low husk lignin varieties Kowari[Ⓢ], Mannus[Ⓢ], Mitika[Ⓢ], Yarran or Yiddah[Ⓢ]. Avoid over-grazing dual-purpose crops or grazing too late into early spring as this will affect grain quality and yield. Crops maturing under hot, dry conditions result in low grain quality.

Choose paddocks with good soil moisture retention characteristics. Use moderate sowing rates and sow at the suggested time. Pay attention to weeds and provide adequate nutrition, but be careful not to apply excessive fertiliser rates (especially nitrogen), which can result in delayed maturity.

Marketing

Before harvest, careful weed and insect control will ensure the best quality product to take to market. In crops used for hay, ensure even curing after cutting.

Prevent weed seeds and insects contaminating grain. If the grain is to be stored for longer than three months, protect against insects. Store in the best possible facility to ensure a quality product.

Grain size, plumpness, variety, husk lignin content, protein and hectolitre (hL) weight are some of the buyers' criteria for feed grain sales. To aid marketing, samples should be protein and energy tested and premiums sought. Varieties and samples vary considerably.

As a marketing aid, collect a representative running sample at harvest from each truckload.

Bannister[Ⓢ], Durack[Ⓢ], Kowari[Ⓢ], Mitika[Ⓢ], Williams[Ⓢ], Wombat[Ⓢ] or Yallara[Ⓢ] are accepted milling varieties. The newer varieties Bannister[Ⓢ], Durack[Ⓢ], Kowari[Ⓢ], Williams[Ⓢ] and Wombat[Ⓢ], whilst acceptable as milling oats, could have limited opportunities for segregation in NSW storage systems. Growers should contact prospective buyers before growing these varieties. Echidna and Yarran may also be accepted.

Variety selection

When selecting a variety consider:

- Region.
- Crop use. For grazing only, for dual-purpose grazing and grain, for hay, for silage, or for grain-only?
- Grazing value. When is feed most important – in early or late winter? Hay. Freedom from leaf and stem diseases, resistance to lodging, and maturity to cutting time?
- Grain.
 - To keep on-farm or sell?
 - To keep – high yield and low husk lignin content?
 - For sale – market requirements? White or cream colour, 'attractive'?
 - For feed – high test weight, protein and low husk lignin content?
 - For milling? As specified by milling companies.
- Forage only varieties. The suggested sowing time for forage-only varieties is mid February to early April. As many of these varieties are late/very late for grain maturity, they may not be suitable for grain production in many regions. Grazing management for the more erect types needs to be different from the usual heavy grazing of dual-purpose grazing and grain varieties. Avoid heavy grazing to below 10 cm if plant recovery is expected. More upright varieties are best suited to grazing with cattle. For coastal and northern regions, consider varieties with the best rust resistance ratings.
- Herbicide tolerance. Refer to the NSW DPI guide [Weed control in winter crops](https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops) (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>).

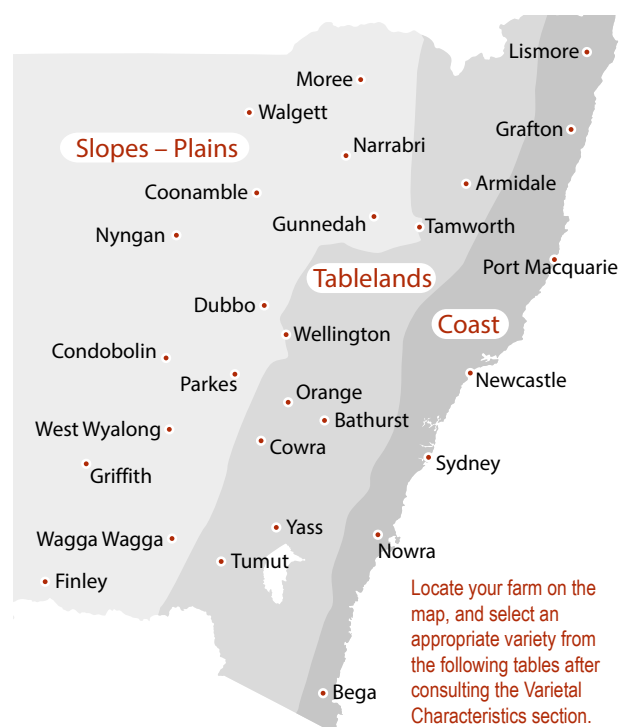


Figure 3. Map of NSW showing oat-growing zones

Yield performance experiments from 2004 to 2009 – the more trials, the greater the reliability.

Table 26. Higher Tablelands dual-purpose compared with Eurabbie = 100%

Variety	1st grazing DM Eurabbie = 2.37 t/ha	2nd grazing DM Eurabbie = 2.51 t/ha	Grain recovery Eurabbie = 2.94 t/ha	Ungrazed Eurabbie = 4.57 t/ha
Bass	94	95	85	92
Bimbil	88	93	87	84
Blackbutt	89	91	84	89
Eurabbie	100	100	100	100
Mannus	87	91	87	72
Nile	99	97	85	93

Consider Nile, Bass and Blackbutt for very early sowing. Eurabbie is outstanding for grain recovery after grazing. Mannus is outstanding for grain quality.

Table 27. Tablelands/Slopes dual-purpose compared with Bimbil = 100%

Variety	1st grazing DM Bimbil = 2.90 t/ha	2nd grazing DM Bimbil = 2.34 t/ha	Grain recovery Bimbil = 2.07 t/ha	Ungrazed Bimbil = 2.50 t/ha
Bimbil	100	100	100	100
Blackbutt	102	97	86	86
Cooba ▲	106	106	87	87
Eurabbie	114	107	119	118
Mannus	99	97	98	101
Yarran ▲	103	95	105	105
Yiddah	109	111	86	85

Consider Eurabbie or Blackbutt for the Tablelands, or areas with later maturity. Eurabbie is outstanding for grain recovery after grazing. Preferred varieties for feeding grain to livestock are Mannus, Yiddah and Yarran.

Table 28. Slopes/Plains dual-purpose compared with Bimbil = 100%

Variety	1st grazing Bimbil = 2.09 t/ha	2nd grazing Bimbil = 2.34 t/ha	Grain recovery Bimbil = 2.26 t/ha	Ungrazed Bimbil = 2.59 t/ha
Bimbil	100	100	100	100
Cooba ▲	106	106	97	86
Eurabbie	107	107	112	120
Mannus	99	97	101	94
Yarran ▲	106	95	120	103
Yiddah	111	111	103	87

For the Slopes, consider Eurabbie, Mannus, Bimbil and Yiddah for grazing and especially Eurabbie and Mannus for grain recovery. For the Plains consider Yarran, Yiddah and Coolabah for grazing and especially Yiddah for grain recovery. Preferred varieties for feeding grain to livestock are Mannus, Yiddah and Yarran.

Table 29. Sowing times for oats in NSW

		January		February				March				April				May				June		
Variety	Weeks	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Higher tablelands/tablelands: Dual-purpose – grazing and/or grain recovery																						
Bass, Blackbutt, Nile		>	★	★	★	★	★	★	★	★	★	<	<									
Eurabbie				>	>	★	★	★	★	★	★	★	★	★	★	<	<					
Bimbil, Mannus						>	>	★	★	★	★	★	★	★	★	<	<					
Tablelands/slopes: Dual-purpose – grazing and/or grain recovery																						
Blackbutt						>	★	★	★	★	<	<	<	<								
Eurabbie						>	★	★	★	★	★	★	<	<								
Cooba▲							>	★	★	★	★	<	<	<	<	<						
Bimbil, Mannus, Yiddah									>	★	★	★	★	<	<	<						
Coolabah▲, Yarran▲										>	★	★	★	★	★	<	<					
Slopes/plains: Dual-purpose – grazing and/or grain recovery																						
Cooba▲, Eurabbie							>	★	★	★	★	★	<	<	<	<						
Bimbil, Mannus, Yiddah									>	★	★	★	★	★	★	<	<	<				
Coolabah▲, Yarran▲										>	★	★	★	★	★	<	<	<				
Tablelands/slopes grain only																						
Bannister, Possum, Williams, Wombat																	>	★	★	★	<	<
Kowari, Mitika, Yarran▲																	>	>	★	★	★	<
Slopes/plains grain only																						
Bannister, Possum, Williams, Wombat, Yallara																	>	★	★	★	★	<
Kowari, Mitika, Yarran▲																	>	★	★	★	★	★
Durack																		>	★	★	★	★

- > Earlier than ideal, but acceptable.
- ★ Optimum sowing time.
- < Later than ideal, but acceptable.

▲ Outclassed varieties.
Warning: High soil temperatures (>25 °C) with early sowings may reduce germination and establishment.

Table 30. Grain only varieties compared with Mitika (2014–2018)


Variety	North east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% Mitika (t/ha)	3.38	3.19	4.89	–	2.47	2.91	
Bannister	107	92	97	–	112	101	5
Durack	103	105	105	–	99	103	5
Kowari	102	103	100	–	99	101	5
Mitika	100	100	100	–	100	100	5
Williams	106	92	106	–	108	102	5
Wombat	104	93	94	–	110	99	5
Yallara	106	100	101	–	109	104	5


Variety	South east						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% Mitika (t/ha)	3.27	3.57	5.39	2.17	2.76	3.68	
Bannister	106	99	115	124	107	110	15
Durack	94	101	90	87	101	94	15
Kowari	103	103	105	101	103	104	15
Mitika	100	100	100	100	100	100	15
Williams	100	95	113	109	104	105	15
Wombat	97	89	99	113	100	98	15
Yallara	91	98	82	100	102	91	15


Variety	South west						
	Yearly group mean					Regional mean	Number of trials
	2014	2015	2016	2017	2018		
% Mitika (t/ha)	3.22	3.77	5.39	2.58	–	3.44	
Bannister	100	104	118	114	–	110	11
Durack	93	89	93	98	–	94	11
Kowari	101	105	105	104	–	104	11
Mitika	100	100	100	100	–	100	11
Williams	88	96	119	114	–	107	11
Wombat	93	96	107	105	–	100	11
Yallara	91	79	89	99	–	89	11

The table presents NVT 'Production Value' multi environment trial(MET) data on a yearly regional group mean and regional mean basis from 2014–2018.

Preferred milling varieties are Kowari, Mitika and Yallara. Preferred varieties for feeding grain to livestock is Mitika and Kowari.




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Varietal characteristics

Most varieties are suitable for grazing. Variety selection depends on the crop use; sowing date; likely diseases and tolerance to acid soil; grain quality; and possible market outlet.

Milling varieties

Bannister[®]. Released in Western Australia in 2012 as a milling oat variety for the western region. It has high grain yield potential and has performed well in trials in southern NSW. It is taller than Mitika[®] and heads about 3–4 days later than Mitika[®]. It is susceptible to and intolerant of cereal cyst nematodes. Bannister[®] is resistant to leaf rust and moderately resistant to bacterial blight. Bannister[®] has a slightly lower hectolitre weight and slightly higher screenings compared with Mitika[®]. Seednet.

Durack[®]. Released in 2016 from the National Oat Breeding Program. Durack[®] is a moderately tall variety, similar in height to Yallara[®]. Durack[®] is the earliest maturing oat variety of any of the current milling varieties available. It is approximately 7–10 days earlier than Mitika[®]. Durack[®] is susceptible to the stem rust pathotypes found in southern Australia. Leaf rust resistance is variable depending on the pathotype present, rated from susceptible to resistant. A fungicide program should be considered in areas prone to oat rust diseases. Durack[®] has performed well in the shorter season environments of southern and central NSW yielding similar to Yallara[®]. Grain quality for Durack[®] is good, with improved hectolitre weight compared to all current grain varieties. Screenings are low and similar to Yallara[®]. Protein is similar to Mitika[®] and higher than Bannister[®], Williams[®] and Yallara[®]. Groat percent is similar to Mitika[®] and an improvement compared with Williams[®] and Bannister[®]. Heritage Seeds.

Kowari[®]. A new release in 2017 from the National Oat Breeding Program, it is a new potential milling oat variety with dwarf stature, slightly taller than Mitika[®]. It has a maturity similar to Mitika[®]. The grain quality is excellent. Kowari[®] has slightly lower hectolitre weight than Mitika[®], similar 1000 grain weight when compared with Mitika[®]. It combines high beta-glucan with low screenings. Kowari[®] has high grain protein and a slightly higher groat percent compared with Mitika[®]. Kowari[®] has a response, similar to Mitika[®] for stem rust and improved leaf rust resistance. Like Mitika[®], it has low hull lignin. Heritage Seeds.

Mitika[®]. A dwarf milling oat released in 2005. It is earlier maturing than Possum[®] and Echidna, favouring Mitika[®] in a dry finish. Mitika[®] was resistant to stem rust until 2010, when a new pathotype of stem rust was identified, rendering it susceptible. It is moderately susceptible to leaf rust. Mitika[®] has improved resistance to bacterial blight and is superior to Echidna for septoria resistance. Mitika[®] is susceptible to BYDV, septoria and red leather leaf disease. It is very susceptible to and intolerant of cereal cyst nematode and moderately intolerant of stem nematode and is not recommended in areas where either of these nematodes are a problem. Mitika[®] has high hectolitre weight, low screenings and high groat percentage compared with Echidna. Mitika[®] also has improved feed quality with low hull lignin and high grain digestibility. Heritage Seeds.

Williams[®]. Released in 2013 by the National Oat Breeding Program, Williams[®] has a high grain yield potential and has performed well in trials throughout NSW medium-high rainfall zone. Williams[®] is an early to mid-season variety similar to Yallara[®], but 3–7 days later than Mitika[®]. It is taller than Mitika[®] by 15 cm, 5 cm taller than Bannister[®], and 15 cm shorter than Yallara[®]. Williams[®] is resistant to leaf rust and, depending on the stem rust pathotype present, can range from moderately resistant to susceptible. It is susceptible to and intolerant of cereal cyst nematodes. Williams[®] is resistant to bacterial blight and moderately resistant–moderately susceptible to BYDV. Williams[®] has a lower hectolitre weight and higher screenings than Mitika[®]. Williams[®] is not recommended for low rainfall areas due to the potential for high screenings. Heritage Seeds.

Wombat[®]. A dwarf milling variety, which is similar in height to Possum[®] and slightly taller than Mitika[®]. It is a mid-season variety flowering about six days later than Mitika[®]. Wombat[®] was the first dwarf milling variety with cereal cyst nematode resistance and tolerance. It is also moderately tolerant to stem nematode. Wombat[®] has a high hectolitre weight and low screenings compared with the feed variety Potoroo, which was the first dwarf variety with cereal cyst nematode resistance and tolerance. It also has a high groat percentage, slightly higher than Mitika[®]. Developed by SARDI. Seednet.

Table 31. Oat varieties

Variety	Grazing		Straw strength after grazing	Grain maturity	Test weight (kg/hL)	Husk lignin content*	Diseases				Acid soils sensitivity to aluminium
	Early dry matter production	Grazing recovery					Stem rust [‡]	Leaf (crown) rust [‡]	BYDV	Red leather leaf	
Dual-purpose varieties											
Bass	medium	excellent	good	late	medium	low	S	S	T	—	Tol
Bimbil	medium	excellent	good	early–mid	high	low	S	MS	MS	—	—
Blackbutt	slow	excellent	good	late	low–medium	medium [•]	S	S	MT	—	Tol
Cooba [▲]	medium	excellent	fair	early–mid	high	low	MS–S	MS–S	MT	—	Int
Coolabah [▲]	quick	moderate	fair	early	medium	high	MS–S	S	MT	—	Sen
Eurabbie	quick	excellent	very good	late	low–medium	low	S	MS–S	VS	—	Tol
Mannus	medium	excellent	good	mid	high	low	S	MS	MS	—	—
Nile	quick	excellent	good	very late	medium	low	S	S	T	—	Tol
Yarran [▲]	medium	moderate	good	early	high	low	S	MS	VS	—	Int
Yiddah	slow	excellent	good	early	high	low	MS	S	MT	—	—
Grain only varieties #											
Bannister	quick	poor	—	early–mid	med–high	high	MR & S	R	MS	MS	—
Durack	quick	poor	—	very early	high	high	S	R & S	MS–S	MS	—
Kowari	quick	poor	—	early	med–high	low	MR & S	R	S	MS	—
Mitika	quick	poor	very good	early	high	low	MR & S	MS & S	MS & S	S	—
Williams	quick	poor	—	mid	med–high	high	MR & S	R	MR & MS	MS	—
Wombat	quick	poor	—	early–mid	high	high	MS & S	MS	MR	MS	—
Yallara	quick	poor	good	early–mid	high	high	S	MS	MS	MS	—

— Insufficient data

R Resistant

R–MR Resistant to Moderately resistant,

MR Moderately resistant

MR–MS Moderately resistant to Moderately susceptible

MS Moderately susceptible

MS–S Moderately susceptible to Susceptible

S Susceptible

VS Very susceptible.

Where ratings are separated by '&' the first is correct for the majority of situations, but pathotypes are known to exist in some regions and the later rating reflects the response to these pathotypes.

† Field resistance to the rusts on crops differ depending on season, maturity and strains present.

Sen Sensitive

Int Intermediate

MT Moderately tolerant

Tol Tolerant.

Ratings for the grain only varieties are from the SARDI Oat Breeding and Pathology programs, they are from SA screening, and might not represent the reaction to stem and leaf rust in NSW where more virulent pathotypes are present.

▲ Outclassed, Yarran (BYDV), Cooba and Coolabah (grain yield).

* Refer to Table 35.

• Lignin content of Blackbutt can be variable.

Yallara[®]. A medium–tall, early- to mid-season variety similar to Euro for flowering and maturity. Yallara[®] was released in 2009. Yallara[®] is a Euro look-alike milling line with slightly better grain quality, but not as susceptible to stem rust. It is resistant but intolerant to cereal cyst nematode. It is moderately susceptible to BYDV and Septoria. Yallara[®] is susceptible and intolerant to stem nematode and moderately susceptible to red leather leaf disease. Yallara[®] has excellent grain quality. It has a high hectolitre weight, low screenings and a high groat percent. Yallara[®] has bright, plump grain suitable for the milling industry and specialised feed end uses like the horse racing industry as well as human consumption. Yallara[®] was evaluated for hay production and although the hay yield may be lower than popular hay varieties it has excellent hay quality. Seednet.



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- **NEW** Butler Field Peas
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- **NEW** Kowari Oats
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Aladdin[®]. A late maturity grazing variety with good semi-erect early growth and quick recovery from grazing. A new leaf rust pathotype affecting Aladdin[®] was identified in 2015. Selected for Queensland and northern NSW. Released by DAF Qld and Heritage Seeds in 2012, and available through Heritage Seeds.

Austin[®]. An erect, medium maturity forage oat with very strong initial growth. Good tillering ability, with good recovery after cutting or grazing. High total season dry matter production. Resistance to current races of leaf(crown) rust. Released in 2018, commercialised by AusWest Seeds.

Bass[®]. Suitable for early sowings on the higher tablelands. Provides extended grazing with good grain recovery. Strong straw. Good BYDV tolerance. Released by the Tasmanian Institute of Agricultural Research and the Department of Primary Industries, Water and the Environment in 1998.

Bimbil. A dual-purpose type suitable for early- to mid-season sowing, grazing and grain recovery. Early and total dry matter production are similar to Cooba. Grain yield and grain recovery after grazing are better than Cooba. Straw is shorter and stronger than Cooba but it can still lodge. High groat percentage. Bred by NSW DPI at Temora. Released in 1993.

Blackbutt. Popular on the higher tablelands and tablelands/slopes, especially for early sowing. Late maturing provides extended grazing with excellent grain recovery. Straw is strong and of medium height. Good resistance to frost damage after grazing. Tends to have small grain and a low test weight. Bred by NSW DPI at Glen Innes. Released in 1975.

Bond[®]. A semi-erect medium-late maturing forage oat with high dry matter yields in both initial growth and regrowth. Dry matter production is equal to or better than Taipan[®]. Maturity is 7–10 days earlier than Taipan[®]. Good germination and establishment with early sowings into warm soil. High level of resistance to all current pathotypes of leaf rust. Suited to central and northern NSW and south east Qld growing environments. AustWest Seeds.

Brigalow[®]. A semi-erect, high tillering, medium-late maturity forage oat variety. Flowers slightly later than Drover. Selected Seeds.

Brusher[®]. A tall, early- to mid-season hay variety with improved hay digestibility. Resistant and moderately intolerant to cereal cyst nematode. Intolerant of stem nematode. Low husk lignin. Released by SARDI in 2003. AEXCO.

Comet[®]. A medium-late maturity grazing variety released by Pacific Seeds. It has, semi-erect early growth, with early growth similar to Aladdin[®]. High level of resistance to leaf rust. Available through Pacific Seeds.

Cooba. Suitable for early sowing, extended grazing and good grain recovery in most areas. Early growth is slow. It is mid-season maturing. Medium straw height and strength, average grain size, low husk percentage, high test weight and high groat percentage. Bred by NSW DPI at Glen Innes, selected at Temora. Released in 1961.

Cooee. A forage oat that has good early growth and dry matter production for multiple grazings. Erect habit with good regrowth, with fine stems. Late maturing. Released by Wrightson Seeds in 2010.

Coolabah. Suitable for lenient grazing and good recovery for grain in most areas. Quick early growth. Early maturing. Straw of medium height and strength. Fairly long grain, satisfactory test weight, high husk percentage. Bred by NSW DPI at Temora. Released in 1967.

Drover[®]. A medium maturity forage oat with intermediate growth habit. Suitable for grazing and hay. Released by Pacific Seeds in 2006.

Empire. A late flowering forage oat with very good rust resistance suitable for grazing and hay production. Marketed by Seed Force and Australian Premium Seeds.

Eurabbie. Eurabbie has a winter habit. It is semi-dwarf with similar maturity to Blackbutt and later than Cooba by about 10 days. Can be very short after heavy late grazing, possibly resulting in harvesting difficulties. Grazing management is crucial for high grain recovery yields at sufficient height. Excellent grain recovery yields, despite its susceptibility to BYDV. Grain quality is generally inferior and very similar to Blackbutt in tablelands/slopes situations. Generally lower quality than Cooba from slopes/plains samples. Bred by NSW DPI at Temora. Released in 1998.

Flinders^Φ. An erect forage variety with quick early forage growth. Late maturing, flowering a few days earlier than Taipan. High total season dry matter production. Resistance to current field strains of leaf(crown) rust. Released in 2018, commercialised by PGG Wrightson.

Forester^Φ. A very late hay variety adapted to high rainfall and irrigated cropping regions. It is three days later than Riel and three weeks later than Wintaroo. Forester^Φ has excellent early vigour and lodging, and shattering resistance. Good foliar disease resistance spectrum. It is moderately resistant to cereal cyst nematode. Good hay colour, but like all late hay varieties might not resist hot dry winds as well as earlier varieties. Forester^Φ has excellent hay quality. Released by SARDI in 2012. Forester^Φ seed is available from AGF Seeds, Smeaton, Victoria.

Galileo^Φ. A forage oat that has good emergence, vigour and early growth. Good dry matter production for early grazing. Late maturing, similar to Enterprise. Moderately tolerant to BYDV; MR to crown rust. Released by Heritage Seeds in 2006.

Genie^Φ. A late maturity erect grazing variety with quick early growth and very high dry matter yields. Susceptible to leaf and stem rust in the northern region. Selected for Queensland and northern NSW. Released by DAF Qld and Heritage Seeds in 2008 and available through Heritage Seeds.

Graza 51^Φ. An erect, quick-growing, medium to late grazing variety developed by Agriculture Canada. Susceptible to leaf and stem rust in the northern region. Released by Pioneer Hi-Bred in 2007. Seed available through Elders.

Graza 53. A Medium maturity forage oat line, with resistance to leaf rust in northern NSW. Semi-erect growth habit. Marketed by Elders.

Graza 80^Φ. An erect, quick-growing, late maturing grazing variety developed by Agriculture Canada. Susceptible to leaf and stem rust in the northern region. Released by Pioneer Hi-Bred in 2005. Seed available through Elders.

Graza 85^Φ. A new grazing forage oat released by Elders. Medium–medium-quick maturity, with good early vigour, quicker to first grazing than Graza 80^Φ. A high tillering oat with soft, broad leaves, with a low growing point. Very limited information available on its performance in NSW. Seed available through Elders.

Lavish^Φ. A semi-erect, high tillering, late maturity forage oat variety. Maturity similar to Taipan^Φ. Marketed by Upper Murray Seeds.

Mammoth^Φ. A long season forage oat variety. Marketed by Heritage Seeds

Mannus^Φ. A tall, strong-strawed, mid maturing variety for feed grain. Grain yield after grazing is similar to Eurabbie on the tablelands/slopes but lower on the slopes/plains. Physical grain quality is better than Eurabbie. Large uniform grain size with high test weight, high groat percentage, medium protein and fat content. Low lignin husk. Moderately susceptible to BYDV, more resistant than Eurabbie and Yarran. The variety might exhibit physiological yellowing in winter. Bred by NSW DPI at Temora. Released in 2006. Waratah Seeds.

Massive.[®] A very late maturing forage oat variety, marketed by Upper Murray Seeds.

Moola^Φ. A grazing variety with rapid early growth developed by Agriculture Canada and released in 1998 by DAF Qld. Susceptible to leaf and stem rust in the northern region.

Mulgara^Φ. A tall, mid-season hay oat slightly earlier in heading time than, and similar in height to, Wintaroo with cereal cyst nematode and stem nematode resistance and tolerance. Mulgara^Φ is an improvement compared with Wintaroo for resistance to stem rust and bacterial blight, lodging and shattering resistance and early vigour. Hay yield is an improvement compared with Brusher^Φ but slightly lower than Wintaroo^Φ. Hay quality is better than Wintaroo^Φ. Mulgara^Φ also maintains good hay colour and resists brown leaf at hay cutting. Grain yield and quality is similar to Wintaroo^Φ but slightly better grain quality. Mulgara^Φ has high husk lignin. Released by SARDI in 2009. AEXCO.

Nile. A medium height, late maturing variety producing good winter grazing in tablelands districts. Grain recovery yields depend heavily on good, late spring finishing conditions. It has good BYDV tolerance. Released by Tasmanian Department of Agriculture in 1982.

Outback. A forage oat that has quick early growth and dry matter production. Susceptible to leaf rust. Erect habit and mid–late maturity. Released in 2005, marketed by Seed Distributors.

Saia. A grazing only type. Has a much smaller seed than most other varieties, so use lower sowing rates. Produces early feed and extended grazing. Recovery from grazing is sometimes poor. Tall, fine, weak straw. Highly tolerant to aluminium and manganese toxicity. Its blackish grain can be regarded as a contaminant if mixed with white grained varieties. Introduced from Brazil.

SF Colossus. A late flowering forage oat suitable for grazing and producing hay. Medium seed size compared with mainline oat varieties reducing overall seed rates (kg/ha). Marketed by Seed Force.

SF Tucana. A late-flowering forage oat suitable for grazing and hay production. Seven days later in flowering than SF Colossus. Marketed by Seed Force.

Savannah[®]. A new medium-late maturing forage oat line with semi-erect growth habit. Marketed by PGG Wrightson Seeds.

Taipan[®]. An erect plant with quick, early growth and high dry matter yields. Ideally suited to cattle, particularly in a continuous grazing situation. Susceptible to leaf and stem rust in the northern region. Released by Pacific Seeds in 2001.

Tammar[®]. A tall, mid-late season hay variety, later in cutting time than Kangaroo[®] or Tungoo[®]. Tammar[®] has a good foliar disease resistance profile and has improved stem rust resistance compared with Tungoo[®]. Has good lodging resistance, comparable with Kangaroo[®]. Tammar[®] has excellent hay colour and resists brown leaf at cutting and has similar hay yields to Kangaroo[®] and Tungoo[®], but lower than Wintaroo[®]. Released by SARDI in 2012. AEXCO.

Tungoo[®]. A medium-tall, mid-late season hay variety. Tungoo[®] combines resistance and moderate tolerance to cereal cyst nematode and stem nematode. Resistant to red leather leaf disease; moderately susceptible to susceptible to stem rust; moderately resistant to leaf rust. Hay yield is similar to Kangaroo[®] but grain yield and grain quality is poor. Hay quality is similar to Wintaroo[®] (better than Kangaroo[®]), although it tends to be higher in neutral detergent fibre (NDF) than Wintaroo[®], but not as high as Kangaroo[®]. Early vigour is not as good as Kangaroo[®]. Low husk lignin. Released by SARDI in 2010. AEXCO.

Victory[®]. Late maturing forage oat line, slightly earlier than Massive in maturity. Semi-erect growth habit. Marketed by Upper Murray Seeds.

Warlock[®]. A new medium-late maturity grazing oat variety. Erect early growth habit, tall plant height, high tillering and medium thickness leaves and stems. Known to be susceptible to at least one known leaf rust pathotype. If leaf rust is present, use an appropriate foliar fungicide to reduce impact. Selected for Queensland and northern NSW. Released by DAF Qld and Heritage Seeds in 2018, and available through Heritage Seeds.

Wintaroo[®]. A tall, mid-season hay variety. Resistant and moderately tolerant to cereal cyst nematode and tolerant to stem nematode. Low husk lignin. Released by SARDI in 2002. AEXCO.

Wizard[®]. A new medium-maturity grazing variety with good semi-erect early growth and quick recovery from grazing. Early growth similar to Genie[®] and better than Aladdin[®]. Resistant to leaf rust strains currently found in northern NSW. Selected for Queensland and northern NSW. Released by DAF Qld and Heritage Seeds in 2017, and available through Heritage Seeds.

Yarran. A medium height, early- to mid-season maturing variety for feed grain. Performs better than Coolabah for grain recovery, or grain-only on the slopes/plains, but is slightly inferior to Coolabah for grazing production. In very dry years it outyields Echidna in grain-only trials. Large grain with a high test weight, protein percentage and medium to low husk content. Very susceptible to BYDV. Bred by NSW DPI at Temora. Released in 1988.

Yiddah[®]. A tall, strong-strawed, early maturing variety for feed grain. It can be sown earlier than Yarran and has quicker early feed production. Grain yield after grazing is similar to Yarran. Physical grain quality is better than Yarran. Very large grain with high test weight and protein percentage and low husk content. Low lignin husk. Moderate tolerance to BYDV, effective stem and some crown rust resistance. Bred by NSW DPI at Temora. Released in 2001. Waratah Seeds.

Table 32. Disease guide – oats

Disease/Cause	Symptoms	Occurrence	Spread	Control
Foliar diseases				
Bacterial stripe blight <i>Pseudomonas striafaciens</i> pv. <i>striafaciens</i>	Water soaked stripes on leaves, drying to tan/red stripes, leaf death.	More severe in early maturing crops in wetter seasons.	Rain splash, insects, seedborne.	Nil
Barley yellow dwarf <i>Barley yellow dwarf virus</i> (BYDV)	Yellowing, dwarfing of infected plants, floret blasting, leaf reddening in some varieties.	Most common near perennial grass pastures and in early-sown crops.	Transmitted by aphids from infected grasses and cereals.	Resistant and tolerant varieties; controlling aphids, insecticidal seed treatments.
Leaf (Crown) rust <i>Puccinia coronata</i> f.sp. <i>avenae</i>	Orange powdery pustules on upper leaf surface.	In wet seasons; more important on the coast.	Airborne spores from living plants.	Graze infected crops in autumn, Varieties with the best possible field resistance. Foliar fungicides.
Leaf spots Several fungi	Leaf spots, leaf death.	Usually minor.	Depends on disease.	None.
Red leather leaf <i>Spermospora avenae</i>	Long lesions with reddish borders and light centres. Leaves may look and feel leathery.	Higher rainfall, cool wet weather.	Oat stubble. Stubble and rain splash.	Avoid susceptible oat varieties and rotate crops.
Stem rust <i>Puccinia graminis</i> f.sp. <i>avenae</i>	Reddishbrown, powdery, oblong pustules with tattered edges on leaf and stem; progressive death of plant.	More important inland, from spring to summer in warm, wet weather.	Airborne spores from living plants.	Early maturing varieties to avoid rust. Foliar fungicides.
Smuts				
Smuts <i>Ustilago avenae</i> , <i>U. segetum</i> var. <i>hordei</i>	Replacement of florets by black sooty mass.	Statewide.	Spores on or in the seed infect the seedling after sowing.	Thorough treatment of seed with appropriate fungicide.

Table 33. Hay oat varieties

Variety	Grazing		Straw strength after grazing	Maturity	Diseases					Acid soils – sensitivity to aluminium
	Early dry matter production	Grazing recovery			Stem rust ♦	Leaf (crown) rust ♦	BYDV	Red leather leaf	Bacterial blight	
Bass	medium	excellent	good	late	S	S	T	–	–	Tol
Bimbil	medium	excellent	good	early–mid	S	MS	MS	–	R	–
Blackbutt	slow	excellent	good	late	S	S	MT	–	R	Tol
Cooba ▲	medium	excellent	fair	early–mid	MS–S	MS–S	MT	–	R	Int
Coolabah▲	quick	moderate	fair	early	MS–S	S	MT	–	R	Sen
Nile	quick	excellent	good	very late	S	S	T	–	R	Tol
Yarran ▲	medium	moderate	fair	early	S	MS	VS	–	R	Int
Yiddah	medium	excellent	good	early	MS	S	MT	–	–	–
Specialist hay varieties[#]										
Brusher	medium	–	good	early–mid	MS & S	MS & S	MS	MS	MR & MS	–
Forester	medium	–	–	very late	R & S	MR & MS	MR & S	MR	MS & S	–
Kangaroo	medium	–	–	mid–late	MS & S	MS & S	MR & S	MS	MR & MS	–
Mulgara	medium	–	–	early–mid	MS	MR & MS	MS	MS & S	MR	–
Tammar	medium	–	–	late–mid	MR & S	MR & MS	MS	MR & MS	MR	–
Tungoo	medium	–	–	mid–late	MS & S	MS	MR & MS	MR	MR	–
Wintaroo	medium	–	fair–good	mid	S	S	MR & MS	MS	MR & MS	–

– Insufficient data

R Resistant

R–MR Resistant to Moderately resistant

MR Moderately resistant

MR–MS Moderately resistant to Moderately susceptible

MS Moderately susceptible

MS–S Moderately susceptible to Susceptible

S Susceptible

VS Very susceptible.

Where ratings are separated by ‘&’ the first is correct for the majority of situations, but pathotypes are known to exist in some regions and the later rating reflects the response to these pathotypes.

♦ Field resistance to the rusts on crops differ depending on season, maturity and

strains present.

Sen Sensitive

Int Intermediate

MT Moderately tolerant

Tol Tolerant.

Select more than one variety, with at least one from the early maturing group and another from mid or late maturing group.

[#] Ratings for the specialist hay varieties are from the SARDI Oat Breeding and Pathology Programs, they are from SA screening, and may not represent the reaction to stem and leaf rust in NSW where more virulent pathotypes are present. ▲ Outclassed, Yarran (BYDV), Cooba and Coolabah (grain yield).

Oaten hay

For information on quality and marketing of oaten hay, including export options, contact the Australian Fodder Industry Association (AFIA) (see [Industry information on page 67](#) for details).

Table 34. Forage, silage or hay oat varieties

Variety	Growth habit	Speed to grazing	Maturity	Diseases	
				BYDV	Leaf (crown) rust
Aladdin	semi-erect	medium–quick	late	—	S *
Austin	erect	quick	medium	—	R*
Bass	semi-prostrate	medium	medium	T	S
Blackbutt	prostrate	slow	medium	MT	S
Bond	semi-erect	quick	medium–late	—	R
Boss	semi-erect	medium–quick	medium	—	S
Comet	semi-erect	medium–quick	medium–late	—	R
Cooee	erect	very quick	medium	—	S
Dawson	erect	very quick	medium–late	—	S
Drover	semi-prostrate	medium	medium–late	—	S *
Empire	erect	medium–quick	late	—	—
Eurabbie	semi-prostrate	medium	medium	S	S
Flinders	erect	quick	late	—	R*
Genie	erect	very quick	late	—	S
Graza 50	erect	quick	late	—	S
Graza 51	erect	quick	medium–late	—	S
Graza 53	semi-erect	medium–quick	late	—	R
Graza 80	erect	quick	late	—	S
Graza 85	semi-erect	quick	late	—	—
Lordship	semi-erect	very quick	late	T	S
Mammoth	—	quick	—	T	—
Mannus	prostrate	medium	medium	MS	MS & S
Massive	—	—	—	—	S
Nile	semi-prostrate	medium	medium–late	T	S
Outback	erect	quick	medium–late	—	S
Quamby	erect	medium	medium–late	—	S
Saia	erect	medium	early	T	S
SF Colossus	—	—	medium–late	—	—
SF Tucana	—	—	late	—	—
Savannah	semi-erect	medium–quick	medium–late	—	S
Taipan	erect	quick	late	—	S
Wizard	semi-erect	medium–quick	medium	—	R*

— Insufficient data
 I Intolerant
 R Resistant
 MR Moderately resistant
 MS Moderately susceptible
 MT Moderately tolerant
 S Susceptible
 Sen Sensitive
 Tol Tolerant.

* Virulent pathotypes have been detected for these varieties, however, they are not common. Crops should therefore be inspected regularly for the presence of leaf rust.

These varieties are rated according to maturity, the relative maturity may change depending on which region in NSW they are grown, particularly in southern NSW

Feeding value of oat grain

The GRDC-supported Premium grains for livestock production project demonstrated large differences between varieties in whole grain digestibility. Cattle feeding trials have subsequently demonstrated that these differences translate into large differences in grain digestibility. Grain testing from the 2014 harvest has shown on average a 17% increase in digestibility of Mitika oats over other grain oat varieties grown at sites in central and southern NSW.

The varietal differences in the lignin content of the oat husk causes most of the difference in whole grain digestibility. Where varieties have a high husk lignin content, digestion of both the husk and the underlying grain is poor. Husk lignin content is assessed using a simple staining test (phloroglucinol stain test). Table 35 on this page shows a list of lignin ratings of a range of oat varieties.

While other seasonal factors affect whole grain digestibility, varieties with a high husk lignin rating will inherently have low whole grain digestibility. NIR tests have been developed to measure the feeding value of grains.

Feed quality tests can accurately measure whole grain digestibility, protein levels and metabolisable energy. For livestock feeding, grain protein is an important attribute. Oats can vary widely in protein levels due to varietal factors, paddock variability, fertiliser inputs and yield levels. Oats with low protein levels (<12%) can limit growth rates of young animals.

Table 35. Hull lignin rating of a range of oat varieties – low is better for ruminant feed value

Low	Medium	Medium–High	High
Bass, Bimbil, Brusher, Carbeen, Cooba, Eurabbie, Graza 68, Kowari, Mannus, Mitika, Mulgara, Nile, Tungoo, Wintaroo, Yarran, Yiddah	Blackbutt (variable), Graza 80, Quoll	Euro, Potoroo, Wandering	Bannister, Carrolup, Coolabah, Dawson, Drover, Dunnart, Durack, Echidna, Forester, Genie, Graza 50, Kangaroo, Mortlock, Nugene, Possum, Taipan, Williams, Wombat, Yallara

Further reading

SARDI website for new variety brochures and further information on hay only varieties.

Contributing authors

Glenn Roberts, former Oat Breeder, NSW DPI, Temora; Pamela Zwer and Sue Hoppo, Oat Breeders, SARDI, Adelaide; Frank McRae, former Technical Specialist Cereals, NSW DPI, Orange; Bruce Winter, Plant Breeder (Oats), DAF Qld, Toowoomba.



Industry information

Seed testing laboratories

The key to getting a reliable seed testing result is making sure you collect a representative sample of your seed lot and using an accredited laboratory. There are a number of commercial seed testing services available to growers. The following list is not exhaustive and others are available.

Seed Services Australia

Primary Industries and Regions South Australia
GPO Box 1671, Adelaide, SA 5001
t: 1300 928 170 or 08 8303 9549 f: 08 8303 9508
e: seeds@ruralsolutions.sa.gov.au

Futari Grain Technology Services

34 Francis Street [PO Box 95], Narrabri NSW 2390
t: 02 6792 4588 f: 02 6792 4221
e: info@futari.com.au

EM Pascoe Seed Testing services

12 Ridge Road, Greensborough, Victoria 3088
t: 03 9434 5072 f: 03 9434 5072
e: elizabethpascoe@gmail.com

GrainCorp Technical Services

30 Barwan Street, Narrabri NSW 2390
t: 1800 809 482 or 02 6792 8605 m: 0408 860 995
f: 02 6792 3825
e: jlowien@graincorp.com.au

Industry organisations

Australian Fodder Industry Association Inc.

www.afia.org.au
PO Box 527, Ascot Vale, Victoria, 3032
t: 03 9670 0523
e: info@afia.org.au

Australian Oilseeds Federation

www.australianoilseeds.com
PO Box H236, Australia Square NSW 1215
t: 02 8007 7553 f: 02 8007 7549
e: admin@australianoilseeds.com.au

Grain Growers Association

www.graingrowers.com.au
Level 19, 1 Market Street, Sydney NSW 2000
PO Box 1355, Queen Victoria Building NSW 1230
t: 1800 620 519 or 02 9286 2000 f: 02 9286 2099
e: enquiry@graingrowers.com.au

Grain Trade Australia (GTA)

www.graintrade.org.au
Level 7, 12 O'Connell Street, Sydney NSW 2000
PO Box R1829, Royal Exchange NSW 1225
t: 02 9235 2155
e: admin@graintrade.org.au

NSW Durum Growers Association

Chairman: Ross Durham
Nombi, Mullaley NSW 2379
m: 0427 437 841
e: ross@nombi.com.au

SA Durum Growers Association

www.durumgrowerssa.org.au
Secretary: Deb Baume m: 0481 322 821
e: sadgasecretary@gmail.com

Pulse Australia Ltd

www.pulseaus.com.au
PO Box H236, AUSTRALIA SQUARE, Sydney, NSW, 1215
t: 02 8007 7553
e: nick@pulseaus.com.au

The University of Sydney

Plant Breeding Unit – Cereal Rust

107 Cobbitty Road, Cobbitty NSW 2570
t: 02 9351 8800 f: 02 9351 8875

Variety Central

<http://varietycentral.com.au>
Contact: Denis McGrath
m: 0408 688 478 f: 03 4206 7015
e: denis@seedvise.com.au

National Cereal Rust Survey

Cereal rust samples can be collected and mailed to the address below. Rusty plant samples can be mailed in paper envelopes; do not use plastic wrapping or plastic lined packages.

Send to:

University of Sydney
Australian Rust Survey
Reply Paid 88076, Narellan NSW 2567

For more information, go to the University of Sydney's **Plant Production page** (<https://sydney.edu.au/agriculture/our-research/plant-production.html>).



Triticale

Crop management

This high-yielding feed grain crop is suited to all soil types, but has yield advantages on light, acid soils high in exchangeable aluminium. In these soils, triticale significantly out-yields wheat, barley and sometimes oats in all seasonal conditions, wet or dry.

In low soil fertility, triticale responds well to high inputs of seed and fertiliser. Adequate fertiliser needs to be applied to achieve optimum yields.

On the better wheat soils, and in better seasons, triticale yields are equal to or exceed those of wheat. However, in dry springs, triticale yields can be 10–15% below wheat, due to its longer grain-filling period.

Triticale often suffers more from frost damage than wheat, hence it should generally be sown later. It flowers earlier than most wheats, but matures at about the same time.

Triticale usually commands a lower price per tonne at the farm gate. An exception to this can be where there is strong local demand for feed grain, where a better cash return with low transport costs could be expected.

Phosphorus (P). Consider using 15–25 kg P/ha, depending on expected yield, paddock history, soil test results and soil type.

Nitrogen (N). Give particular attention to nitrogen supply. Triticale used for grazing and grain could use up to 100 kg/ha of N. Consider applying 60–100 kg/ha of N as a topdressing if soil nitrogen levels are low.

Long fallow paddocks following good legume pastures generally have satisfactory nitrogen levels. Long fallow paddocks have the highest yield potential because of stored moisture and have the greatest potential to respond to soil nitrogen. Yield increases are likely when nitrogen is applied to paddocks with low nitrogen status.

Cover crop. The low tillering growth of some varieties and good shattering tolerance of triticale has proven useful as a cover crop for undersowing pastures on the slopes and tablelands.

Sowing rates

Aim to achieve the same plant populations as for wheat by setting the seeder 25–40% above the setting recommended for district wheat sowings. The higher setting is needed because the:

- grain is larger than wheat, and flows more slowly
- plants tiller less than wheat.

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How to calculate sowing rates: [page 8](#).

Table 36. Sowing rates for triticale

Purpose/growing conditions	Sowing rate (kg/ha)
Grain only	60–100
Grazing and grain	100–120
Irrigation and favourable environments	100–120
Undersowing pasture	15–30

Check germination and seed size to calculate sowing rate.

Grazing

The ideal stage to start grazing dual-purpose varieties is when plants are well anchored and the canopy has closed. Continuous grazing is better than rotational grazing for fattening stock. Maintain adequate plant material to give the crop continuous and quick regrowth (1000–1500 kg DM/ha).

For the best recovery after grazing, do not graze below 5 cm for prostrate varieties, or below 10 cm for more erect types. Over-grazing greatly reduces the plant's ability to recover.

Disease

Triticale is susceptible to loose smut and should be treated with a fungicidal seed dressing. It is slightly less susceptible to take-all than wheat. It has vastly superior tolerance over wheat to *Septoria tritici* blotch. Although it does not usually exhibit severe symptoms of yellow spot, it will harbour this disease. Triticale is also susceptible to crown rot.

Growers should check to ensure their current variety has adequate field resistance to stripe rust, or consider using foliar fungicides to control the disease in-crop if required.

Consider seed or fertiliser–fungicide treatment for controlling seedling stripe rust in susceptible varieties, especially those sown early for grazing.

Variety selection

Grazing and grain recovery: Endeavour[®], Cartwheel[®], Crackerjack 2, Wonambi, and Tuckerbox.

Outclassed: Tobruk[®] (stripe rust).

Grain only: Astute[®], Bison[®], Fusion[®] – for main season sowings (mid-May–June).

Outclassed: Chopper[®], Hawkeye[®], Tahara and Tobruk[®] (for earlier sowings in higher rainfall areas) (all stripe rust and grain yield).

Varietal characteristics

Dual-purpose grazing varieties

Cartwheel[®]. A long-season dual-purpose triticale that is suitable for an early March to early April sowing. A stripe rust resistant replacement for Tobruk[®]. Good early forage production when sown in March and recovers from grazing to give excellent forage in winter. Straw strength is good and has shorter stature than Tobruk[®]. Grain yield after grazing is equivalent to Tobruk[®]. Released by the University of Sydney. Seed is available from Waratah Seeds.

Crackerjack 2. A medium-late season replacement for the original Crackerjack. Earlier sowing option than the original Crackerjack, with sowing from early April. Excellent establishment and early vigour. Suited to rotational grazing and silage or hay production. Improved stripe rust resistance over the original Crackerjack. Released by Heritage Seeds.

Endeavour[®]. A semi-awnless dual-purpose variety. Excellent dry matter production and grain recovery after grazing. Released by the University of Sydney. Waratah Seeds.

Wonambi. A late spring type triticale suitable for grazing, forage conservation and grain production. Tip-awned, dense grained triticale. Good rust resistance, but susceptible to cereal cyst nematode. Bred at Sherlock, South Australia, by Kath Cooper. Marketed by Naracoorte seeds. Non PBR.

Tobruk[®]. A fully-awned, dual-purpose and long season grain-only variety. Strong winter habit. Excellent grain yield after grazing. Susceptible to stripe rust head infection, rated moderately susceptible - susceptible to the Tobruk[®] pathotype of stripe rust. Consider seed treatment for stripe rust when sown early for grazing. Released by the University of Sydney. Waratah Seeds.

Tuckerbox. A reduced-awn, medium season, tall, dual-purpose triticale. A variety suitable for hay or silage. Tuckerbox is most suited to production areas of 450 mm annual rainfall or greater, but will grow to maturity in lower rainfall areas or in tough seasons. Approximately one week later than Rufus to heading, slightly earlier than Yukuri. Selected at Sherlock, South Australia, by Kath Cooper. Non-PBR. Cooper & Elleway and Yankalilla Seeds.

Grain only varieties

Astute[®]. Mid maturity variety suited to the medium–high rainfall areas of NSW, with high yield potential. Astute[®] is a suitable replacement for Hawkeye[®], with a similar flowering time. It is a fully-awned variety, with good lodging resistance. Seed is available through AGT Affiliates. AGT.

Bison[®]. An early to mid-maturity variety, suited to low–medium yield potential environments, performing well across NSW. Reduced-awned variety; possible replacement for Rufus with improved stripe rust resistance. Seed is available through AGT Affiliates. AGT.

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Read in conjunction with [Table 40. Variety characteristics and reaction to diseases on page 71.](#)

Table 37. Suggested sowing times for triticale

Variety	Weeks	February		March				April				May				June				July	
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Endeavour		>	★	★	★	★	★	★	★	<	<										
Cartwheel			>	★	★	★	★	★	★	<	<										
Tobruk▲			>	★	★	★	★	★	★	★	★	★	★	★	★	<					
Crackerjack 2							>	★	★	★	★	★	<	<							
Wonambi#								>	★	★	★	★	★	<							
Tuckerbox										>	★	★	★	★	★	★	<				
Astute, Bison, Fusion, Hawkeye▲, Tahara▲												>	★	★	★	★	★	<			
Chopper▲, KM10												>	>	★	★	★	★	★	★	<	<

Aim to sow in the earlier part of the optimum time indicated to achieve maximum potential yield, particularly in western areas. Soil moisture, soil fertility and the likelihood of frost in a particular paddock at flowering influence the actual sowing date.

Note: new variety – limited information available on the response to sowing time for these varieties.

> Earlier than ideal, but acceptable. ★ Optimum sowing time. < Later than ideal, but acceptable. ▲ Outclassed.

Table 38. Dual-purpose triticale performance compared to Endeavour (2011–2017)

Variety	1st grazing DM	2nd grazing DM	Grain recovery
% of Endeavour (t/ha)	2.30	2.83	4.10
Cartwheel	91	102	107
Endeavour	100	100	100
Wonambi	97	87	91
Tobruk	92	102	108

Table 39. Triticale variety performance – NSW (compared with Fusion = 100%)

Variety	North east				Regional mean (2008–2015)	Number of trials
	2012	2013	2014	2015		
% Fusion (t/ha)	3.38	3.00	2.87	3.15	4.14	
Astute	–	98	96	99	104	6
Bison	–	100	100	107	101	6
Chopper▲	88	92	95	100	89	15
Fusion	100	100	100	100	100	11
Hawkeye▲	92	94	91	95	95	15
KM10	–	–	92	94	87	4
Tahara▲	82	84	86	82	84	15

Variety	South east				Regional mean (2008–2015)	Number of trials
	2012	2013	2014	2015		
% Fusion (t/ha)	5.90	4.34	4.44	4.40	4.57	
Astute	–	101	103	105	105	10
Bison	–	100	102	106	101	10
Chopper▲	90	91	86	95	87	29
Fusion	100	100	100	100	100	22
Hawkeye▲	94	91	93	99	95	29
KM10	–	–	88	91	89	7
Tahara▲	88	87	77	85	83	29

Variety	South west irrigated				Regional mean (2008–2015)	Number of trials
	2012	2013	2014	2015		
% Fusion (t/ha)	6.46	–	8.07	6.49	6.08	
Astute	–	–	104	111	112	2
Bison	–	–	100	110	103	2
Chopper▲	87	–	91	99	87	6
Fusion	100	–	100	100	100	5
Hawkeye▲	105	–	96	108	102	6
KM10	–	–	90	100	91	2
Tahara▲	86	–	91	90	86	6

▲ Outclassed – Chopper, Hawkeye and Tahara (all stripe rust and yield). The tables presents NVT 'Production Value' MET (multi environment trials) data on a regional mean basis from 2008–2015. Yearly group means shown for 2012, 2013,

2104 and 2105. No recent data is available for the NSW north-western region as only a limited number of trials were conducted in the period of 2008–2015.

Table 40. Variety characteristics and reaction to diseases

Variety	Grazing production	Straw strength	Maturity	Resistances						Acid soils—sensitivity to aluminium	Release date
				Stem rust	Leaf rust	Tobruk pathotype	Stripe rust	Cereal cyst nematode	RLN <i>P. neglectus</i>		
							Yr 17–27 pathotype				
Dual-purpose											
Cartwheel	quick–early	very good	mid–late	R	R	—	R	R	R–MR	—	2016
Crackerjack 2	quick–early	moderate	mid–late	—	—	—	—	—	—	—	—
Endeavour	quick–early	very good	late	R	R–MR ^p	R–MR	R–MR	R	—	V. tol	2007
Wonambi	quick–early	good	mid–late	R	R–MR	—	R–MR ^p	MS	MR	—	2018
Tobruk▲	quick–early	very good	mid–late	R	R–MR ^p	MS–S ^a	MR	—	—	—	2007
Tuckerbox	quick–early	—	mid	MR	R–MR ^p	MR–MS	MR	R	—	V. tol	—
Grain only											
Astute	NR	very good	early–mid	R–MR	R–MR	—	R–MR	R	R	V. tol	2015
Bison	NR	good	early–mid	R–MR	R–MR	—	R	R	R	V. tol	2014
Chopper▲	NR	very good–good	very early	MR–MS	R–MR ^p	MS–S	MR–MS	R	MR	—	2010
Fusion	NR	medium–good	mid	R	R–MR ^p	MR ^b	R–MR	R	R–MR	V. tol	2012
Hawkeye▲	NR	good	mid	R–MR	R–MR ^p	MR, MS–S ^b	MR, MS ^b	R	R	V. tol	2007
KM10	NR	good	very early	R	MR–MS	—	R–MR	S	R–MR	—	—
Tahara▲	NR	moderate	early–mid	R	R–MR ^p	MS	MR–MS	R	R	V. tol	—

NR Not recommended

R Resistant

R–MR Resistant to Moderately resistant

MR Moderately resistant

MR–MS Moderately resistant to Moderately susceptible

MS Moderately susceptible

MS–S Moderately susceptible to Susceptible

S Susceptible

S–VS Susceptible to Very susceptible

VS Very susceptible

V. tol Very tolerant

^p Provisional rating[▲] Outclassed^a Susceptible to head infection^b mixed population, some plants are more susceptible to stripe rust.

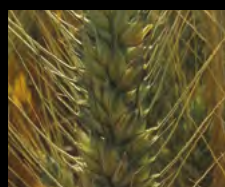
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- Endeavour Triticale
- Astute Triticale
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KM10. A quick-maturing line, suited to late sowing or short-season environments. Reduced-awned variety with quick early growth. Could be suitable for fodder production systems as it has good early growth. It could be used as part of an annual ryegrass management program where sowing is delayed and/or the option for cutting as silage is used. Non PBR variety. Selected at Sherlock, South Australia, by Kath Cooper. Non-PBR.

Marketing

Triticale is predominantly used as a stockfeed, often processed into prepared ration mixes or pellets. As with other cereal grains, care is needed when introducing stock to triticale due to grain poisoning issues.

The market is small compared with other feed grains such as barley. Grain is traded domestically through merchants or directly to end users in the dairy, feedlot, pig and poultry industries.

Prices offered are often relative to Australian Standard White wheat and are influenced by the:

- supply and price of other grains such as barley, wheat, sorghum and possibly oats
- quality and quantity of grain
- location of grain and transport costs
- seasonal effects on the grazing industries.

Prices tend to be lowest at, or soon after, harvest and rise during winter.

Aim for a maximum 12% moisture, with a test weight of 65 kg/hL with a minimum of admixture. Grain protein and metabolisable energy levels (ME) should be known before negotiating sales. ME levels are similar to wheat.

Since triticale is often grown in acid soils and later in the rotation, low protein grain can result, affecting marketability and price. Apply adequate nitrogen fertiliser to alleviate this problem.

Storage

Triticale grain is very prone to weevil attack; more so than barley. Be careful of high grain moisture contents.

Contributing authors

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Managing grazing cereals

Choosing a cereal

Forage and dual-purpose cereals are normally grown to help overcome winter feed shortages.

Oats and other grazing cereals have higher winter growth rates than most pastures. Saved autumn growth from early-sown crops can also be used to carry feed through into winter. Crop and variety selection, and sowing time will influence the total amount of feed available. Choose dual-purpose varieties where a grain harvest is required after grazing. For hay production, cereal types with large awns such as barley, some triticales, cereal rye and some wheats should be avoided. The same applies with grazing when head emergence cannot be controlled.

Ideally, there should only be one type of cereal sown in a paddock as stock will preferentially graze one cereal over another.

Oats will generally produce more overall forage than wheat, barley, cereal rye or triticale. Grain recovery, however, is not so clear cut, with winter wheats and triticale often having similar, or better yields than oats.

Table 41. Average dry matter yield performance for cereals in NSW

Crop type	Dry matter 1# (kg/ha)	Dry matter 2# (kg/ha)
Oats	2593	2324
Barley	2183	2570
Wheat	1922	2222
Triticale	2303	2525

Dry matter results are an average of combined across-sites analysis for each crop type from the NSW DPI mixed cereal trials in NSW from 2004 to 2010.

Dual-purpose grazing cereal varieties have been evaluated across NSW for their dry matter production and grain yield recovery. View the latest variety performance data for dual purpose varieties.

Testing early forage quality of oat, wheat, barley, cereal rye and triticale, grown under similar conditions, has shown similar protein, energy or digestibility levels. The decision to sow an alternative cereal to oats is, therefore, mostly made depending on paddock suitability, grain recovery and expected higher grain returns. Soil acidity also influences cereal choice, as species and/or varieties vary in their tolerance to soil aluminium. Even when highly acid soils are limed, acid-tolerant types should be grown where the subsoil is acidic.

Consider the diseases that affect the various grazing cereals. Diseases such as *Barley yellow dwarf virus* (BYDV) or *Wheat streak mosaic virus* can limit a crop that is grown in a particular area. Applying seed insecticide dressings can reduce the impact of diseases such as BYDV have on the crop by reducing the levels of early aphid feeding activity that spreads the virus. Cereal rust diseases can also be an issue so avoid susceptible varieties. Forage quality and palatability decreases with high foliar rust loads.

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See [Table 72 on page 145](#) for a list of currently available seed dressings for aphid control.

Growth habit

Understanding a variety's winter habit and maturity will influence the variety choice, sowing time and expected grazing performance.

Winter habit

Varieties with a strong winter habit, such as Mackellar[®] wheat and Blackbutt oats, are suitable for early sowing as head initiation does not occur until there has been exposure to periods of cold temperature (vernalisation – this exposure is cumulative). Once these requirements have been met, head initiation begins as warmer temperatures and increasing day length occurs. The degree of winter habit will depend on each variety's genetics. Varieties described as semi-winter types require a shorter cold temperature exposure to initiate heading than the varieties with a strong winter habit.

Maturity

Cereals described as late maturing do not necessarily have a strong winter habit, but respond to a photoperiod response, where the day length controls the rate of development. Without this strong requirement for vernalisation, these types, when sown early in warm/long day conditions, can quickly initiate heads. Removing the immature heads with grazing will kill tillers with a subsequent loss in forage production from delayed regrowth. Late-maturing types without a winter habit, when sown early, often require quick early grazing to retard early growth and head initiation. This earlier than normal grazing will assist subsequent regrowth.

Sowing

Cereals used for either grazing or grain production will only attain maximum production if seed rates are kept high and crop nutrition is adequate. Optimum seed rates will vary with climate and region; see the specific crop section in this book for suggested plant populations. Nutritional requirements will likewise vary according to climate, soil type and paddock history. Where nitrogen fertiliser is required, split applications are suitable for dual-purpose cereals, for example, applying some nitrogen at sowing, then following up with topdressing(s) after grazing for subsequent hay/silage or grain production.

Early sowings, particularly on the higher tablelands, will allow more growth before the onset of cold winter temperatures. However, sowing too early in other areas can cause germination and establishment problems if soil temperatures are high. Early crop vigour could be reduced with stubble retention and reduced tillage practices.

Wider row sowings can also affect forage yields. At Gulgong, for instance, on a light granite soil, a 25 cm row spacing resulted in a reduction of nearly 12% in early dry matter production of Coolabah oats compared with a 17.5 cm row spacing.

Grazing management

The earliest time to start grazing is when the plants are well anchored and have reached the tillering stage (Zadoks [Z] 21–29). For most grazing types under good growing conditions, this will occur 6–8 weeks after plant emergence, depending on variety. Should you need to graze earlier than this, check how well the young plants are anchored by doing a ‘twist and pull test’ by holding the plant between the thumb and forefinger and pulling as you twist the plant. If the plant remains anchored, grazing livestock should not be able to pull it out. At this early stage, choosing livestock with sound teeth will help reduce any plant damage.

Grazing withholding periods must be observed on crops sown with treated seed. Withholding periods vary from a few days up to 12 weeks, depending on the product and rate used. Always check the pesticide label before cereal crops sown with treated seed are grazed.

Delaying early grazing of winter types allows more feed to accumulate and saved for winter. For erect types, crops should be 20–25 cm high and for prostrate types, 10–15 cm high. Varieties without a strong winter habit, but sown in early autumn, should be grazed pre-tillering to retard growth and prevent premature stem elongation/head initiation. When stem elongation occurs, immature heads are located just above the highest node (joint). If these are removed by grazing, tiller death occurs and, while the plant is usually able to produce more tillers, forage production (and grain production) will be severely reduced.

The latest grazing time and severity on crops intended for grain recovery or hay production should be governed by the position of the immature head in the stem.

Stock should be removed, at the latest, by growth stage Z31. Z31 is determined when the first node is 1 cm or more above the base of the shoot and the gap between the first node and the second is less than 2 cm. Examine the plant for the first sign of stem elongation and the presence of the developing head. The beginning of stem elongation can be seen by slicing the main tiller with a sharp blade to expose the developing head as shown in Figure 3 below.

Some growers choose to graze later and remove these heads, particularly if they need the feed for livestock or if the crop or variety is prone to lodging. These growers accept lower grain or hay yields as a trade-off. Late grazing of semi-dwarf types can also greatly reduce crop height, possibly causing harvesting problems in rocky or uneven paddocks.

Leaf diseases such as rust (oats) or powdery mildew (barley) could also influence the timing and severity of grazing. By removing the canopy and opening up the crop, leaf disease incidence and severity can be greatly reduced.

GRAZING WITHHOLDING PERIODS

For the current withholding periods for the main seed fungicide and insecticide dressings, see [Table 71 on page 142](#).



Figure 4. Cross-section showing wheat head in young plant.

All cereals in the vegetative stage under good growing conditions are highly digestible and often contain 80–85% moisture (15–20% dry matter). The resulting loose faeces of stock are regarded as normal on highly digestible, high moisture, green feed. Adding hay or roughage to the diet will generally reduce scouring, but also reduce animal performance as the animal substitutes the hay/roughage for the higher quality forage. In some cases, adding hay can be of benefit by extending the grazing life of the crop. Veterinary advice should be sought if abnormal scouring occurs, as there are many non-nutritional causes of scours, including internal parasites.

Livestock health

A number of health conditions or disorders such as mineral and vitamin imbalances, enterotoxaemia (pulpy kidney), hypomagnesaemia (grass tetany), hypocalcaemia (milk fever), bone growth disorders in lambs (rickets), photosensitisation in sheep and nitrate poisoning can affect stock that are grazing cereals. Growers should seek advice from their local livestock adviser or veterinary officer and develop a plan to minimise the possibility of animal health disorders.

Stocking rates

Stocking densities will depend on specific animal production targets. Research has shown that continuous grazing of winter forage cereals gives better animal performance, as the best feed on offer will always be selected. This will only be achieved if stocking rates are balanced with crop growth rates, and the feed on offer is not being significantly depleted (Table 43).

Growers should consider developing a feed budget to work out how much feed will be required by a set livestock mob, and how many grazing days would be available from a particular paddock. This will maximise overall whole farm feed production, particularly in high stocking density situations.

High stocking densities are used under rotational grazing, but lower animal performance can be expected than from continuous grazing. With continuous grazing, stock densities should be set so that plants are left with enough residual leaf material to enable both good regrowth and animal performance. Benchmarks exist for both purposes. Residual plant heights of around 5–10 cm for prostrate types and 10–20 cm for erect types will correspond fairly closely to benchmarks of around 1000–1500 kg/ha of dry matter, suitable for lactating ewes, fattening steers and all other classes of livestock.

Feed on offer to stock can be estimated by using crop height as an indicator, or by taking physical crop dry matter cuts. Table 42 shows an estimated relationship between crop height and available dry matter (DM) (kg/ha) for crops 25 cm or shorter. Use this as a guide only. For a more precise estimate, take dry matter cuts.

Rotational grazing can be used to maximise a crop's grazing value by reducing wastage from trampling and/or frost damage, or by restricting intake per head. Techniques such as strip grazing or limiting access times to the crop can also be used for rationing feed.

Table 42. Drymatter production of cereal crop types by canopy height

Crop	Relationship to crop height DM per each 1 cm crop height#
Wheat	60 kg DM/ha
Barley	75 kg DM/ha
Oats	65 kg DM/ha

These relationships are based on a 20 cm row spacing for crops sown at 100 kg/ha. Subtract or add 10% to the estimate for every 2.5 cm increase or decrease in row spacing. Source: Mingenew–Irwin Group – Grazing cereals fact sheet.

Table 43. Sustainable continuous stocking rate for oats

Stock class	Kg of forage dry matter removed per head*	Sustained stocking rate/ha**
Ewes and lambs (6 weeks)	3.2	9.3
Weaned lambs (30 kg)	2.0	15.0
350 kg steers	12.4	2.4
450 kg steers	13.9	2.1
Cow and calf (3 months)	19.1	1.5

* Calculated using GrazFeed™ for green oats at 2000 kg DM/ha, 20 cm tall, 73% DDM assuming 25% spoilage rate.

** Assuming 30 kg DM/ha/day crop growth.

DM Dry matter.

DDM Digestible dry matter.

Contributing authors

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Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Canola

Crop management

Canola is an excellent break crop and is profitable in its own right. Its broad range of herbicide options provides the opportunity to control a range of weeds, especially grasses. It competes strongly with weeds, which complements herbicide control and reduces reliance on herbicides.

Canola is best suited to paddocks with a high nitrogen (N) level as it has a greater nitrogen demand than other commonly grown crops. Growing a pulse crop the year before sowing canola can be useful for fixing and conserving more organic N, controlling weeds and storing more soil water. A pulse crop will also have a low stubble load at sowing, which will aid with crop establishment, but could increase the risk of diseases such as sclerotinia stem rot (*Sclerotinia*). In northern and western areas, canola can be an 'opportunity' crop, targeting paddocks and seasons where stored soil water is above average.

Canola will grow in a range of soils, but is best suited to high fertility paddocks free of hard pans, crusting, waterlogging potential, or subsoil constraints. Avoid acidic soils, especially those high in aluminium and manganese. Severely acidic layers ($\text{pH}_{\text{Ca}} < 4.5$) are common at depths of 5–10 cm and 10–15 cm in the main cropping soils of central and southern NSW. Check for acidic layers by sampling soils at 5 cm intervals to 20 cm deep two years before sowing canola.

Where acidity is detected below the surface soil, the most rapid method to increase pH is to incorporate fine-grade lime to 10 cm deep, at least 12 months before sowing canola.

Maintain an adequate break between canola crops to minimise the risk of yield losses from blackleg and *Sclerotinia*. Select a paddock as far from last year's canola stubble as possible to minimise the blackleg spore load reaching the new crop. A minimum distance of 500 m is recommended. Avoid paddocks with major weed problems or choose an appropriate herbicide-tolerant variety.

Canola is very sensitive to herbicide residues. Plantback periods shown on herbicide labels should be strictly adhered to. Spray equipment previously used to apply Group B herbicides should be thoroughly decontaminated before being used on canola.

Sowing

Seedbed preparation

Canola can be sown using no-till systems or sown into a well-prepared, cultivated seedbed. Stubble retention and strict fallow weed control will greatly increase the chances of sowing canola on time.

When sowing into cereal stubble, ensure that straw and header residue is pushed away from the sowing row. Stubble covering the row can reduce canola emergence and early plant growth, and reduce yield. Burning stubble residue from the previous crop can be a useful strategy to improve canola emergence, but this should be done as close as possible to sowing to minimise soil moisture loss from the surface.

Sowing depth

Where conditions allow, aim to drill seed through the main seed box to 1.5–3 cm deep and up to 5 cm in self-mulching clays. Where there is moisture below 1.5–3 cm, a reduced but viable establishment can still be achieved by sowing deeper, provided large seed is sown. This strategy can be used to sow some crop on time in seasons of good summer rainfall that are followed by drying surface seedbeds in autumn. A crop sown on time with a reduced establishment will generally yield more than a late-sown crop. Success with this strategy is very dependent on soil type, soil structure and the amount and timing of follow-up rainfall.

Dry sowing

Canola can be successfully dry-sown in reliable rainfall zones, allowing emergence following the first rain after sowing. Seed should be placed at around 1.5–2 cm deep and pressure on closing devices (e.g. press wheels) should be minimised. When sowing dry, select a variety with flexible phenology for the likely germination date, not the sowing date.

Seed quality and establishment

Research has shown that retaining and replanting seed from hybrid crops can reduce yield by 7–17%. In addition, other traits such as flowering and maturity evenness, blackleg resistance and oil content will be affected. However, retaining and replanting open-pollinated (OP) varieties is now widely practised. Where OP varieties are to be retained, aim to grade seed to 2 mm diameter and pay particular attention to seed storage, ensuring it is in a cool, dry place and evenly treated with the appropriate seed dressings.

Aim to establish 30–50 plants/m² (20–30 plants/m² in northern and western NSW), which can normally be achieved with 2–4 kg/ha of seed. Plant densities as low as 15 plants/m², if consistent across a paddock, can still be profitable when crops are sown early and plants have time to compensate. Seed size varies between and within OP varieties and hybrids. Check seed size to calculate the correct number of seeds per square metre to be sown.

Sowing too deep, sowing late into cold, wet soils, and no-till sowing into dense stubble can reduce establishment. In these situations, use the higher sowing rate, consider sowing the seed at a shallower depth, or select a variety with high vigour. Hybrids are generally more vigorous than OP varieties, primarily because of the larger seed size.

Varietal phenology

Recent research has shown that there are major differences in canola variety phenology, especially when sown early. Early sowing fast varieties can lead to flowering starting in early winter, exposing the crop to increased frost and disease risk, and often lower yield potential. Where early sowing is a viable option, choose a slow developing variety that still flowers at the optimum time for the environment (see *Ten tips to early-sown canola*).

Slow developing varieties generally have a wider optimum sowing window as large variations in sowing date only result in small changes in flowering date. On the other hand, fast varieties have a shorter sowing window as small variations in sowing date can lead to large changes in flowering date, especially when sowing date is moved earlier. The optimum sowing times for key canola growing environments are summarised in Table 44. For locations not included in the table, it is best to take the middle point of two nearby locations. Adjustments can be made based on local knowledge, for example sowing early in the sowing window is feasible in low frost-risk paddocks, while sowing later in the window is recommended in high disease risk environments.

Consider the chances of sowing early when selecting a variety. In western and northern regions there is generally less opportunity to sow canola in the first two weeks of April, so fast and mid season varieties are more suitable. For eastern regions, especially in the key canola growing regions of the eastern Riverina, South-West Slopes and Central-West Slopes, early sowing opportunities are more likely sowing slower developing varieties early should be considered to increase water use efficiency and profitability.

Phenology ratings (especially response to early sowing) of most varieties are now available so growers and agronomists can match the sowing date recommendations in Table 44 with the varietal phenology ratings in Table 45. *Variety characteristics and disease reactions on page 86*. It is more important to consider a variety's phenology rather than its maturity. Newer varieties will be included following evaluation.

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Ten tips to early-sown canola (<https://grdc.com.au/resources-and-publications/all-publications/publications/2018/ten-tips-to-early-sown-canola>)

Table 44. Suggested sowing times for variety types with slow, mid and fast phenology (speed to flowering).

Region/locations	Phenology	March				April				May			
		1	2	3	4	1	2	3	4	1	2	3	4
North-east / Liverpool Plains Gunnedah, Bellata, North Star	Slow					■	■	■	■				
	Mid						■	■	■	■	■		
	Fast							■	■	■	■	■	
North-west Coonamble, Burren Junction, Garah	Slow						■	■	■				
	Mid							■	■	■	■		
	Fast								■	■	■	■	
Central-east Wellington, Parkes, Canowindra	Slow			■	■	■	■	■	■				
	Mid				■	■	■	■	■	■			
	Fast					■	■	■	■	■	■		
Central-west (north) Gilgandra, Trangie, Nyngan	Slow			■	■	■	■	■	■				
	Mid				■	■	■	■	■	■			
	Fast					■	■	■	■	■	■		
Central-west (south) Condobolin, West Wyalong, Rankins Springs	Slow			■	■	■	■	■	■				
	Mid				■	■	■	■	■	■			
	Fast					■	■	■	■	■	■		
South West Slopes Young, Cootamundra, Culcairn	Slow		■	■	■	■	■	■	■	■	■		
	Mid			■	■	■	■	■	■	■	■	■	
	Fast				■	■	■	■	■	■	■	■	
Riverina Coolamon, Lockhart, Corowa	Slow		■	■	■	■	■	■	■				
	Mid			■	■	■	■	■	■	■			
	Fast				■	■	■	■	■	■	■		

■ Optimal sowing time (green)

■ Earlier or later than optimal; potential yield reduction

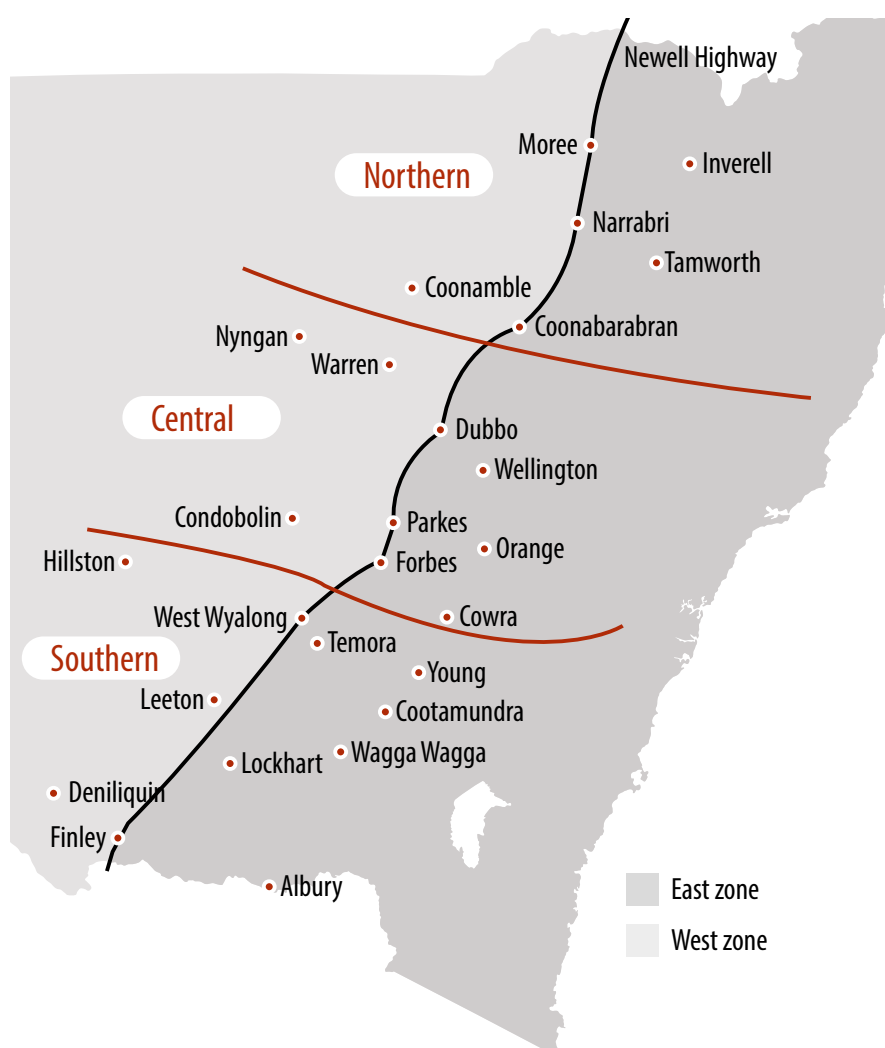


Figure 5. Map of NSW showing canola-growing zones

Nutrition

Nitrogen (N)

High yielding canola crops have a high N requirement, which can be provided by:

- 2–4 years of legume-dominant pasture
- pulse crops that supply some of the N requirement
- applying adequate N throughout the rotation
- applying N before, at, or after sowing.

Split application of N at, or just before sowing, followed by topdressing in the vegetative stage is a very effective strategy, allowing N requirements to be adjusted as seasonal conditions dictate. There is no penalty from applying all N at sowing. Crops can be topdressed until the stem elongation stage. Topdressing at early flowering can still be economic in seasons where the crop has high yield potential. However, the total amount of N is more important than the application timing. Deep soil testing for N before sowing or during the seedling stage will help determine appropriate N rates and timing. As a rule of thumb, canola requires 80 kg N/ha per tonne of grain, so a 2.5 t/ha crop requires 200 kg N/ha, which can be supplied through a combination of soil mineral N at sowing, fertiliser and soil mineralisation during the growing season.

High N application rates can reduce oil content; however, excess N does not cause canola to 'hay off' as it does in cereals.

Canola is sensitive to high rates of N in close proximity to the seed, especially in the lighter textured, warmer and drier soils typical of low rainfall zones and should therefore be separated at sowing.

Eastern zones of central and southern NSW: No more than 10 kg N/ha should be sown in direct contact with the seed on the common row spacing of 20–25 cm.

Northern region, and for early sowings in western zones of the centre and south: Limit rates to a maximum of 5 kg N/ha with the seed, especially on a row spacing of 30 cm and wider.

Avoid placing high rates of N (above 25 kg/ha) under canola seed as this can also affect emergence.

Sulfur (S)

Canola has a high S requirement – more than double that of wheat. Apply 25 kg S/ha as sulfate S (not elemental S), unless local experience or a deep soil test clearly indicates that your soil is not deficient, or that a lower rate is adequate. Sulfur is often found deep in the soil profile, so soil sampling should include the whole root zone. Even where there is high S down deep, roots might not be able to access it in dry or waterlogged years. Recent research has not been able to demonstrate consistent responses to applied sulfur. Apply sulfur fertiliser test strips at sowing to confirm that sulfur is not lacking. Sulfur deficiency can be quickly corrected in-crop by applying sulfate of ammonia.

The main sources of sulfur are sulfate of ammonia, gypsum and single super.

Phosphorus (P)

Ensure that adequate P is applied at sowing. Unless the crop is sown into a soil with high P, apply at least 8 kg P/ha for every tonne of canola expected to be harvested, e.g. apply 20 kg P/ha if the target yield is 2.5 t/ha. Low or deficient P levels can limit the crop's potential response to N. Research has shown that canola can respond to higher rates of up to 12 kg P/ha for every tonne of grain yield in responsive soils. As with N, canola seed is sensitive to phosphate fertilisers.

Avoid drilling high rates of P in direct contact with canola seed. Rates as low as 10 kg P/ha applied in direct contact with seed can reduce establishment with the low soil disturbance of narrow sowing points and disc seeders.

Micronutrients

Several micronutrients, including boron, molybdenum and zinc, are known to be essential for healthy, high yielding canola crops. In soils with a long cropping history or where deficiencies are suspected, using a supplemented fertiliser at sowing should be considered. Some micronutrients can be applied with pre-emergent herbicides, but check to ensure compatibility.

Pests

There are a number of pests that can affect canola crops, particularly during emergence, early seedling and flowering/podding growth stages. Pests are best managed using an integrated pest management (IPM) approach. All canola pests have a range of natural enemies that can help keep the pest populations below economic damage levels. Careful planning before sowing, then regularly monitoring crops after sowing will ensure potential problems are identified and, if necessary, treated early. Decisions to use chemical controls should consider the effects on the beneficial populations, especially early in the season when using broad-spectrum insecticide could destroy many of the natural enemies that will keep later season pests in check.

Earth mite

Earth mites are the major pests of seedling canola, especially in central and southern NSW. Damage can be caused by **redlegged earth mites** (RLEM) and **blue oat mites** (BOM), which often occur in mixed populations. *Bryobia* and *Baluastium* mites are an increasing problem in some areas. An effective mite control program starts with a population reduction treatment the previous spring. Learn to identify these four species of mites to ensure that the correct insecticide and rate is applied to the relevant species.

Bare earth treatments

Protect germinating and establishing crops by:

- boom spraying the soil surface of previous pasture or high-risk paddocks with a residual insecticide immediately after sowing
- perimeter spraying bare ground in low-risk paddocks, not forgetting to spray around trees, rocky outcrops and dams, and along water flow lines. If you are unsure of the level of risk from mites, spray the whole paddock.

There are three registered bare earth sprays that will give several weeks of residual protection. Bifenthrin is registered for RLEM, BOM and *Bryobia* mites, but the application rate varies according to the targeted mite species. Alpha-cypermethrin will control RLEM, while methidathion is registered for both RLEM and BOM.

Seed treatments

Imidacloprid (see [Table 73. Canola and pulse seed dressings – 2019 on page 146](#)) and Poncho® Plus (clothianidin + imidacloprid) are registered for use on canola seed to protect against RLEM, BOM and aphids. Poncho® Plus is also registered to control lucerne flea, wireworm and cutworm. Cruiser® Opti (thiamethoxam + lambdacyhalothrin) is registered for suppression of RLEM and lucerne flea. These seed dressings will protect emerging seedlings for 3–5 weeks after sowing. Use treated seed following a pasture phase if a well-timed spring spray of insecticide has been applied. Apply a bare earth border spray where untreated pastures border the canola crop. Seed companies supply seed pre-treated with imidacloprid, Poncho® Plus and Cruiser® Opti.

Cosmos® Insecticidal Seed Treatment (active ingredient fipronil) is also registered for controlling RLEM in canola.

Even where a seed dressing or bare earth treatment has been used it is advisable to regularly check seedling canola for earth mite damage.

Lucerne flea

Lucerne flea is an occasional pest found in establishing canola crops. The pest is identified by its jumping and hopping action between plants rather than flying. It is mainly a problem in heavier clay/loam soils in southern NSW. Early-sown crops are more at risk. Frequent crop inspection from the time of emergence, and early control measures, are important because of the effects on seedling vigour and crop performance. Ensure that monitoring is sufficient to detect localised patches or hot spots. Lucerne flea will move in from the edge of paddocks and a border spray is often all that is needed to give control. Seek advice on management and spray strategies.

Slugs

Slugs are a potential problem along the northern, central and southern slopes, and occasionally adjacent to rivers on the western plains. Slugs kill plants at the seedling and rosette stages and can leave large, bare soil areas.

Wet springs and summers favour slug reproduction. The abundant growth and damp conditions provide an ideal habitat, which allows slugs to breed and survive into autumn and winter, when they attack newly-sown crops.

Canola sown into dense stubble or next to grassy fence lines, creek banks or damp areas is at the greatest risk as these areas provide an ideal habitat for slugs to survive over summer. Heavy, cracking soils provide additional hiding places for slugs.

Closely monitor crops at risk for 6–8 weeks after sowing so that any infestation can be treated with slug pellets containing metaldehyde.

Diamondback moth

Diamondback moth (DBM) has been observed in canola crops for many years in NSW. Moisture-stressed crops will attract DBM, so monitoring early along tree lines will give an indication that populations are about to increase. DBM caterpillars do most damage when large numbers are present in seedling crops, or when they move from leaves to graze on developing pods during crop ripening. Winter canola crops that are sown in late summer–early autumn, and those maturing in early summer are more likely to require DBM control. It has developed resistance to a range of insecticides, so future management will involve regular monitoring and careful selection of control methods.

Aphids

Aphid flights can occur in autumn and winter in some years and can infest young canola crops. Crops might need treating with insecticide to prevent virus transmission, and also to reduce seedling damage and the risk of spring infestations. The green peach aphid is the major vector of *Turnip yellows virus* (TuYV) – formerly known as *Beet western yellows virus* – which caused some crop damage in southern and central NSW in 2014. Seed treated with imidacloprid, Poncho® Plus and Cruiser® Opti will protect seedling canola for up to five weeks. This is especially important in seasons and at sites where early infestation with aphids occurs. The GRDC GrowNotes publication *Reducing aphid and virus risk* has more information. Green peach aphid has developed resistance to the synthetic pyrethroid, carbamate and organophosphate groups of insecticides. Transform™ (sulfoxaflor) is a new selective insecticide to control early-season infestations of green peach aphid.

Aphids can also infest crops in the spring, especially in years of moisture stress. High aphid populations are more evident and potentially damaging in dry seasons. Aphids have a wide range of natural enemies that will keep populations in check in many seasons. In spring lady beetles, hover flies, lacewings and parasitic wasps will become active, providing aphid control, e.g. the cabbage aphid. Using the ‘soft’ insecticide Pirimor™ (pirimicarb) will help maintain populations of natural enemies.

Be aware of nearby beehives when two insecticides are tank-mixed, to ensure that damage is not caused to hives. Ensure the harvest withholding period (WHP) of the insecticide is adhered to.

Helicoverpa (heliathis) caterpillars

Helicoverpa caterpillars are an occasional pest of canola in southern NSW and might require control measures if present in high numbers. They are more frequent in central and northern NSW. Because of the seasonal variation in incidence and infestation timing relative to the crop growth stage, growers should seek advice and check the harvest WHP of the chosen insecticide before deciding to spray.

Soil pests

As with slugs, there are increasing reports of **European earwigs** causing significant damage to emerging crops, particularly in the South West Slopes region. Stubble retention, combined with wet springs and summers and an early autumn break appear to favour the build-up of these insects. The damage earwigs cause can be difficult to identify and, as control can also be difficult, growers should seek advice if they either suspect or see earwigs.

A number of other soil dwelling insect pests such as **Portuguese millipede**, **cutworm**, **wireworm**, **bronzed field beetle**, **cockchafer** and **false wireworm** have damaged emerging canola seedlings in recent years. Occurrence of these pests is difficult to predict and is therefore best managed by thorough paddock sampling. In severe cases, plant stands can be thinned to such an extent that the paddock requires re-sowing. The most severe damage tends to occur in crops following pasture, or where stubble has been retained.

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Reducing aphid and virus risk (<https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/02/reducing-aphid-and-virus-risk>)

Diseases

Blackleg

Blackleg is the most important disease of canola, but management does not have to be complex. The most effective strategies to reduce its severity include growing varieties with an adequate level of resistance for each district, separating this year's crop from last year's canola stubble with a buffer zone of at least 500 m (up to 1 km), and using a fungicide seed dressing or fungicide-amended fertiliser.

Typically around 90% of spores that infect new-season crops originate from the previous year's stubble. However, significant numbers of spores from two-year-old stubble can be produced if seasonal conditions have been dry or the stubble is still largely intact. Spores can travel 1–2 km on the wind, but most of them originate more locally. Using fungicide seed dressings containing fluquinconazole or fertiliser treated with flutriafol will also help to minimise any effects and protect seedlings from early infection, which later can cause crown/stem canker. The foliar fungicides Prosaro®, Aviator Xpro® and Miravis® are registered for managing blackleg at the seedling to early vegetative stage.

Upper canopy infection

Symptoms of upper canopy infection (infection on stems, branches and pods) have increased in NSW in recent years and were widespread in 2018, despite the dry conditions. Symptoms include either single or a number of branches dying off prematurely without a crown canker developing at the stem base. Yield loss occurs due to reduced seed size and when pods shatter prematurely before harvest. These symptoms could be confused with sclerotinia stem rot. This blackleg symptom is thought to be related to an earlier flowering time, where some crops are elongating and flowering during mid-winter when conditions are ideal for infection by airborne spores of the blackleg fungus. Research is underway to improve our understanding of this type of infection and develop management strategies.

Blackleg resistance groups

All current canola varieties are now assessed for the presence of resistance genes and classified into resistance groups. If the same variety has been grown for two or more seasons, consider changing varieties this season. Consult the *Blackleg management guide* on the GRDC website to determine the resistance group for your current canola varieties and select future varieties that belong to a different group.

Blackleg rating

All varieties are rated according to the independent Australian National Blackleg Resistance rating system; all canola breeding companies participate. The relative differences between varieties are as follows:

- Resistant: R
- Resistant to Moderately resistant: R–MR
- Moderately resistant: MR
- Moderately resistant to Moderately susceptible: MR–MS
- Moderately susceptible: MS
- Moderately susceptible to Susceptible: MS–S
- Susceptible: S
- Susceptible to Very susceptible: S–VS
- Very susceptible: VS

Varieties with a rating of 'Resistant' (R) in high blackleg-risk areas and at least 'Moderately resistant' (MR) in lower blackleg-risk areas will normally give sufficient disease protection.

Table 45. Variety characteristics and disease reactions on page 86 list the blackleg resistance rating for each variety. Please note they are the ratings released in autumn 2019. Blackleg resistance ratings can change from year to year.

Sclerotinia stem rot

Sclerotinia stem rot is a fungal disease that can infect a wide range of broadleaf plants including canola. Prolonged wet conditions in late winter followed by periods of prolonged canopy wetness (at least 48 hours) during flowering favours disease development. Yield losses can be up to 20% in some years, but have been as high as 35%. Districts with reliable spring rainfall and long flowering periods for canola appear to develop the disease more frequently. Intensive wheat/canola rotations are also very effective at building up levels of soil-borne sclerotia and increasing disease pressure.

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Consult the *Blackleg management guide* on the GRDC website (<https://grdc.com.au/resources-and-publications/all-publications/publications/2018/blackleg-management-guide>)

Burning canola stubble will not effectively control *Sclerotinia* as sclerotia survive mainly on or in the soil. The most effective means of reducing the disease level are:

- Increasing the length of time between broadleaf crops in the same paddock (especially canola)
- separation from last year's canola stubble
- avoiding early crop flowering; and using foliar fungicides, which are best applied at 20–30% bloom (14–20 open flowers on the main stem).

The dry spring conditions across most of inland NSW in 2018 kept potential *sclerotinia* stem rot levels low. However, the disease still developed at low levels in districts that are affected every year. Despite low levels of disease in 2018, the risk of *Sclerotinia* developing in high-disease districts will be present in 2019. The environmental conditions for *sclerotinia* stem rot to develop are very specific and will not occur every year, so even when the fungus is present the disease can fail to develop in dry conditions, such as those in 2018. Consult your farm adviser and refer to the fact sheet *Sclerotinia stem rot in canola* on the GRDC website. The foliar fungicides Prosaro® and Aviator Xpro®, along with products containing iprodione and some procymidone products are registered for managing *Sclerotinia*.

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Sclerotinia stem rot in canola (<https://grdc.com.au/resources-and-publications/all-publications/factsheets/2014/03/grdc-fs-sclerotinia>)

Viral diseases

Three virus species have been recorded in canola in Australia: *Turnip yellows virus* (TuYV, formerly known as *Beet western yellows virus*), *Turnip mosaic virus* (TuMV) and *Cauliflower mosaic virus* (CaMV). Of these, TuYV is the more common with the potential to cause yield losses in canola. Commercial canola varieties appear resistant to TuMV. However, some lines of condiment mustard and juncea canola (both *Brassica juncea*) have been severely affected by TuMV in trials in northern NSW in the past. The importance of CaMV in canola and *B. juncea* is not known.

All three viruses are spread by aphids from weeds, which act as hosts. TuYV can come from a range of weed, pasture and crop species. Turnip weed, wild radish and other *Brassica* weeds are important hosts of TuMV.

Substantial yield losses from viruses, particularly TuYV, can occur even when there are no obvious symptoms. Seed treated with either imidacloprid or Poncho® Plus is recommended to protect crops from early infestation with aphids. Further information on viruses and control options is available in Agnote DPI 495 *Virus diseases in canola and mustard*.

The GRDC GrowNotes: *Reducing aphid and virus risk* is also available.

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Agnote DPI 495
Virus diseases in canola and mustard (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/general-disorders-of-crops/virus-canola-mustard>)

GRDC GrowNotes:
Reducing aphid and virus risk (<https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/02/reducing-aphid-and-virus-risk>)

Windrowing and harvesting

Although all varieties have improved shattering tolerance, windrowing is still favoured in most areas as it greatly reduces seed loss during heavy winds. It also allows harvest to start 7–10 days earlier as there is no waiting for green plants to dry down. Cutting the crop as high as possible reduces the risk of windrows being blown across the paddock in windy/stormy conditions. When windrowing, ensure the crop is cut at the recommended stage of maturity i.e. when 60% of the ripening seeds averaged across the whole plant (main stem and branches) have started to change to a bronze colour, and most seeds are firm when rolled between the forefinger and thumb. This stage is later than previous recommendations where only the main stem was used to assess seed colour change. Recent research has shown that the main stem is only contributing 25–35% of the yield with the branches contributing 65–75%; windrowing too early increases the risk of harvesting immature green seed, which is also smaller, reducing yield and oil content. As the crop is at the correct stage for windrowing for only 3–4 days, the ripening crop needs careful and regular monitoring to ensure it is done on time. The delivery standard for grain moisture is a maximum 8%.

Direct harvesting is increasingly seen as a viable option. Direct harvesting is a cost-effective option for crops that have a yield potential of around 1 t/ha or lower, have a short plant height, or the plant stand is low and stems cannot hold the windrow above the ground. Using glyphosate for crop desiccation might be required to stop the crop from growing, especially when late rain falls on droughted, frosted crops. In practice, there could be justification to use both windrowing and direct harvesting on portions of the overall farm crop to ensure the crop is harvested at its optimum stage for yield and oil content.

New varieties

There are expected to be 50 canola varieties on the market in NSW for 2019.

New releases – there are 10 for NSW:

- Hyola® 550TT, Hyola® 580CT, Hyola® 410XX and Hyola® 530XT from Advanta Seeds
- InVigor T 3510 and InVigor R 4020P from BASF
- Pioneer® 43Y29 (RR), Pioneer® 45Y93 (CL) and Pioneer 45T03 (TT) from Pioneer Brand Seeds
- SF Spark TT from Seed Force

Outclassed, but still available:

AV-Garnet.

Withdrawn

Archer, ATR-Gem, DG 460RR, GT-41, Pioneer 45T01 (TT) and SF Brazzil.

Varietal characteristics

The amount of information on the following varieties varies as some of them are new and have very limited independent data. Some statements about the newer varieties are based on seed company information. Blackleg resistance ratings and resistance groups published for each variety are for autumn 2019 and based on blackleg nursery data from 2016–2018. Resistance ratings and resistance groups are updated each year and available on the [GRDC website](https://grdc.com.au/).

Yield. Comparative performance data for early and mid maturing NVT trial groups for 2014–2018 is presented in [Table 46](#) and [Table 47](#).

Oil content. Oil data is not presented for the 2018 season due to severe drought and frost which resulted in data being highly variable between sites and therefore not representative.

Varieties. Canola varieties are either hybrid or open-pollinated (OP). Within these breeding groups there are now six herbicide tolerance groups:

1. Conventional
2. Triazine tolerant
3. Imidazolinone tolerant
4. Roundup Ready
5. TruFlex Technology
6. Dual herbicide tolerant.

The following are new releases for 2019. Information on characteristics and disease reactions of all current commercial varieties has been placed in [Table 45. Variety characteristics and disease reactions on page 86](#)

Conventional varieties

There are no new conventional varieties for 2019.

Triazine tolerant (TT) varieties

Hyola® 550TT. New release. Mid–early maturing hybrid. Suited to low–high rainfall areas. Medium plant height, with compact plant type. Blackleg rating MR and resistance group ABDF. Tested in NVT trials for the first time in 2018. Marketed by Advanta Seeds.

InVigor T 3510. New release (coded CHYB2124TT). Early to early–mid maturing hybrid. Particularly suited to early season areas. Blackleg rating MS and resistance group BF. Tested in NVT trials for the first time in 2018. Limited seed 2019. Marketed by BASF.

Pioneer® 45T03 (TT). New release. Mid maturing hybrid. Suited to medium–high rainfall zones. Medium plant height. Blackleg rating R–MR and resistance group ABD. Tested in NVT trials for the first time in 2018. Marketed by Pioneer Brand Seeds.

SF Spark TT. New release (coded SFR65-023). Early maturing hybrid. Suited to low–medium rainfall areas. Medium plant height. Blackleg rating MR and resistance group ABDF. Tested in NVT trials for the first time in 2018. Marketed by Seed Force

CLEARFIELD® (imidazolinone tolerant) varieties

Pioneer® 45Y93 (CL). New release (coded PHI 1706). Early flowering mid maturing hybrid. Suited to medium–high rainfall areas. Medium–tall plant height. Blackleg rating R–MR* (see Table 45) and resistance group BC. Tested in NVT trials in 2017, and in limited trials in 2018. Marketed by Pioneer Brand Seeds.

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[GRDC website](https://grdc.com.au/) (<https://grdc.com.au/>).

Table 45. Variety characteristics and disease reactions

Herbicide group	Variety	Type	Phenology# sown before 15 April	Maturity	Plant height	Blackleg rating autumn 2019	Blackleg group autumn 2019	NVT testing years	Company
Conventional	AV-Garnet	OP	Mid	Mid to mid-early	Medium	MS	A	2006–2018	Nuseed
	Nuseed Diamond	Hybrid	Fast	Early	Medium	MR	ABF	2012–2018	Nuseed
	Nuseed Quartz	Hybrid	Mid	Mid to mid-early	Medium	R	ABD	2016–2018	Nuseed
	Victory V3002	Hybrid; specialty	n.d.	Early-mid	Medium	R-MR	ABF	2011–2018	AWB
Triazine tolerant (TT)	ATR-Bonito	OP	Mid-fast	Early to early-mid	Short-medium	MS	A	2012–2018	Nuseed
	ATR-Mako	OP	Mid-fast	Mid-early	Medium	MR-MS	A	2014–2018	Nuseed
	ATR-Stingray	OP	Fast	Early	Short	MR-MS	C	2010–2018	Nuseed
	ATR-Wahoo	OP	Mid-slow	Mid-late	Medium	MS	A	2012–2018	Nuseed
	DG 560TT	Hybrid	n.d.	Mid	Medium	MR	BF	2015–2016	Landmark
	DG 670TT	Hybrid	Mid	Mid-late	Medium-tall	MR	BF	2016	Landmark
	Hyola 350TT	Hybrid	Fast	Early	Medium	R	ABDF	2016–2018	Advanta
	Hyola 550TT	Hybrid	n.d.	Mid-early	Medium	R-MR	ABDF	2018	Advanta
	Hyola 559TT	Hybrid	Mid	Mid	Medium	MR	ABD	2012–2018	Advanta
	Hyola 650TT	Hybrid	n.d.	Mid	Medium	R	ABD	2013–2018	Advanta
	HyTTec Trophy	Hybrid	Mid-fast	Early to early-mid	Medium-tall	R-MR	ABD	2017–2018	Nuseed
	InVigor T 3510	Hybrid	n.d.	Early to early-mid	Medium	MS	BF	2018	BASF
	InVigor T 4510	Hybrid	Mid-fast	Early-mid	Medium-tall	MR-MS	BF	2016–2018	BASF
	Monola 416TT	OP; specialty	n.d.	Early-mid	Short-medium	MR	B	2014–2018	Nuseed
	Monola 515TT	OP; specialty	n.d.	Mid	Medium	MR	Unknown	2014–2016	Nuseed
	Pioneer 44T02 (TT)	Hybrid	Mid-fast	Early-mid	Medium	MR	ABD	2015–2018	Pioneer
	Pioneer 45T03 (TT)	Hybrid	n.d.	Mid	Medium	R-MR	ABD	2018	Pioneer
	SF Ignite TT	Hybrid	Mid-slow	Mid to mid-late	Medium	MR	BF	2016–2018	Seed Force
	SF Spark TT	Hybrid	n.d.	Early	Medium	R-MR	ABDF	2018	Seed Force
	SF Turbine TT	Hybrid	Mid	Early-mid	Medium	MR-MS	BF	2015–2018	Seed Force
Imidazolinone tolerant (Clearfield®)	Banker CL	Hybrid	Mid-fast	Mid	Medium	MR	A	2014–2018	Heritage
	Hyola 575CL	Hybrid	n.d.	Mid to mid-early	Medium	R	BF	2010–2016	Advanta
	Hyola 970CL	Hybrid	Winter type	Very late	Tall	R	H	No	Advanta
	Pioneer 43Y92 (CL)	Hybrid	Mid-fast	Early	Medium	R-MR	B	2016–2018	Pioneer
	Pioneer 44Y90 (CL)	Hybrid	Mid-fast	Early-mid	Medium	R-MR	B	2015–2018	Pioneer
	Pioneer 45Y91 (CL)	Hybrid	Mid-slow	Mid	Medium-tall	MR	B	2014; 2016–2018	Pioneer
	Pioneer 45Y93 (CL)	Hybrid	Mid-fast	Mid	Medium	MR*	BC	2017–2018	Pioneer
	Saintly CL	Hybrid	n.d.	Mid to mid-early	Medium-tall	MR	B	2015–2018	Heritage
	SF Edimax CL	Hybrid	Winter type	Late	Tall	R-MR	C	No	Seed Force
	Victory V7002CL	Hybrid; specialty	n.d.	Early-mid	Medium-tall	R-MR	ABF	2017–2018	AWB
Roundup Ready® (RR)	Victory V7001CL	Hybrid; specialty	Slow	Mid-late	Medium-tall	R-MR	ABF	2014–2015	AWB
	DG 408RR	Hybrid	Mid-fast	Early-mid	Medium	MS	AC	2016–2018	Landmark
	Hyola 404RR	Hybrid	n.d.	Early to early-mid	Medium	MR	ABD	2010–2018	Advanta
	Hyola 506RR	Hybrid	Fast	Mid-early	Short-medium	R	ABD	2016–2018	Advanta
	IH51 RR	Hybrid	n.d.	Mid	Medium	MR	A	2014–2016	BASF
	InVigor R 3520	Hybrid	Mid-fast	Early to early-mid	Medium	MR	Unknown	2016–2018	BASF
	InVigor R 4020P	Hybrid	n.d.	Early-mid	Medium	n.d.	n.d.	2018	BASF
	InVigor R 5520P	Hybrid	Mid-slow	Mid	Medium	MR	AC	2015–2018	BASF
	Monola G11	Hybrid; specialty	n.d.	Early-mid	Medium	MR	ABS	2013–2016	Nuseed
	Nuseed GT-42	Hybrid	n.d.	Early to early-mid	Medium	R	ABDF	2015–2016	Nuseed
	Nuseed GT-53	Hybrid	Mid	Mid	Medium	R	ABDF	2014–2018	Nuseed
	Pioneer 43Y23 (RR)	Hybrid	Fast	Early	Medium	MR	B	2011–2018	Pioneer
	Pioneer 43Y29 (RR)	Hybrid	n.d.	Early	Medium	MR*	BC	2017	Pioneer
	Pioneer 44Y27 (RR)	Hybrid	Mid-fast	Early-mid	Medium	R-MR	B	2016–2018	Pioneer
	Pioneer 45Y25 (RR)	Hybrid	Mid-slow	Mid	Medium	MR	BC	2012–2018	Pioneer
	Victory V5003RR	Hybrid	n.d.	Mid	Medium	R-MR	A	2013–2018	AWB
TruFlex Technology	Hyola 410XX	Hybrid	n.d.	Mid-early	Medium	n.d.	n.d.	2017	Advanta
TruFlex + TT	Hyola 530XT	Hybrid	n.d.	Mid	Medium	n.d.	n.d.	No	Advanta
TT + RR	BASF 3000TR	Hybrid	n.d.	Early-mid	Medium	MS-S	B	2015–2018	BASF
TT + IMI	Hyola 580CT	Hybrid	Mid-fast	Mid-early	Medium	R	BC	2017–2018	Advanta

N.B. The relative maturity of varieties can vary depending on location and sowing time.

The groupings are made as a guide only and relate to physiological maturity or windrow/harvest maturity.

Phenology - speed to flowering when sown before 15 April.

* Hybrid was screen in 2017, but not in 2018. It was therefore not exposed to the most recent pathogen populations.

n.d. No data

Blackleg rating disclaimer

NSW DPI publishes this rating system on the basis of the best information available at the time of publication. However, nursery and grower experience has shown that disease severity can vary between locations and years depending on seasonal conditions and possible changes in the fungus for reasons that are not currently understood. Therefore, growers can sometimes experience significant variation from the averages shown in these ratings.

Roundup Ready® varieties

Invigor R 4020P. New release. Early–mid maturing hybrid suited to medium rainfall zones, with pod shatter tolerance trait PodGuard. Suited to later windrow timings or direct harvesting. No GRDC blackleg rating or resistance group. Tested in NVT trials for the first time in 2018. Marketed by BASF.

Pioneer® 43Y29 (RR). New release (coded PHR 1703 in 2017). Early maturing hybrid. Suited to medium–low rainfall areas. Medium plant height. Blackleg rating MR* (see Table 45) and resistance group BC. Tested in NVT trials in 2017 only. Marketed by Pioneer Brand Seeds.

TruFlex® Technology varieties

Hyola 410XX. New release. Mid–early maturing hybrid. Suited to medium–high rainfall areas. Medium plant height. No GRDC blackleg rating or resistance group. Tested in NVT trials in 2017 (one trial). Marketed by Advanta Seeds.

Dual herbicide tolerant varieties

CLEARFIELD® + triazine tolerant varieties

Hyola® 580CT. New release (coded T61001 in 2017). Mid–early maturing hybrid. Suited to medium–high rainfall areas. Medium plant height. Blackleg rating R and resistance group BC. Tested in NVT trials in 2017 and 2018. Marketed by Advanta Seeds.

TruFlex® Technology + triazine tolerant varieties

Hyola 530XT. New release. Mid maturing hybrid. Medium plant height. Suited to medium–high rainfall areas. No GRDC blackleg rating or resistance group. Not yet tested in NVT trials in NSW. Marketed by Advanta Seeds.

Table 46. Comparative performance in NVT trials¹ – early maturing

Variety	North west	Trial no.	North east	Trial no.	South west	Trial no.
Year	2014–2018		2014–2018		2014–2018	
Early maturing conventional trials – mean seed yield expressed as a % of Nuseed Diamond						
AV-Garnet	74	6	73	5	94	3
Nuseed Diamond	100	6	100	5	100	3
Nuseed Quartz	96	3	98	3	109	2
Victory V3002	83	5	76	5	92	2
Nuseed Diamond t/ha	1.61		1.34		1.25	
Early maturing Triazine tolerant (TT) trials – mean seed yield expressed as a % of ATR-Stingray						
ATR-Bonito	103	6	99	5	109	3
ATR-Stingray	100	5	100	2	100	2
BASF 3000TR	111	3	n.d.		102	2
Hyola 350TT	114	2	112	2	n.d.	
Hyola 559TT	116	6	112	4	117	3
HyTTec Trophy	118	2	119	2	n.d.	
InVigor T 4510	118	3	113	3	123	2
Monola 416TT	99	4	n.d.		107	2
Pioneer 44T02 (TT)	115	5	113	3	119	2
SF Turbine TT	113	5	105	4	120	2
ATR-Stingray t/ha	1.75		1.42		1.36	
Early maturing Clearfield trials – mean seed yield expressed as a % of Pioneer 43Y92 (CL)						
Hyola 575CL	89	6	85	5	89	3
Pioneer 43Y92 (CL)	100	3	100	3	100	2
Pioneer 44Y90 (CL)	101	5	102	4	99	2
Saintly CL	99	4	101	2	n.d.	
Victory V7002CL	100	2	95	2	n.d.	
Pioneer 43Y92 (CL) t/ha	1.62		1.35		1.25	
Early maturing Roundup Ready trials – mean seed yield expressed as a % of Pioneer 43Y23 (RR)						
InVigor R3520	101	2	n.d.		98	2
Nuseed GT-42	92	3	n.d.		104	2
Pioneer 43Y23 (RR)	100	4	n.d.		100	3
Pioneer 44Y27 (RR)	105	2	n.d.		n.d.	
Pioneer 43Y23 (RR)	1.81				1.23	

The more trials, the greater the reliability.

n.d. no data.

¹ Based on predicted yields from an analysis across all sites (2014–2018 NVT trials). New varieties have less trial data supporting the five-year dataset and hence should be viewed with some caution, especially where there are only two trial results.

Table 47. Comparative performance in NVT trials¹ – mid maturing

Variety	North west	Trial no.	North east	Trial no.	South west	Trial no.	South east	Trial no.
Year	2014–2018		2014–2018		2014–2018		2014–2018	
Mid maturing conventional trials – mean seed yield expressed as a % of AV-Garnet								
AV-Garnet	100	3	100	4	100	5	100	5
Nuseed Diamond	117	3	114	4	112	5	113	5
Nuseed Quartz	n.d.		125	2	128	3	127	3
Victory V3002	99	3	96	4	101	5	101	5
AV-Garnet t/ha	1.83		1.54		1.39		1.63	
Mid maturing Triazine Tolerant (TT) trials – mean seed yield expressed as a % of ATR-Bonito								
ATR-Bonito	100	7	100	8	100	10	100	28
ATR-Mako	100	7	98	7	100	8	100	28
ATR-Wahoo	97	7	100	5	103	6	101	29
DG 560TT	106	4	105	5	103	6	104	18
DG 670TT	109	2	117	3	118	4	115	12
Hyola 550TT	n.d.		n.d.		114	2	113	6
Hyola 559TT	111	7	109	9	110	10	109	30
Hyola 580CT	n.d.		103	3	105	3	104	12
Hyola 650TT	107	4	108	8	112	6	110	28
HyTTec Trophy	n.d.		125	3	124	4	121	12
InVigor T 4510	115	3	122	5	120	6	118	18
Monola 416TT	96	6	99	2	95	9	96	21
Monola 515TT	87	7	84	5	84	6	86	17
Pioneer 44T02 (TT)	112	5	111	6	108	8	108	21
Pioneer 45T03 (TT)	n.d.		n.d.		n.d.		107	6
SF Ignite TT	110	2	120	5	118	4	115	16
SF Spark TT	n.d.		n.d.		102	2	n.d.	
SF Turbine TT	112	5	115	7	111	8	111	24
ATR-Bonito t/ha	1.97		1.64		1.60		1.92	
Mid maturing CLEARFIELD® trials – mean seed yield expressed as a % of Saintly CL								
Banker CL	96	7	99	7	102	8	100	21
Hyola 575CL	84	7	80	9	84	10	84	30
Pioneer 43Y92 (CL)	100	3	100	5	101	6	100	14
Pioneer 44Y90 (CL)	98	5	100	7	105	8	103	20
Pioneer 45Y91 (CL)	94	4	95	4	99	3	97	20
Pioneer 45Y93 (CL)	n.d.		102	2	107	2	104	8
Saintly CL	100	5	100	6	100	8	100	23
Victory V7002CL	n.d.	1	77	2	88	4	86	9
Saintly CL t/ha	2.26		1.93		1.76		2.12	
Mid maturing Roundup Ready trials – mean seed yield expressed as a % of Nuseed GT-53								
Hyola 506RR	n.d.		n.d.		94	4	96	11
IH51 RR	88	4	n.d.		82	8	86	16
InVigor 4420P	n.d.		n.d.		100	2	103	4
InVigor R 5520P	95	3	n.d.		94	6	97	15
Monola G11	93	3	n.d.		78	10	83	10
Nuseed GT-42	93	3	n.d.		90	8	92	11
Nuseed GT-53	100	3			100	7	100	18
Pioneer 43Y29 (RR)	n.d.		n.d.		98	2	101	3
Pioneer 44Y27 (RR)	103	2	n.d.		99	6	102	11
Pioneer 45Y25 (RR)	95	4	n.d.		100	5	102	18
Pioneer 45Y28 (RR)	n.d.		n.d.		102	2	103	7
Victory V5003RR	86	4	n.d.		86	10	89	20
Nuseed GT-53 t/ha	2.19				1.81		2.19	

The more trials, the greater the reliability.

¹ Based on predicted yields from an analysis across all sites (2014–2018 NVT trials).
New varieties have less trial data supporting the 5-year dataset and hence should be viewed with some caution, especially where there are only two trial results.

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HyTTec Trident	
Development Code	NCH15T103
Maturity	Early
Disease Platform	
Blackleg Rating*	R
Bare Seed	R-MR
Blackleg Group	ABDF
Trial Platform	
NVT	2017
CAT	2018/2019
Available	2020

*Jockey Stayer treated



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Further information

NSW DPI Agriculture website for:

Weed control in winter crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Insect and mite control in field crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops>)

Agnote DPI 495, **Virus diseases in canola and mustard** (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/general-disorders-of-crops/virus-canola-mustard>)

Primefact 115, **Clubroot of canola and mustard** (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/general-disorders-of-crops/clubroot-canola-mustard>)

Primefact 783, **Juncea canola in the low rainfall zone of south-western NSW** (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/canola-and-safflower/juncea-canola>)

Primefact 786, **Brassica juncea in north-western NSW** (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/canola-and-safflower/brassica-juncea-in-north-west-nsw>)

GRDC website for:

Canola best practice management guide for southeastern Australia (GRDC, 2009) (<https://grdc.com.au/resources-and-publications/all-publications/publications/2009/08/canola-best-practice-management-guide-for-southeastern-australia>)

Ten tips to early-sown canola (<https://grdc.com.au/resources-and-publications/all-publications/publications/2018/ten-tips-to-early-sown-canola>)

Reducing aphid and virus risk (GRDC GrowNotes) (<https://grdc.com.au/Resources/Factsheets/2015/02/Reducing-aphid-and-virus-risk>)

Fact sheets:

Blackleg management guide (<https://grdc.com.au/resources-and-publications/all-publications/publications/2018/blackleg-management-guide>)

Sclerotinia stem rot in canola (<https://grdc.com.au/Resources/Factsheets/2014/03/Sclerotinia-Stem-Rot-in-Canola>)

Australian Oilseeds Federation website for:

AOF standards manual (http://www.australianoilseeds.com/Technical_Info/standards_manual)

Contributing authors

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Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Chickpea

Chickpea is a winter pulse crop that is profitable in its own right. The crop contributes to crop rotations by fixing nitrogen and providing a disease and weed break for cereal crops. However, chickpea crops require systematic monitoring for foliar and root diseases, and insect pests.

There are two distinct types of chickpea grown in Australia: desi and kabuli. Both chickpea types are usually sold whole, so seed size and appearance is critically important.

Desi chickpea has relatively small, light-brown angular seeds that are commonly dehulled and split for use as split seed (dhal) or further ground to a flour (besan). Desi varieties are most widely grown under dryland production in Queensland and northern New South Wales.

Kabuli chickpea is more rounded, coloured creamy-white, and generally much larger seed than desi chickpea. Kabuli varieties flower at a similar time to the desi type, but have a longer grain-filling period, requiring more water and sunlight to ensure an adequate seed size. Kabuli variety yields are generally lower (15–30%), and more variable than desi varieties, which can be offset by premiums for larger seeds (8–10 mm). Small kabuli seeds can also be ground for flour (besan).

Chickpea is well adapted to warm spring environments because it can better tolerate higher temperatures during and after flowering than other winter pulse crops such as faba bean, lupin and field pea.

Chickpea is best suited to loams and self-mulching clay soils that have neutral–alkaline pH. Soils with high chloride levels (>600 mg/kg) in the subsoil (30–90 cm depth) are best avoided. Acidic soils ($\text{pH}_{\text{Ca}} < 5.2$) with high aluminium levels, sodic, saline and/or shallow soils are generally not suitable. Most pulses in southern NSW are grown in soils where pH stratification (acid soil layers) can affect root growth, nodulation, crop vigour and yield potential. Severely acidic layers ($\text{pH}_{\text{Ca}} < 4.5$) are common at depths of 5–10 cm and 10–15 cm in the main cropping soils of central and southern NSW. Check for acidic layers by sampling soils at 5 cm intervals down to 20 cm two years before sowing acid-sensitive pulses.

Where acidity is detected below the surface soil, the most rapid method to increase pH is to incorporate fine-grade lime to 10 cm deep at least 12 months before sowing chickpea.

Chickpea does not tolerate waterlogging, and should not be grown in poorly-drained paddocks or those prone to flooding.

Sowing

Seed

Profitable crops start with quality planting seed (i.e. high germination and vigour). Obtain seed from a commercial supplier or from a source known to have negligible levels of seed-borne pathogens. If using grower-retained seed from previous crops, be aware that seed could be infected with *Botrytis*, *Ascochyta* or *Sclerotinia*, even if the disease did not cause economic damage or was not obvious in the crop. Desi seeds with noticeable tiger stripe/blotch markings on the seed coat should be removed, where possible, before sowing. Irrespective of the harvest year and source, all sowing seed must be thoroughly treated with a thiram-based fungicide. Chickpea seed quality deteriorates after 12 months, and should not be kept any longer than 18 months as sowing seed. Information on seed treatment and establishing a profitable crop can be found on the [Pulse Australia website](http://www.pulseaus.com.au/). Refer to [Further information on page 106](#).

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Pulse Australia website
(www.pulseaus.com.au/)

Paddock selection

Maintain a distance of at least 500 m (further is better) from the previous year's chickpea paddocks and a break of at least three years between chickpea in the

same paddock. These practices aim to reduce the amount of disease inoculum available to initiate new season infection. Do not sow chickpea in paddocks with a history of lucerne, medics, phytophthora root rot, *Sclerotinia*, or waterlogging. Flooding can also carry disease inoculum long distances. Do not sow consecutive chickpea crops in the same paddock in the rotation.

Stubble

In the northern grain zone, no-till crops sown into cereal stubble consistently yield 10% higher than those sown into conventionally prepared or reduced-tillage seedbeds. During the early vegetative stage, standing cereal stubble will also help to deter aphids (which can transmit viruses).

Sowing depth

Sow chickpea seed 5–7 cm deep into moisture. If moisture is not present at the desired sowing time, chickpeas can be sown deep into moisture by placing the seed 10–17.5 cm below the paddock soil surface, depending on moisture depth, and levelling the seedbed with a disc chain before the crop emerges.

Use high-quality seed if intending to sow deep. Levelling the seedbed will make harvesting easier, especially for later-sown crops, which tend to be shorter in height. A level seedbed can also reduce the risk of herbicide damage to establishing seedlings. Ensure that seed is well covered with at least 7 cm of soil if using Balance® (active ingredient isoxaflutole) or triazine herbicides.

Sowing rate

Aim to establish 20–30 plants/m² under most conditions in northern and central NSW. In southern NSW, the target plant density is 35–45 plants/m². Aim for the lower end of the range when yield potential is low (e.g. lower initial soil moisture); target the higher end of the range when yield potential is high, such as when good subsoil moisture is available or under irrigation. Adjust sowing rates to take account of seed size, germination, vigour and establishment conditions. Avoid skimping on seed, which could lead to gaps in plant stands, as a uniform plant establishment has been found to be highly effective in reducing aphid infestation.

Table 48. Sowing rate (kg/ha) based on 100% germination, 80% establishment and estimated seed weight for each variety

Variety	100 seed weight (g)	Target plant density/m ²			
		Northern and Central NSW		Southern NSW	
		20	30	35	45
Almaz	41	103	154	179	231
Genesis 090	30	75	113	131	169
Genesis Kalkee	45	113	169	197	253
Jimbour	20	50	75	88	113
Kyabra	26	65	98	114	146
PBA Boundary	19	48	71	83	107
PBA HatTrick	20	50	75	88	113
PBA Maiden	24	60	90	105	135
PBA Monarch	42	105	158	184	236
PBA Seamer	23	58	86	101	129
PBA Slasher	18	45	68	79	101
PBA Striker	21	53	79	92	118
Yorker	21	53	79	92	118

Your calculation

100 seed weight # (grams)		target plant population		establishment percentage*	×	germination percentage		
.....	×	.....	× 1000 ÷	.....	×	.....	=	your sowing rate kg/ha

To determine your seed weight, weigh 100 seeds in grams.

* Establishment percentage – 90% is a reasonable estimate, unless sowing into adverse conditions.

Row spacing

In northern NSW, there is generally no yield difference between row spacing of 25 cm and 75 cm.

In some situations, wide row spacing (up to 100 cm) offers a number of advantages, including:

- sowing into heavy stubble in zero-till situations
- in-crop pesticide application by ground rig
- the ability to band spray, reducing costs and chemical usage
- the option of inter-row cultivation or shielded spraying
- better airflow to reduce foliar diseases
- more moisture to finish the crop in low moisture situations.

The disadvantages of wide row spacing can include reduced crop competition with weeds and increased crop lodging, making harvesting more difficult. Yield penalties can occur in above-average seasons. Wider row spacing (>50 cm) in southern NSW can result in lower grain yields.

Sowing time

Aim to sow in the early–mid period of the recommended sowing window to maximise yield potential. However, early sowing exposes the crop to more rain, which can increase the risk of *ascochyta* blight and *phytophthora* root rot diseases. It can also result in greater crop biomass, which can increase the risk of *botrytis* grey mould later in the season and increase the risk of lodging. Very early sowing can also lead to potential moisture shortage during the grain-fill period, which can reduce seed size and hence yield.

Later sown crops generally have lower yield potential. They can attract greater pest pressure (*Helicoverpa* spp. as a result of being later maturing than surrounding crops) and are often shorter in height, which can lead to harvesting difficulties. However, later sowing can reduce the risk of *Ascochyta* and *Phytophthora* infections and lessen the risk of *botrytis* grey mould, frosted grains and tiger stripe/blotch seed markings.

Table 49. Suggested sowing times

Region	Weeks	April				May				June				July			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Moree–Narrabri																	
Walgett–Coonamble																	
Liverpool Plains																	
Central NSW (grey soil)																	
Central NSW (red soil)																	
Southern NSW																	

■ Preferred sowing time

■ Earlier or later than recommended, yield reduction likely.

Table 50. Chickpea seed treatments

Active ingredient	Example product	Rate	Target disease
thiram 360 g/L + thiabendazole 200 g/L	P-Pickel T®	200 mL/100 kg seed	Seed-borne <i>Ascochyta</i> and <i>Botrytis</i> , damping off, Fusarium
thiram 600 g/L	Thiram® 600	200 mL/100 kg seed	Damping off, seed-borne <i>Botrytis</i> and <i>Ascochyta</i>
thiram 800 g/kg	Thiragranz®	150 g/100 kg seed	Seed-borne <i>Botrytis</i> and <i>Ascochyta</i> , damping off
metalaxyl 350 g/L	Apron® XL 350 ES	75 mL/100 kg seed	Phytophthora root rot

Inoculation

Inoculation is essential, regardless of soil type or previous chickpea history. Use the commercially available Group N chickpea inoculant. Effective nodulation requires forward planning and care to ensure it is done correctly. Treat seed with fungicide first, then apply inoculant separately just before sowing. Avoid



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*Paddocks can have multiple biotypes (ryegrass with different resistance profiles) and a mix of herbicides can manage the variation of mutations as it is less likely biotypes will be resistant to all herbicides in a mix compared to only one being applied.

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inoculating directly into air-seeder bins as the seed needs to dry before being sown. Newly inoculated seed is often sticky and does not flow properly causing uneven seed flow in the bin and leading to blocked hoses, patchy establishment and future weed burdens.

A number of new inoculant products are available for chickpeas, such as freeze-dried and dry granular products. Read and follow the instructions to avoid inoculation problems.

Nutrition

Most growers in NSW use starter fertiliser (MAP, DAP) or other phosphorus-based fertilisers such as Granulock® with added zinc (1–2% zinc), due to its availability. A common starter fertiliser rate is 50–75 kg/ha. Responses to zinc are most likely in alkaline soils. These products should be drilled with the seed. If using more than 100 kg/ha of starter fertiliser, band it slightly away from the seed to avoid fertiliser toxicity, especially on wider (60–100 cm) row spacing. Extra care should also be taken if sowing into marginal moisture seedbed conditions with high rates of fertiliser.

A good method for determining the response from starter fertilisers is to put down test strips, leaving a control (nil) strip and a double rate strip for comparison.

Variety selection

When choosing a variety, a number of factors should be considered including:

- maturity to suit the environment
- disease susceptibility
- paddock suitability
- seed availability and cost
- seed size and sowing rate (with reference to sowing machinery)
- harvesting ease and marketing options.

A Pulse Breeding Australia (PBA) variety brochure or Variety Management Package (VMP) is available from the [GRDC website](#), [Pulse Australia](#) or the relevant seed supply company for each variety. Refer to [Table 51](#) and [Table 52](#) for yield, varietal characteristics and disease reactions.

There is one new desi chickpea variety, released in spring 2018, PBA Drummond[Ⓢ], which is best suited to the chickpea-growing areas of central Queensland.

A change in virulence in the ascochyta blight (AB) pathogen population has occurred in Victoria, South Australia, New South Wales and Queensland. This has resulted in separate ascochyta blight resistance ratings for southern and northern Australia. In southern Australia, current varieties are rated as either susceptible or moderately susceptible to AB infection. This follows observations of severe AB on previously resistant chickpea varieties in 2015, 2016 and 2017 across South Australia and Victoria. Severe AB was also observed in 2017 on PBA Seamer[Ⓢ] which, when released in 2016, was rated resistant to AB. Every case of virulent AB on PBA Seamer[Ⓢ] in 2017 was in crops that were sown into 2016 chickpea stubbles i.e. back-to-back chickpea. In northern regions, AB was common and severe in 2016, leading to high levels of inoculum carrying over to infect the 2017 crop. As more aggressive isolates evolve, following recommended integrated disease management packages for AB (especially not sowing back-to-back chickpea) will reduce growers' risk of expensive AB control or crop failure, slow the rate of pathogen evolution and ensure a profitable outcome.

Resistance abbreviations: R – resistant; MR – moderately resistant; MS – moderately susceptible; S – susceptible; VS – very susceptible.

The revised *Ascochyta* ratings are based on two seasons' trials with a limited number of pathogen isolates and two seasons' observations in commercial crops – interpret these ratings accordingly; there may be highly aggressive isolates in some districts that might change the AB management strategy.

Desi types

Ambar[Ⓢ]. MR–MS to ascochyta blight, similar to Genesis™ 509 and Genesis™ 090 in NSW (S in Vic/SA), superior to PBA HatTrick[Ⓢ] and PBA Boundary[Ⓢ]; S to phytophthora root rot so not recommended for northern NSW. Developed by DAFWA and UWA from germplasm bred by NSW DPI. Marketed by Heritage Seeds. EPR is \$4.40/tonne incl. GST.

PULSE BREEDING AUSTRALIA

Find the Pulse Breeding Australia (PBA) variety brochure or Variety Management Package (VMP) information on the [GRDC website](#) (<https://grdc.com.au/>), [Pulse Australia](#) (www.pulseaus.com.au/) or the relevant seed supply company for each variety.

Jimbour. VS to *Ascochyta*, suited to areas where *Ascochyta* is not considered a major threat and experience shows that the disease can be managed in susceptible varieties; MS–MR to *Phytophthora*. Marketed by Mt Tyson Seeds. No EPR.

Kyabra[®]. VS to *Ascochyta*, suited to areas where *Ascochyta* is not considered a major threat and experience shows that the disease can be managed in susceptible varieties; MS to *Phytophthora*; S to botrytis grey mould. Larger seed size and superior grain quality for the whole seed market compared with other current varieties. Marketed by Heritage Seeds. A seed royalty applies. No EPR.

Neelam[®]. MR–MS to *Ascochyta*, similar to Genesis™ 509 and Genesis™ 090 in NSW (MS in Vic/SA), superior to PBA HatTrick[®] and PBA Boundary[®]; S to *Phytophthora* so not recommended for northern NSW. Marketed by Heritage Seeds. EPR is \$4.40/tonne incl. GST.

PBA Boundary[®]. MS to *Ascochyta*, better resistance than to PBA HatTrick[®] in NSW (S in Vic/SA); S to *Phytophthora*, less resistant than PBA HatTrick[®] and only suitable for paddocks with a low *Phytophthora* risk. Highest yielding variety across chickpea growing regions of northern NSW and southern QLD. Lower yielding than PBA Slasher[®] in southern NSW, but a suitable option if a tall, erect plant type is required. Mid season maturity, equivalent to PBA HatTrick[®]. Medium sized desi seed suited to human consumption. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

PBA Drummond[®]. New release for central Queensland. S to *Ascochyta*, better than Kyabra[®] but not as good as PBA HatTrick[®]; S to *Phytophthora*, less resistant than PBA HatTrick[®]. Only tested in NVT in NSW for the first time in 2018. Potentially suited to north-western areas where Kyabra[®] has been grown and in paddocks with a low *Phytophthora* risk. Not recommended for southern NSW. Tall, erect plant type with early–mid season maturity, similar to PBA Seamer[®]. Medium sized seed suited to human consumption. Developed by PBA. Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

PBA HatTrick[®]. MS to *Ascochyta*, better resistance than Flipper[®] in NSW (S in Vic/SA); MR to *Phytophthora*, more resistant than Jimbour. High-yielding across growing regions of northern NSW and southern Qld; recommended and suited to areas north of Parkes. Tall, erect plant type with mid season maturity, equivalent to Jimbour. Medium-sized desi seed suited to human consumption. Developed by PBA. Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

PBA Maiden[®]. MS to *Ascochyta*, less resistant than PBA Slasher[®] in NSW (S in Vic/SA); S to *Phytophthora*, not recommended for northern NSW. Semi-spreading plant type with mid season maturity, similar to PBA Slasher[®]. Large sized desi seed for southern environments with a yellow–tan seed coat suited to whole-seed markets. Developed by PBA. Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

PBA Seamer[®]. MR to *Ascochyta*, better resistance than PBA HatTrick[®] and PBA Boundary[®] in NSW (S in Vic/SA); MR to *Phytophthora*, more resistant than Jimbour. High-yielding across growing regions of northern NSW, southern and central Qld; recommended and suited to areas north of Dubbo. Semi-erect plant type with mid season maturity. Medium-sized desi seed (larger than PBA HatTrick[®] and PBA Boundary[®]) suited to human consumption. Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

PBA Slasher[®]. MR–MS to *Ascochyta*, similar to Genesis™ 509 and Genesis™ 090 in NSW (S in Vic/SA), better resistance than PBA HatTrick[®] and PBA Boundary[®]; S to *Phytophthora*, not recommended for northern NSW. High-yielding across all southern and western Australian growing regions; recommended and suited to areas south of Parkes. Semi-spreading plant type with mid season maturity. Medium-sized desi seed with a tan–brown seed coat suitable for whole and split seed. Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

PBA Striker[®]. MS to *Ascochyta*, less than PBA Slasher[®] in NSW (S in Vic/SA); S to *Phytophthora*, not recommended for northern NSW. High-yielding in short season environments in southern and western Australian growing regions. Semi-spreading plant type with earlier flowering and maturity than PBA Slasher[®]. Medium-sized desi seed with tan–brown seed coat suitable for whole and split seed. Marketed by Seednet. EPR is \$4.40/tonne incl. GST.

Yorker[®]. MS to *Ascochyta*, less resistant than PBA HatTrick[®] and PBA Boundary[®]; MR to *Phytophthora*, better resistance than PBA HatTrick[®]. Suited to areas where *Phytophthora* rather than *Ascochyta* is the greater risk. Marketed by Seednet. EPR is \$3.30/tonne incl. GST.

Kabuli types

Almaz^①. MR–MS to *Ascochyta*, inferior to Genesis™ 090 in NSW (MS in Vic/SA); S to *Phytophthora*. Medium seed size, 8–9 mm. Introduced from ICARDA, Syria and selected by DAFWA. Marketed by Seednet in eastern Australia. EPR is \$7.15/tonne incl. GST.

Genesis™ 090. MR to *Ascochyta*, equal to Genesis™ 509 in NSW (MS in Vic/SA); broadly adapted; VS to *Phytophthora*, suited only to areas with a low *Phytophthora* risk. Seed size is smaller than Almaz^①, predominantly 7–8 mm. Introduced from ICARDA, Syria and selected by Vic DPI. Marketed by PB Seeds. EPR is \$5.50/tonne incl. GST.

Genesis™ Kalkee. MR–MS to *Ascochyta*, inferior to Genesis™ 090 in NSW (MS in Vic/SA); S to *Phytophthora*. Larger seed size than Almaz^①, predominantly 9 mm. Yield is similar to Almaz^① in northern and southern NSW. Excellent harvestability with an erect plant habit and good lodging resistance. Introduced from ICARDA, Syria and selected by Vic DPI and NSW DPI. Marketed by PB Seeds. EPR is \$5.50/tonne incl. GST.

PBA Monarch^①. MS to *Ascochyta*, less resistant than Genesis™ 090 in NSW (S in Vic/SA); S to *Phytophthora*. Early flowering and early maturing. Medium seed size, 8–9 mm, similar to Almaz^①. Highest yielding medium sized kabuli chickpea. Semi-spreading plant type, which can be prone to lodging. Marketed by Seednet. EPR is \$7.15/tonne incl. GST.

Table 51. Chickpea variety ratings for common chickpea diseases in Australia

Variety	Ascochyta blight ①	Phytophthora root rot ②	Botrytis grey mould ③	Virus ④	Root-lesion nematode (Pratylenchus thornei)		Root-lesion nematode (Pratylenchus neglectus)	
					Resistance ⑤	Tolerance ⑤	Resistance ⑤	Tolerance ⑤
Desi types								
Ambar	MR–MS	VS	S	–	MS	–	MR–MS	–
Jimbour	VS	S	S	S	S	T	–	T
Kyabra	VS	S	S	S	VS	–	MR–MS	–
Neelam	MR–MS	VS	S	–	MS	–	MR–MS	–
PBA Boundary	MS	VS	S	S	MS	–	–	–
PBA Drummond	S	S	S	MS	–	–	–	–
PBA HatTrick	MS	MR	S	S	MS	–	MR–MS	–
PBA Maiden	MS	VS	S	S	MR–MS	–	MR–MS	–
PBA Seamer	MR	MR	S	S	MS	–	MR–MS	–
PBA Slasher	MR–MS	VS	S	S	MR–MS	–	MR–MS	–
PBA Striker	MS	VS	S	S	–	–	MR–MS	–
Yorker	MS	MR	S	S	–	MT	–	–
Kabuli types								
Almaz	MR–MS	VS	S	S	VS	T	MR–MS	–
Genesis™ 090	MR	VS	S	S	MS	T	MR–MS	–
Genesis™ Kalkee	MR–MS	VS	S	S	MS	–	MR–MS	–
PBA Monarch	MS	VS	S	S	MS–S	–	MR–MS	–

Source: NVT chickpea national disease ratings.

– No data.

R Resistant

MR Moderately resistant

MS Moderately susceptible

S Susceptible

VS Very susceptible

T Tolerant

MI Moderately intolerant

I Intolerant

^① *Ascochyta* ratings are for northern Australia (NSW) only, not southern Australia (Vic & SA).

^② Ratings are a compilation of NSW (Tamworth) and Qld (Warwick) data.

^③ The risk of botrytis grey mould (BGM) damage can be affected by the spray programs for ascochyta blight (AB); fungicides used to control *Ascochyta* can also control *Botrytis*. Note that if BGM risk is high, then a fungicide with greater efficacy for BGM than for AB might also be needed. BGM screening is conducted in a controlled environment and rating is independent of plant architecture.

^④ Virus ratings could change with different virus species predominating in different areas.

^⑤ Resistance measures the plant's ability to resist disease. Tolerance measures the plant's ability to yield at a given disease level. Tolerant varieties, while potentially yielding well, are unlikely to reduce nematode numbers for following crops.

Weed control

Chickpea does not compete well with weeds, and there are few options for broadleaf weed control. However, isoxaflutole (e.g. Balance®) and terbuthylazine (e.g. Terbyne®) have made weed control more effective. Sow chickpea in paddocks with relatively low broadleaf weed seed banks. Chickpea can be sensitive to herbicide wash in sowing furrows and care needs to be taken, particularly when deep sowing, that seed is well covered with at least 7 cm of soil.

Table 52. Chickpea variety characteristics

Variety	Plant height	Lodging resistance	100 seed weight (g)	Maturity	North		South	
					Yield as a % of PBA HatTrick 2014–2018		Yield as a % of PBA Slasher 2014–2018	
					East 1.76 t/ha	West 1.46 t/ha	East 1.74 t/ha	West 1.63 t/ha
Desi types								
Ambar	MS	VG	16	E	n.d.	n.d.	88 (6)	86 (4)
Jimbour	T	VG	20	M	100 (14)	98 (32)	n.d.	n.d.
Kyabra	T	VG	26	M	103 (14)	99 (32)	n.d.	n.d.
Neelam	MT	VG	17	M	n.d.	n.d.	99 (6)	97 (4)
PBA Boundary	T	M	19	M	104 (14)	103 (32)	91 (6)	92 (4)
PBA Drummond	T	VG	22	E–M	118 (2)	118 (4)	n.d.	n.d.
PBA HatTrick	T	M	20	M	100 (14)	100 (32)	91 (6)	91 (4)
PBA Maiden	MS	M	24	M	n.d.	n.d.	95 (6)	98 (4)
PBA Seamer	M	VG	23	M	104 (14)	104 (32)	93 (6)	91 (4)
PBA Slasher	MS	M	18	M	n.d.	n.d.	100 (6)	100 (4)
PBA Striker	MS	M	21	E	n.d.	n.d.	96 (6)	102 (4)
Kabuli types								
Almaz	MT	G	41	L	100 (8)	100 (15)	93 (5)	n.d.
Genesis™ 090	M	G	30	M–L	104 (8)	110 (15)	100 (5)	n.d.
Genesis™ Kalkee	T	VG	45	L	98 (8)	92 (15)	92 (5)	n.d.
PBA Monarch	M	F	42	F	102 (8)	103 (15)	96 (5)	n.d.

Yield results are a combined-across-sites analysis using NVT and PBA data from 2014–2018.

Number of trials in brackets (). n.d. = no data.

Plant height	Lodging resistance	Maturity
T tall	VG very good	E early
MT medium–tall	G good	M medium
M medium	M moderate	L late
MS medium–short	F fair	

Plants weakened by herbicide injury are more susceptible to diseases. The most common problems come from residual herbicides applied to preceding cereal crops, such as:

- **Sulfonylurea herbicides** (Group B, e.g. Logran® B-Power, Glean®, Ally®, Eclipse®) applied to preceding cereal crops. Take special note of label instructions concerning crop rotation, rainfall required for breakdown and plantback periods, particularly on high pH and/or compacted soils where rainfall has been limited. Residues could persist longer in soils that have received surface-applied lime to raise soil pH.
- **Triazine herbicides** (Group C, e.g. atrazine). Seek advice as to potential chickpea crop damage when using triazine herbicides in summer cereals (sorghum and maize) and TT canola, as application rates on different soil types influence the extent of residual herbicide breakdown. Follow label recommendations and avoid spray overlaps.
- **Clopyralid** (Group I, e.g. Lontrel®), **2,4-D amine and some other hormone herbicides**. Under dry conditions, these herbicides break down more slowly and residues can also carry over in stubble and affect subsequent crops. Read labels carefully and observe plantback periods, including rainfall requirements.

Isoxaflutole products (e.g. Balance®) can, under certain conditions, damage chickpea varieties. Damage can occur where rain follows soon after spray application and the full rate is used. However, the full rate will provide longer residual activity throughout the chickpea growing season. Ensure the trench above the seed is closed at sowing to reduce risk of herbicide washing into the seed furrow.

To minimise the risk of spray-rig herbicide residues damaging the crop, decontaminate the main tank, mixing hopper and all spray lines, hoses and filters. Herbicide injury from residual fallow spray mixtures has occurred in many chickpea crops via the main tank, despite decontamination. If this cannot be done satisfactorily, fit end taps to booms so that they can be thoroughly flushed. Be aware herbicides can accumulate in filters and in the nozzle bodies.

Be aware of plantback periods for herbicides such as Broadstrike® if used later in the season, especially when considering double cropping.

Consult herbicide labels and the NSW DPI guide [Weed control in winter crops](http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops) for further information on current weed control and plantback recommendations.

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Weed control and plantback information

[Weed control in winter crops](http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops) (www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops)

Insect control

The major insect pest of chickpea is *Helicoverpa* spp. (heliopsis caterpillars). They can reduce yield and grain quality. Careful crop monitoring is required from flowering until seed maturity.

DAF Qld research recommends changes to control decisions for *Helicoverpa*. The change is from a fixed threshold of 1–2 larvae/m², to a threshold based on the relationship between damage potential (determined by size and number of larvae, and crop growth stage), chickpea grain price and control cost. Full details of the monitoring protocol to determine the cost/benefit of control are outlined in [Helicoverpa management in chickpea](#).

Helicoverpa management must be considered in terms of area-wide management and the regional insecticide resistance management strategy. Where possible, growers should consider using products that do not increase the risk of *Helicoverpa* developing resistance to chemicals used in summer crops. This means growers are advised not to use certain chemicals such as synthetic pyrethroids or thiodicarb (Larvin®) without actively considering the benefits and disadvantages this will have to both their own crop and those of summer crop growers. Possible options are the 'softer', more selective products such as Vivus® or Gemstar®, Steward®, and Dipel®. There are many factors to consider such as *Helicoverpa* species and risk of resistance, compatibility with fungicides, cost and harvest withholding period (WHP) when deciding which product to use.

Read pesticide labels carefully before use. See [Insect and mite control in field crops](#) and [Helicoverpa management in chickpea](#) for more information on pest control measures and thresholds.

Diseases

Disease monitoring and management is an important aspect of chickpea production. Growers are urged to seek advice on which diseases occur in their area. Control measures include crop rotation; paddock, variety and seed selection; and seed treatment, so it is best to start planning one season ahead of sowing.

Disease can occur at any time, but economic losses are more likely late in the season, making pre-harvest contracts risky. The major chickpea diseases in NSW are ascochyta blight, phytophthora root rot, botrytis grey mould, botrytis seedling disease, viruses, and ill-thrift caused by root lesion nematodes. *Sclerotinia* can also cause problems in dense canopy crops. Physiological disorders with disease-like symptoms are also significant, in particular injury from low temperature, frost, herbicides, waterlogging, sodicity and salinity. See GRDC [Chickpea disease management \(Southern and Northern regions\)](#).

Further information on chickpea disease can be found at the [Pulse Australia website](#).

Minimising risk of disease in 2019 chickpea crops

Drought conditions in winter/early spring 2018 across most of NSW meant disease incidence (*Ascochyta*, *Phytophthora*, *Sclerotinia* and *Botrytis*) was low overall in 2018; consequently, there will be lower amounts of inoculum from 2018 to infect 2019 crops. However, dry conditions in 2017 will mean some *Ascochyta* inoculum from 2016 (very high levels throughout the season), winter 2017 outbreaks, and isolated cases in spring 2018, will have survived to this season. Most of the spring 2018 *Ascochyta* infections were in paddocks that had chickpea in 2016 or 2017.

This section describes strategies that will reduce the risk of each of these diseases. Some of these strategies are based on local and international field experiments; others are based on observations of reduced disease in 2017 and 2018 crops.

Ascochyta blight, AB (fungus *Ascochyta rabiei*)

Ascochyta inoculum will be present in four forms:

1. *Ascochyta*-infected chickpea residue being discharged from the back of headers or spread by floods and surface water.
2. Seed internally infected by the fungus (a consequence of pod infection).
3. Seed contaminated externally with infected chickpea residue during harvest and handling.
4. Volunteer chickpea plants infected over summer and autumn.

The following will reduce the occurrence and effects from ascochyta blight in 2019 chickpea crops.

- **Do not grow chickpea crops in paddocks that grew chickpea in the previous year.**
- **Grow varieties with improved AB resistance:** Varieties such as PBA Seamer[®], PBA Boundary[®], PBA HatTrick[®], PBA Slasher[®] and most Genesis™ varieties will have less disease and require fewer fungicide sprays.

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Insect monitoring protocol for cost/benefit ratio

[Helicoverpa management in chickpea](#) (www.daf.qld.gov.au/__data/assets/pdf_file/0005/76739/HelicoverpaManagement-InChickpea.pdf)

Information on pest control and thresholds:

[Insect and mite control in field crops](#) (www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops)

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Disease management

[Chickpea disease management \(Southern and Northern regions\)](#)

(<https://grdc.com.au/resources-and-publications/all-publications/factsheets/2013/05/chickpea-disease-management>)

[Pulse Australia website](#) (www.pulseaus.com.au/)

- **Remove volunteers:** Volunteer chickpea plants infected with *Ascochyta* will provide inoculum even if the volunteer plants are killed with herbicide. Controlling volunteers early will restrict their size and limit the amount of inoculum they can produce.
- **Treat all sowing seed:** Properly treating seed with a registered fungicide will control both internally-borne *Ascochyta* and external contamination.
- **Apply fungicide before the first post-emergence rain, even PBA Seamer[®]:** Crops that received an early preventative fungicide in 2017 had less disease than crops that were not sprayed until after the disease was detected. Even though PBA Seamer[®] is rated MR to *Ascochyta*, growers are urged to apply a preventative fungicide:
 - to minimise the probable carryover of inoculum from 2017–2018
 - to safeguard against changes developing in the *Ascochyta* pathogen that are more virulent on PBA Seamer[®].
- **Plant on wider row spacing (66 cm+):** Wide rows improve airflow through the crop leading to more rapid drying after rain or dew. Canopy closure can also be delayed, which will improve fungicide penetration later in the season.

Applying foliar fungicides

Foliar fungicides provide cost effective *Ascochyta* management in all varieties including those rated VS e.g. Kyabra[®]. The key to a profitable outcome is spray timing – labels for all registered products state they are most effective when applied before rain.

- Applying fungicides by ground rig is preferred. Select a nozzle such as a DG TwinJet or Turbo TwinJet that will produce droplets no smaller than medium (ASABE standard) and deliver the equivalent of 80–100 L/ha water at the desired speed.
- Where aerial application is the only option (e.g. wet weather delays) ensure the aircraft is set up properly and that contractors have had their spray patterns tested to ensure full canopy coverage.

Botrytis grey mould (fungus *Botrytis cinerea*)

Botrytis grey mould (BGM) is an airborne foliar disease active only when temperatures warm up towards spring (approx. 15 °C). It is more prevalent in the warmer regions of the north, where significant crop losses can occur in high biomass crops during wet or humid conditions as happened in 2016. BGM is controlled with foliar fungicides; **seed treatment is ineffective**. *Botrytis cinerea* is ubiquitous, has a wide host range (over 138 genera in 70 families) and is a good saprophyte, meaning it can survive, grow and sporulate on any dead plant tissue. The fungus readily produces airborne spores and some isolates form sclerotia. This means that inoculum of BGM is **always present** and if conditions favour BGM, it will occur irrespective of what has happened earlier in the chickpea season.

The following will reduce the risk of BGM in 2019 chickpea crops:

- **Paddock selection:** Avoid sowing chickpea next to paddocks where BGM was an issue the previous season. As for ascochyta blight, chickpea should be grown as far away from paddocks in which BGM was a problem as is practically possible. However, under conducive conditions, this practice will not guarantee that crops will remain BGM-free, because of the pathogen's wide host range, ability to colonise dead plant tissue, and its airborne spores.
- **Sow later:** If long-term weather forecasts suggest a wetter than normal season, consider sowing in the later part of the sowing window as this will reduce biomass – dense canopies favour BGM development.
- **Plant on wider rows (66 cm +):** Wide rows improve airflow through the crop leading to more rapid drying after rain or dew. Canopy closure can also be delayed, which will improve fungicide penetration.
- **Foliar fungicide:** In areas outside central QLD, spraying for BGM is not needed in most years. However, in seasons and situations favourable to the disease, a preventative fungicide spray just before canopy closure, with another application two weeks later will help minimise BGM development in most years. If BGM is detected in a district or in an individual crop, particularly during flowering or pod fill, a fungicide should be applied before the next rain. None of the fungicides currently registered or under permit for chickpea BGM will eradicate established infections. Consequently, timely and thorough application is critical.

Phytophthora root rot fungus-like oomycete (*Phytophthora medicaginis*)

Phytophthora root rot (PRR) is a soil- and water-borne disease whose inoculum can become established in some paddocks. Damage is greatest in seasons with above average rainfall, but only a single saturating rainfall is needed for infection. Avoid high-risk paddocks such as those with a history of *Phytophthora* in chickpea, waterlogging, or pasture legumes – particularly medics and lucerne. Alternative *Phytophthora* hosts such as pasture legumes, particularly medics and lucerne, must be managed to provide a clean break between chickpea crops.

The PREDICTA® B soil test can be used to assess PRR risk. Detecting any level of *Phytophthora* in a paddock makes it at high risk of developing PRR if conditions become conducive. However, not detecting *Phytophthora* does not mean the PRR risk is low. If considerations other than *Phytophthora* warrant sowing in a high-risk paddock, choose PBA HatTrick[®] or PBA Seamer[®] and consider treating seed with metalaxyl. Metalaxyl can be applied in the same operation as other seed dressings. Metalaxyl only provides protection for about eight weeks; crops can still become infected and die later in the season. Do not plant PBA Boundary[®] in any paddock that has had a history of pasture legumes or chickpea with PRR.

Phytophthora inoculum will be present in three forms:

1. **Chickpea plants** that had PRR in previous seasons (up to 10 years back).
2. **Other hosts e.g. medics, lucerne**, and other leguminous plants including sulla (*Hedysarum* species) and sesbania (*Sesbania* species) in which *Phytophthora* can survive and multiply.
3. **Soil and water** containing PRR-infected material and survival structures (oospores, chlamydospores).

The following will reduce the risk of PRR in 2019 chickpea crops:

- **Avoid PRR high-risk paddocks** where annual or perennial medics have been a component of pastures and where PRR has occurred in the past in lucerne or chickpea; the oospores of *Phytophthora medicaginis* can survive for more than 10 years.
- **Avoid paddocks with areas prone to waterlogging** although the conditions that induce waterlogging might not occur every year.
- **Metalaxyl-based seed dressings are registered for PPR**, but they are relatively expensive and provide only 6–8 weeks protection after sowing.
- **Grow a variety with the highest level of resistance**, particularly in medium–high-risk situations, such as where medics, chickpea or lucerne has been grown in the past 5–6 years.

Sclerotinia, (fungi *Sclerotinia sclerotiorum*, *S. minor*)

In the northern region, *Sclerotinia* fungi (*S. sclerotiorum* and *S. minor*) infect chickpea plants in two ways:

1. **Sclerotia germinate directly** in or on soil and invade the plant through root or basal stem tissue, producing sclerotia on and within the basal stem tissues
2. **Sclerotia germinate indirectly**, produce apothecia at ground level, which then release airborne ascospores (carpogenic germination) that infect plant parts higher in the canopy.

In most seasons, direct germination is generally only seen because carpogenic germination needs cool, moist conditions. In August–September 2016, *Sclerotinia* disease was very common in chickpea crops in north-western NSW and southern QLD. Importantly, every case of *Sclerotinia* involved carpogenic germination, i.e. infection at mid-canopy, meaning that the sclerotia formed on and inside the chickpea stems and was been captured during harvest. This led to problems at receival points because the cylindrical sclerotia formed inside the stems resembled ryegrass ergots, causing some loads to be rejected or docked. Dry conditions across NSW in 2017 reduced the opportunities for infection by ascospores in most districts.

Sclerotinia inoculum will be present from four potential sources:

1. **Sclerotia spread by floods and surface water.**
2. **Sclerotia admixed with chickpea seed** and introduced into 2019 chickpea paddocks during sowing.
3. **Sclerotia in canola residue in paddocks** intended for chickpea in 2019; large sclerotia can survive for up to seven years.
4. **Sclerotia in weed hosts** in paddocks intended for chickpea in 2019.

The following will reduce the risk of *Sclerotinia* in 2019 chickpea crops:

- grade seed to remove sclerotia
- grow varieties with improved resistance
- avoid paddocks with a history of *Sclerotinia*
- avoid paddocks with a history of canola
- avoid paddocks with a history of broadleaf weeds.

Root lesion nematode (*Pratylenchus thornei*, *Pratylenchus neglectus*)

Root lesion nematodes (RLN) cause poor plant growth in situations that otherwise appear favourable. They attack cereals and pulses and are thus a threat to the whole farming system. Nematodes feed and multiply on and in the roots of chickpea plants and, in high numbers, will reduce growth and yield. Chickpea varieties differ in their resistance and tolerance to RLN, but are generally considered more susceptible (allowing nematodes to multiply) than field pea, faba bean and lupin. Reduce the risk of losses from RLN by not sowing chickpea in paddocks that had susceptible or intolerant cereal varieties in 2018, and by following the recommendations in *Management of root lesion nematodes in the northern grain region*.

Virus diseases

Flying aphids spread viruses, which can cause major losses in some years, often later in the season as was the case in 2012. The Liverpool Plains, Gilgandra and Narrabri districts have a history of virus disease. Prevention is the only option to limit losses, because there is no in-crop control. However, prevention measures are often not adequate due to limited effectiveness and practicality, and there are no immune chickpea varieties. Follow best agronomic practices including retaining standing stubble, optimising sowing rate and sowing time, and controlling in-crop and fallow weeds. Stressed crops tend to be more prone to insect attack (particularly from aphids), hence the basic principles of paddock selection and plant health to avoid stressed crops should apply. Other measures that can be beneficial in some cases include:

- using virus-free seed
- controlling host weeds
- distancing from lucerne crops
- using narrow row spacing
- a higher sowing rate.

Monitoring and spraying aphids is not recommended. Virus control is different for chickpea than for other pulses, because spread is almost entirely by non-colonising aphids that visit crops only briefly. The prevention options are detailed in *Managing viruses in pulses*.

Fungicide seed dressings

Chickpea seed should always be treated to control seed-borne *Ascochyta* and *Botrytis* and some soil-borne diseases. Research has shown that P-Pickel T® (thiram plus thiabendazole), and products containing thiram only (e.g. Thiram® 600) are equally effective against *Ascochyta* or *Botrytis*. Additionally, applying metalaxyl could be warranted if there is a risk of *Phytophthora* in a paddock, but seed treatment with metalaxyl only provides protection for 6–8 weeks from sowing.

Injury from herbicide residues in soil

Herbicide residues can cause disease-like symptoms. Damage is greatest on alkaline soils above pH_{Ca} 7.6 and can be aggravated by compacted soil. Group B sulfonylurea herbicides (e.g. Ally®, Associate®, Glean®, Logran® B-power, Lynx®, Nugran® and Tackle®) on preceding cereal crops are especially risky, requiring special attention to crop rotation recommendations on labels. The trend in northern NSW to double crop sorghum and include triazine tolerant (TT) canola varieties in the rotation also increases the risk of Group C herbicide damage.

Consult herbicide labels and the NSW DPI guide *Weed control in winter crops* for further information on plantback periods and rainfall requirements.

Harvesting

Chickpea plants often contain pods with various stages of maturity (i.e. first set pods can be mature whilst young, green pods are still forming). Chickpea seeds are physiologically mature when yellowing from the seed beak begins to extend through the remainder of the seed.

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Managing root lesion nematodes

Follow the recommendations in *Management of root lesion nematodes in the northern grain region* (www.daf.qld.gov.au/business-priorities/plants/field-crops-and-pastures/broadacre-field-crops/crop-diseases/root-lesion-nematode)

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Virus prevention in pulses

Managing viruses in pulses (www.pulseaus.com.au/growing-pulses/publications/manage-viruses)

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Weed control in winter crops

(www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops)

Chickpea crops can be desiccated using glyphosate (540 g/L) ± metsulfuron-methyl (600 g/kg), or diquat (200 g/L), to aid harvest efficiency once the majority (90–95%) of seeds have reached physiological maturity.

Ensure that the harvest WHP is observed according to the label of the product used (e.g. seven days for glyphosate products; two days for diquat products).

Desiccation allows earlier harvest, maximising both yield and grain quality. However, a crop ripening evenly under very hot conditions or with no weed problems might not require desiccation (see [Chickpea harvest and seed storage](#), available from [Pulse Australia](#)). Crops desiccated with glyphosate should not be kept for sowing seed as dessication can reduce seed viability.

The receival standard for chickpea is 14% seed moisture content. Harvest should start as soon as the seeds have dried down sufficiently to thresh. Harvesting chickpea at 14–15% moisture then drying or aerating will normally result in a higher yield, better quality, fewer harvest difficulties and less problems with late *Ascochyta* infection. Harvest losses and downgrading in quality (cracking) can be substantial if chickpea harvest is delayed until moisture is below 11–12%. A delayed harvest also increases the risk of lodging and late rain or hail leading to lower yields (reduced seed density and brittle seeds), and downgraded quality (observed as darkened, discoloured or sprouted seeds).

Significant harvest losses can occur if harvest operators are inexperienced. Make sure contractors are experienced in chickpea harvesting, that header settings are optimised for each crop and that they travel at appropriate speeds. Use appropriate harvest strategies to minimise header fires, such as dragging chains behind headers, and blowing dust and debris out of the header with compressed air as frequently as every 30 minutes if required.

Late rains can cause a second flush of growth and podding. When this occurs, timing the desiccation is a balance between minimising losses at the bottom of the plant (potential pod and seed loss when overripe/dry) and losses or defects from the top of the plant (killing the new growth resulting in immature/wrinkled seeds, green seeds and higher moisture seeds that can promote mould in storage). Harvesting should then start shortly after desiccation to avoid yield losses. A header that is well set up for the crop should be able to capture the good quality seed without retaining any smaller defective seed caused by this second flush of growth. Contact your header dealer or manufacturer for assistance in optimal header set up.

Marketing

The bulk of the Australian chickpea crop is exported. Most desi chickpeas go to the subcontinent countries of India, Pakistan, Bangladesh and Sri Lanka for human consumption as whole seed, dhal (split seed) or besan (flour). A small proportion is split or milled into flour in Australia and consumed locally, or sold to expatriate Indian communities in the UK, Canada and Fiji.

Prices in the subcontinent are lower in their postharvest period from April to June and Turkish imports fill the period from August to December. The Australian crop meets the off-season demand from December to March, although prices for chickpea in Australia in October and November are often higher than in December and January.

Small seeded kabulis (up to 7 mm diameter) meet separate market requirements from large kabulis and are therefore priced accordingly. They are mainly exported to the subcontinent and Middle East. Larger kabulis command a higher price, with premiums applying to each 1 mm increment in seed diameter. The size of these premiums varies from year to year, depending on supply from key competitors.

Larger kabuli chickpeas are exported to the subcontinent, Middle East and Europe. A small amount of both small and large seeded kabulis are retained in Australia for local processing and consumption.

The [current marketing specifications](#) for the different grades of chickpea can be found on the [Pulse Australia website](#).

Contributing authors

Kristy Hobson, Chickpea Breeder, Tamworth; Kevin Moore, Pulse Plant Pathologist, Tamworth; Sean Bithell, Chickpea Phytophthora Research Officer, Tamworth; Kurt Lindbeck, Plant Pathologist, Wagga Wagga; Mark Richards, Pulse Research Agronomist, Wagga Wagga; Jenny Wood, Pulse Quality Chemist, Tamworth; Leigh Jenkins, Research and Development Agronomist, Trangie, all from NSW DPI.

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[Chickpea harvest and seed storage](#) (www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf)

[Pulse Australia](#) (www.pulseaus.com.au/)

[Irrigated chickpea management](#) (http://www.pulseaus.com.au/storage/app/media/crops/2010_SPB-Chickpea-irrigation.pdf)

[Current marketing specifications](#) (www.pulseaus.com.au/marketing/receival-trading-standards)

Table 53. Disease and crop injury guide – chickpea

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Fungal and oomycete diseases				
Pre-emergence diseases Many fungi	Seedlings fail to emerge.	Mainly kabuli cultivars (due to thinner seed coat).	Wet soils. Survives in soil.	Treat seed with a thiram-based fungicide.
Botrytis seedling disease <i>Botrytis cinerea</i> (fungus)	Seedlings wilt and die. Random distribution (not patches of plants).	Related to infected seed source.	Survives in seed after pods become infected.	Treat seed with a thiram-based fungicide (first grading out small or mouldy seed, if present).
Damping off Pythium (oomycete) and several fungi	Seedlings wilt and die. Patchy distribution.	Wet soils.	Survives in soil.	Treat seed with a thiram-based fungicide (might not give adequate control of Pythium).
Phytophthora root rot <i>Phytophthora medicaginis</i> (oomycete)	Rotted roots, plants easily pulled up. Patches of plants wilting; yellowing and defoliation starting from bottom leaves.	In patches with poor soil drainage, after heavy rainfall. Paddock history of medic, lucerne, or root rot in chickpea.	Survives in soil. Can persist for years. Spreads by water and soil movement.	Use the desi variety PBA HatTrick, which combines improved resistance to both <i>Phytophthora</i> and <i>Ascochyta</i> . Avoid kabuli varieties. Avoid paddocks with a history of PRR in chickpea. Rotate with cereals. In high risk situations, treat seed with metalaxyl (effective against early, but not late, infection).
Ascochyta leaf, stem and pod blight <i>Phoma rabiei</i> (syn. <i>Ascochyta rabiei</i>) (fungus)	Lesions with concentric rings of tiny black specks. Leaves, stems, pods and, when severe, whole plants and patches of plants die. Can kill entire crops of susceptible varieties if not managed properly.	Endemic in NSW. Favoured by wet, humid weather.	Seed, chickpea trash, volunteer chickpeas.	Use NSW DPI/DAF Qld/Pulse Australia management strategy. Prevent introduction of chickpea trash, especially on equipment. Maintain machinery hygiene. Control volunteers early in the fallow. Use varieties with improved resistance.
Botrytis grey mould <i>Botrytis cinerea</i> (fungus)	Grey or dead patches on stem, collar, flowers or pods. Spore clusters evident as 'bunches of grapes' on dark brown stalks, best seen with hand lens	Warm (> 15 °C), humid, overcast conditions, dense canopies.	Many sources including any crop trash, sclerotes in soil, neighbouring crops, in-crop weeds, and infected seed. Inoculum usually not limiting.	Prevention is the same as for <i>Ascochyta</i> blight. Current recommendations for <i>Ascochyta</i> management has also reduced botrytis grey mould. Pre-emptive spraying might be possible; check current recommendations.
Sclerotinia wilt <i>Sclerotinia sclerotiorum</i> , <i>S. minor</i> (fungi)	Beige–tan lesions on stems at ground level or higher. White—grey mould in wet or humid weather. Sclerotes (1–5 mm black bodies) usually form on, or inside stems, or on tap roots.	Basal stem rot usually occurs in late winter/ early spring. Canopy stem rot favoured by dense, luxuriant growth.	Sclerotes survive in soil for at least eight years, germinate directly and infect roots and stem bases, or indirectly to release wind-blown spores. Very wide host range in broadleaf weeds and crops.	Rotate with cereals, maintain a 4-year break between broadleaf crops. Avoid sowing next to canola paddocks; control broadleaf weeds.
Virus diseases				
Beet western yellows virus (BWVY), Alfalfa mosaic virus (AMV), Subterranean clover redleaf virus (SCRLV), Cucumber mosaic virus (CMV), Mastrevirus spp., Bean leafroll virus (BLRV), Tomato spotted wilt virus (TSWV), and at least three other species	First symptoms are bunching, reddening, yellowing, or shoot tip death. Later symptoms are reddening or yellowing and early death of whole plants. Diseased plants are scattered, i.e. solitary or in small groups of 2–4 plants.	Seasons or districts with major aphid flights. Most common in crops that have a low plant density and/or broadleaf weed infestation.	Survives in weeds and pasture legumes, especially lucerne. Spread by aphids and, to a minor extent, thrips and leafhoppers. AMV and CMV are transmitted through seed to seedlings at incidences up to 1% and 2% respectively.	Aim for optimal establishment, standing stubble, and no weeds by following best agronomic practices. Controlling aphids on nearby legume pastures may help to prevent virus transmission in both autumn and spring.
Nematodes				
Ill-thrift <i>Pratylenchus thornei</i> , <i>P. neglectus</i>	Poor plant growth in situations where nodulation and other factors are favourable. Microscope shows nematodes with stylets.	Widespread in soils with high clay content.	Survives and spreads in soil.	Crop rotation with a nematode-resistant cereal variety could be beneficial. Some chickpea varieties are less susceptible than others (seek advice).
Herbicide injury				
Injury from soil residues of Group C herbicides (e.g. triazines) and sulfonyleurea herbicides, and isoxaflutole (Balance®)	Discolouration, stunting, death, or leaf necrosis, especially in seedlings.	Related to pre-emergence herbicide use in current and previous seasons. Damage greatest in boom overlaps and compacted soil areas. Retained stubble may capture herbicide and slowly release after rain, potentially causing damage.	Most persistent in alkaline soils.	Observe label recommendations and avoid spray overlaps. Thoroughly decontaminate spray equipment, especially auto rigs. Be aware of Group C herbicide risk when following sorghum or maize (double crop) and triazine-tolerant (TT) canola. Be careful in flattened high cereal stubble loads.
Waterlogging				
Injury from saturated soil or standing water	Similar to phytophthora root rot, but roots remain intact. Initially plants do not pull easily out of ground. Onset is more rapid (1–2 days after rain) than for <i>Phytophthora</i> . Leaflets show bleaching, yellowing or reddening and might not fall.	Soil saturation for one day or longer; plants most sensitive when stressed and/or podding.	Poor drainage due to compacted soils or subsoil constraints.	Ensure good paddock drainage. Avoid irrigation during and after podding, particularly if plants are already moisture stressed (see Pulse Australia publication <i>Irrigated chickpea management</i>).

Further information

NSW DPI

Weed control in winter crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Insect and mite control in field crops (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops>)

Pulse Point 7, **Reducing disease risk** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157144/pulse-point-07.pdf)

Pulse Point 20, **Germination testing and seed rate calculation** (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf)

GRDC

PBA Fact Sheet, September 2013, **Seed markings of desi chickpea** (https://grdc.com.au/__data/assets/pdf_file/0023/126473/seed-markings-of-desi-chickpea-pdf.pdf)

May 2013, **Chickpea disease management (Southern and Northern regions)** (<https://grdc.com.au/resources-and-publications/all-publications/factsheets/2013/05/chickpea-disease-management>)

GRDC bookshop for:

Chickpea disorders: The ute guide (<https://grdc.com.au/resources-and-publications/all-publications/bookshop/2004/05/grdc-uteguide-chickpeadisorders>)

Field crop herbicide injury: The ute guide (<https://grdc.com.au/resources-and-publications/all-publications/bookshop/2002/01/field-crop-herbicide-injury-the-ute-guide>)

Pulse Australia

2018–19 Pulse Trading Standards (<http://www.pulseaus.com.au/marketing/receival-trading-standards>)

PA Bulletin, **Chickpea: High quality seed** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/high-quality-seed>)

Northern Pulse Bulletin, **Chickpea: Effective crop establishment** (http://www.pulseaus.com.au/storage/app/media/crops/2011_NPB-Chickpea-crop-establishment.pdf)

PA Bulletin, **Chickpea: Integrated disease management** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/idm-strategies>)

PA Bulletin, **Chickpea: Ascochyta blight management** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/ascochyta-blight>)

PA Bulletin, **Chickpea: Botrytis grey mould management** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/botrytis-grey-mould>)

PA Bulletin, **Chickpea: Phytophthora root rot management** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/phytophthora-root-rot>)

PA Bulletin, **Chickpea: Identifying Sclerotinia** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/sclerotinia>)

PA Bulletin, **Managing viruses in pulses** (<http://www.pulseaus.com.au/growing-pulses/publications/manage-viruses>)

PA Bulletin, **Chickpea: deep seeding strategies** (<http://www.pulseaus.com.au/growing-pulses/bmp/chickpea/deep-seeding>)

PA Bulletin, **Chickpea harvest and seed storage** (http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf)

PA Bulletin, **Irrigated chickpea management** (http://www.pulseaus.com.au/storage/app/media/crops/2010_SPB-Chickpea-irrigation.pdf)

Pulse traders (<http://www.pulseaus.com.au/marketing/pulse-traders>)

Crop protection products (<http://www.pulseaus.com.au/growing-pulses/crop-protection-products>)

Department of Agriculture and Fisheries Qld (DAF)

Management of root lesion nematodes in the northern grain region (https://www.daf.qld.gov.au/__data/assets/pdf_file/0010/58870/Root-Lesion-Nematode-Brochure.pdf)

Helicoverpa management in chickpea (https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/76739/HelicoverpaManagement-InChickpea.pdf)



Faba bean

Crop management

Many dryland and irrigated grain growing areas are well suited for faba bean production. All varieties are suitable for stockfeed or human consumption. However, in some warmer and drier environments, seed size and colour could limit the potential to achieve human consumption market specifications. The highest yield potential is achieved on deep, neutral-alkaline, well-structured soils. Avoid shallow, acidic (less than pH_{Ca} 5.2) or light to sandy textured soils with poor water holding capacity.

Good soil and paddock drainage is preferable, however, faba bean can withstand short periods of waterlogging much better than chickpea, field pea or lupin. If possible, locate crops at least 500 m from faba bean stubble to reduce disease risk. In northern NSW, faba bean should be sown on a minimum of 100 mm plant available water (PAW) at sowing.

Most pulses in southern NSW are grown in soils where pH stratification (acid soil layers) can affect root growth, nodulation, crop vigour and yield potential. Severely acidic layers ($\text{pH}_{\text{Ca}} < 4.5$) are common at depths of 5–10 cm and 10–15 cm in the main cropping soils of central and southern NSW. Check for acidic layers by sampling soils at 5 cm intervals to 20 cm deep two years before sowing acid-sensitive pulses.

Where acidity is detected below the surface soil, the most rapid method to increase pH is to incorporate fine-grade lime to 10 cm deep, at least 12 months before sowing faba bean.

Well-nodulated faba bean enhances soil nitrogen levels and breaks weed and disease cycles in cereal crop rotations. With adequate moisture, it can be sown immediately following maize, sorghum or cotton, provided no residual herbicides that damage faba bean have been applied in the preceding crop.

The optimum temperature range for growth is 15–25 °C, with flowering ideally from July to late September. Flowering could start as soon as June if crops are sown early and can extend to mid October in southern NSW. High temperatures and hot, dry winds during flowering will reduce yield potential. Severe frosts following mild weather often causes elongating stems to develop a bent stick (hockey stick) appearance, blackened leaf margins and aborted flowers and pods in some varieties.

Faba bean is an open-pollinated crop, so out-crossing from one variety to another can occur. If retaining faba bean for seed, put as much distance as possible to separate crops of different varieties to reduce any out-crossing and varietal contamination.

Introducing beehives to paddocks at flowering has been shown to benefit pod set and increase yields in areas where there are low, naturalised honey bee or native bee populations.

Grain yield potential and nitrogen benefit are closely related to growth – the more dry matter produced, the higher the potential yield and the more nitrogen added to the soil.

Plant residues, particularly lost grain left after harvest, can provide valuable grazing with no stock health risks. Adhere to harvest withholding periods (WHP) for all herbicides, insecticides and fungicides applied to the crop.

Sowing

Seeds are relatively large and flat compared with cereal seed. Some equipment cannot successfully sow seed of this size and shape. It is important to test equipment with inoculated seed before sowing as the peat carrier increases seed bridging in planter boxes and air seeder bins. Ensure the air seeder sowing boots and hoses are large enough to handle large seeds. Check with machinery manufacturers, but sowing at a slower ground speed will reduce the chance of hose blockages and ensure air seeders have enough airflow to push the seed

evenly to the sowing boot. Ideally, sow faba bean into cereal stubble for maximum nitrogen fixation, rotational benefits and to minimise aphid infestation. Wider sowing row spacing can improve stubble flow.

Faba bean is generally sown 4–6 cm deep, depending on soil moisture, but it can be sown up to 12–13 cm deep if needed. Deep furrow or moisture-seeking techniques can be used to sow on time. The large seed size makes faba bean very suitable for this type of sowing system. Deep sowing can also reduce potential effects on crop establishment from post-sowing, pre-emergent herbicides. Under furrow-irrigated conditions, it is best to sow shallow (2–3 cm) and water the crop up.

Sowing time

Aim to sow in the earlier part of the sowing window to maximise yield potential. However, avoid sowing earlier than the suggested sowing times, particularly under irrigation, as this can promote excessive vegetative growth and consequently increase crop lodging and foliar diseases. Sow irrigated crops in southern NSW in early to mid May. See Table 54 below for the suggested sowing time for different regions.

Table 54. Suggested sowing times

Variety	Week	April				May				June			
		1	2	3	4	1	2	3	4	1	2	3	4
Northern													
Narrabri–Boggabilla													
Walgett–Coonamble													
Liverpool Plains													
Central West													
Dubbo–Warren													
Cowra–Forbes													
Central and Southern													
Temora–Wagga; Wagga–Lockhart													
Griffith–Hillston (irrigated)													

- Best sowing time
 ■ Earlier or later than recommended, yield reduction likely.

Your calculation

100 seed weight # (grams)		target plant population		establishment percentage*	×	germination percentage		
.....	×	.....	×	1000 ÷	.....	×	.....	= your sowing rate kg/ha

To determine your seed weight, weigh 100 seeds in grams.

* Establishment percentage – 90% is a reasonable estimate, unless sowing into adverse conditions.

Table 55. Sowing rates for faba bean varieties

Sowing rates	Average 100 seed weight (g)	Seed rate (kg/ha) 20 plants/m ²	Seed rate (kg/ha) 30 plants/m ²
Establishment %		90	90
Doza	50 (40–60)	111	166
PBA Warda	55 (52–57)	122	183
PBA Nanu	59 (57–61)	131	196
PBA Nasma	61 (58–64)	135	203
PBA Bendoc	64 (50–72)	142	212
Fiesta VF, Farah, Nura,	68 (60–75)	151	226
PBA Marne, PBA Samira	74 (61–87)	164	246
PBA Rana, PBA Zahra	75 (65–85)	167	250

Note: Calculations based on 100% seed germination and 90% establishment.

Table 56. Sowing density

Plant population target	Plants/m ²
North dryland	15–25
North irrigated	15–20
South dryland	20–35
South irrigated	20–30

Sowing rate

Sowing rates for faba bean vary according to seed size, germination percentage, sowing time and region. Over a wide range of plant populations under favourable conditions, faba bean can yield well as it has the ability to compensate and fill in plant rows. Trials conducted in northern and southern NSW under dryland conditions show that plant densities below the recommended populations reduce yield in most years. Later-sown crops require a higher plant population to minimise potential yield loss. A 20 plants/m² plant population has been acceptable on a 50–100 cm row spacing in northern NSW dryland crops and southern NSW irrigated crops. Plant populations of 20–35 plants/m² are required for southern NSW dryland crops, depending upon sowing time.

Inoculation

Inoculation is essential on all soil types. Use the commercially available faba bean inoculant (Group F). Faba bean rhizobia are very sensitive to soil acidity. Some products are more sensitive to drying out than others, so ensure seed is sown into good soil moisture, especially when moisture seeking. Calibrate the planter using inoculated seed. To optimise all stages of the nodulation process, follow all the manufacturer's guidelines regarding storage and inoculant application.

Nutrition

Phosphorus (P) is the main nutrient that faba bean requires. Apply P fertiliser on deficient soils at equivalent rates to that used on cereals. Phosphorus is best banded close to, but not in direct contact with, the seed at sowing, especially in soils that have grown rice within the previous two years. Yield responses to zinc have been recorded on alkaline clay soils, but only where zinc had not been applied to other crops in the rotation. Select paddocks with a low level of residual nitrogen to promote effective nodulation and nitrogen fixation. Consider applying molybdenum to acid soils to aid nodulation. Fifty grams of actual molybdenum per hectare applied every five years is recommended.

Variety selection

When selecting a variety consider season length, seed size with reference to sowing machinery, disease tolerance, seed availability and suitability to markets. A number of varieties are available, with different characteristics and most are suited to specific growing regions in NSW. Carefully select varieties based on local data.

Table 57 below lists the variety characteristics.

Resistance classifications: R – resistant; MR – moderately resistant; MS – moderately susceptible; S – susceptible.

Table 57. Variety characteristics, yield performance and reactions to disease

Variety	PBR	Maturity	Seed colour	Seed size (g/100 seeds)	Disease			North				South			
					Ascochyta	Chocolate spot	Rust	Yield as % of PBA Warda		Yield as % of PBA Warda		Yield as % of PBA Samira		Yield as % of PBA Samira	
								East 3.03 t/ha	Trial no.	West 2.28 t/ha	Trial no.	East 2.65 t/ha	Trial no.	West irrigated 4.08 t/ha	Trial no.
Doza	yes	early	light buff	40–60	VS	MS	MR–R	95	19	96	35	95	5	–	–
Farah	yes	mid	light buff	60–75	MR–R	S	S	–	–	–	–	97	11	89	6
Fiesta VF	no	mid	buff	60–75	MR–MS	S	S	–	–	–	–	98	11	92	6
Nura	yes	mid	light buff	50–65	MR–R	MS	MS	–	–	–	–	93	11	85	6
PBA Bendoc	yes	early–mid	light brown	50–72	MR–R	S	S	–	–	–	–	103	3	88	2
PBA Marne	yes	early–mid	light buff	61–87	MR–R	S	MR	104	3	–	–	102	11	99	6
PBA Nanu	yes	early	beige to brown	57–61	S	MS	MR–R	102	15	98	28	98	2	–	–
PBA Nasma	yes	early	beige to brown	61–79	S	MS	MR	101	20	99	36	103	8	100	5
PBA Rana	yes	mid–late	light buff	75–90	R	MS	MS–MR	–	–	–	–	89	11	94	6
PBA Samira	yes	mid	light buff	60–80	R	MS	MS	100	–	96	2	100	11	100	6
PBA Warda	yes	early	beige to brown	58–70	S	MS	MR–R	100	21	100	37	100	11	98	3
PBA Zahra	yes	mid–late	light buff	65–85	MR	MS	S	–	–	98	2	100	11	97	6

Yield results are a combined across sites analysis using PBA and NVT yield trials from 2014–2018.

– Insufficient data

VS Very susceptible MR Moderately resistant

S Susceptible R Resistant

MS Moderately susceptible

Northern NSW

Doza[®]. Released in 2008 by Pulse Breeding Australia's (PBA) northern faba bean breeding node at Narrabri. It is better adapted to warmer spring temperatures than Barkool, Cairo[®] and Fiord; higher yielding than Cairo[®], with improved rust resistance. Smaller seed than Cairo[®], but more uniform; coloured light buff. Not generally recommended for southern NSW where *Ascochyta* is a major constraint. Licensed to Seednet; available through local seed suppliers. EPR is \$3.63/tonne incl. GST.

PBA Warda[®]. Released in 2012 for the northern region with higher yield and bigger seed than Doza[®]. Best adapted to eastern areas with higher rainfall. Similar to Doza[®] for earliness, chocolate spot and rust resistance, but has better tolerance than Doza[®] to *Bean leafroll virus* and vegetative frost damage. Its seed is more uniform and bigger than Doza[®] making it suitable for the human food market. Licensed to Seednet. EPR is \$3.85 /tonne incl. GST.

PBA Nasma[®]. Released in spring 2015 for northern NSW and southern Queensland with a higher yield than PBA Warda[®]. Larger and more uniform seed than PBA Warda[®], making it readily acceptable into the human consumption market. Flowering, maturity time, resistance to chocolate spot and frost tolerance are similar to PBA Warda[®]. It also has improved resistance to *Bean leafroll virus* over PBA Warda[®]. Rust resistance is slightly inferior to Doza[®]. S to *Ascochyta*. Licensed to Seednet. EPR is \$3.85/tonne incl. GST.

PBA Nanu[®]. (coded IX486/7-6). New release. Released in spring 2018. A new variety for the northern region and highest yielding in the state's north-west. It has good overall resistance to disease and is MR–R to rust and MR to *Bean leafroll virus*. It is similar to other northern varieties and is MS to chocolate spot. PBA Nanu[®] seed is smaller than PBA Nasma[®], but is larger than PBA Warda[®] so more suited to Middle East markets. Licensed to Seednet. EPR is \$3.85/tonne incl. GST.

Southern NSW

Farah[®]. Selected from Fiesta VF with improved resistance to *Ascochyta*. Similar agronomic characteristics and yield to Fiesta VF. Improved *Ascochyta* resistance will lower the level of *Ascochyta*-stained seed compared with Fiesta VF. Reduced environmentally stained seed and improved seed size uniformity. Licensed to Heritage Seeds; available through local seed suppliers. EPR is \$3.30/tonne incl. GST.

Nura[®]. Released in 2005 from the southern node of the National Faba Bean Breeding Program. Produced from a cross between Icarus and Ascot and selected for improved resistance over Fiesta VF to both chocolate spot and *Ascochyta*. Later flowering than Fiesta VF, however, it has similar maturity. Suited to the medium–high rainfall areas of southern NSW; not recommended for northern NSW. Shorter height than Farah[®] and Fiesta VF and less likely to lodge. Seed is slightly smaller than Farah[®] and coloured light buff. Licensed to Seednet; available through local seed suppliers. EPR is \$3.30/tonne incl. GST.

PBA Rana[®]. Released in 2011. Suited to the higher rainfall, longer season growing areas. Mid–late flowering, with improved resistance to chocolate spot compared with Farah[®] and R to *Ascochyta*. Large, plump, light-brown seed that is bigger than current varieties. Investigate marketing options as PBA Rana[®] needs to be segregated to achieve a premium for its larger seed size. Licensed to Seednet. EPR is \$3.85/tonne incl. GST.

PBA Samira[®]. Released in spring 2014. Adapted to a wide range of environments in the southern region. It is mid–late flowering, but matures at the same time as Farah[®] and Fiesta VF. R to *Ascochyta*, including the new strain that was recently identified in the Mid North of South Australia. Seed is slightly larger than Farah[®] and Fiesta VF, but the same colour and should be suitable for co-mingling with other varieties for human consumption. Licensed to Seednet. EPR is \$3.85/tonne incl. GST.

PBA Zahra[®]. Released in spring 2015. Selected for the southern region where it has shown very high yield potential and is particularly responsive to high-yielding situations. R to *ascochyta* blight in most districts in the southern region, although MS–MR to a new pathotype in the Mid North region of South Australia. Less susceptible to chocolate spot and rust than Fiesta and Farah[®]. Flowers at the same time as Nura[®] and PBA Samira[®], but can mature slightly later under conducive seasonal conditions. Large, plump seed, similar to PBA Rana[®]. The two varieties could be co-mingled for a large-seeded category for the Middle East market. Licensed to Seednet. EPR is \$3.85/tonne incl. GST.

PBA Bendoc[®]. (coded AF15369) New release. The first faba bean variety with tolerance to imidazolinone herbicides. A minor use permit is currently available for applying imazamox and a further permit for an additional herbicide is being sought for 2019. PBA Bendoc[®] is adapted to southern NSW, Victoria and SA. It is

MR–R to both pathotypes of ascochyta blight, but S to chocolate spot. It is later than Fiesta VF and Farah[®] and flowers at the same time as Nura[®] and PBA Samira[®]. Seed is a similar size to Nura[®] and suited to the Middle East market. PBA Bendoc[®] is not recommended for northern NSW as it is not adapted to the short growing season and is S to rust. Very limited data for southern NSW and irrigation. Licensed to Seednet. EPR is \$4.29 /tonne incl. GST.

PBA Marne[®] (coded AF09169) New release. PBA Marne[®] is adapted to the lower rainfall or shorter season environments of southern NSW, Victoria and SA. It is MR–R to the old pathotype of ascochyta blight, but MR–MS to the new pathotype found in SA. It is more resistant to rust than other southern varieties and is classified as MR. However it is S to chocolate spot. PBA Marne[®] has good stem strength and standing ability. Seed is similar in size to PBA Samira[®] and should be suitable to co-mingle with other major varieties for the Middle East market. Commercialised by Seednet. EPR is \$3.85 /tonne incl. GST.

Irrigation

Faba bean is grown in rotation with irrigated summer crops such as cotton, rice, maize or sorghum. Faba bean is a safe crop to sow dry and water up on either beds or hills. To increase rhizobium inoculum survival, dry-sown beans should be watered immediately after sowing. Always ensure good seed-soil contact.

North

Plant population can be lowered to 15 plants/m² without yield penalties, provided plant establishment is even. In short-season northern areas, one irrigation at early pod-fill (early–mid August) might be all that is required. Avoid irrigating before flowering as often tall, vegetative, low-yielding crops can result.

South

Plant population can be lowered to 20 plants/m² without yield penalties, provided plant establishment is even.

Apply the first spring irrigation early to avoid stress during flowering and early pod-filling as delays will reduce yield potential. Follow-up irrigations can be scheduled according to plant water use. Although the crop tolerates some waterlogging, a good layout is essential and irrigation times should be kept as short as possible for high yields.

Furrow irrigation is preferred over spray irrigation as overhead watering encourages more foliar disease. Border check layouts increase the risk of waterlogging during and after irrigation. In these layouts, irrigation and drainage should be complete within eight hours.

Weed control

To maximise rotational benefits, effective weed control is essential. Herbicides can damage faba bean, so use only registered products and follow the label directions.

Plants weakened by herbicide injury are more susceptible to diseases, especially chocolate spot. The most common problems come from residual herbicides applied to preceding cereal crops, but non-residual herbicides have also been implicated.

1. **Sulfonylurea herbicides** (triasulfuron, chlorsulfuron, metsulfuron methyl, metosulam) applied to preceding cereal crops. Take special note of label instructions concerning crop rotation and plant-back periods, particularly on high pH and/or compacted soils where rainfall has been limited. Residues could persist longer in soils that have received surface-applied lime to raise soil pH.
2. **Clopyralid** applied to preceding cereal crops and summer fallows. Clopyralid can carry over in straw and affect subsequent crops.
3. **Atrazine** applied at full rates to preceding maize and sorghum crops. Check the label for crop rotation guidelines.
4. **Picloram** and **aminopyralid** formulations e.g. Grazon™ Extra and FallowBoss® or Tordon® applied to previous summer fallows. Under dry conditions the breakdown of these fallow herbicides is reduced and subsequent crops can suffer herbicide injury.
5. **Triazine herbicides** (simazine, cyanazine, terbuthylazine) applied in-crop can potentially cause crop damage in some circumstances – application rates influence herbicide action on different soil types. Follow label recommendations and avoid spray overlaps.

In addition, some spray oils used with post-emergent selective grass herbicides can cause minor leaf spotting and/or burning; do not confuse these with disease symptoms.

READ PESTICIDE LABELS

and the NSW DPI guide *Weed control in winter crops* (www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops) for further information on current weed control recommendations, plant-back periods and correct spray unit decontamination procedures.

Correct boomspray decontamination procedures must be followed to avoid potential herbicide injury.

Be aware of the plantback periods for the post-sowing pre-emergent herbicides (e.g. imazethapyr – Spinnaker®) used in faba bean crops as these can affect subsequent crops, especially other non-pulse broadleaf crops such as sunflowers and canola.

Read pesticide labels and the NSW DPI guide *Weed control in winter crops* for further information on current weed control recommendations, plant-back periods and correct spray unit decontamination procedures.

Insects

A range of pests can attack faba bean plants and pods, but all these pests have natural enemies that can help keep them in check. Monitoring pest and beneficial populations will show if chemical control is needed as it is important in improving crop health and vigour, and in reducing the crop's susceptibility to foliar disease. The **two critical times** when pests need monitoring are at establishment and from flowering to harvest.

Redlegged earth mite and **blue oat mite** – large populations can cause distorted early growth and can kill seedlings. The rasping of the leaf surface during feeding results in a distinctive silvery on the leaves. Areas can redden and be confused with early disease infection.

Lucerne flea – damage is characterised by clear membranous windows chewed into leaf surfaces. It is a sporadic pest in the paddock, so not all the crop will be infested. Hot spots can occur along weedy fence lines and around trees and rocky outcrops in paddocks. A border spray around crop boundaries will often be enough to control lucerne flea.

Detecting and controlling mite and flea damage early improves crop health and vigour, reducing the crop's susceptibility to foliar diseases.

Aphids – monitor from early establishment. Dense colonies of cowpea aphid (*Aphis craccivora*), consisting of shiny black adults and dull grey juveniles, often damage shoot tips early in the season and can reduce yield. Cowpea aphid is a vector of several virus diseases. Pea aphid (*Acyrtosiphon pisum*) and blue green aphid (*Acyrtosiphon kondoi*) are large green aphids that are less conspicuous on plants. They are not known to cause major feeding damage. However, out of all the colonising and visiting aphids, pea aphid is the most damaging as it is an important vector of virus diseases in faba bean.

The identification of the bean aphid (*Megoura crassicauda*) at Tamworth and on the Liverpool Plains is potentially of great importance to the Australian faba bean industry. A native of north-east Asia (Korea, Japan, Siberia), this aphid species was only described in Australia in 2016 when it was found on broad beans in a Sydney home garden.

Observations during the 2017 and 2018 seasons at the Liverpool Plains Field Station show this aphid to have an extremely fast reproduction rate and an ability to create large colonies on faba bean plants in just a few days. Host preference trials at Tamworth are ongoing, but indicate that the aphid has a very limited host range. Faba bean is its preferred host, but it can survive on a number of vetch species and also feeds and multiplies on field pea. The aphid does not feed on chickpea, lupin or lucerne. Its risk to the faba bean industry is primarily through feeding damage, but preliminary virus transmission studies have demonstrated its ability to be a vector for a number of non-persistently transmitted viruses such as *Bean yellow mosaic virus* (BYMV) and *Pea seed-borne mosaic virus* (PSbMV).

The aphid has not been found in commercial crops, but growers and advisers should report any suspicious aphid activity.

Thrips – monitor from early establishment. Thrips feeding can damage seedlings and high populations can cause seedling death. Fields sown close to cotton often have high populations. Thrips can cause flower and early pod abortion and should be monitored regularly during flowering. Thrips can also spread *Tomato spotted wilt virus* in faba bean.

Mirids – green mirids are pod-sucking insects. Monitor crops from early pod-fill for nymphs and adults. Mirids have been shown to cause spotting on the seed coat and, in high populations, reduce seed size. Mirids are quite mobile within the crop and currently there are no spray thresholds.

***Helicoverpa* spp. (Heliothis)** – base control decisions on regular monitoring. Crops should be monitored twice weekly from flowering onwards. Larvae feed on leaves, stems and pods. Once they are of sufficient size, larvae burrow into pods and feed on the developing seed. Human consumption markets have strict limits on *Helicoverpa*-damaged seeds, so spray thresholds of one larva per square metre warrant control. Early-sown crops can mature before *Helicoverpa* moth infestation, avoiding the need for control. *Helicoverpa* spp. can develop resistance to certain insecticides, so check the resistance status for your region.

The recommended strategy for limiting resistance is:

- check crops regularly to detect eggs and small caterpillars
- correctly identify the species present
- spray caterpillars when they are less than 10 mm long
- rotate insecticides from different chemical groups according to the *Helicoverpa* strategy for each region.

See the NSW DPI guide [Insect and mite control in field crops](http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops) for more detailed information on pest control measures and thresholds.

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NSW DPI guide [Insect and mite control in field crops](http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops)
(www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops)

Disease management

Proactive decisions will help to manage disease risks. Monitoring from emergence for disease, especially during favourable conditions, is crucial. Effective disease control depends on strategic fungicide use, but careful attention to other management practices can reduce disease pressure, making the fungicide program more effective, including:

- growing faba bean no more than once in four years in the same paddock
- separating crops by 500 m from the preceding faba bean crops
- reducing disease-infected stubble load by grazing and/or incorporating
- controlling volunteer faba bean
- using clean ascochyta blight-lesion-free seed
- growing locally adapted varieties that are the most resistant to the major regional diseases.

Fungicide control

Seven fungicides – mancozeb, carbendazim, chlorothalonil, copper, metiram, tebuconazole and procymidone are all registered. Tebuconazole is available under permit ([PER13752](#), expiry 30/06/24). Check pesticide permits and registrations for any changes in use patterns before using fungicides. Mancozeb, chlorothalonil, metiram and copper are protectants and have no curative action on existing infections. Newly grown, untreated foliage will not be protected. Carbendazim, procymidone and tebuconazole have limited curative action and work best when applied before infection occurs. These fungicides are not translocated from sprayed leaves so foliage that grows after spraying is not protected.

Spray on time

Organise spraying ahead of schedule so that fungicides can be applied as soon as a decision is made. Frequently viewing the four-day weather forecasts can help decision making. Do not compromise a fungicide spray to wait for a herbicide application. Plan to spray one or two days before a significant rain period, but do not delay spraying because of the threat of rain. Light rain (less than 12 mm) can actually increase mancozeb efficacy. For ground application, aim for 100 L water/ha. If the label or permit specifies a minimum water rate, the fungicide must be applied at that specified water rate. Correctly timing fungicide application is essential for good disease control.

Ascochyta blight, chocolate spot and rust management (southern NSW)

Research and commercial evaluation have shown that strategic spraying with mancozeb, carbendazim, chlorothalonil or procymidone is effective for disease management.

The recommended program includes applying mancozeb 4–6 weeks after emergence to control *Ascochyta* and early chocolate spot. Mancozeb, carbendazim, chlorothalonil or procymidone is then applied for continued chocolate spot control throughout the growing season. Under registration restrictions, carbendazim must not be applied for more than two consecutive sprays and should be rotated with other fungicides. The number of sprays depends on the number of infection periods (i.e. rain). Monitor crops regularly in spring for chocolate spot development, which can be rapid under favourable conditions (i.e. mild temperatures and frequent rain).

Fungicides are effective for up to 14 days. Severe disease pressure will reduce the protection period, as will rapid growth, which will be totally unprotected. A final spray of mancozeb should be considered for rust and late control of *Ascochyta*, which can cause blemishes on the seed. Use mancozeb or chlorothalonil earlier if rust becomes a problem, as carbendazim has no control of this disease.

Mancozeb or chlorothalonil are broad-spectrum fungicides and might need to be used throughout the season on varieties that are susceptible to *Ascochyta*. This is particularly important when producing grain for whole-seed markets, as *Ascochyta* staining will cause downgrading.

Be aware of the critical spray application times as part of an overall fungicide program. This includes:

1st critical period – 4–6 weeks after emergence.

2nd critical period – during early flowering just before canopy closure. This is the last opportunity to apply fungicides that will penetrate into the crop canopy and protect potential infection sites from disease establishment and spread.

3rd critical period – at the end of flowering and early pod fill. Fungicide applications at this time should be aimed at protecting developing pods and preventing any further disease spread. The target diseases at this time are ascochyta blight, chocolate spot and rust. An insecticide might also be required during this period.

Disease management (northern NSW)

Rust and chocolate spot are the main diseases in the northern region

To manage both diseases:

- control volunteer faba bean over summer
- select paddocks as far from preceding faba bean crops as possible (preferably at least 500 m).

Apply a mancozeb spray 4–6 weeks after crop emergence or before significant rain or canopy closure. This can be combined with a grass herbicide spray if the timing is correct for both products. This early spray is critical and will help to control early chocolate spot and rust infection.

Monitor crops for signs of rust and chocolate spot. It is very important to protect the crop during flowering and early pod set.

During 2016, high incidences of stemphylium blight were noted in several paddocks. Initial research indicates that this disease will only be a problem in years with very high rainfall. There are large differences in susceptibility among faba bean genotypes, with the newly released PBA Warda[®] among the more susceptible. Currently no advice can be given on fungicide use to control stemphylium blight.

Spraying just before canopy closure is more effective than after as the fungicide can still reach the lower parts of the plant. Mancozeb is the preferred fungicide for disease control in northern NSW, because of its proven effectiveness against rust.

Tebuconazole has excellent action on rust, but limited activity on chocolate spot. It is therefore advisable to only use tebuconazole if rust is detected in the crop.

Note that the permit ([PER13752](#), expiry 30/06/24) restricts the number of applications to three only in any one season.

At late crop stages consult your agronomist, as disease levels, seasonal conditions and outlook, crop development stage, yield potential and grain prices determine spraying economics. In Doza[®], PBA Warda[®] and PBA Nasma[®] crops it is likely that chocolate spot will be the main disease present, in which case carbendazim or procymidone are the most effective fungicides when a second fungicide spray is necessary. Identify the disease correctly before choosing a product.

In wet seasons, chocolate spot can become a problem in its own right and additional sprays could be warranted. Consult your agronomist.

Virus disease management

Virus diseases in faba bean crops can be a problem throughout NSW, even though varieties released for the north have greatly improved resistance compared with older varieties. Disease management still depends on reducing aphids entering the crop and spreading the viruses they picked up from other host plants.

Table 58. Disease and crop injury guide – faba bean

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Foliar diseases				
Ascochyta blight <i>Ascochyta fabae</i>	Small, grey, circular leaf spots, showing through both sides of the leaf, developing light brown centres with age. Under humid conditions lesions become dotted with black specks. The disease also causes stem breakage and pod lesions, which result in seed discolouration.	Wet conditions in mid to late winter or when late rains occur before harvest and cause pod infection.	Spores spread by wind and rain splash. Infected seed, faba bean residues and volunteer plants are sources of initial infection.	Disease-free seed. Crop rotation. Destroy or incorporate infected stubble. Locate crops at least 500 m from last year's faba bean crop. Control volunteer plants. Use resistant varieties. Foliar fungicides.
Chocolate spot <i>Botrytis fabae</i>	Leaf spots are initially reddish-brown, pin-head sized and on one side of the leaf only. Under suitable conditions spots expand into large, irregular, black, dead areas, expanding onto the stem. Flowers and pods can also be affected.	Extended (>day) periods of leaf wetness. Favoured by mild temperatures 15–20 °C, which can rapidly spread the disease.	Infected faba bean residues. Infected volunteer plants. Spores spread by wind and rain.	Use resistant varieties, foliar fungicides, crop rotation and good crop hygiene. Locate crops at least 500 m from last year's faba bean crop or from wind-blown stubble residues. Control volunteer faba bean.
Rust <i>Uromyces viciae-fabae</i>	Several spore stages can appear on leaves, stems and sometimes pods at the same time. Early on, creamy-yellow pustules form on leaves. These are soon replaced by orange-brown pustules. Later, black spore masses develop on stems.	Only a short period of leaf wetness during the night (such as a heavy morning dew) is needed for infection to occur. Infection can occur under a wide range of temperatures, but disease development is favoured by high (>20 °C) temperatures and therefore of more importance in northern NSW and towards the end of the season in southern NSW.	Infected volunteer plants are high risk. Infected faba bean residues.	Use resistant varieties. Foliar fungicides. Locate crops at least 500 m from last year's faba bean crop. Control volunteer faba bean. Crop rotation.
Stemphylium blight <i>Stemphylium</i> spp.	Large grey-black necrotic lesions restricted to leaves only, often starting from the leaf edge.	Extended periods of leaf wetness.	Survival on crop residue is likely. Seed transmission has been demonstrated.	There is little information on the relative value of different fungicides, however it is likely that fungicide application will help to control stemphylium blight. Growers are advised to continue with normal fungicide programs.
Viral diseases				
Virus yellowing diseases: <i>Bean leafroll virus</i> (BLRV), <i>Soybean dwarf virus</i> (SbDV), synonym, <i>Subterranean clover redleaf virus</i> , <i>Subterranean clover stunt virus</i> (SCSV)	Yellowing, interveinal at first, and often prominent at shoot tips. Leaves are stiffer than normal and often rolled upwards at the edges, pointing upwards. Infected plants are usually stunted and often die prematurely.	Seasons or districts with major aphid flights.	These viruses survive in weeds and pastures, particularly in forage legumes. All are spread by aphids and are persistently transmitted (aphids remaining infective for four days or longer).	Follow best management recommendations including: retaining standing cereal stubble (deters aphids), using recommended sowing rates, sowing on time, and controlling weeds. The systemic seed-applied insecticide imidacloprid will provide early control against these viruses. Poorly established, weedy crops suffer most from viruses. If detected early, controlling aphids with a registered aphicide can be beneficial for limiting virus spread. Seek advice from your agronomist.
Virus mosaic diseases: <i>Bean yellow mosaic virus</i> (BYMV), <i>Alfalfa mosaic virus</i> (AMV)	Leaves show mosaic, dark green colour against a pale green or yellow background. Leaf texture is abnormal, ranging from uneven to crinkled. Early infection by BYMV can lead to reduced pod set and to pod discolouration. Late infection is unlikely to lead to yield loss. Combined BYMV and AMV infections can be lethal to faba bean.	Seasons or districts with major aphid flights.	These viruses survive in weeds and pastures, particularly in forage legumes. BYMV and AMV are spread by aphids and are non-persistent, lasting no more than four hours in aphids and usually less.	Follow best management recommendations including: retaining standing cereal stubble (deters aphids), using recommended sowing rates, sowing on time, and controlling weeds. Poorly established, weedy crops suffer most from viruses. Foliar- or seed-applied insecticides are not reliable for controlling these non-persistently transmitted viruses.
Necrosis: <i>Tomato spotted wilt virus</i> (TSWV)	Large dark lesions are formed on the leaves and later dark brown streaks develop on the upper stem, often on one side. The shoot's growing point is often killed. Seed production from affected plants is severely reduced.	Common in some years in northern NSW, but incidence is yet to exceed 5% of infected plants.	TSWV survives in weeds and is spread by thrips. The western flower thrips is the most effective vector.	No proven control.
Herbicide injury				
Group A such as fops and dims	Grey or brown spotting or burning on the upper sides of leaves, which can be confused with diseases such as chocolate spot.	More common where cheap oil adjuvants are added to post-emergent grass herbicides.		Follow label recommendations and only use adjuvants specified on the label.
Group B such as sulfonyleureas (SUs)	Seedlings become stunted, stem and leaf margins blackened, leaflets cupped and lateral root growth reduced. Plants often die.	Related to use of pre- and post-emergent herbicides. Alkaline soils increase risk of injury. Alkaline soils or sandy soils, low in organic matter.		Follow label recommendations especially plantback periods, soil pH and minimum rainfall requirements. Avoid spray overlaps and drift.
Group C such as triazines	Leaves blackened and die back from edges and tips.	Shallow sowing. Wet conditions following application to dry soil.		Follow label recommendations especially plantback periods. Avoid spray overlaps and drift.
Group I such as phenoxys	'Hormone-type' injury including abnormal leaves.	Related to herbicide use in previous crops and fallows, also drift from neighbouring crops.		Follow label recommendations and be aware of rainfall and soil pH requirements in plantback periods.

Crop management techniques to reduce aphids entering faba bean crops include:

- retaining standing cereal stubble to deter aphids
- sowing at the recommended times for your district but, where possible, avoiding autumn flights of aphids
- sowing at recommended sowing rates for early canopy closure
- separate faba bean crops from lucerne pastures, which act as reservoirs for aphid species that transmit viruses to faba bean.

Research on controlling aphids in crops and reducing virus transmission through insecticide application is continuing, however, no clear thresholds have been determined for the different viruses and the type or number of aphids infesting faba bean crops. The systemic seed-applied insecticide imidacloprid is registered for faba bean and will provide early control of aphid feeding and prevent infection from persistently transmitted viruses such as *Bean leafroll virus* (BLRV). Growers should consult their agronomist if considering either a seed dressing and/or a foliar insecticide. Ensure that the viral disease is correctly identified before deciding to apply any insecticides.

Harvesting

Faba bean should be harvested to give 14% seed moisture at delivery into storage. At this stage, the crop will be black, although some top growth could still be green. If the pod splits and the seeds become exposed, they can be discoloured by sunlight or stained by rainfall. It is preferable to harvest the crop before the seed changes colour, is stained, becomes brittle or splits, particularly for human consumption markets.

Faba bean can be windrowed, potentially allowing an earlier harvest and to reduce harvest problems from crop lodging and late-maturing weeds.

Harvest efficiency surveys in northern NSW showed windrowed crops had less grain losses than direct heading, but were not always more profitable due to the extra costs of windrowing. In large biomass crops, windrowing faba bean crops can be beneficial as it quickens crop dry-down and allows crops to be harvested before rainfall. Consider windrowing for higher yielding crops.

Windrowed faba bean samples can contain more dirt, especially if rain falls on the windrow. Where possible, avoid placing windrows onto deepened wheel tracks where controlled traffic farming systems are used.

Swath width might need adjusting according to crop biomass. Large bulky windrows will result in slower dry-down time, delaying harvest. In seasons with low crop biomass, avoid windrowing as small windrows might not pick up well and the extra cost will not be recouped. Crops can appear green at the correct windrow timing; determining windrow timing is relatively simple. See Pulse Point 9 **Windrowing faba bean** for more detailed information.

Faba bean pods thresh easily so reduce rotor speed to 400–600 rpm and set concave clearance at 15–35 mm to reduce mechanical damage to the grain. Remove blanking plates and alternative wires from the concave so that the grain is not cracked, as separation can occur at the concave. Use a top sieve of 32–38 mm and a bottom sieve of 16–19 mm.

Grain damaged during harvest or subsequent auger movement can be downgraded and have a lower germination percentage and lower seedling vigour. Rotary harvesters and belt conveyers are gentler on the grain and generally cause less grain damage than conventional augers.

Marketing

The majority of the Australian faba bean crop is exported for human consumption, mostly to Egypt, but also to Saudi Arabia, Indonesia and the United Arab Emirates. Around 10% is retained domestically for stockfeed and some is split for human consumption. It is difficult to achieve food quality standards where disease or insects have not been controlled, or after prolonged storage.

Australia cannot compete on price with other exporters, but has other advantages. We are reliable shippers, have low moisture content grain, and harvest in the northern hemisphere's offseason. Northern NSW- and southern Queensland-grown crops often have smaller seed than the main growing areas in southern Australia. This situation has improved somewhat with the release of the larger seeded variety, PBA Nasma[®]. Small seed is a marketing disadvantage, however, good quality grain marketed before the southern harvest can achieve human

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The **current marketing specifications** (www.pulseaus.com.au/marketing/receival-trading-standards) for the different grades of faba beans can be found on the **Pulse Australia** (www.pulseaus.com.au/) website.

consumption export grade. After this window of opportunity, northern beans will normally be traded domestically at reduced prices.

Domestic uses of faba bean as a source of protein include the aquaculture, pig, poultry and horse industries and hence it competes with field pea, fishmeal, lupin, soybean meal and other protein supplements.

The **current marketing specifications** for the different grades of faba beans can be found on the **Pulse Australia** website.

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Further information

NSW DPI

Weed control in winter crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Insect and mite control in field crops (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops>)

Agfact P4.2.7, **Faba bean** (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157729/faba-bean-pt1.pdf)

Agnote DAI 128, **Honey bees in faba bean pollination** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/117110/bee-faba-bean-pollination.pdf)

Pulse Point 7, **Reducing your disease risk** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157144/pulse-point-07.pdf)

Pulse Point 9, **Windrowing faba bean** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0018/157203/pulse-point-09.pdf)

Pulse Point 12, **Seeding equipment problems with faba beans** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157306/pulse-point-12.pdf)

Pulse Point 20, **Germination testing and seed rate calculation** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf)

Primefact 1163, **Nitrogen benefits of chickpea and faba bean** (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/general-information/nitrogen-chickpea-faba-bean>)

GRDC

NSW DPI and GRDC Bulletin: **Legumes in acidic soils – maximising production potential in south eastern Australia**, (<https://grdc.com.au/resources-and-publications/all-publications/publications/2018/legumes-in-acidic-soils>)

Integrated Pest Management Factsheet (https://grdc.com.au/__data/assets/pdf_file/0031/225877/integrated-pest-management.pdf.pdf)

GRDC bookshop

Winter pulse disorders: The ute guide (GRDC) (<https://grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-40-wa/pinpointing-pulse-problems>)

Pulse Australia

Faba bean production: Southern and western region 2017–18 (<http://pulseaus.com.au/growing-pulses/bmp/faba-and-broad-bean/southern-guide>)

Australian Pulse Trading Standards (<http://www.pulseaus.com.au/marketing/receival-trading-standards>)



Field pea

Field pea is a valuable pulse crop rotation option in cereal farming systems. The crop fixes nitrogen from the atmosphere and conserves soil mineral nitrogen. It uses less subsoil water than other crops because of its shallower root system and earlier maturity. Growing field pea also increases flexibility for weed control and provides a break for cereal disease cycles. It is now commonly used as a brown manure crop providing a double-break crop, and is also grown for hay or silage in a forage mix with oats. Wheat yields after field pea are well above those of wheat after wheat, and increased wheat protein is common.

Field pea is suited to a wide range of soils from light to heavy textured and pH_{Ca} 4.5–8.0. The crop is sensitive to high soil-exchangeable aluminium levels and does not tolerate extended periods of waterlogging. Grain can be used for both stockfeed and human consumption. The critical management factors for producing high yields and good quality seed are:

- optimising plant density
- effective nodulation
- post-sowing rolling to flatten clods and stones
- weed and insect control
- timely harvest.



Figure 1. Map of NSW showing field pea growing zones

Sowing time

Field pea is one of the few crops that can perform from a later sowing window relative to other pulse crops, giving it the edge in dry autumns, plus an extended pre-sowing weed control period. However, yield potential will be maximised by sowing as early as possible within the recommended window for each region. Sowing too early increases the risk of disease and frost damage; delayed sowing increases the risk of moisture stress and high temperatures during the critical grain filling stage. The suggested sowing times shown in Table 59 apply to average to wet years. Grower experience and research over the past two decades clearly show positive yield responses from sowing up to two weeks earlier in dry seasons when disease in spring has not been a problem.

There is now a wider range of varieties available, with differing maturities and some with shatter-resistant pods. Growers should consider their preferred sowing window and select a variety that has a maturity to match. Any variety intended as a brown or green manure crop, or for hay, should be sown as early as possible within the recommended sowing window, to maximise dry matter production.

Table 59. Field pea sowing times

Region	May				June			
	1	2	3	4	1	2	3	4
Western zone								
Eastern zone								

■ Suggested only for the lower rainfall areas of zones or for hay crops

■ Preferred sowing time

■ Later than recommended, yield reduction likely

Sowing rate

Optimum plant populations vary depending on the height and vigour of the specific variety and on sowing time. Population targets for tall, vigorous, scrambling types such as Morgan, PBA Percy[®], or Sturt[®] can be as low as 30 plants/m² when sown early, or as high as 40 plants/m² when sown late. For hay/brown manure, establish at least 40–50 plants/m² to maximise biomass. For the shorter, less vigorous group of varieties (see Table 62. Variety characteristics and reaction to diseases on page 125) such as PBA Pearl[®] and PBA Oura[®], target 40 plants/m² with early sowing, increasing up to 60 plants/m² when sowing late. Kaspera type varieties with intermediate growth characteristics such as Kaspera[®], PBA Gunyah[®], PBA Twilight[®] and PBA Wharton[®] should be sown to establish 35–50 plants/m².

These establishment targets can only be achieved by considering seed size, germination and sowing conditions when calculating sowing rates. Also, consider the seedbed condition and adjust accordingly. Use Your calculation below to calculate the desired sowing rate based on target density, seed size, germination and estimated establishment percentage of your seed.

Air seeders can reduce germination and establishment, particularly with weather-damaged seed or seed with low moisture content. Larger, round-seeded varieties such as PBA Pearl[®] are particularly susceptible to impact damage from distributor heads and other hard surfaces, as their seed coats are less tightly attached to the cotyledons. Lowering the seeder's air speed reduces the impact of seed on the seed distributor heads and other hard surfaces. Adjust ground speed to avoid problems of seed and fertiliser blockages. Lowering the seeder's ground speed and air flow at sowing also reduces seed bounce and improves seed placement in the furrow, aiding establishment.

Table 60. Sowing rate (kg/ha) based on 100% germination and 80% establishment

Field pea type	Variety	Average 100 seed weight (g)	Target plant density/m ²			
			30	40	50	60
Tall scrambling	Morgan	18	68	90	–	–
	Sturt	19	71	95	–	–
	PBA Percy	23	86	115	–	–
Medium–tall semi-leafless	PBA Pearl, PBA Oura	22	–	110	138	165
Kaspera types	Kaspera, PBA Butler, PBA Gunyah, PBA Twilight, PBA Wharton	22	–	110	138	–

Your calculation

100 seed weight # (grams)	target plant population	establishment percentage*	×	germination percentage	
.....	.....	.....	×	.....	= your sowing rate kg/ha

To determine your seed weight, weigh 100 seeds in grams.

* Establishment percentage – 90% is a reasonable estimate, unless sowing into adverse conditions.

Sowing depth

Field pea should be sown 3–5 cm deep. They will emerge from deeper sowing (up to 7 cm) provided moisture is adequate for consistent germination. Do not sow dry or deep sow if there is uneven moisture, as crops will germinate unevenly, causing management difficulties (such as herbicide timing) for the crop. Crops sown later in the sowing window (for example due to a delay in sowing rainfall) should be sown shallower to improve germination under cold conditions.

Inoculation

Inoculation each season is essential on all soil types. Use the commercially available Group E field pea inoculant. Check for effective nodulation 6–10 weeks after sowing to ensure nodulation has been effective.

Take care with seed inoculation. If seed is to be treated with a fungicide, carry out this operation first and apply inoculant separately just before sowing.

Avoid inoculating directly into air seeder bins. Newly inoculated seed is often sticky and does not flow properly, leading to uneven seed flow in the bin, which causes blocked hoses and patchy establishment across the paddock. The seed will need to dry in the short period before being sown.

A number of new inoculant products are available for field pea, such as freeze-dried and dry granular products. Read and follow the instructions carefully to avoid inoculation problems.

Nutrition

Apply phosphorus (P) fertiliser at rates equivalent to those used with cereals (10–25 kg P/ha). Adjust the P rate according to paddock cropping history and potential crop yield for your area. A long history of phosphorus use can build up soil P levels; at high levels little or no additional P will be required.

Select paddocks with a low level of residual nitrogen to promote effective nodulation and nitrogen fixation. Consider applying molybdenum to acid soils to aid nodulation. Fifty grams of actual molybdenum per hectare applied every five years is recommended.

Paddock rolling

Rolling paddocks after sowing levels the ground and presses loose stones and sticks into the soil, avoiding header damage and grain contamination at harvest. Rolling can be carried out either directly after sowing or at the 2–3 node stage. Rolling after crop emergence has the advantage of avoiding crusting on soils prone to this condition, but can increase the chance of bacterial blight disease infection.

Variety selection

When selecting a variety consider seed type (white, dun, blue), varietal maturity and sowing date, disease resistance, standing ability, seed shattering resistance, ease of harvest, yield in your region, market outlets and seed availability. A large number of varieties are available, with a wide range of characteristics; some are only suited to specific growing regions in NSW and growers should select varieties carefully based on local data. For characteristics of the different varieties, refer to [Table 62](#).

Susceptibility abbreviations: R – resistant; MR – moderately resistant; MS – moderately susceptible; S – susceptible; VS – very susceptible.

Kaspa-type dun field pea

Kaspa[®]. Released in 2002 from the Australian Coordinated Field Pea Improvement Program. High yield potential in average to good seasons, but due to its late flowering, has performed poorly across southern Australia in harsh finishes. Dun seed type with round (no dimples) light brown–red seeds. It flowers seven days later than Parafield. MS to the new Kaspa strain of downy mildew, but MR to the Parafield strain; S to bacterial blight (*P. syringae* pv *syringae*), S to powdery mildew, *Pea seed-borne mosaic virus* (PSbMV) and blackspot. Licensed to Seednet. EPR is \$2.20/tonne incl. GST.

PBA Butler[®]. Released in 2017 by Pulse Breeding Australia (PBA). A Kaspa[®] seed type rated MR–MS to bacterial blight, similar to PBA Oura[®]. Mid–late flowering with early–mid maturity, erect, semi-dwarf, semi-leafless type. MS to black spot

and the Kaspas strain of both downy mildew strains, S to the Parafield strain. While broadly adapted, it performs best in medium- to long-season climates. Recommended for bacterial blight-prone regions. Licensed to Seednet. EPR is \$2.97/tonne incl. GST.

PBA Gunyah[®]. Released in 2010 by PBA. Higher yielding Kaspas type, adapted to the low- and medium-rainfall zones of southern and central western NSW. Similar plant type to Kaspas[®] with distinctive pink-white flowers, semi-dwarf and semi-leafless plant habit, medium height and early vigour. Starts flowering about five days earlier than Kaspas[®]. Flowers for longer than PBA Twilight[®] and Kaspas[®], particularly in shorter growing seasons. Matures earlier than Kaspas[®]. Sugarpod trait, resistant to pod shattering at maturity. Disease resistance similar to Kaspas[®]. S to powdery mildew, bacterial blight, PSbMV and blackspot, S to the Kaspas strain of downy mildew, but R to the Parafield strain. Produces a dun seed with spherical (non-dimpled) grain; marketed as a Kaspas type to suit Asian subcontinent human consumption requirements. Licensed to Seednet. EPR is \$2.75/tonne incl. GST.

PBA Twilight[®]. Released in 2010 by PBA. Adapted to the lower rainfall, short season climates of southern and central western NSW. Similar plant type to Kaspas[®] with distinctive pink-white flowers, semi-dwarf and semi-leafless plant habit, medium height and early vigour. Starts flowering about a week earlier than Kaspas[®]. Shorter flowering duration than PBA Gunyah[®], but longer than Kaspas[®], particularly in shorter growing seasons. Matures earlier than Kaspas[®]. Sugarpod trait, resistant to pod shattering at maturity. Disease resistance similar to Kaspas[®]: S to powdery mildew, bacterial blight, PSbMV and blackspot and the Kaspas strain of downy mildew, but R to the Parafield strain. Produces a dun seed with spherical (non-dimpled) grain; marketed as a Kaspas-type to suit Indian subcontinent human consumption requirements. Licensed to Seednet. EPR is \$2.75/tonne incl. GST.

PBA Wharton[®]. Released by PBA in 2013. Kaspas-type pea, well suited to all field pea production regions of NSW, including central and northern NSW, due to both powdery mildew and virus resistance. This variety is well positioned to replace Kaspas[®], PBA Gunyah[®] and PBA Twilight[®] across all production regions of NSW. A similar plant type to Kaspas[®] with a semi-leafless erect growth habit and distinctive pink-white flowers. Early to mid-season flowering (similar to PBA Gunyah[®]) and early maturing. Sugar-pod trait, resistant to pod shattering at maturity. Has broader disease resistance than Kaspas[®] by combining disease resistance to powdery mildew and the viruses PSbMV and *Bean leafroll virus* (BLRV) with higher soil boron toxicity tolerance; R to the Parafield strain of downy mildew but S to the Kaspas strain; S to blackspot and bacterial blight. Produces a medium size, non-dimpled, tan coloured seed. Grain is marketed as a Kaspas type to suit Asian subcontinent human consumption requirements (dhal, flour and roasted snack foods). Licensed to Seednet. EPR is \$2.86/tonne incl. GST.

Dimpled type dun field pea

Morgan[®]. Released in 1998 by NSW DPI. Tall semi-leafless dun type with excellent vigour and bulky upright growth habit. Late flowering, purple flowered with dimpled, dun-coloured seed. Seed size approximately 25% smaller than PBA Percy[®]. MS to bacterial blight; S to black spot, PSbMV, powdery mildew and downy mildew. Very competitive with weeds; best choice for hay, forage, silage and green/brown manure; lodges at maturity. Holds up well in dry seasons and tight finishes because of its height. Licensed to Hart Bros Seeds. No EPR.

PBA Oura[®]. Released in 2011 by PBA. Broadly adapted across all major field pea production regions; performs relatively well in short growing seasons and low-rainfall environments. Erect semi-dwarf, semi-leafless type with vigorous early growth, medium height and purple flowers. Early-mid flowering (earlier than Kaspas[®]) and early maturing. Suitable for crop-topping in longer seasons. Fair to good lodging resistance and moderate pod shatter resistance at maturity. MR-MS to bacterial blight and the Parafield strain of downy mildew, but S to the Kaspas strain; S to powdery mildew and PSbMV; MS to blackspot. Recommended for bacterial blight-prone regions. Produces a medium size, dimpled dun-type grain, coloured light green; similar size to Kaspas[®]. Grain is marketed as Australian dun type, which is exported to the Asian subcontinent to produce dhal (splits) and pea flour; also sold for stockfeed. Licensed to Seednet. EPR is \$2.86/tonne incl. GST.

PBA Percy[®]. Released in 2011 by PBA. Broadly adapted across all major field pea production regions; performs relatively well in short growing seasons and low-rainfall zones. Recommended for bacterial blight-prone regions. Conventional type with vigorous early growth, tall height and purple flowers. Very early

flowering (about a week earlier than PBA Oura[®]) and early maturing. Suitable for crop-topping in longer seasons. Lodges at maturity but moderate pod shatter resistance at maturity. Excellent R (better than PBA Oura[®]) to bacterial blight, but S to powdery mildew, blackspot and PSbMV as well as the Kasper and Parafield strains of downy mildew. Produces a very large, dimpled dun type grain, coloured tan–green. Grain is marketed as Australian dun type, which is exported to the Asian subcontinent for dhal production (splits) and pea flour; also sold for stockfeed. Licensed to Seednet. EPR is \$2.86/tonne incl. GST.

White pea

PBA Pearl[®]. Released in 2012 by PBA. Broadly adapted across all major field pea production regions; highest yielding variety in the state's south-eastern and south-western production regions. Semi-leafless, semi-dwarf erect growing variety with white flowers. Early–midseason flowering (10 days earlier than Kasper[®] and similar to Sturt[®]) and early maturing (earlier than Sturt[®]). Ideally suited to crop-topping due to early maturity. Superior lodging resistance compared with other semi-dwarf varieties. MR to pod shattering, S to the Kasper strain of downy mildew and MS to the Parafield strain. Resistant to BLRV; MS to bacterial blight and MR–MS to blackspot; S to powdery mildew and PSbMV. Produces medium–large spherical white pea seed (larger than Sturt[®]) suitable for human consumption or stockfeed markets. Recommended for regions where growers can deliver white pea seed for export or for domestic sale. Licensed to Seednet. EPR is \$2.97/tonne incl. GST.

Sturt[®]. Released in 2005 from the Australian Coordinated Field Pea Improvement Program. Conventional tall plant type, scrambling growth habit, early to mid-season flowering; small, smooth white seeds. Still one of the most adapted and highest yielding varieties in the drier production areas of south-western NSW. MS to bacterial blight, black spot and BLRV; S to powdery mildew, PSbMV and the Kasper strain of downy mildew, MS to the Parafield strain. No EPR.

Table 61. Field pea yield performance 2014–2018

Variety	South			
	Yield as a % of PBA Wharton 2014–2018			
	East	Trial no.	West	Trial no.
	1.56 t/ha		1.39 t/ha	
Kaspa-type dun field pea				
Kaspa	90	17	92	16
PBA Butler	102	14	107	14
PBA Gunyah	95	7	98	9
PBA Twilight	93	7	96	9
PBA Wharton	100	17	100	16
Dimpled type dun field pea				
Morgan	91	12	91	7
PBA Oura	98	17	105	16
PBA Percy	95	16	101	14
White pea				
PBA Pearl	98	17	112	16
Sturt	93	14	103	11

Yield results are a combined-across-sites analysis using NSW DPI, PBA and NVT yield trials from 2014–2018.

Weed control

Field pea provides valuable management strategies for integrated weed management and has unique features to assist weed control in the cropping rotation. These include a relatively late sowing window compared with other crops; the availability of competitive varieties such as Morgan and the availability of earlier maturing varieties such as PBA Oura[®] and PBA Twilight[®] that enable crop-topping to be synchronised with maturity.

Crop-topping and brown manuring are important tools in integrated weed management. Field pea has the widest range of herbicides available for broadleaf weed control of any pulse crop. There are several soil-applied residual herbicides registered, which provide an excellent opportunity to use alternative herbicides as part of a herbicide resistance management program. They might also be more cost effective than post-emergent herbicide options for weed control. As residual herbicides applied to the previous cereal crop can affect field pea establishment and growth, refer to current labels for information on plant-back periods. Residues could persist longer in soils that have received surface applied lime to raise soil pH.

For detailed information on registered herbicides, refer to the NSW DPI guide *Weed control in winter crops* and pesticide labels.

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Weed control in winter crops (www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops)

Insect control

Field pea is host to several common pests so careful monitoring is required to ensure they do not cause economic damage. All the pests have a number of natural enemies that can help keep them in check. Regular monitoring with good record keeping will keep track of the population dynamics so that controls can be applied when needed.

Redlegged earth mite, blue oat mite and lucerne flea

Monitor for these pests closely from emergence up to the 4-node stage. If crop damage becomes apparent, undertake appropriate control measures.

Aphids

Monitor for aphids from the early establishment stage. High numbers of aphids, particularly pea aphids (*Acyrtosiphon pisum*) can cause feeding damage and yield loss. Controlling aphids could be more important for reducing certain viruses that are persistently transmitted than actual feeding damage.

Pea weevil

This pest is a continuing problem in most areas. Be careful not to introduce it onto the farm as an impurity in purchased seed or any other seed containing field pea. Monitor crops at least weekly from flowering through to early pod set for pea weevil adults. Apply a border spray of insecticide if pea weevils are found, or if you know that you are in a pea weevil area. Fumigate all seed with phosphine in a sealed silo soon after harvest to destroy any pea weevil that might be present or developing in the grain.

On farm problems can be reduced by:

- harvesting promptly
- fumigating carry-over seed soon after harvest
- controlling all self-sown field pea in following crops.

For further information, see Pulse Point 4 – [Managing pea weevil](#).

Helicoverpa spp. (*Heliothis*)

Most crops require spraying during late flowering and pod filling and should be checked at least twice a week during this time. The spray threshold for human consumption grade is 1–2 larvae per 10 sweeps, and for stockfeed, four or more larvae per 10 sweeps. One well-timed early spray before larvae get too large (10 mm) is generally adequate. However, control can be very difficult once larvae enter the pods if not detected early. Monitor crops after spraying to determine effectiveness.

For detailed information on insecticides, refer to the NSW DPI guide [Insect and mite control in field crops](#).

Disease management

Disease effects on field pea production can be minimised by:

- sowing disease- and virus-free seed
- planning sensible crop rotations (not growing field pea in the same paddock more than once every five years)
- eliminating volunteer field pea plants
- not sowing near, or immediately downwind of the previous season's field pea paddock.

The following diseases have the potential to cause severe yield losses.

Bacterial blight

This disease is very sporadic and often unpredictable. It is caused by the bacterium *Pseudomonas syringae*. There are two pathovars (pv) of *P. syringae* found in NSW: *P. syringae* pv *lisi* and *P. syringae* pv *syringae*. Frost damage followed by wind and frequent rain encourages the disease to develop and spread. This highly infectious disease can be easily spread by machinery, people and animals moving through the crop. There are currently no post-emergence control options available to manage bacterial blight outbreaks.

P. syringae bacterium can survive on both seed and infected plant material – the main means of disease transmission to new crops. Therefore, do not use seed

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Pulse Point 4: [Managing pea weevil](#) (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/157034/pulse-point-04.pdf).

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[Insect and mite control in field crops](#) (www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops)

harvested from infected crops for sowing. Also note that wind and water can move pea stubble to adjacent paddocks and should be closely monitored, as should movement on stubble baled for hay, as these are a ready source of infective bacteria. Finally, crops having no obvious signs of disease can still carry the bacteria at low levels.

Bacterial blight will often first develop in frost-prone, low-lying areas. Be aware that frosts can trigger disease development so check these areas first for symptoms. Avoid sowing field pea crops in paddocks prone to frequent frosts.

Operations favouring rapid pea trash breakdown can greatly reduce the bacterium's survival rate. Controlling volunteer pea plants is equally important to manage this disease between seasons. Survival can be up to three years on seed in storage.

The varieties PBA Oura[®] and PBA Percy[®] were released in 2011 with significantly improved resistance to *Pseudomonas syringae* pv *syringae*. In the older varieties, Morgan[®] and Sturt[®] display the best field tolerance.

Traditionally, major outbreaks of bacterial blight in NSW result from early frosting coinciding with wet conditions. Outbreaks of bacterial blight were widespread in NSW in 2018 due to severe frosts in some districts.

Management factors that favour a bacterial blight outbreak include sowing field pea crops early, sowing infected seed, and new season crops coming into contact with infected pea straw. Field pea crops sown into a mulch of cereal stubble (soil surface covered by straw) are also more prone to frost injury and are predisposed to developing bacterial blight. If field pea crops are to be sown into cereal stubble, leave the stubble standing.

Kaspa[®] is one of the most susceptible varieties to bacterial blight. The safest strategy is to only grow the more resistant varieties and only use seed from crops inspected as visibly free of symptoms. A seed test is available to detect the bacteria's presence. Under conditions favouring disease development, even very low levels of seed-borne bacterial blight can lead to an epidemic.

Black spot and septoria blotch

These two fungal diseases regularly infect pea crops in southern and central NSW. In wetter years and in high-rainfall production zones, yield losses of 10–30% are common. Drier growing conditions might have reduced the effects from these diseases in recent years, but under ideal conditions these diseases can develop quickly, even from very low levels of disease in the previous year. Dry winter and spring conditions in 2018 kept levels of blackspot low, with few crops developing the disease in southern and central NSW. The highest levels of disease develop in crops sown early, sown adjacent to last year's field pea stubble, or with a recent history (past three years) of field pea in the same paddock. The **Black Spot Manager prediction model** can be used to predict spore release for southern NSW. Outputs from the model are available on the **DPIRD** (Western Australia Department of Primary Industries and Regional Development) website.

Black spot and septoria blotch effects can vary with proximity to old field pea stubble and paddock rotation history. Using a fungicidal seed dressing, crop rotation and separation from last year's field pea stubble by at least 500 m will reduce disease potential. In recent years, black spot has been observed at high levels in some districts, mainly in field pea crops sown early for manuring. Dry summer conditions in combination with early sowing opportunities and wet winter conditions favour a disease epidemic.

Downy mildew

Warm, dry weather does not favour disease development, but cool and wet conditions favour fast development (5–15 °C and wet for 4–5 days), often when field pea crops are emerging and in the early vegetative stage. Heavy dews will promote spore production, and rain splash is the main means of disease spread within a crop. The fungus *Peronospora viciae* causes the disease, which can survive in soil, on old field pea trash and also on seed. The most notable symptom of downy mildew is the appearance of stunted, yellowish pale-green seedlings within a crop, which have fluffy grey spore masses on the underside of infected leaves. Heavy infection can stunt plants early and kill seedlings if favourable conditions continue. Downy mildew can impair wax formation on leaves, rendering field pea plants more susceptible to post-emergent herbicides.

Growing resistant varieties is the most effective means of managing the disease. Varieties such as Morgan and Kaspa[®] have useful resistance. A new strain of downy mildew was identified in South Australia in 2008 that can overcome the resistance contained in many field pea varieties. This strain has not yet been detected in

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The **Black Spot Manager prediction model** (<https://www.agric.wa.gov.au/field-peas/field-pea-blackspot-management-guide-southern-new-south-wales-22-may-2018>)

DPIRD (<https://www.agric.wa.gov.au/>)

NSW. Other methods of managing downy mildew include using a fungicide seed dressing containing metalaxyl, crop rotation (at least four years between field pea crops), and separating this year's field pea crop from last year's field pea paddock.

Powdery mildew

This disease can cause yield losses and occurs more frequently in the drier areas of the central and northern wheat belt, generally towards the end of the season. Mild day temperatures and cool nights with dew formation favour the disease. Varietal resistance is the best method of control. Of the newer varieties, only PBA Wharton^{db} carries a powdery mildew resistance gene that provides complete protection against this disease. Other currently commercially available varieties have varying degrees of susceptibility. Foliar fungicides can be used to manage the disease in more susceptible varieties, but must be applied early before the disease becomes damaging.

Virus diseases

Several virus species cause disease in field pea and other pulses. As virus infection symptoms can be easily confused with those caused by environmental stresses, expert advice should be sought to correctly identify the virus. All the important pulse viruses are aphid transmitted and most need to survive in living plants between cropping seasons. Control strategies for virus diseases can only be preventive as infected plants cannot be cured.

Not enough is known about virus and vector epidemiology in NSW to recommend economic control of aphid vectors. Following the recommended crop management guidelines will reduce the risk of virus infections, as poorly growing crops and plants are more prone to infection. Aphid vectors are most active during the warmer periods of autumn and spring. Avoid sowing crops early in virus-prone areas so that plants can miss autumn infections. Plant resistance is the best defence against virus infection and Pulse Breeding Australia's field pea breeding program is making rapid progress in developing varieties with adequate resistance to the most important field pea viruses.

Table 62. Variety characteristics and reaction to diseases

Variety	Standing at maturity	Leaf type	Height	Maturity	Shatter resistance	Disease				Viruses		Seed size (g/100 seeds)	
						Bacterial blight# (<i>Pseudomonas syringae</i> pv <i>syringae</i>)	Downy mildew	Powdery mildew	Black-spot	<i>Pea seed-borne mosaic virus</i>	<i>Bean leafroll virus</i>		
						Kaspa strain	(Parafield strain)						
Kaspa-type dun field peas													
Kaspa	4	SL	M	8	R	S	MS	MR	S	MS	S	S	22
PBA Butler	4	SL	M	5	R	MR—MS	MS	S	S	MS	S	S	22
PBA Gunyah	4	SL	M	5	R	S	S	R	S	MS	S	S	22
PBA Twilight	4	SL	M	4	R	S	S	R	S	MS	S	S	22
PBA Wharton	4	SL	M	5	R	S	S	R	R	MS	R	R	23
Dimpled type dun field peas													
Morgan	3	SL	T	9	MR	S	S	MR	S	MS	S	S	18
PBA Oura	4	SL	M	5	MR	MR—MS	MR—MS	MR	S	MS	S	R	22
PBA Percy	2	C	T	5	MR	R	S	S	S	MS	S	S	23
White field peas													
PBA Pearl	5	SL	M	4	MR	MS	S	MS	S	MR—MS	S	R	22
Sturt	2	C	T	5	MR	MS	S	MS	S	MS	S	MS	19

Resistance only demonstrated to the bacterial blight pathovar *Pseudomonas syringae* pv *syringae*.

Disease ratings

Standing: 1–9 (1 = flat on ground, 9 = erect)

Leaf type: C = Conventional; SL = Semi-leaffless

Height: T = Tall; M = Medium; S = Short.

Maturity: 1 to 9 (1 = early, 9 = late); less than 5 best for crop-topping.

Shatter resistance and disease resistance ratings

R = Resistant; MR = Moderately resistant; MS = Moderately susceptible;

S = Susceptible.

Pea seed-borne mosaic virus (PSbMV)

PSbMV survives between seasons in infected seed. The virus is found wherever susceptible pea varieties are grown and infected seed has been sown. PSbMV reduces yields and can, depending on the plant's growing environment, cause distinctive brown ringed markings on the seed. Seed lots with high levels of seed

infection have lower levels of plant emergence and seedling vigour. A field survey in 2006 highlighted the importance of seed infection; crops sown with clean seed had low levels of PSbMV, while neighbouring paddocks sown with infected seed showed severe infection. Growers are advised to have their seed tested and not to use seed lots with infection levels greater than 1%. Of the current varieties, only PBA Wharton[®] has resistance to PSbMV.

Bean leafroll virus (BLRV)

BLRV infection results in leaves yellowing and stiffening. BLRV can cause severe yield losses and, with early infection, stunting and plant death. The virus survives between seasons on pasture legumes and lucerne. Higher levels of infection are generally found in the higher rainfall cropping zones or near irrigated lucerne paddocks. Kaspera[®] is highly susceptible to BLRV and should not be grown in virus-prone areas. PBA Pearl[®] and PBA Wharton[®] have good resistance, while a number of other breeding lines with good BLRV resistance are in advanced testing.

Desiccation and harvest

Desiccation

Early chemical termination of plant growth through desiccation should be strategically timed when field pea pod and seed development has physiologically finished so that grain yield is not compromised. Desiccation advances pea maturity and harvest by up to 10 days, reducing problems caused by uneven ripening and/or late weed growth. However, desiccating seeds that have not yet reached physiological maturity can result in defective grain such as shrivelled grain and green seeds.

Desiccation also doubles as a spray-topping operation to prevent seed set in weeds, provided timing is targeted at the correct stage of the weed.

Field pea crops can be desiccated using glyphosate (540 g/L) or diquat (200 g/L). Ensure that harvest withholding periods (WHP) is observed according to the label of the product used (e.g. seven days for glyphosate products; nil for diquat products). Crops desiccated with glyphosate should not be kept for sowing seed as it reduces seed viability.

Timing of desiccation

Note and record the end-of-flowering date and, from then on, start regular monitoring every few days for changes in pod colour, and particularly seed developmental and colour changes within the pod. From the end of flowering, days to desiccate vary enormously depending on the length of the spring and finishing conditions, but should occur within 3–4 weeks. Desiccate when the lower three-quarters of pods along the stem are brown; seeds are firm, rubbery, and split, rather than squash when squeezed; and the shells are thin and leathery. Pea pods mature from the lowest flowering node upwards. Many plants at this stage can still have green tips.

Seed moisture changes can also be monitored. Desiccate when seed moisture drops to around 30%. To collect seed for this, randomly pick 10–20 stems or more across the paddock. Further information on desiccation timing can be found in Pulse Point 5, *Desiccation and harvest of field pea*.

Harvest

This normally occurs well ahead of the wheat harvest and, to maximise yield, should start as soon as seed moisture falls to 14%. Delayed harvest leads to seed quality loss; harvest clashes with other crops; more severe crop lodging with greater soil contamination; increased pod shattering; pea weevil emergence in the field; problems with late weed growth; and increased vulnerability to late-season rain and hail damage. The important message is planning to start harvest early.

Rolling after sowing reduces rock and clod pick up at harvest. Crops sown into cereal straw have considerably less soil contamination in the grain sample. Use contour-following crop lifters. Seed to be kept for sowing should be harvested first, when moisture content is higher and header damage is least. Minimise subsequent handling to reduce seed cracking and splitting.

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Pulse Point 5, *Desiccation and harvest of field pea* (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157099/pulse-point-05.pdf)

Marketing

The domestic stockfeed industry continues to be the main user of field pea produced in NSW, as supply and grain quality over the past few years has been erratic from drought conditions or wet weather at harvest, which reduced yields. Each type of field pea (dun, white, and blue) has its own markets and end-uses. Dun field pea continues to be the most robust of the pea types, with both food- and feed-market opportunities, and remains the preferred type to be exported to Asia and the subcontinent. The smooth, non-dimpled Kaspia-type varieties PBA Gunyah[®], PBA Twilight[®] and PBA Wharton[®] can attract a small premium in human consumption export markets, particularly in southern India and in Sri Lanka, but quality is an ongoing issue, particularly with damage from pea weevil and heliothis grubs, and the amount of dirt in samples.

The recent erratic supply of Australian white field pea has hampered overseas market development, with the main competitor, Canada, producing large quantities of quality white field pea. The domestic stockfeed industry has been the major consumer of white field pea and this is expected to continue until more stable production occurs to allow export markets to be reliably supplied.

The Australian blue pea crop supplies a small niche domestic market and a few niche export markets. Quality is vital. Colour bleaching, pea weevil, heliothis grub damage and contamination from other pea types are major problems that growers need to carefully manage.

The current marketing specifications for the different grades of field peas can be found on the [Pulse Australia website](#).

Further information

NSW DPI

Weed control in winter crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Insect and mite control in field crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops>)

Pulse Point 4, **Managing pea weevil** (3rd edition) (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/157034/pulse-point-04.pdf)

Pulse Point 5, **Desiccation & harvest of field pea** (2nd edition) (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157099/pulse-point-05.pdf)

Pulse Point 7, **Reducing disease risk** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157144/pulse-point-07.pdf)

Pulse Point 13, **Strategies to minimise bacterial blight in field pea** (http://archive.dpi.nsw.gov.au/__data/assets/pdf_file/0006/157335/pulse-point-13.pdf)

Pulse Point 14, **Powdery mildew in field peas: A growers guide to management** (http://archive.dpi.nsw.gov.au/__data/assets/pdf_file/0011/157349/pulse-point-14.pdf)

Pulse Point 20, **Germination testing and seed rate calculation** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf)

GRDC website

NSW DPI and GRDC Bulletin: Legumes in acidic soils – maximising production potential in south eastern Australia, <https://grdc.com.au/resources-and-publications/all-publications/publications/2018/legumes-in-acidic-soils>

Integrated Pest Management Factsheet (https://grdc.com.au/__data/assets/pdf_file/0031/225877/integrated-pest-management.pdf.pdf)

Pulse Australia

Australian Pulse Trading Standards (<http://www.pulseaus.com.au/marketing/receival-trading-standards>)

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Table 63. Field pea variety disease guide

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Seedling disease				
Damping off <i>Pythium</i> spp., <i>Rhizoctonia</i> spp.	Seedlings collapse within a few days of emergence. Stem/taproot near ground level sunken, water soaked.	Cool, wet, poorly drained soils. Late sowing leading to slow germination.	Spores survive in soil for extended periods. Wide host range among other broadleaf crops.	Sow on time into well-drained soils. Treat seed with fungicide seed dressing. Cultivate below seed sowing depth.
Root diseases				
Foot rot <i>Phoma medicaginis</i> var. <i>pinodella</i> <i>Mycosphaerella pinodes</i>	Purplish-black rot of lower stem. Black rot of upper tap root.	Cool, damp weather. Paddocks with a recent field pea history or adjacent paddocks.	Survives on infected pea trash and as spores in soil for several years. Also seed-borne at low levels.	Crop rotation – four years between pea crops and avoid sowing into paddocks beside last year's field pea crop.
Root rots <i>Pythium</i> , <i>Rhizoctonia</i> and <i>Fusarium</i> spp.	Dark brown, girdling lesions on taproot and lateral roots. Patches of stunted plants within crops.	Wet, poorly drained conditions. Variable moisture.	Survives in soil and on plant debris.	Crop rotation – four years between field pea crops. Aim to sow on time. Avoid poorly-drained paddocks.
Foliar diseases				
Black spot complex <i>Mycosphaerella pinodes</i> , <i>Ascochyta pisi</i> , <i>Phoma medicaginis</i> var. <i>pinodella</i>	Dark brown to black spots on leaves, with reddish/purplish margin, often with an irregular outline. Girdling of lower stem and tendrils with a dark lesion. Bluish-black sunken spots on pods. Spreading, light brown, angular leaf lesions containing very small, dark brown to black spots. Tends to appear on moisture-stressed crops in spring.	Cool, wet conditions. More severe on early-sown crops.	Spores survive in soil and plant debris. Spread by rain splash and wind-blown rain.	Avoid early sowing. Crop rotation – four years between field pea crops and avoid sowing into paddocks adjacent to last year's field pea crop.
Septoria blotch <i>Septoria pisi</i>	White, cottony fungal growth on aerial parts of plants. Plants wilt. Sclerotia of fungus form on plant surfaces and inside stems.	Cool, wet conditions. More severe on early-sown crops.	The fungus survives on infected plant debris and can be seed-borne at low levels.	Avoid early sowing. Crop rotation – at least four years between pea crops and avoid sowing into paddocks adjacent to last year's field pea crop.
Sclerotinia wilt <i>Sclerotinia sclerotiorum</i>	Thick, grey-brown fungal growth on lower leaf surface. Upper leaf surface turns yellow above growth on lower surface. Leaf death.	Cool-mild humid conditions following rain in spring. Worse in dense crops.	Survives as resting sclerotia in soil. Sclerotia germinate in spring and infect with airborne spores.	Difficult because of wide host range and long survival in soil – 10 years. Avoid sowing consecutive broadleaf crops.
Downy mildew <i>Peronospora viciae</i>	White, powdery growth on upper leaf surface. Leaf withering. Poor seed-set in late pods.	Favoured by cool, moist conditions. Rarely causes economic damage.	Survives on plant debris and soil. Spores spread by wind.	Crop rotation. Grow resistant varieties.
Powdery mildew <i>Erysiphe polygoni</i>	White, powdery growth on upper leaf surface. Leaf withering. Poor seed-set in late pods.	Warm, humid (but not wet) weather. More likely when sowing is late or on late-maturing varieties.	Over-summerers on infected pea trash or volunteer plants. Spores blown by wind into new crops.	Crop rotation. Grow resistant varieties. Burn or fungicides in susceptible varieties. Burn or incorporate infected crop residue after harvest.
Bacterial disease				
Bacterial blight <i>Pseudomonas syringae</i> pv <i>psii</i> <i>Pseudomonas syringae</i> pv <i>syringae</i>	Fan-shaped, water-soaked lesion spreading into the leaf from the base. Dark brown, spreading stem lesions. Sometimes a sheen on the lesion when dry.	Frost events followed by cool, wet weather.	Infected seed. Infected crop debris. Easily spread in crop by machinery, people and animals.	Crop rotation. Seed testing. Do not keep seed from infected crops for sowing. Use newer resistant varieties.
Major virus diseases				
Bean leafroll virus (BLRV), Soybean dwarf virus (SbDV, syn. <i>Subterranean clover redleaf virus</i>).	Yellowing or sometimes reddening, stunting, leaf stiffening, premature death.	Areas prone to aphid flights. Can be very damaging, occasionally causing complete crop loss.	Survives in legumes including lucerne, subterranean clover and medic. Spread by aphids. Source is usually infected seed. Spread within crops by aphids.	Follow best management recommendations including retaining standing stubble to deter aphids from landing in the crop.
Pea seed-borne mosaic virus (PSbMV)	Commonly symptomless. Can show leaf mosaic, stunting, pod abortion, seed markings.	Has the potential to reach high incidence in all districts.		Use seed that has been tested and found to be free of PSbMV. Grow resistant varieties.
Cucumber mosaic virus (CMV), Alfalfa mosaic virus (AMV)	Mosaic, mottle or yellowing along leaf veins. Early infection can result in stunting, stem necrosis and premature death.	Uncommon in the major pea growing areas.	Range of weed and pasture spp. AMV also in lucerne. Spread by aphids.	Follow best management recommendations including retaining standing stubble to deter aphids from landing in the crop.



Lupin

Lupin is a profitable pulse crop well suited to lighter soil types in central and southern NSW. Lupin has many advantages in both cropping and mixed cropping–livestock farming systems. It can be used to extend cereal crop rotations by acting as a break crop (non-host) for cereal diseases, weeds and insect pests. Benefits include significant nitrogen contribution for subsequent crops, improved soil structure, and alternative weed control options to delay or reduce the incidence of herbicide resistance. Lupin also provides a high protein grain that can be valuable as part of a profitable livestock enterprise. More recently, research has identified human health benefits from lupin protein to manage diabetes.

Two species of lupin, narrow-leaf (*Lupinus angustifolius*) and albus (*L. albus*), are widely grown. Although narrow-leaf lupin tolerates moderately acid soils (pH_{Ca} 4.5–5.5) and high levels of exchangeable aluminium (up to 20%), and manganese, its vigour and yield potential can be affected when soil pH_{Ca} drops below 5.0. Most pulses in southern NSW are grown in soils where pH stratification (acid soil layers) can affect root growth, nodulation, crop vigour and yield potential. Severely acidic layers ($\text{pH}_{\text{Ca}} < 4.5$) are common at depths of 5–10 cm and 10–15 cm in the main cropping soils of central and southern NSW. Check for the presence of acidic layers by sampling soils at 5 cm intervals to a depth of 20 cm two years before sowing acid-sensitive pulses.

Where acidity is detected below the surface soil, the most rapid method to increase pH is to incorporate fine-grade lime to 10 cm deep, at least 12 months before sowing lupin.

Albus lupin is less tolerant of acid soils than narrow-leaf lupin (but more tolerant than canola or wheat) and can accumulate high manganese levels in the grain when grown in high manganese soils. Both species are sensitive to soils containing free lime (bicarbonate). High pH soils can be tolerated provided free lime is not present. High pH soils can reduce nodulation as symbiosis with rhizobia is impaired. Albus lupin is more susceptible to waterlogging than narrow-leaf lupin.

Albus lupin yields average 5–15% higher than narrow-leaf lupin under high rainfall conditions. The lupin anthracnose biosecurity zone in place for southern NSW 2016–2018 has been lifted, meaning there are no restrictions on where albus lupin can be grown.

Sowing

Direct drilling lupin into cereal stubble is a successful crop establishment method. Stubble conserves soil moisture, reduces brown leaf spot incidence, and also reduces aphid infestations, which minimises virus infection and transfer.

Dry sowing lupin is an option in higher rainfall areas, with grower experience showing it to be successful in establishing crops on time (see Pulse Point 6, *Dry sowing*). Dry sowing can be difficult on virgin lupin paddocks where inoculation will be required and rhizobia survival could be poor – new granular inoculants might help.

Aim to sow at a depth of up to 5 cm. Albus lupin has a much larger seed than narrow-leaf types – if the soil moisture is marginal then albus seeds are at greater risk of not imbibing enough water, resulting in false germination. Deeper sowing into warmer soils (moisture seeking) can be a successful method to allow earlier sowing, but is risky, especially with larger-seeded albus lupin. Low vigour seed and sowing late into soils with low temperatures results in poor establishment and often crop failure, especially in albus lupin.

Sowing time

All current lupin varieties are susceptible to frost damage. Lupin is most vulnerable during the reproductive phase, which occurs once they initiate stem elongation. Frost damage risk can be reduced by not sowing varieties earlier than the recommended sowing window to avoid flowering in July to early August. For most lupin-growing areas in southern NSW, sowing before late April with early flowering varieties such as Mandelup[®] increases the risk of frost damage.

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Pulse Point 6, *Dry sowing*
(https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/157117/pulse-point-06.pdf)

Seed quality

Profitable crops start with quality planting seed (i.e. high germination and vigour). Always do a germination test on seed and adjust the sowing rate accordingly. Mature lupin crops exposed to heavy rain before harvest are at high risk of damage to seed viability even though the seed can appear normal. In trials, yields increased by 20% when using high-germination seed (more than 80%) compared with low-germination seed (50%), even when the seed rate was doubled to compensate.

Headers easily damage seed, as does excessive handling during harvesting, grading and sowing. Rotary headers cause less damage. Seed that is to be kept for sowing should be harvested as soon as seed moisture content reaches 14%. Use a low header-drum speed and open the concave, also minimise subsequent handling.

Test germination in a laboratory or at home, counting only healthy seedlings – those with both cotyledons (seed leaves) present. Test narrow-leaf lupin seed for *Cucumber mosaic virus* (CMV) and obtain documentation of germination, seeds/kg and CMV status when purchasing seed. For further details see Pulse Point 20, [Germination testing and seed rate calculation](#).

Bitterness in albus lupin seed

To maintain the seed quality standards for the sweet (low seed alkaloid) albus lupin industry, growers should test all sowing seed for possible bitter (high alkaloid) contamination. Bitterness seed testing for albus lupin is available through Futari Grain Technology Services, 34 Francis Street, Narrabri 2390 (phone 02 6792 4588).

The albus industry has set a zero bitter contamination level for seed to be used for sowing.

Avoid growing lupini bean (100% bitter, large seeded albus) in sweet albus production areas. These measures are to protect the most recently released 100% sweet albus varieties Luxor[®], Rosetta[®] and Murringo[®] from bitter pollen contamination. Bitterness prevention in these new varieties is crucial to maintain the albus threshold standards set for both human consumption and stockfeed use.

Only grow one albus lupin variety on the farm – discard old varieties – and keep a minimum one kilometre isolation from all other albus crops. Check with neighbours about their albus sowing intentions. If growing a small quantity of albus for seed increase, surround it with a narrow-leaf lupin crop – the agronomy is similar and the albus crop will be protected from pollen contamination by foraging honey bees. Test all sowing seed for bitterness every year, including new varieties. Do not buy any albus seed without a testing certificate showing that the seed is free from bitterness.

Sowing rate

Aim to establish 35 plants/m² for early sowing and up to 45 plants/m² for later sowings. Sowing rates will vary depending on seed size and germination percentage. Albus lupin seed rates are much higher than narrow-leaf varieties due to their large seed size. For further detail see Pulse Point 20, [Germination testing and seed rate calculation](#).

Table 64. Suggested sowing times for narrow-leaf and albus lupin

	April				May			
Week	1	2	3	4	1	2	3	4
Low rainfall								
High rainfall								

- Preferred sowing time
- Later than recommended, yield reduction likely depending on spring conditions

Your calculation

$$\begin{array}{c} \text{100 seed weight} \\ \text{\# (grams)} \end{array} \times \begin{array}{c} \text{target plant} \\ \text{population} \end{array} \times 1000 \div \begin{array}{c} \text{establishment} \\ \text{percentage*} \end{array} \times \begin{array}{c} \text{germination} \\ \text{percentage} \end{array} = \text{your sowing rate} \dots\dots\dots \text{kg/ha}$$

To determine your seed weight, weigh 100 seeds in grams.

* Establishment percentage – 90% is a reasonable estimate, unless sowing into adverse conditions.

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Pulse Point 20,
[Germination testing and seed rate calculation](#)
(https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf).

Table 65. Sowing rates (kg/ha) based on 100% germination and 80% establishment

Lupin type	100 seed weight (g)	Target plant density	
		35 plants/m ²	45 plants/m ²
Narrow-leaf lupin	13	56	73
Albus lupin	35	153	197

Inoculation

Lupin requires specific rhizobium (Group G) to form active root nodules. Take care with seed inoculation techniques, especially into paddocks where lupin has not previously been grown. Adequate inoculum can persist for more than five years once established, but survival is reduced with increasing soil acidity, or prolonged periods of low rainfall or drought. If the sowing seed is to be treated with a fungicide, treat first and allow the seed to dry thoroughly. Apply inoculant immediately before sowing. A number of new inoculant products are available for lupin such as freeze-dried and dry granular products – read the instructions and follow them carefully to avoid inoculation failure.

Nutrition

Phosphorus – Application rates on responsive soils should be similar to cereals to achieve optimum yields and maintain soil phosphorus (P) levels – usually 15–25 kg/ha. Responses in albus lupins are often very low or negligible to these rates of applied P. Be careful when using higher rates of high-analysis fertilisers as lupin seed is sensitive to fertiliser burn. Select paddocks with a low level of residual nitrogen to promote effective nodulation and nitrogen fixation.

Wider rows and narrow tynes, which can concentrate the seed and fertiliser together in a narrow band, exacerbate the risk of fertiliser burn. Sowing into marginal moisture conditions can also increase this risk. Consider separating the seed and fertiliser by banding fertiliser below the seed where possible.

Sulfur – Fertilisers blended with a sulfur component are recommended.

Molybdenum – If soils are acid or likely to be deficient, an application every five years promotes rhizobial activity. Sodium molybdate is relatively cheap and is compatible in mixes with most herbicides.

Variety selection

Select lupin varieties depending on yield potential for your environment and resistance to diseases that cause regular problems in your area.

For characteristics and yield potential of different varieties, refer to Table 66.

Susceptibility abbreviations: R – resistant; MR – moderately resistant; MS – moderately susceptible; S – susceptible; VS – very susceptible.

Narrow-leaf lupin

Jenabillup[®]. Released in 2007 by the Western Australian Department of Agriculture and Food (DAFWA). High yielding, medium-tall, early flowering variety. It has performed very well in NSW. Jenabillup[®] is MR to *Bean yellow mosaic virus* (BYMV) infection, which can cause significant damage in eastern states when seasons are suitable, such as in 2014. It is MR to anthracnose and does not tolerate metribuzin herbicide. It is also MS to phomopsis stem infection. Commercialised by Seednet, protected by PBR. The End Point Royalty (EPR) is \$2.53/tonne incl. GST.

Mandelup[®]. Released in 2004 by DAFWA. High yielding, early maturing variety with good early vigour. Suited to the low-medium rainfall zones of NSW. It has a tendency to lodge in very high productivity situations and is not generally recommended for the higher rainfall zones. Mandelup[®] is the earliest maturing variety currently available and therefore the most suitable for crop topping. Marketed by Heritage Seeds, protected by PBR. EPR is \$2.53/tonne incl. GST.

PBA Barlock[®]. Released in 2013 by Pulse Breeding Australia (PBA) in Western Australia, to replace Mandelup[®] and Tanjil in all WA lupin-growing zones. Compared with Mandelup[®], PBA Barlock[®] is slightly later flowering and maturing, but has a shorter harvest height. It is moderately resistant to lodging in high rainfall regions and is more resistant to pod shattering than Mandelup[®]. R to anthracnose; MR to phomopsis stem blight. Tolerance to metribuzin is equal to Mandelup[®]. Commercialised by Seednet, protected by PBR. EPR is \$2.75/tonne incl. GST.

PBA Bateman[®]. Limited release in 2018. It offers significant yield improvements over current varieties, particularly in the eastern cropping zones of NSW where virus infection from CMV and BYMV can cause significant yield loss in susceptible varieties when seasonal conditions are conducive to high aphid numbers. Marketed by Seednet. EPR is \$2.86/tonne incl. GST.

PBA Gunyidi[®]. Released in 2011 by PBA in Western Australia, as a replacement for all varieties in the medium and low rainfall zones of WA. PBA Gunyidi[®] has superior resistance to pod shatter and good lodging resistance, allowing later harvest without incurring significant shatter losses. R to phomopsis stem blight; MR to anthracnose. Tolerance to metribuzin is equal to Mandelup[®], but is more susceptible to damage from Eclipse[®]. Commercialised by Seednet, protected by PBR. EPR is \$2.75/tonne incl. GST.

PBA Jurien[®]. Released in 2015 by PBA in Western Australia. It is a broadly adapted high-yielding variety that is R to anthracnose, phomopsis and grey spot. It tolerates metribuzin (superior to PBA Barlock[®]) with early flowering and maturity similar to other current varieties. NSW trials have shown it to be more susceptible to plant lodging than other current varieties in high rainfall areas, particularly when sown early and when conditions suit high biomass levels. Commercialised by Seednet, protected by PBR. EPR is \$2.75/tonne incl. GST.

Albus lupin

Luxor[®]. Released in 2005 by NSW DPI. Higher yielding than Kiev Mutant or Ultra. R to pleiochaeta root rot (the cause of many seedling deaths in older varieties). Luxor[®] is seven days later flowering than Ultra, but earlier flowering than its sister line Rosetta[®]. Suited to the medium–low rainfall zones of NSW. Commercialised by Seednet, protected by PBR. EPR is \$3.08/tonne incl. GST.

Murringo[®]. Released by NSW DPI in late 2017, it is early–mid flowering. It has moderate resistance to pleiochaeta root rot and phomopsis. Murringo[®] is S to anthracnose. Marketed by Seednet. EPR is \$3.52/tonne incl. GST.

Rosetta[®]. Released in 2005 by NSW DPI, it is higher yielding than Kiev Mutant or Ultra in longer season environments. MR to pleiochaeta root rot (less resistant than Luxor[®]), much better than Kiev Mutant, slightly better than Ultra. Later flowering and taller than Luxor[®], it is especially suited to higher rainfall areas. Commercialised by Seednet, protected by PBR. EPR is \$3.08/tonne incl. GST.

Weed control

There is a range of herbicides to control both broadleaf and grass/cereal weeds in lupin. Sowing early with good crop establishment is essential to achieve more effective herbicide results.

Herbicide damage from both residual herbicides applied before cereal crops and from in-crop herbicides has caused yield losses in lupin crops. Plants weakened by herbicides are more susceptible to root and foliar diseases such as phytophthora root rot, pleiochaeta root rot and brown leaf spot.

1. **Sulfonylurea herbicides** (e.g. Glean[®] or Logran B-Power[®]) applied to preceding cereal crops. Take special note of label instructions concerning crop rotation and plantback periods, particularly on high pH and/or compacted soils, and after prolonged periods of low rainfall or drought. Residues could persist longer in soils that have received surface-applied lime to raise soil pH.
2. **Triazine herbicides** (e.g. simazine). Be aware that application rates vary significantly on different soil types. Follow label recommendations and avoid spray overlaps. Albus lupin is more sensitive to triazine damage than narrow-leaf lupin.
3. **Clopyralid** (e.g. Lontrel[®]) applied to preceding cereal crops and in fallow tank mixes. Clopyralid can carry over in straw and affect subsequent crops.
4. **Metosulam** (e.g. Eclipse[®]). Damage can occur if applied beyond the recommended growth stage. Some varieties are sensitive and have narrow safety margins. Follow label recommendations.

For more detailed information on current weed control and plantback recommendations, refer to pesticide labels and the NSW DPI guide *Weed control in winter crops*.

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Weed control in winter crops (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Table 66. Variety characteristics and reaction to diseases

Variety	Flowering time	Pod loss, shatter resistance	Lodging resistance	Seed size (g/100 seeds)	Disease					North				South				
					Brown leaf spot	Pleiochaeta root rot	Phomopsis stem infection	CMV ¹ seed transmission	BYMV ¹	Anthracnose resistance	Yield as a % of Mandelup 2013–2017				Yield as a % of Mandelup 2013–2017			
											East 1.68 t/ha	Trial no.	West 2.18 t/ha	Trial no.	East 2.32 t/ha	Trial no.	West 1.00 t/ha	Trial no.
Narrow-leaf																		
Jenabillup	early	G	MG	14	MR–MS	R	S	MR–MS	MR	S	90	3	91	7	99	29	93	3
Jindalee	mid–late	G	G	13	MR–MS	MR	R	MS	S	S	77	3	78	7	89	29	85	3
Mandelup	very early	G	MP	14	MS	R	R	MS	MS	MR	100	3	100	7	100	29	100	3
PBA Barlock	early	VG	G	13	MS	R	MR	MR	MS	R	98	3	98	7	102	29	100	3
PBA Bateman	very early	G	MP	14	MS	R	MR	MR	MS	MR–MS	n.d.	1	102	3	110	13	n.d.	1
PBA Gunyidi	very early	VG	G	13	MS	R	R	MS	MR–MS	MR	107	3	99	7	105	29	100	3
PBA Jurien	early	G	G	13	MS	R	R	MS	MS	R	99	3	102	7	104	25	104	3
Quilinoock	early	G	MP	16	MS	R	MR–MS	MR	–	VS	75	3	92	7	94	28	90	3
Wonga	early–mid	G	MG	13	MS	S	R	R	MS	R	90	3	89	7	94	29	93	2
Yield as a % of Luxor 2012–2016#																		
Yield as a % of Luxor 2012–2016#																		
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Yield results are a combined across sites analysis using NVT, NSW DPI and PBA yield trials from 2013–2017.

Albus lupin trials discontinued in NSW from 2017, view data with caution.

¹ Data from Pulse Breeding Australia

n.d. no data.

Lodging, pod loss and shattering resistance

MP Moderately poor
MG Moderately good
G Good
VG Very good

Disease resistance

VS Very susceptible
S Susceptible
MS Moderately susceptible
MR Moderately resistant
R Resistant
I Intermediate

Lupin

Insect control

A range of pests can be found in lupins, but all have several natural enemies that will help keep populations in check. With regular monitoring and good record keeping, population dynamics will show if pest populations are increasing and if chemical control might be needed.

Redlegged earth mite and **blue oat mite** – large mite populations are common and can cause distorted early growth and kill seedlings. The rasping of the cotyledon and leaf surface during feeding results in a distinctive silvering on the leaves. Mite damage can be confused with brown leaf spot lesions, so correct identification is required before control measures are used. Early detection and control improves crop health and vigour.

Lucerne flea – damage is common and is characterised by clear membranous windows chewed into cotyledons and leaf surfaces. Early detection and control improves crop health and vigour.

Cutworms, armyworms and **pasture cockchafers** – these caterpillar pests can cause sporadic damage to seedlings and young plants. Monitor crops regularly during the establishment phase and control as necessary.

Aphids – these insects rarely cause significant feeding damage on lupin in NSW, but can transmit viruses. Aphids are vectors of two potentially serious lupin viruses: (CMV and BYMV). Yield losses are greatest when aphids arrive early in the season, usually following wet seasonal conditions that provide a green bridge of weed hosts over the summer months. BYMV is not seed-borne, whereas CMV can be. Lupin varieties differ in their susceptibility to viruses (see disease section on *Cucumber mosaic virus*). PBA Bateman[®] appears to have more resistance to aphid attack than other varieties. Uniform plant density, early canopy closure and retaining cereal stubble can reduce aphid visitation.

Thrips – monitor for thrips from early flowering. Thrips can cause reduced vigour, and flower and early pod abortion. Thrips can be particularly damaging to albus lupin. Critical control decisions should be made at early flowering. Control threshold is 1–2 thrips per open flower, not 1–2 per flowering spike.

Heliothis (*Helicoverpa* spp.) – occurrence is common and control decisions should be based on regular monitoring. Crops should be monitored twice weekly once flowering has started. Larvae feed on leaves, stems and pods and, when big enough, they burrow into pods and feed on the developing seed. Human consumption markets have strict limits on insect-damaged seeds, so populations of 1–2 larvae per square metre warrant control. Aerial insecticide application is often required.

Refer to the NSW DPI guide *Insect and mite control in field crops* for more detailed information on pest control measures and thresholds.

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Insect and mite control in field crops

(<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops>)

Diseases

Anthracnose – this destructive disease was detected for the first time in commercial lupin crops in NSW in 2016. A thorough surveillance program has shown no diseased plants since 2016, so restrictions have been lifted for 2019. Wonga, PBA Jurien[®] and PBA Barlock[®] are R while PBA Gunyidi[®] (MR–R) and Mandelup[®] (MR) are slightly more susceptible. All other narrow-leaf and albus lupin varieties are S to anthracnose.

The disease is specific to lupin species only and does not affect any other pulse species including field pea, faba bean, chickpea or lentil. The fungus survives on infected lupin stubble and can be carried on, or within, infected seed, which is the main means of disease survival and spread. Infected seed will lead to infected seedlings the following year and initiate the disease. The fungus does not survive in the soil.

Symptoms of the disease include a distinct bending and twisting of stems into a shepherd's crook. The stem bending is due to lesions formed within the crook of the bend causing collapse down one side. Within the lesion are bright pink/orange spore masses that spread the disease within the crop. Lesions can also later form on developing pods. Symptoms become most obvious when crops enter the reproductive phase and start flowering and podding. The disease attacks the soft plant tissue at the growing points (including stem tips, flowering spikes and pods) and works downwards into the crop canopy. Anthracnose will develop in patches or hotspots within the crop. As the disease is spread through rain splash of spores, patches of deformed plants will form within the crop as the disease spreads following rain.

A five-point management plan is recommended for all lupin producers in NSW to prevent the disease from establishing and spreading.

1. Treat seed for sowing with a fungicide seed treatment containing thiram.
2. Separate this year's lupin crop away from last year's lupin stubble.
3. Control volunteer lupins.
4. Control machinery and people movement into and out of lupin crops.
5. Apply a foliar fungicide at 6–8 weeks post emergence (with a grass spray) using fungicides containing mancozeb or chlorothalonil, and a follow up at pre-canopy closure.

Growers are encouraged to inspect lupin crops regularly and report any unusual disease symptoms to their nearest NSW DPI or LLS office.

Be aware that movement of lupin material and machinery into NSW from South Australia and Western Australia (including seed for livestock feed) is prohibited and carries the high risk of introducing the disease into NSW.

Brown leaf spot (BLS) – this can potentially be a damaging disease affecting narrow-leaf lupin. It is more likely to occur in crops that are sown into a paddock with a bare surface and in paddocks with a recent lupin history. Albus lupin is less affected by this disease where it is not usually a significant problem – some lesions might develop on pods but do not cause any yield loss. The disease is favoured by cool, wet conditions during seedling emergence when soil-borne spores are splashed onto leaves and cause infection. Seedlings can rapidly become defoliated and die. Good crop management can prevent losses from BLS. There are no foliar fungicides currently registered to manage the disease. Preventative measures to protect crops in high disease risk situations, particularly in areas with intensive lupin production include:

- crop rotation (at least four years between lupin crops)
- paddock separation from last year's lupin crop
- cereal stubble cover and minimum tillage
- using a fungicide seed dressing.

Pleiochaeta root rot (PRR) – albus lupin is reasonably tolerant to PRR when grown on red–brown loamy soils. However, older varieties are S to PRR caused by the same fungus, *Pleiochaeta setosa*. Soil-borne spores can infect the taproot of albus plants causing stunting and premature death. Luxor[®] is rated R and Rosetta[®] rated MR to the disease. Disease management is the same as for BLS. Treat seed at sowing with a fungicide seed dressing, separate this year's crop from last year's lupin paddock and avoid growing lupin for at least four years in the same paddock.

Cucumber mosaic virus (CMV) – this disease tends to be more prevalent in central and northern NSW, but only in narrow-leaf lupin. Albus lupin is immune to the disease. It is spread through infected seed and by aphid movement. Narrow-leaf lupin seed should be tested for CMV infection. Wonga is the most resistant narrow-leaf lupin to CMV seed transmission. CMV can cause symptoms in all narrow-leaf lupin varieties, but it is the seed transmission from infected plants that causes problems for growers. The infected seed then carries over the disease into next year's lupin crop. Infected plants are most commonly seen around crop margins and in areas of low plant density or in gaps. Best management practices, including retaining standing cereal stubble and weed control (to deter aphids), will reduce disease incidence.

Bean yellow mosaic virus (BYMV) – this is a common virus infection in both narrow-leaf and albus lupin. The disease causes yellowing, wilting and plant death. It is most common on crop margins and near gaps in the crop where aphids land more often. BYMV infection in narrow-leaf lupin can cause three types of symptoms:

1. When infected before pod set, the most common symptom is necrosis that kills the infected plant.
2. The less common non-necrotic symptom causes stunting without killing the plant.
3. Plants can be infected after pod set where black pods develop (black pod syndrome).

There are no seed-borne BYMV strains in Australia. Best management practices, including retaining standing cereal stubble and weed control (to deter aphids), will reduce disease incidence.

Phomopsis and lupinosis – be aware of the potential danger to stock grazing stubble, and seed infected with the phomopsis stem blight fungus. The fungus that causes the disease infects lupin plants in winter, but doesn't express in plants until maturity. Often early development of the fungus and toxin production can occur following moisture stress before harvest while summer rain stimulates fungal growth and toxin production on stubble.

Strategies to avoid lupinosis in stock involve careful grazing management in the first few months after harvest and growing a narrow-leaf lupin variety with the best available phomopsis resistance. Current albus lupin varieties have a good level of resistance to stem infection from the phomopsis pathogen, but are susceptible to pod and seed infection especially after heavy rain, wind, or hail close to harvest. In 2018, the disease was detected in lupin crops before harvest across southern NSW. This indicated that lupin stubble was already toxic before harvest and could not be safely grazed. Look for pink, tan or brown discoloured or mouldy seed. Do not feed grain to stock or deliver for human consumption if phomopsis-infected seed is suspected. Manage the disease through separating this year's crop from last year's paddock and avoid growing lupin for at least four years in the same paddock. For further information see NSW DPI Primefact 1308, *Reducing the risk of lupinosis and the incidence of phomopsis*.

Phytophthora root rot 'Sudden death' – a serious disease in years when late winter and early spring are wet, and plants suddenly wilt and die around the pod set stage. The disease can occur in individual plants or patches within a crop. Disease occurrence can be associated with soil hard pans or perched water tables as initiation requires a brief period of waterlogging to infect lupin roots. In narrow-leaf lupin, an undescribed species of *Phytophthora* causes the disease. In albus lupin the disease is caused by *Phytophthora cryptogea*. The latter fungus is also highly pathogenic to lentil. Disease management is difficult because of the extended period of survival of the fungus in the soil. Methods to minimise disease occurrence include crop rotation and avoiding paddocks with a known water-logging problem.

Sclerotinia stem rot – this disease is caused by the same fungus that infects canola. Disease development is favoured by prolonged wet conditions in late winter followed by periods of prolonged leaf wetness during flowering. Districts with reliable spring rainfall and long flowering periods for lupin appear to develop the disease more frequently. The environmental conditions for *Sclerotinia* to develop are very specific and will not occur every year, so even when the fungus is present the disease could fail to develop in dry conditions. Outbreaks of the disease were rare in southern and central NSW in 2018, driven by below average rainfall and dry crop canopies. Be aware of crop rotations that include lupin and canola in close rotation as this can increase soil-borne sclerotia. Burning canola or lupin stubble will not effectively control *Sclerotinia* as sclerotia survive mainly on, or in, the soil. Crop rotation with cereals, following recommended sowing times and ensuring crops do not develop heavy vegetative growth (which are likely to reduce air circulation) are the best means of managing the disease. There are currently no foliar fungicides registered, in NSW, to manage *Sclerotinia*.

Harvest

Lupin seed can be harvested and delivered as soon as seed moisture content is below 14% (maximum receival standard). Timing is critical to maximise yields. Pods are prone to shattering if left too long after maturing, especially albus lupin. If harvest is delayed or dry conditions prevail, harvest at night or in the early morning with dew to minimise shattering and pod drop. Use extended fingers to help trap pods. Grower reports suggest pod loss is reduced if draper fronts are used. Windrowing and crop desiccation are viable options, particularly for crops with variable maturity or high weed burdens. For further details see Pulse Point 10, *Windrowing lupin*. Registered products for desiccation are listed in NSW DPI guide *Weed control in winter crops*. As desiccation timing is similar to windrowing, seek advice from your local agronomist if unsure.

Marketing

Narrow-leaf lupin is a readily marketable, high protein stockfeed and is sold domestically for use in pig, poultry, dairy and feedlot rations. A small quantity is exported, but the price is driven by competition with soymeal.

Albus varieties are suitable to export for human consumption provided grain quality parameters are met. The principal export market for Australian albus is Egypt. Albus lupin is also suitable for dairy and cattle feedlot rations, but is not readily accepted into pig rations at high inclusion rates. Albus lupin is commonly de-hulled, concentrating the protein content for use in feed mixes, while the hulls provide a fibre source.

Recent research is showing lupin proteins used in human diets are a blood sugar stabiliser and will help reduce the effects of diabetes.

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Reducing the risk of lupinosis and the incidence of phomopsis (<http://www.dpi.nsw.gov.au/animals-and-livestock/sheep/health/other/lupinosis-phomopsis>)

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Windrowing lupin (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/lupins/windrowing-lupins>)

Weed control in winter crops (<https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Further information

NSW DPI website

Weed control in winter crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/weed-control-winter-crops>)

Insect and mite control in field crops (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/insect-mite-crops>)

Primefact 1308, **Reducing the risk of lupinosis and the incidence of phomopsis** (<http://www.dpi.nsw.gov.au/animals-and-livestock/sheep/health/other/lupinosis-phomopsis>)

Pulse Point 6, **Dry sowing** (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/general-information/dry-sowing>)

Pulse Point 10, **Windrowing lupin** (<http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/lupins/windrowing-lupins>)

Pulse Point 17, **Phytophthora root rot of lupin** (http://archive.dpi.nsw.gov.au/__data/assets/pdf_file/0019/157411/pulse-point-17.pdf)

Pulse Point 18, **Cucumber mosaic virus in lupin** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157433/pulse-point-18.pdf)

Pulse Point 20, **Germination testing and seed rate calculation** (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf)

Lupin anthracnose (<https://www.dpi.nsw.gov.au/biosecurity/plant/insect-pests-and-plant-diseases/lupin-anthrachnose>).

GRDC website

NSW DPI and GRDC Bulletin: **Legumes in acidic soils – maximising production potential in south eastern Australia**, (<https://grdc.com.au/resources-and-publications/all-publications/publications/2018/legumes-in-acidic-soils>)

Integrated Pest Management Factsheet (https://grdc.com.au/__data/assets/pdf_file/0031/225877/integrated-pest-management.pdf.pdf)

Pulse Australia

Variety Management Packages (VMP) for all new varieties (<http://www.pulseaus.com.au/growing-pulses/bmp/lupin>)

Australian Pulse Trading Standards (<http://www.pulseaus.com.au/marketing/receival-trading-standards>)

Contributing authors

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Table 67. Disease guide: lupin

Disease/cause	Symptoms	Occurrence	Survival/spread	Control
Root diseases				
Damping off <i>Pythium</i> spp., <i>Rhizoctonia</i> spp.	Seedlings collapse within a few days of emergence. Stem/taproot near ground-level sunken, water soaked.	Cool, wet, poorly-drained soils. Late sowing leading to slow germination and emergence.	Spores survive in soil for long periods. Wide host range among other broadleaf crops.	Sow on time into well-drained soils.
Pleiochaeta root rot <i>Pleiochaeta setosa</i> (mainly in albus lupin, rare in narrow-leaf lupin)	Dark brown, girdling lesions on taproot and lateral root spots.	Winter/spring. More severe in older albus varieties. Paddock with a recent lupin history. Favoured by minimum tillage, marginal soil moisture, mild conditions and some herbicide residues. Survives as fungal fragments in soil.	Survives in soil and on infected plant debris.	Crop rotation; four years or more between crops. Avoid growing near last year's lupin stubble. Grow resistant albus varieties Luxor or Rosetta.
Rhizoctonia root rot <i>Rhizoctonia</i> spp.	Dark brown, girdling lesions on taproot, fine roots rotted with 'spear point' effect. Patches of stunted plants within crops.		Host range depends on strain, but can include cereals and other broadleaf crops.	Suppressed by frequent cultivation. Cultivate below seed-sowing depth.
Phytophthora root rot <i>Phytophthora</i> spp.	Plants wilt, turn yellow and die suddenly between flowering and pod set. Roots are completely rotted with a blackish, sunken lesion extending up to 5 cm up the stem base.	Favoured by wet, late winters and early springs on poorly-drained, heavier soils, especially with hard pans.	Resting spores survive for extended periods in soil.	Avoid hard pans and poorly-drained sites.
Foliar diseases				
Anthraxnose <i>Colletotrichum lupini</i>	Twisting of stems and 'shepherd's crook' syndrome. Dark lesions with pale pink centres on stems, leaves and pods.	Detected in a small number of crops in southern NSW. Currently under surveillance in NSW.	Seed-borne and on trash. Spread by rain splash, machinery and animal movement.	Narrow leaf varieties with improved resistance are available. Resistance in albus lupin is poor. Crop rotation; use fungicide seed dressings and foliar fungicides.
Brown leaf spot <i>Pleiochaeta setosa</i> (mainly in narrow-leaf lupin, rare in albus lupin)	Initially dark brown spots on cotyledons, which die and drop off. Dark brown spots on leaves. Leaves distorted, can be shed. Lesions might girdle stems in extreme cases.	Cool, wet conditions. Worse on late sown crops, low pH soils and exacerbated by wetting agents used with herbicides. Only a problem in narrow-leaf lupin.	Spores survive in soil and on infected plant debris. Spread by rain splash and wind-blown rain.	Crop rotation; four years between crops. Early sowing. Retain cereal stubble. Minimum tillage and soil disturbance at sowing. Avoid growing near last year's lupin stubble. Use fungicide seed dressings.
Grey mould <i>Botrytis cinerea</i>	Dead areas on stem, covered with fluffy, greyish-brown fungal growth, usually near ground level. Stem girdling leads to wilting and death. Generally few symptoms on living plants. Black fruiting bodies of the fungus form on the surface of dead stems after harvest. Infected seeds discoloured, especially visible in albus. Fungal toxin poisons stock, causing lupinosis.	The disease is worse in dense crops. The fungus can survive in infected trash for extended periods as resting mycelium and is favoured by cool to mild, wet conditions in spring.	Survives on many alternative hosts. Aerial spores blown considerable distances.	Consider wider rows and/or lower plant populations to reduce dense canopies and increase air movement in the canopy. Use foliar fungicides.
Phomopsis stem blight <i>Diaporthe toxica</i>		Plants can be infected at any time during growth. Infection usually during cool, moist conditions in autumn, winter or spring.	Survives on infected stubble. Spores spread by rain splash and in wind-blown rain. Infected seed can spread disease.	Resistant varieties. Safe grazing practices reduce lupinosis.
Sclerotinia stem rot <i>Sclerotinia sclerotium</i>	White cottony fungal growth on stem at ground level and sometimes in upper canopy. Plants wilt. Sclerotia of the fungus develop on plant surfaces and inside stems. Can sometimes cause a basal rot.	Humid conditions following rain in spring. Worse in dense crops.	Survives as resting sclerotia in soil. Sclerotia germinate in late winter and early spring and infect with airborne spores.	Difficult because of wide host range and long survival in soil (10 years). Canola is a major host of sclerotinia and should not be sown too close to lupin in the crop rotation. Consider wider rows in high rainfall areas to increase air movement in the canopy.
Virus diseases				
<i>Bean yellow mosaic virus</i> (BYMV)	Plants yellow with blackened, flat pods. Plants wilt and die. The non-necrotic strain causes downturned leaflets.	Mainly in mild conditions during spring. Often seen at crop margins.	Survives in many legume and weed species. Spread by several aphid species.	Follow best management practices including retaining standing cereal stubble and weed control.
<i>Cucumber mosaic virus</i> (CMV) (narrow-leaf lupin only)	Plants stunted, foliage distorted, bunchy leaves with upturned leaflets. Persistent green plants at harvest. Infected narrow-leaf lupin seeds smaller.	Occurs early in the season from infected seed; at any other time from aphid transmission.	Survives in many legume and weed species. Infected seed of narrow-leaf lupin only. Spread by several aphid species.	Grow narrow-leaf lupin varieties resistant to seed transmission e.g. Wonga. Use virus-tested narrow-leaf lupin seed. Follow best management practices including retaining standing cereal stubble and weed control. In high-risk areas, grow albus lupin.

Grain insects – options for control

Table 68. Insecticides for disinfesting empty grain storages and grain handling equipment

Purpose	Insecticide	Mixing rate per L	Summary notes: READ THE LABEL BEFORE USING
Desiccant dust treatments (activated amorphous silica or diatomaceous earth) for treating clean empty storage surfaces and equipment such as grain driers, headers, augers, mobile bins.	Dryacide® Perma-Guard® D-10 Absorba-cide® Cut N Dry® Abrade®	120 g (1 L/20 m ²) 200 g (1 L/33 m ²) 120 g (1 L/20 m ²) 120 g (1 L/20 m ²) 240 mL (1 L/20 m ²)	Spray surfaces using a slurry (10–20% depending on product) with a centrifugal pump or venturi-type sand blaster with continuous agitation. Alternatively apply dust to empty silos and bins (2 g/m ²) using a hand- or power-operated duster (a venturi blower is effective). Avoid heavy deposits of dust that can dislodge. Header/ harvesters can be treated with 2.5 kg of dry dust. Refer to label for instructions. Always wear a disposable dust mask/respirator and goggles for safety. Please note: Some desiccant dust products are ineffective against rust red flour beetle (<i>Tribolium</i> spp.), studies have shown Dryacide® to be most efficacious.
Disinfesting empty silos, storage areas and equipment such as headers, augers, mobile bins.	Carbaryl 500	10 mL/L per 10m ²	Ensure silos are cleaned thoroughly before any treatment. Carbaryl is registered only to control lesser grain borers. Mixtures of carbaryl with any of the other components listed here can be used to control all species. Follow label precautions about mixing. Do not premix. Agitate thoroughly and clean equipment after use. Refer to label for spraying rates.
	Actellic® 900 Reldan™ Fenitrothion 1000 Reldan™ PluS IGR*	11 or 22 mL 20 mL 10 mL 20 mL	Actellic®, Reldan™ and Fenitrothion are not effective against lesser grain borer. Can be mixed with carbaryl (above), or methoprene (IGR). However, methoprene will not kill any live adult lesser grain borers that are present. * A premixed formulation of Reldan™ and methoprene. NOTE: None of these chemicals are to be used in storages where canola and other oilseeds or pulses are to be stored.

Table 69. Fumigants for grain in storage

Grain situation	Fumigant	Summary notes: READ THE LABEL BEFORE TREATING for limitations and full instructions.
Disinfest cereals, pulses, oilseeds and malting barley by fumigation	Aluminium phosphide (150 tablets/100 m ³) producing phosphine gas	Ensure silo is gas-tight. Calculate fumigant dose on total volume of silo. Fumigate for 7–20 days, withholding period two days after ventilation. Do not mix tablets in with the grain. Other phosphine formulations are available, including bag chains, belts, blankets and cylinder gas. Refer to labels for rates and methods of use.
Disinfest cereals only by fumigation	Sulfuryl fluoride (Profume®)	Requires a licensed fumigator trained to use Profume and a gas-tight storage.

Registered insecticides as at February 2019

The product names are supplied on the understanding that no preference between equivalent products is intended, and that including a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

ALWAYS READ THE LABEL. Users of agricultural chemical products must always read the label and any permit before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from any compliance with the directions on the label or the conditions of the permit by reason of any statement made or omitted to be made in this publication.

Cereal grains include wheat, barley, oats, maize, sorghum, triticale, paddy rice and millet. Canola and other oilseeds may only be treated with phosphine. Withholding periods listed on some labels ensure that residues decay to acceptable levels before grain is sold. Any queries, please seek information from Joanne Holloway, NSW DPI Grain Storage Unit Wagga Wagga t: 02 6938 1605.

Do you know what is eating at your profits?

– common stored grain insect pests of NSW

Lesser grain borer – *Rhyzopertha dominica*



Key features: dark brown, pellet shaped, 3 mm long, eyes and mouth parts tucked underneath

Rust-red flour beetle – *Tribolium castaneum*



Key features: red brown, 3–4 mm long, three larger segments at end of antennae

Rice weevil – *Sitophilus oryzae*



Key features: dark brown to black, 2–4 mm long, long weevil snout

Saw-toothed grain beetle – *Oryzaephilus surinamensis*



Key features: dark brown, 3 mm long, fast moving, saw tooth pattern on side of body behind head

Flat grain beetle or rusty grain beetle
– *Cryptolestes ferrugineus*



Key features: brown, small, 2 mm long, fast moving, keen to hide, long thin antennae

India meal moth – *Plodia interpunctella*



Key features: distinctive bicoloured wings, 5–7 mm long, larvae create webbing on grain surface

Figure 7. Common stored grain insects

A – Images courtesy Department of Agriculture, Fisheries and Forestry, Queensland.

B – Image courtesy K Walker, PaDIL www.padil.gov.au

Table 70. Protectants for treating cereal grain in storage

Grain situation	Insecticide rate per 100 L		Summary notes: READ THE LABEL BEFORE TREATING for limitations and full instructions.
Protect cereal grain (including malting barley, rice and maize)	Conserve™ Plus (100 g/L Spinosad and 100 g/L S-Methoprene) 500 mL in 50 L of water		Ensure treatment is acceptable to buyer. Conserve™ Plus should NOT be applied to any cereal grain to be sold into markets designated Pesticide Residue Free (PRF). Durum wheat is assumed to have a PRF delivery requirement, as it is regularly sold into European markets, which have low MRLs for grain protectant compounds. Apply at the rate of 1 L diluted spray per tonne of grain for up to nine months protection. One application per parcel of grain. To control <i>Sitophilus</i> spp. (eg. Rice weevil) tank mix with a compatible product suitable for your grain type. (see product labels).
Protect cereal grain except malt barley	K-Obiol® Combi (Deltamethrin) 2.0 L		Ensure treatment is acceptable to buyer. K-Obiol® can be used against all the major stored grain insect pests. However, K-Obiol® is restricted to one application per parcel of grain. It is also only available through stewardship programs with Bayer (K-Obiol®). Make up ONE Group A insecticide to strength before adding the required amount of ONE Group B insecticide to the spray mix. Mixtures are needed to control the whole range of grain insects. Apply 1 L of diluted spray per tonne of grain entering storage. Ensure an even coverage of the grain. Treat only non-infested grain with protectants. Check labels for WHP. Different twin packs are available containing one Group A and one Group B insecticide. Twin pack premixed formulation might be available and can be used to control all stored grain insect pests. Please note: Resistance in lesser grain borer to IGR is widespread.
	GROUP A	Actellic® 0.45 L Reldan® 2.0 L Fenitrothion 1.2 L	
	GROUP B	Rizacon-S® 0.2 L IGR grain protectant (methoprene) various rates	
	TWIN PACK PRE-MIXED	Two-component packs Reldan® plus IGR 2.0 L ①	
Protect malting barley	K-Obiol® Combi 2.0 L ② Fenitrothion 1.2 L, PLUS IGR (methoprene) at rates indicated above. Conserve™ Plus ② (see directions above)		
Protect cereal grain (for treating cereal grain to be retained and used on farm only)	Dryacide® 1 kg/1 t Perma-Guard® D-10 1 kg/1 t Absorba-cide® 1 kg/1t Cut 'N Dry® 1 kg/1 t Carbaryl 500, 1.6 L PLUS ONE Group A insecticide at rates indicated above		Apply dusts evenly, and reduce auger rate to prevent choking. Follow label directions when mixing carbaryl with the Group A insecticide. Do not pre-mix concentrates. Agitate thoroughly and clean equipment after use. Vat mix can lose compatibility if left overnight. Withholding period three months. Not accepted off-farm by most traders.
Protect organic cereal grain	Dryacide® 1 kg/1 t Perma-Guard® D-10 1 kg/1 t Absorba-cide® 1 kg/1 t Cut 'N Dry® 1 kg/1 t		Dusted grain can retain protection for more than 12 months if grain moisture is low. Higher rates can be used for dirty or infested grain, but not where grain is for human consumption. Apply dusts evenly, and reduce auger rate to prevent choking. Check with buyers before application.

① A premixed formulation of Reldan® and methoprene.

② When using K-Obiol® Combi or Conserve™ Plus to control *Sitophilus* spp. (e.g. rice weevil). Fenitrothion needs to be added at 1.2 L.



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Seed dressings and foliar fungicides



Table 71. Cereal seed dressings – 2019: Control of seed-borne disease (page 1 of 3)

Cereal seed dressings control smuts and bunt, and some can suppress certain leaf and root diseases. Outbreaks of bunt and flag smut in wheat emphasise the need for annual seed treatment to avoid them building up in seed crops, or causing grain delivery issues.

Recommendations for controlling smuts are:

- discard grain carrying the disease
- avoid sowing wheat for at least two seasons into land where flag smut or bunt have occurred
- treat all seed for sowing

Some fungicides only control one or two of the three smuts.

Use a product controlling all three diseases. Some dressings can reduce the coleoptile length and emergence of some varieties. The risk of emergence failure is increased when some fungicides are used on varieties with short coleoptiles, or when seed is sown deeply or into a poor seedbed.

Active ingredient of fungicide or insecticide	Examples of seed treatment trade name and manufacturer	Rate to apply to each 100 kg	Approx. cost to treat 100 kg of seed (\$)	Smuts controlled:				F – wheat flag smut		Diseases suppressed								
				B – bunt; C – covered smut; L – loose smut				Wheat		Wheat		Wheat		Wheat/Barley		Barley		Grazing withholding period (weeks)
				Wheat	Barley	Oats	Triticale	Seed-borne flag smut	Soil-borne flag smut	Septoria tritici	Stripe rust	Leaf rust	Take-all	Rhizoctonia	Scald	Powdery mildew	Seed-borne net blotch	
Powders – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.																		
Flutriafol 100 g/kg + cypermethrin 4 g/kg	Armour® C SD – FMC	100 g	2.73	BL	CL	–	–	F	✓	–	–	–	✓	–	–	–	4	
Flutriafol 25 g/kg + cypermethrin 4 g/kg	Veteran™ C SD – Nufarm	100 g	2.41	BL	CL	CL	L	F	–	–	–	–	–	–	–	–	4	
Tebuconazole 25 g/kg + triflumuron 4 g/kg	Conquest Veto T – Conquest Agrichemicals	100 g	2.62	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	Not required when used as directed	
Triadimenol 150 g/kg + cypermethrin 4 g/kg	Triadimenol 150+® SD – 4 Farmers	100 g	2.82	BL	CL	CL	–	F	–	✓	–	–	✓	–	–	✓	5	
		150 g	4.22	BL	CL	CL	–	F	–	✓	✓	–	✓	✓	–	✓	5	
Flowable liquids – water based – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.																		
Carboxin 400 g/L + cypermethrin 3.2 g/L	Vitaflo® CST – Arysta LifeScience	125 mL	3.66	B	C	CL	–	F	–	–	–	–	–	–	–	–	7	
		250 mL	7.33	BL	CL	–	L	F	–	–	–	–	–	–	–	–	7	
Carboxin 200 g/L + thiram 200 g/L	Vitavax® 200 FF ST – Arysta LifeScience	250 mL	7.70	B	C	CL	–	F	–	–	–	–	–	–	✓	–	7	
		375 mL	11.55	B	C	–	–	F	–	–	–	–	–	–	✓	✓	7	
		500 mL	15.40	BL	CL	–	L	F	–	–	–	–	–	–	✓	✓	7	
Difenoconazole 92 g/L + metalaxyl-M 23 g/L	Dividend® FSD – Syngenta	100 mL	4.50	B	C	–	–	F	–	–	–	–	–	–	–	–	6	
		130 mL	5.85	BL	CL	–	–	F	–	–	–	–	–	–	–	✓	6	
		260 mL	11.70	BL	CL	–	–	F	–	–	–	–	–	✓	–	✓	6	
Difenoconazole 66.2 g/L + metalaxyl-M 16.5 g/L + sedaxane 13.8 g/L	Vibrance® – Syngenta	180 mL	7.21	BL	CL	L	BL	F	–	–	–	–	–	–	–	✓	6	
		360 mL	14.41	BL	CL	L	BL	F	–	–	–	–	–	–	–	✓	6	
Difenoconazole 36.9 g/L + thiamethoxam 30.7 g/L + metalaxyl-M 9.5 g/L + sedaxane 8 g/L	Vibrance® Extreme – Syngenta	325 mL	6.61	BL	CL	L	BL	F	–	–	–	–	–	–	–	✓	8	
		650 mL	13.23	BL	CL	L	BL	F	–	–	–	–	–	–	–	✓	8	
Fluquinconazole 167 g/L	Jockey® Stayer® – Bayer CropScience	300 mL	20.27	BL	CL	–	–	F	✓	✓	✓	✓	✓	✓	✓	✓	6, 12	
Flutriafol 6.25 g/L	Vincit® C Zinc FSD – FMC	450 mL	30.41	BL	–	–	–	F	✓	✓	✓	✓	✓	–	–	–	6, 12	
Flutriafol 25 g/L + cypermethrin 4 g/L	Vincit® C FSD – FMC	400 mL	7.92	BL	CL	CL	L	F	–	–	–	–	–	–	–	–	4	
Flutriafol 100 g/L + cypermethrin 4 g/L	Veteran® C – Nufarm	100 mL	2.15	BL	CL	CL	L	F	–	–	–	–	–	–	–	–	4	
Flutriafol 6.25 g/L + imidacloprid 180 g/L	Arrow® C FSD – Nufarm	100 mL	2.53	BL	CL	–	–	F	✓	–	–	–	–	–	–	–	4	
	Veteran® Plus – Nufarm	400 mL	9.70	BL	CL	CL	L	F	–	–	–	–	–	–	–	–	9	

Table 71. Cereal seed dressings – 2019: Control of seed-borne disease (page 2 of 3)

Active ingredient of fungicide or insecticide	Examples of seed treatment trade name and manufacturer	Rate to apply to each 100 kg	Approx. cost to treat 100 kg of seed (\$) ^①	Smuts controlled:				F – wheat flag smut		Diseases suppressed							
				B – bunt; C – covered smut; L – loose smut				Wheat	Wheat	Wheat/Barley		Barley			Grazing withhold-ing period (weeks)		
				Wheat	Barley	Oats	Triticale	Seed-borne smut	Soil-borne flag smut	Septoria tritici	Stripe rust	Leaf rust	Take-all	Rhizoctonia		Scald	Powdery mildew	Seed-borne net blotch
Flutriafol 6.25 g/L + metalaxyl-M 15 g/L + imidacloprid 180 g/L	Pontiac® Seed Treatment– NuFarm ^④	400 mL	11.38	BL	CL	CL	L	F	–	–	–	✓ ^⑤	–	–	–	–	9
Fluxapyroxad 333g/L	Systiva – BASF	150 mL	35.53	B	L	–	–	–	–	–	–	–	–	–	✓✓	✓✓	4
Ipconazole 20 g/L + cypermethrin 4 g/L	Rancona® C – Arysta LifeScience	100 mL	3.70	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	6
Ipconazole 25 g/L + metalaxyl 20 g/L	Rancona® Dimension – Arysta LifeScience	80 mL	3.78	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	10
	Arysta LifeScience	320 mL	15.12	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	10
	EverGol® Prime – Bayer CropScience	40 mL	6.93	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	5
		80 mL	13.86	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	5
Penflufen 240 g/L		65 mL	3.90	B	C	–	–	–	–	–	–	–	–	–	–	–	6
		100 mL	6.00	–	–	–	–	–	–	–	–	–	–	–	–	–	6
Penflufen 38.4 g/L + 61.4 g/L metalaxyl	EverGol® Energy ^⑪	130 mL	7.80	L	L	L	L	F	–	–	–	–	–	–	–	–	6
+76.8 g/L prothioconazole	Bayer CropScience	260 mL	15.60	–	–	–	–	–	–	–	–	–	–	–	–	–	6
Tebuconazole 25 g/L + cypermethrin 4 g/L	Innova® Tebuconazole 25 C FSD – Syngenta	100 mL	2.59	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	0
	Hombre® Ultra – Bayer CropScience ^④																
Tebuconazole 12.5 g/L + imidacloprid 360 g/L	Proguard® Ultra – Arysta LifeScience ^④	200 mL	7.95	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	9
Tebuconazole 25 g/L + triflumuron 4 g/L	Raxil® T FSD – Bayer CropScience	100 mL	2.26	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	4
Triadimenol 150 g/L + cypermethrin 4 g/L	Foliarflo® C ST – Arysta LifeScience	100 mL	2.53	BL	CL	CL	–	F	–	✓	–	–	–	✓	–	–	5
		150 mL	3.80	BL	CL	CL	–	F	✓	✓	–	–	–	✓	✓	–	5
	4 Farmers Imid-Triadimenol Seed Dressing – 4 Farmers Australia ^④	400 mL	5.37	BL	CL	CL	–	F	✓	✓	–	–	–	✓	✓	–	9
Triadimenol 56 g/L + imidacloprid 180 g/L		100 mL	2.62	BL	CL	CL	–	F	–	✓	–	–	–	✓	–	–	5
Triadimenol 150 g/L + triflumuron 4 g/L	Baytan® T FSD – Bayer CropScience	150 mL	3.93	BL	CL	CL	–	F	✓	✓	–	–	–	✓	✓	–	5
Triticonazole 25 g/L + cypermethrin 4 g/L	Premis® Pro C – BASF	100 ml	3.65	BL	CL	CL	–	F	–	–	–	–	–	–	–	–	Nil

✓ Affords useful suppression in early crop growth stages. ✓✓, ✓✓✓ and ✓✓✓✓ affords extended suppression.

① Prices quoted are GST inclusive at February 2019 and approximate only. Prices will vary depending on pack size purchased and special marketing arrangements.

② Rate of product varies for disease controlled, check label.

③ Also controls seed-borne flag smut in triticale. There is no registered seed treatments for cereal rye.

④ Barley yellow dwarf virus. Hombre® Ultra and ProGuard® Ultra provide early season control of BYDV.

⑤ Plus Raxil® T with Jockey® Stayer® at 100 mL/100 kg seed.

⑥ Also provides control of pythium root rot.

⑦ Suppresses Rhizoctonia root rot in oats.

⑧ Suppression only.

⑨ Withholding period – Livestock producing milk for human consumption 12 weeks.

⑩ Vibrance registered at 90–180 mL/100 kg seed for control of covered and loose smut in barley.

⑪ 160–180 mL/100 kg seed will give suppression of rhizoctonia root rot in barley.

⑫ EverGol® Energy is registered for the suppression of Crown rot and Pythium root rot for seed treatment, see label for rates.

Read label before using pesticides.

Treated seed must not be used for animal or human consumption.

Caution: Observe stock withholding periods on crops produced from treated seed.

Table 71. Cereal seed dressings – 2019: Control of seed-borne disease (page 3 of 3)

Cereal seed dressings control smuts and bunt, and some can suppress certain leaf and root diseases. Outbreaks of bunt and flag smut in wheat emphasise the need for annual seed treatment to avoid them building up in seed crops, or causing grain delivery issues.

Some fungicides only control one or two of the three smuts.

- Recommendations for controlling smuts are:
- discard grain carrying the disease
 - avoid sowing wheat for at least two seasons into land where flag smut or bunt have occurred
 - treat all seed for sowing

Use a product controlling all three diseases. Some dressings can reduce the coleoptile length and emergence of some varieties. The risk of emergence failure is increased when some fungicides are used on varieties with short coleoptiles, or when seed is sown deeply or into a poor seedbed.

Active ingredient of fungicide or insecticide	Examples of seed treatment trade name and manufacturer	Rate to apply to each 100 kg	Approx. cost to treat 100 kg of seed (\$) ^①	Smuts controlled:				F – wheat flag smut		Diseases suppressed							
				B – bunt; C – covered smut; L – loose smut				Wheat		Wheat/Barley	Wheat			Barley		Grazing withhold-ing period (weeks)	
				Wheat	Barley	Oats	Triticale	Seed-borne flag smut	Soil-borne flag smut		Septoria tritici	Stripe rust	Leaf rust	Take-all	Scald		Powdery mildew	Seed-borne net blotch
In furrow treatments – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.																	
Rate and approx. cost \$/ha																	
Azoxystrobin 322 g/L + metalaxyl-m 124 g/L	Uniform® – Syngenta ^⑦	200 mL/ha	13.93	–	–	–	–	–	–	–	✓✓	–	–	–	–	–	6
		300 mL/ha	20.89	–	–	–	–	–	–	–	–	–	–	–	–	–	6
		400 mL/ha	27.85	–	–	–	–	–	–	–	–	–	–	–	–	–	6
Flutriafol 250 g/L	Innova® Flutriafol 250 – Syngenta	200 mL/ha	8.80	–	–	–	–	–	–	–	✓✓	–	–	✓	✓	–	4
		400 mL/ha	17.60	–	–	–	–	–	–	–	✓✓✓	–	–	✓✓	✓✓	–	4
Flutriafol 500 g/L	Intake® HiLoad Gold NuFarm ^②	100 mL/ha	4.23	–	–	–	–	–	–	–	✓✓	–	–	✓	✓	–	4
		200 mL/ha	8.46	–	–	–	–	–	–	–	✓✓✓	–	–	✓✓	✓✓	–	4
		400 mL/ha	16.91	–	–	–	–	–	–	–	✓✓✓	–	–	✓✓	✓✓	✓	4
Penflufen 240 g/L	EverGol® Prime – Bayer CropScience	60 mL/ha	10.40	BL ^④	CL ^④	CL ^④	–	F ^④	F ^④	–	–	–	✓✓	✓✓	–	5	
Penflufen 38.4 g/L + 61.4 g/L metalaxyl +76.8 g/L prothioconazole	EverGol® Energy ^⑩ Bayer CropScience Triad® 500 WP – Genfarm	300 mL/ha	18.00	–	–	–	–	–	–	–	–	–	–	–	–	–	6
		200 g/ha	3.96	–	–	–	–	–	–	–	–	–	✓	–	–	–	Not stated ^⑫
		200 g/ha	2.68	–	–	–	–	–	–	–	–	✓✓	✓	–	✓	–	Not stated ^⑪
Triadimefon 500 g/kg	Triadimefon 500 DRY – 4 Farmers	200 g/ha	3.96	–	–	–	–	–	–	–	✓✓	✓	✓	✓	–	–	Not stated ^⑪

⑤ Plus Raxil® T with Jockey® Stayer® at 100 mL/100 kg seed.

⑥ Also provides control of pythium root rot.

⑦ Suppresses Rhizoctonia root rot in oats.

⑧ Suppression only.

⑨ Vibrance registered at 90–180 mL/100 kg seed for control of covered and loose smut in barley.

⑩ 160–180 mL/100 kg seed will give suppression of rhizoctonia root rot in barley.

⑪

EverGol® Energy is registered for the suppression of Crown rot and Pythium root rot for in-furrow application at 300 mL/ha. Do not apply in-furrow application to solid fertiliser, see label for application instructions.

Read label before using pesticides.

Treated seed must not be used for animal or human consumption.

Caution: Observe stock withholding periods on crops produced from treated seed.

① Prices quoted are GST inclusive at February 2019 and approximate only.

Prices will vary depending on pack size purchased and special marketing arrangements.

② Rate of product varies for disease controlled, check label.

④ Barley yellow dwarf virus. Hombre® Ultra and ProGuard® Ultra provide early season control of BYDV.

Table 72. Cereal insecticide seed dressings for aphid and Barley yellow dwarf virus (BYDV) control 2019

Active ingredient of insecticide and fungicide – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.	Examples of seed treatment trade name and manufacturer	Rate to apply to each 100 kg ²	Approx. cost to treat 100 kg of seed (\$) ¹	Aphid feeding damage suppression (wheat aphid and corn aphid)	Reduces spread of BYDV	Grazing with-holding period (weeks)
Imidacloprid 360 g/L + tebuconazole 12.5 g/L	Hombre® Ultra – Bayer CropScience Proguard® Ultra – Ayasta LifeScience 4 Farmers Imid-Triadimenol Seed Dressing – 4 Farmers Australia	200 mL	7.95	✓	✓	9
Imidacloprid 180 g/L + triadimenol 56 g/L		400 mL	5.37	✓	✓	9
Imidacloprid 180 g/L + flutriafol 6.2 g/L	Veteran® Plus – NuFarm	400 mL	10.44	✓	✓	9
Imidacloprid 180 g/L + flutriafol 6.25 g/L + 15 g/L Metalaxyl	Pontiac® – NuFarm	400 mL	11.38	✓	✓	9
Imidacloprid – 600 g/L	Gaucho® 600 – Bayer CropScience Senator® 600 RED – NuFarm	120–240 mL	5.32–10.64	✓	✓	9
Lambda-cyhalothrin 37.5 g/L + Thiamethoxam 210 g/L	Cruiser® Opti – Syngenta	165–330 mL	22.61–45.23	✓	✓	8
Thiamethoxam 350 g/L	Cruiser® 350FS	100–200 mL	5.28–10.56	✓	✓	8

✓ Affords useful suppression in early crop growth stages.

¹ Prices quoted are GST inclusive at February 2019 and approximate only. Prices will vary depending on pack size purchased and special marketing arrangements.

² Rate of product varies for length of disease control and risk level, check label.

Table 73. Canola and pulse seed dressings – 2019

Example seed treatment, trade name and manufacturer	Active ingredient of fungicide or insecticide	Rate to apply to each 100 kg of seed	Approximate cost to treat 100 kg (\$) #	Range of pack sizes (kg or L)	Canola	Chickpea	Field pea	Faba bean	Lupin	WHP weeks grazing
Powders										
Thiragranz* – Nufarm	thiram (800 g/kg)	150 g chickpea 125–150 g lupin	2.34 1.95–2.34	20 kg	–	Seed-borne botrytis, ascochyta blight	–	–	Seed-borne anthracnose	
Flowable liquids										
Gaucha® 600 Red Flowable – Bayer Crop Science	imidacloprid (600 g/L)	300 mL (lupin) 400 mL (canola) 120 mL (faba bean) 60 mL (field pea)	13.30 17.73 5.32 2.66	1–200 L	Redlegged earth mite, blue oat mite, aphids	–	Aphids	Aphids	Redlegged earth mite, blue oat mite	6
Emerge™ Flowable Seed Treatment – Syngenta	imidacloprid (600 g/L)	300 mL (lupin) 400 mL (canola)	12.55 16.74	1 & 10 L	Redlegged earth mite, blue oat mite, aphids	–	–	–	Redlegged earth mite, blue oat mite	6
Cosmos® – BASF	flupyrifluorid (500 g/L)	400 mL	291.77	5–1000 L	Redlegged earth mite	–	–	–	–	9
Cruiser® Opti - Syngenta	thiamethoxam (240 g/L) + lambda-cyhalothrin (37.5 g/L)	500–1000 mL	68.53–137.06		Green peach and grey cabbage aphid					6
		1000 mL	137.06	–	Suppression of: redlegged earth mite, lucerne flea	–	–	–	–	
Jockey® Stayer® – Bayer Crop Science	fluquinconazole (167 g/L)	2 L	135.16	5–1000 L	Blackleg (suppression)	–	–	–	–	8
Apron® XL 350 ES – Syngenta	metalaxyl-M (350 g/L)	75 mL	33.55	1–1000 L	–	Phytophthora root rot	Damping-off, downy mildew	–	–	
Maxim® XL – Syngenta	fludioxonil (25 g/L) + metalaxyl-M (10 g/L)	200–400 mL	80.85–161.70	1–1000 L	Damping-off (<i>Pythium</i> spp.), <i>Rhizoctonia solani</i> , blackleg (suppression)	–	–	–	–	6
P-Pickel T® – Nufarm	thiram (360 g/L) + thiabendazole (200 g/L)	200 mL	8.32	10 & 200 L	–	Ascochyta blight, botrytis seed rot, seedling root rots (<i>Pythium</i> spp., <i>Fusarium</i> spp.)	Black spot, (Leaf and pod spot (<i>Pythium</i> spp., <i>Fusarium</i> spp.)	Seedling root rots (<i>Pythium</i> spp., <i>Fusarium</i> spp.)	–	
Poncho® Plus – BASF	clothianidin (360 g/L) + imidacloprid (240 g/L)	500 mL	139.29	5–1000 L	Wireworm, cutworm, aphids, lucerne flea, redlegged earth mite, blue oat mite	–	–	–	–	8
Thiram 600 Flowable Fungicide – Nufarm	thiram (600 g/L)	200 mL (chickpea) 170–200 mL (lupin)	3.15 2.67–3.15	10–200 L	–	Damping-off (<i>Pythium</i> spp.), seed-borne botrytis and ascochyta blight	–	–	Seed-borne anthracnose	
Rovral® Liquid Seed Dressing – FMC	iprodione (250 g/L)	100–500 mL	2.42–12.12	5–1000 L	–	–	–	–	Brown leaf spot	
Sumisdx® Broadacre – Sumitomo	procymidone (500 g/L)	100 or 200 mL	3.63 or 7.26	20 L	–	–	–	–	Brown leaf spot	9
In furrow treatments										
Intake® Hiload Gold – Nufarm	flutriafol (500 g/L)	200 mL	8.46	5–1000 L	Blackleg	–	–	–	–	4

* Wettable granule formulation.

Prices quoted are GST Inclusive at 30 January 2019 and approximate only. Prices will vary depending on pack size purchased, seed treatment services and special marketing arrangements.

Table 74. Cereal foliar fungicides – 2019 currently registered products (NSW) – winter cereals (page 1 of 3)
Trade names sometimes available under these active ingredients and concentrations. See specific labels for details.

Examples of commercial trade names		WHP (weeks) W – wheat B – barley		Cost/L ^①	Adjuvant (as per label)	Diseases controlled ^②										Regis- tered for aerial appli- cation
		Product	Manufac- turer			Grazing	Har- vest	Stripe rust	Stem rust	Leaf rust	Crown (leaf) rust	Septoria tritici blotch	Septoria nodorum blotch	Yellow spot	Barley scald		Net blotch	Powdery mildew
Active and concentration					Barley – addition of Adigor® at 200 mL/100 L improves disease control at lower rates	400–800 mL (wheat) \$18.13– 36.26	400–800 mL (wheat) \$18.13– 36.26	400–800 mL (wheat & barley) \$9.06–36.26	–	–	400–800 mL (wheat) \$18.13–36.26	–	200–800 mL (barley) \$9.06–36.26	200–800 mL (barley) \$9.06–36.26	400–800 mL (wheat & barley) \$18.13–36.26	Yes
	Azoxystrobin 200 g/L + cyproconazole 80 g/L	Amistar® Xtra	Syngenta	3	6	\$45.32	1000– 2000 mL (wheat) \$25.30– 50.60 or 500 mL (wheat) \$500–1000 mL or 500 mL + Banjo® Banjo® 1% at v/v (wheat & barley) \$12.65	1000– 2000 mL (wheat & barley) \$25.30– 50.60 or 500 mL (wheat) \$500–1000 mL or 500 mL + Banjo® Banjo® 1% at v/v (wheat & barley) \$12.65	1000– 2000 mL (wheat) \$25.30–50.60 or 500 mL (wheat) \$500–1000 mL or 500 mL + Banjo® 1% at v/v (wheat & barley) \$12.65–25.30	–	1000– 2000 mL (wheat) \$25.30–50.60 or 500–1000 mL (barley) \$25.30–50.60 or 500–1000 mL + Banjo® 1% at v/v (wheat & barley) \$12.65–25.30	1000– 2000 mL (wheat & barley) \$25.30–50.60 or 500–1000 mL (barley) \$25.30–50.60 or 500–1000 mL + Banjo® 1% at v/v (wheat & barley) \$12.65–25.30	1000– 2000 mL (wheat & barley) \$25.30–50.60 or 500–1000 mL (barley) \$25.30–50.60 or 500–1000 mL + Banjo® 1% at v/v (wheat & barley) \$12.65–25.30	1000– 2000 mL (wheat & barley) \$25.30–50.60 or 500–1000 mL (barley) \$25.30–50.60 or 500–1000 mL + Banjo® 1% at v/v (wheat & barley) \$12.65–25.30	Yes	
	Taze® Xpert™ Epiconazole 31.25 g/L	Nufarm	3		Plus Banjo® 1%v/v for some diseases. Adding Banjo® might improve efficacy at lower rates. Refer to label.	420–840 mL (wheat) \$13.37– 26.73	420–840 mL (wheat) \$13.37– 26.73	420–840 mL (wheat & barley) \$13.37–26.73	–	420–840 mL (wheat) \$13.37–26.73	420–840 mL (wheat) \$13.37–26.73	420–840 mL (wheat) \$13.37–26.73	420–840 mL (barley) \$13.37–26.73	420–840 mL (barley) \$13.37–26.73	420–840 mL (wheat & barley) \$13.37–26.73	Yes
	Azoxystrobin 75 g/L + Epoxiconazole 75 g/L	Adama Australia	6 + ESI	6	\$31.83	–	315 mL or 630 mL (wheat) \$8.64 or \$17.27	315 mL or 630 mL (wheat) \$8.64 or \$17.27	315 or 630 mL (wheat & barley) \$8.64 or \$17.27	–	315 mL or 630 mL (wheat) \$8.64 or \$17.27	315 mL or 630 mL (wheat) \$8.64 or \$17.27	315 mL or 630 mL (barley ^③) \$8.64 or \$17.27	315 mL or 630 mL (barley ^③) \$8.64 or \$17.27	315 mL or 630 mL (barley ^③) \$8.64 or \$17.27	Yes
	Azoxystrobin 120 g/L + tebuconazole 200 g/L	Adama Australia	3 + ESI	6	\$27.42	–	250–500 mL (wheat) \$5.99–11.97	250–500 mL (wheat) \$5.99–11.97	500 mL (wheat) 250–500 mL (barley) \$5.99–11.97	–	250–500 mL (wheat) \$5.99–11.97	250–500 mL (wheat) \$5.99–11.97	250 mL (barley) \$5.99	250–500 mL (barley ^⑤) \$5.99–11.97	250 mL (wheat & barley) \$5.99	Yes
	Epoxiconazole 125 g/L	Opus® 125	BASF	6 + ESI	6	\$23.94	150–300 mL (wheat) \$1.98–3.96	–	–	–	–	–	–	–	–	Yes
	Fenbuconazole 240 g/L	Indar®	Dow Agro- Sciences	2 + ESI	NR	\$13.20	–	–	–	–	–	–	–	–	–	No

¹ Indicative costs only: significantly lower prices are often obtained for bulk purchases of commonly used products.
² Body of table shows rate mL/ha, g/ha and associated cost \$/ha for registered products.
³ Net form of net blotch only.

⁷ Rate on barley is 200–800 mL.
⁹ Suppression only.
 + ESI Export slaughter interval applies. Do not slaughter animals destined for export within 7 days of consumption of treated cereal forage or straw.
 NR Not required when used as directed.

Growers applying a foliar fungicide to control rust or other diseases need to observe the withholding period (WHP). Fungicides applied late, closer to harvest, may produce an excessive, illegal residue if applied within the WHP. For most of the fungicides registered to control diseases in winter cereals, the maximum residue limit (MRL) is set very low, at the limit of detection. A residue above the MRL is illegal under the *Pesticides Act 1999* and renders the offender liable to prosecution and a fine. Excessive residues also put Australia's export trade at risk. If it's necessary to apply a fungicide late, select a product with a short WHP.

Table 74. Cereal foliar fungicides – 2019 currently registered products (NSW) – winter cereals (continued; page 2 of 3)
Trade names sometimes available under these active ingredients and concentrations. See specific labels for details.

Active and concentration	Examples of commercial trade names		WHP (weeks) W – wheat B – barley		Cost/L ^①	Adjuvant (as per label)	Diseases controlled ^②										Regis- tered for aerial appli- cation	
	Product	Manufac- turer	Grazing	Har- vest			Stripe rust	Stem rust	Leaf rust	Crown (leaf) rust	Septoria tritici blotch	Septoria nodorum blotch	Yellow spot	Barley scald	Net blotch	Powdery mildew		
Flutriafol 250 g/L	Various Jubilee® Loaded Intake®Combi Sapphire	Adama Australia Nufarm	7-W 10-B	7-W 10-B	200 mL/100 L B\$1000®	200 mL/100 L B\$1000®	250–500 mL (wheat) \$4.95–9.90	–	250–500 mL (wheat) \$4.95–9.90	–	250–500 mL (wheat) \$4.95–9.90	250–500 mL (wheat) \$4.95–9.90	–	–	–	250–500 mL (barley) \$4.95–9.90	Yes	
Flutriafol 500 g/L			7-W 10-B	7-W 10-B	200 mL/100 L B\$1000®	200 mL/100 L B\$1000®	125–250 mL (wheat) \$5.25–10.51	–	125–250 mL (wheat) \$5.25–10.51	–	125–250 mL (wheat) \$5.25–10.51	125–250 mL (wheat) \$5.25–10.51	–	–	–	125–250 mL (barley) \$5.25–10.51	Yes	
Propiconazole 250 g/L ^⑩			1	4	\$15.62	Not required	250–500 mL (wheat) \$3.91–7.81	500 mL (wheat & oats) \$7.81	150–500 mL (wheat) \$2.34–7.81	250–500 mL (oats) \$3.91–7.81	250–500 mL (wheat & oats ^④) \$3.91–7.81	150–500 mL (wheat) \$2.34–7.81	250–500 mL (wheat) \$3.91–7.81	500 mL (barley) \$7.81	250–500 mL (barley) \$3.91–7.81	150–500 mL (wheat & barley) \$2.34–7.81	Yes	
Propiconazole 435 g/L	Tilt® 250 EC	Syngenta	1	4	\$15.62	Not required	145 mL ^{or} 285 mL (wheat) \$4.31–8.46	285 mL (wheat & oats) \$8.46	85–285 mL (wheat) \$2.58–\$8.46	145–285 mL (oats) \$4.31–8.46	145–285 mL (wheat & oats ^④) \$4.31–8.46	145–285 mL (wheat) \$4.31–8.46	145–285 mL (wheat) \$4.31–8.46	285 mL (barley) \$8.46	285 mL (barley ^⑤) \$8.46	85–285 mL (wheat & barley) \$2.58–\$8.46	Yes	
Propiconazole 500 g/L	Throttle® 500	Nufarm	1	4	\$31.85	Not required	125 mL ^{or} 250 mL (wheat) \$3.98–7.96	250 mL (wheat & oats) \$7.96	125–250 mL (barley) \$2.39–\$7.96	125–250 mL (oats) \$3.98–7.96	125–250 mL (wheat & oats ^④) \$3.98–7.96	75–250 mL (wheat) \$1 (wheat) \$1 \$2.39–7.96	125–250 mL (wheat) \$3.98–7.96	250 mL (barley) \$7.96	125–250 mL (barley) \$3.98–7.96	75–250 mL (wheat & barley) \$2.39–7.96	Yes	
Propiconazole 250 g/L + cyproconazole 80 g/L	Tilt® Xtra	Syngenta	3 + ESI	6	\$39.19	Not required	250–500 mL (wheat) \$9.80–19.59	500 mL (wheat) \$19.59	150–500 mL (wheat & barley ^⑤) \$5.88–19.59	–	250–500 mL (wheat) \$9.80–19.59	150–500 mL (wheat) \$5.88–19.59	250–500 mL (wheat) \$9.80–19.59	500 mL (barley) \$19.59	250 or 500 mL (barley) \$9.80–19.59	150–500 mL (wheat & barley) \$5.88–19.59	Yes	
Propiconazole 250 g/L + tebuconazole 250 g/L	Cogito®	Syngenta	2	5	\$29.96		125 – 250 mL (wheat) \$3.74–7.49	125–250 mL (wheat) \$3.74–7.49	125–250 mL (wheat & barley) \$3.74–7.49	125–250 mL (oats) \$3.74–7.49	125–250 mL (wheat & oats ^④) \$3.74–7.49	125–250 mL (wheat) \$3.74–7.49	125–250 mL (wheat) \$3.74–7.49	250 mL (barley) \$7.49	125–250 mL (barley) \$3.74–7.49	125–250 mL (wheat & barley) \$3.74–7.49	Yes	
Prothioconazole 210 g/L + tebuconazole 210 g/L	Prosaro® 420 SC ^⑧	Bayer CropScience	2	5	\$81.95	Various(adjuvants required for some diseases) – As per label directions	150–300 mL (wheat & triticale) \$12.29– 24.59	150–300 mL (wheat) \$12.29– 24.59	150–300 mL (wheat & barley) \$12.29– 24.59	300 mL (oats) \$24.59	150–300 mL (wheat, oats) \$12.29–24.59	150–300 mL (wheat) \$12.29–24.59	150–300 mL (wheat) \$12.29–24.59	150–300 mL (barley) \$12.29–24.59	150–300 mL (barley) \$12.29–24.59	150–300 mL (wheat & barley) \$12.29–24.59	Yes	
Pyraclostrobin 85 g/L + epoxiconazole 62.5 g/L	Opera®	BASF	3 + ESI	NR	\$35.05	Non-ionic surfactant (not specified)	500 mL (wheat) \$17.53	500 mL (wheat) \$17.53	500–1000 mL (wheat) \$17.53–35.05	500 mL (barley) \$17.53	500 mL (oats) \$17.53	500 mL (wheat) \$17.53	–	500 mL (barley) \$17.53	500–1000 mL (barley) \$17.53–35.05	500 mL (wheat) \$17.53–35.05	Yes	

Table 74. Cereal foliar fungicides – 2019 currently registered products (NSW) – winter cereals (continued; page 3 of 3)
Trade names sometimes available under these active ingredients and concentrations. See specific labels for details.

Examples of commercial trade names		WHP (weeks)		Adjuvant (as per label)	Diseases controlled ^②										Registered for aerial application	
		W – wheat	B – barley		Cost/L ^①	Stripe rust	Stem rust	Leaf rust	Crown (leaf) rust	Septoria tritici blotch	Septoria nodorum blotch	Yellow spot	Barley scald	Net blotch		Powdery mildew
Active and concentration	Product	Manufacturer	Grazing	Harvest	1% D-C-Trate or equivalent may improve results	145–290 mL (wheat) \$2.82–5.64	145–290 mL (wheat & oats) \$2.82–5.64	145–290 mL (wheat) \$2.82–5.64	145–290 mL (oats) \$2.82–5.64	290 mL (wheat) \$5.64	145–290 mL (wheat) \$2.82–5.64	145–290 mL (wheat) \$2.82–5.64	145 mL (barley) \$2.82	–	145–290 mL (barley) \$2.82–5.64	Yes
	Various	–	2	5		1370 g or 2750 kg (wheat) \$8.58–17.16	1370 g or 2750 g (wheat & oats)	1370 g or 2750 g (wheat)	1370 g or 2750 g (wheat & oats)	2750 g (wheat)	1370 g or 2750 g (wheat)	1370 g or 2750 g (wheat)	1370 g or 2750 g (wheat)	1370 g (barley)		1370 g or 2750 g (barley)	No
Triadimefon 125 g/L	Triadimefon 125	Genfarm	Not stated, see foot-note ^⑫	4	Not required	500 mL or 1000 mL (wheat) \$8.58–17.16				–	1000 mL (barley) \$17.16	–	1000 mL (barley) \$17.16	–	1000 mL (barley) \$17.16	Yes
	Ospray Triadimefon 500WG	FMC	Not stated, ^⑪	4	Not required	125–250 g (wheat) \$2.48–4.95	125–250 g (wheat) \$2.48–4.95	125–250 g (wheat – southern NSW only) \$2.48–4.95	–	125–250 g (wheat – southern NSW only) \$2.48–4.95	–	–	–	–	250 g (barley) 125–250 g (wheat) \$2.48–4.95	Yes

^① Indicative costs only: significantly lower prices are often obtained for bulk purchases of commonly used products.

^② Body of table shows rate mL/ha, g/ha and associated cost \$/ha for registered products.

^⑩ Various formulations and active ingredient concentrations of propiconazole and tebuconazole are available.

^⑪ Do not mix leaves treated with this product with feed intended for animal consumption.

^⑫ Feed treated with this product must not be used for animal consumption, poultry feed or mixed with animal feed.

+ ESI Export slaughter interval applies. Do not slaughter animals destined for export within 7 days of consumption of treated cereal forage or straw.

NR Not required when used as directed.

Growers applying a foliar fungicide to control rust or other diseases need to observe the withholding period (WHP). Fungicides applied late, closer to harvest, may produce an excessive, illegal residue if applied within the WHP. For most of the fungicides registered to control diseases in winter cereals, the maximum residue limit (MRL) is set very low, at the limit of detection. A residue above the MRL is illegal under the *Pesticides Act 1999* and renders the offender liable to prosecution and a fine. Excessive residues also put Australia's export trade at risk. If it is necessary to apply a fungicide late, select a product with a short WHP.

Table 75. Canola and pulse foliar fungicides – 2019

Example foliar fungicide trade name and manufacturer	Active ingredient	Harvest withholding period (WHP) – weeks/days		Rate to apply per hectare (L/ha or kg/ha)	Cost of product per litre (\$)	Size of pack (kg or L – range of pack sizes)	Canola	Chickpea	Field pea	Faba bean	Lupin
		Harvest	Grazing								
Spin Flo® – Nufarm	carbendazim (500 g/L) ❶	28 days	28 days	500 mL	14.95			Botrytis grey mould		Chocolate spot	
Bravo® Weather Stik – Syngenta	chlorothalonil (720 g/L)	7 days	Do not graze	1.4–2.3 L	17.65	5–200 L	–	–	–	Chocolate spot, rust	–
Barrack® 720 – Crop Care	chlorothalonil (720 g/L)	14 days	14 days ❸	1.4–2.3 L (faba bean)	14.48	5–200 L	–	Ascochyta blight	–	Chocolate spot, rust	–
Unite® 720 – Nufarm	chlorothalonil (720 g/L)	14 days		1.2–1.9 kg (faba bean)		5–1000 L	–	–	–	–	–
Echo® 900 Fungicide – Spicam	chlorothalonil (900 g/kg)	14 days	14 days ❸	0.8–1.6 kg (chickpea)	18.05	1–20 kg	–	Ascochyta blight	–	Chocolate spot, rust	–
Rovral® Liquid – FMC	iprodione (250 g/L)	42 days	42 days	2.0 L	18.80	5–1000 L	Sclerotinia stem rot	–	–	–	–
Dithane® Rainshield Neo Tec Fungicide – Dow								Ascochyta blight, botrytis grey mould, rust	Ascochyta blight blackspot, botrytis grey mould	Ascochyta blight, chocolate spot, Cercospora, rust	Anthracnose, botrytis grey mould
AgroSciences	mancozeb (750 g/kg)	28 days	14 days	1.0–2.2 kg	11.40	20 kg	–	–	–	–	–
Fortress® 500 – Nufarm		Canola not required	9 weeks	1.0 L (canola)		5–10 L	–	–	–	–	–
Sumisdex® Broadacre – Sumitomo	procymidone (500 g/L) ❷	Faba bean 9 days	Not stated	0.5 L (faba bean)	34.35	20 L	Sclerotinia stem rot	–	–	Chocolate spot	–
Prostaro® 420 SC – Bayer	prothioconazole (210 g/L)				81.95	5–20 L	Blackleg, sclerotinia stem rot	–	–	–	–
CropScience	+ tebuconazole (210 g/L)	Not required	14 days	375–450 mL				–	–	–	–
				Canola blackleg 550–650 mL; sclerotinia stem rot 550–800 mL							
				Chickpea Ascochyta blight 400–600 mL							
				Faba bean chocolate spot, rust 600 mL							
				Ascochyta blight, Cercospora 400–600 mL							
				Field pea black spot complex 600 mL	59.95	10 L	Blackleg, sclerotinia stem rot	Ascochyta blight	–	–	–
Aviator® Xpro™ – Bayer	Prothioconazole (150 g/L) + bixafen (75 g/L)	Not required	all 35 days	300–450 mL#	153.45	–	Blackleg, White leaf spot	–	–	–	–
Miravis® Fungicide – Syngenta	pydiflumetofen (200 g/L)	Not required	6 weeks	450–600 mL				–	–	–	–
		3 days	3 days								
Orius® 430 SC Fungicide – Adama	tebuconazole (430 g/L)	PER13752 21 days	PER13752 14 days	145 mL	18.20	5–1000 L	–	–	Powdery mildew	Cercospora, rust (PER13752, expiry 30/06/24)	–
		Canola, not required	Canola 14 days	Canola sclerotinia stem rot 1.0 L; Pulses 0.75–1.0 L				Botrytis grey mould, ascochyta blight, chocolate spot, Cercospora, rust	Botrytis grey mould	–	–
Veritas® Fungicide – Adama	tebuconazole (200 g/L) + azoxystrobin (100 g/L)	Pulses 28 days	Pulses 28 days	Faba bean rust and Cercospora 300 mL	27.42	1–1000 L	Sclerotinia stem rot	Botrytis grey mould, ascochyta blight	Botrytis grey mould	Botrytis grey mould	Botrytis grey mould
Triadimefon 125EC – FMC	triadimefon (125 g/L)	14 days	Not stated	500 mL	17.60	5–1000 L	–	–	Powdery mildew	–	–

❶ Health warnings are in place for potential effects on male fertility.

❷ Health warnings are in place for women of child bearing age.

❸ Do not feed to livestock producing milk for human consumption.

When combined with use of a seed treatment or in-furrow fungicide treatment Prices quoted are GST inclusive at 30 January 2019 and approximate only.

Prices will vary depending on pack size purchased.

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