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2018 **Barley** **variety sowing guide** for Western Australia



WESTERN AUSTRALIA



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Company and industry abbreviations:

- CCDM – Centre for Crop and Disease Management
- DAFWA – Department of Agriculture and Food Western Australia
- DPIRD – Department of Primary Industries and Regional Development
- GIWA – Grain Industry Association of Western Australia
- GRDC – Grains Research and Development Corporation
- NFI – National Frost Initiative
- NVT – National Variety Trials
- QDAFF – Queensland Department of Agriculture and Fisheries

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2018 **Barley** **variety sowing guide** for Western Australia

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Contents

Introduction	4
Best management agronomy	9
Market feedback	12
Grain yield comparisons.....	16
Disease resistance	23
Agronomic attributes.....	31
Herbicide tolerance	36
Factsheets	39



Introduction

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This variety guide is designed as a reference to help determine which barley variety to grow in your region. It provides market feedback, relative grain yield comparisons, disease ratings, agronomic information and herbicide tolerance ratings for all malt barley varieties segregated in Western Australia (WA) and selected feed varieties (Tables 1 to 11; Figures 1 to 6).

The decision whether to grow barley with a malt or feed classification depends on five main factors:

- (1) Premium paid for different varieties when segregated.
- (2) Relative grain yield of malt and feed grade barley varieties.
- (3) Differences in input costs due to their agronomy and disease characteristics.
- (4) Likelihood that grain of a malt variety will meet malt barley receival specifications.
- (5) Location of receival segregations for malt barley varieties.

Identifying which option will lead to the greatest returns for a grower is complex. In some instances, the price premium paid for malt will offset the yield difference between malt and feed varieties. In other situations, the substantially higher yield of feed varieties, the low likelihood of a malt variety being segregated as malt or the higher costs of growing a malt barley, may justify the choice of a feed variety.

There is greater market demand for some malt varieties in some port zones and lesser demand in other port zones. That demand will influence the choice of malt variety that is sown regionally. No one malt or feed variety matches all the different farming systems in which barley is grown or the brewing and shochu markets we service. Use the market and agronomic information presented in Tables 1 to 11 and Figures 3 to 6 to assist with decisions on what variety to grow.

In 2016 four varieties, Scope CL, La Trobe, Hindmarsh and Bass (in decreasing popularity) occupied just over eight in every 10 hectares sown to barley (Figure 1). In 2017 the area sown to Flinders and Granger will increase (depending on port zone), whilst Hindmarsh will decrease following market signals indicating it will no longer be segregated after the 2017/18 harvest. As we move into 2018 we expect to see the area sown to Bass and Scope CL decline and Spartacus CL increase. Markets signals will influence the planted areas of Compass, Flinders and Granger,

whilst production of RGT Planet will rise or fall on the back of its agronomic performance in 2017 and feedback from Barley Australia's malt accreditation.

What's new?

Two new feed barley varieties – LG Maltstar (tested as SMBA11-1771) and RGT Planet (tested as SFR85-014) are available for sowing in 2018.

InterGrain also has a new semi-dwarf line, IGB1305, that is being evaluated in Stage 1 by Barley Australia, the same accreditation stage as RGT Planet. The earliest possible accreditation date for IGB1305 and RGT Planet is March 2019. IGB1305 (WABAR2312/WABAR2332) is slightly earlier maturing than Flinders and Bass. Information provided by InterGrain suggests that IGB1305 has a greater yield stability and a higher yield potential than Flinders and Bass across a range of environments. InterGrain has indicated that IGB1305 will only be commercially released if it meets the standards set by Barley Australia and is accredited as a malt barley variety. Seed of IGB1305 is therefore not commercially available for sowing in 2018.

Why consider the new varieties LG Maltstar and RGT Planet?

LG Maltstar

LG Maltstar (Henley/Sebastian) was developed by Elders through its breeding partner Edstar Genetics. It has been sown in the WA barley NVT since 2011 and is a competitor to Bass, Flinders and Granger in higher rainfall areas of WA. It has a similar plant type to Granger with durable resistance to powdery mildew (based on the *mlo* gene) and good tolerance to both Beecher pathotypes of NTN. WA barley NVT suggests that LG Maltstar has no grain yield advantage relative to Flinders or Granger in WA, having a similar yield in 62% and 70% of 82 NVT trials sown since 2011, respectively. In fact, occurrences of LG Maltstar yielding higher than Flinders and Granger are infrequent, occurring in less than one in every 10 trials.

LG Maltstar has been accepted by Barley Australia for inclusion in their malting and brewing accreditation process and will enter Stage 1 in 2018 (subject to the availability of grain suitable for evaluation). The earliest possible accreditation date is March 2020.

Seed of LG Maltstar is now available for purchase through the Elders network. As with any new variety being evaluated by Barley Australia we recommend caution in adopting them or sowing large areas to them unless there is a clear agronomic or grain yield advantage. Therefore, for the moment we are advising growers and consultants to continue to watch the performance of LG Maltstar in industry and research trials before acting.

RGT Planet

RGT Planet (Tamtam/Concerto) has been introduced into Australia by SeedForce and was bred by RAGT Semences, an agricultural company founded in 1919 by Aveyronnais farmers in France. RGT Planet is the highest yielding spring barley in the United Kingdom (UK) and has outperformed market leading varieties in trials across Europe (including Spain, France, Germany, Ireland, Italy, Poland and Spain) and South America. In 2016 in Australia, RGT Planet topped the barley NVT yield tables, being 8% higher yielding than Rosalind (the current benchmark nationally) Australia wide and 4% higher yielding in WA. It is therefore reasonable for growers to be very interested in RGT Planet because of its grain yield potential. It is worth noting that 2016 is the only year that RGT Planet has been sown in public variety trials in Australia. Growers should therefore be cautious until there are more years and locations of data available to make a considered statement on its true yield potential and true agronomic performance in Australia.

RGT Planet has been accepted by Barley Australia for inclusion in their malting and brewing accreditation process and is currently being evaluated in Stage 1 in 2017. Subject to successful completion of Stage 1 and the availability of grain suitable for evaluation RGT Planet will enter Stage 2 in 2018. The earliest possible accreditation date is March 2019.

It is important to note that in the markets where RGT Planet is accredited (Denmark, France, Germany and the UK) it is used in beer styles which use 100% malt. For European beers, European brewers target varieties with a lower

diastatic power. Diastatic power is a measure of the ability of the malt to break down starch into simpler fermentable sugars during the mashing process. In a 100% malt beer no starch adjunct is added. Therefore the brewer only requires malt with a low to moderate diastatic power. Australian beer is typically made with malt and liquid sugar adjunct, with some beers using up to 20% liquid sugar adjunct. Australian brewers therefore target varieties with low diastatic power like Charger, Commander and Navigator. Chinese brewers (our largest market) use less than 70% malt in their beer, with between 30–55% adjunct usage (typically rice and corn syrup but also other starch sources). Chinese brewers therefore target varieties with a higher diastatic power like Bass, Baudin, Flinders, La Trobe and Scope CL to convert their starch adjuncts to fermentable sugars. The point is that until RGT Planet is grown and malted under Australian conditions we don't know if it is suitable for all, just some or none of the beer markets that Western Australian growers service in Asia.

Seed of RGT Planet is available for purchase through Melchiorre Seeds at Narrogin. Growers should not purchase seed with an expectation that malt segregations will be available if they grow enough. The WA barley industry places value on the Barley Australia accreditation process, just like many of our customers, and segregations should not be expected until it is an accredited variety.

What should I grow?

The following varieties should be high on the list of what to grow – Bass, Flinders, Granger, La Trobe, Scope CL and Spartacus CL. There are also other options for specific agronomic situations like the sowing of Litmus on soils with a sub-soil pH_{Ca} below 4.8 or Fathom where stubble-borne STNB is a high risk. Compass is a future option for lower rainfall areas where plump grain would be a benefit to deliver as malt, but accreditation as a malt barley is the trigger to start growing this variety as its yields in WA are similar to La Trobe and Spartacus CL. The current advice in regard to Compass is to watch but don't act. Oxford was previously suggested as a variety to consider but the increased prevalence of NTNB and powdery mildew infection plus its susceptibility to STNB mean Oxford is now a higher cost option for the south coast. Lockyer is another possible option, particularly for late April

sowing, but is generally outclassed for grain yield by Rosalind.

Why consider Bass, Fathom, Flinders, Granger, La Trobe, Litmus, Scope CL and Spartacus CL?

Bass

Bass (WABAR2023/Alexis) is an established malt variety with strong market demand due to its high malt quality profile. From a grower's perspective, Bass has had a higher selection rate as malt than any other malt variety received over the last three seasons. The development of a new barley leaf rust pathotype (from 5453P- to 5457P- and now 5656P+) has meant Bass is no longer a resistant variety to that disease. The prevalence of powdery mildew infection on Bass is also increasing. As a seedling it is rated as VSp to the new Skiff virulent pathotype of NTNB that is increasing in its prevalence on the south coast. Head loss has been reported to be an issue with Bass in the Esperance region but not in other cropping regions.

Best suited:

- To environments with a potential above 3 tonnes per hectare (t/ha).
- Where crown rot and barley leaf rust is a low risk.
- Rotations in which low grain protein may be a problem.
- Where high grain plumpness is important.

Fathom

Fathom (JE013D-020/WI3806-1) is a feed barley with the best tolerance to STNB of the currently grown barley varieties, but is rated as MSS or below to both Beecher pathotypes of NTNB and VSp to the new Skiff pathotype of NTNB (as a seedling). Fathom is similar yielding to La Trobe below 3t/ha and up to 0.2t/ha lower yielding than La Trobe in higher yielding environments. The grain yield of Fathom was lower than Rosalind in 50% of WA barley NVT (2014–2016) and similar in the other 50%.

Best suited:

- To environments with a yield potential below 3t/ha where there is a high risk of STNB.
- To paddocks with a higher weed burden as it is one of the more competitive barley varieties.

Flinders

Flinders (Baudin/Cooper) is a new malt variety. Flinders has short, stiff straw and a low head loss risk. There is a positive outlook from Australian maltsters and international users who have been using Flinders grain and malt. Flinders is of interest to malt customers who wish to malt without the need for the growth hormone gibberellic acid. There is a growing international demand for malt made without the use of gibberellic acid as an additive. As production of this variety is still building, limited segregation opportunities are to be expected in 2018. Whilst Flinders displays adult plant resistance (APR) to barley leaf rust, it will still need spraying when infection occurs before early grain fill. Observations from agronomy trials in the Esperance region suggest that Flinders (and Granger) has a lower risk of germ end staining than Bass and La Trobe.

Best suited:

- To environments with a potential above 3t/ha.
- Where crown rot is a low risk.
- Where both late season barley leaf rust and powdery mildew are a risk.
- Where short, stiff straw and good head retention are important.

Granger

Granger (Braemar/Adonis) is a new malt variety being evaluated for its suitability in international brewing markets. Granger is still in the early stages of international market development with the first shipment of grain from the Esperance Port Zone being used by international brewing customers during 2017. Limited segregation opportunities are to be expected until full market acceptance is achieved. Granger has the best seedling tolerance (rated as MRMSp) to the new Skiff virulent pathotype of NTNB that is increasing in its prevalence on the south coast. Granger has durable resistance to powdery mildew (due to *mlo* gene). Even though it has APR to barley leaf rust, Granger will benefit from fungicide application with early rust infection. National Frost Initiative data suggests that Granger (like La Trobe and Oxford) is more sensitive to frost (higher frost induced sterility) than other barley varieties and should not be sown where there is a high risk of frost. Whilst having a naturally darker kernel (in terms of grain brightness) than other malt varieties, observations from agronomy trials in

the Esperance region suggest that Granger (like Flinders) has a lower risk of germ end staining than Bass and La Trobe.

Best suited:

- To environments with a potential above 3t/ha.
- Where crown rot and frost is a low risk.
- Where both barley leaf rust in spring and powdery mildew are a risk.
- Away from the coast to reduce the risk of kernel discolouration at harvest (if targeting malt).

La Trobe

La Trobe (Dash/VB9409) is suited to all environments but is susceptible to STNB and barley leaf rust. Whilst recognised as a malt barley by international markets, La Trobe is not recognised as a premium variety and in years of adequate supply is likely to be priced below varieties like Bass and Baudin. The removal of Hindmarsh from the segregated list however will increase the demand for La Trobe in the shochu market in Japan as none of the other segregated varieties (except Baudin) are accepted into that market. National Frost Initiative data suggests that La Trobe (like Granger and Oxford) is more sensitive to frost (higher frost induced sterility) than other barley varieties and should not be sown where there is a high risk of frost. In the high frost year encountered in 2016, yield loss in frosted La Trobe plots was equivalent to many varieties of similar maturity. Observations from agronomy trials in the Esperance region suggest that La Trobe, like Compass and many other shorter seasoned varieties, has a higher risk of germ end staining than Flinders and Granger. Due to its susceptibility to smut, every La Trobe seed should be treated with a good quality smuticide.

Best suited:

- To environments with a potential below 4t/ha.
- Where STNB and barley leaf rust are not a risk.
- Where frost is a low risk.

Litmus

Litmus (WB229/2*Baudin//WABAR2238) is a feed barley. Litmus is the best available barley for sowing on soils with an acidic profile as it carries the *Alt1* gene which increases the exudation of citrate from its root decreasing the toxicity of Aluminium in the soil solution surrounding its roots. On acidic soils this results in increased grain yield relative to traditional barley varieties and a similar yield to wheat varieties like Calingiri and Wyalkatchem. On soils without an acidic sub-soil, Litmus is generally lower yielding than La Trobe. Litmus has also performed well when crown rot is present, having the lowest yield loss of the commercial barley varieties evaluated. Unfortunately Litmus grains can display a blue aleurone, as detected in Henley, which affects its ability to be delivered against current GTA and GIWA barley receival standards. Litmus is currently being received by CBH as a feed barley with stack averaging for blue aleurone to ensure feed stack do not exceed the limit of one in 100 blue kernels. Malt accreditation of Litmus has stalled whilst industry debates the merits of allowing blue aleurone in export malt and feed cargoes of barley. Litmus has poor straw strength and is susceptible to all leaf diseases.

Best suited:

- To environments with a yield potential below 2t/ha where the sub-soil (10–30cm) has a pH_{Ca} below 4.8.
- Where leaf diseases are a low risk or can be easily managed.

Rosalind

Rosalind (Lockyer/Dash) is a new feed barley released in 2015 with a good level of disease resistance except to STNB. There is however evidence of increased virulence of NTNB on Rosalind barley growing on the south coast. It is the yield benchmark for barley in WA based on its overall agronomic performance from 2014 to 2016. In that period (2014–2016), the state-wide grain yield of Rosalind was 11% higher than La Trobe in the WA barley NVT (48 trials). The credentials of Rosalind as the highest yielding variety overall in WA, however, look set to be superseded by RGT Planet if RGT Planet's performance in the 2016 WA barley NVT is repeated in coming seasons. The decision to grow Rosalind instead of a malt variety will be dependent on the premium offered and the probability of meeting malt barley receival

specifications in your production area. Due to its susceptibility to smut, every Rosalind seed should be treated with a good quality smuticide.

Best suited:

- To environments where there is a low probability of delivering malt grade barley.
- Where you just want to grow feed barley.
- Where STNB and Skiff virulent NTNB are not a risk.

Scope CL

Scope CL (Franklin/VB9104/VB9104) is an established malt variety with good market demand. Due to its tolerance to imi-herbicides, Scope CL is best suited to environments where brome and barley grass are a problem or where there is imidazolinone residues. Growers should follow the label when applying herbicides to Scope CL barley and should not apply any off label imidazolinone herbicides. The only imidazolinone herbicides registered for use with Scope CL barley are Sentry® (imazapic + imazapyr) and Intervix® (imazapyr + imazamox). In 2016 Scope CL was sown on a similar area to that of La Trobe, with each accounting for one in every four barley hectares in WA. Scope CL's heartland however is the Geraldton and Kwinana Port Zones where it accounts for nearly one in every two barley hectares. The area sown to Scope CL will be challenged by the new imidazolinone tolerant barley Spartacus CL, which has shown an overall grain yield advantage over Scope CL of 15% in the WA barley NVT sown from 2014–2016. The yield advantage of Spartacus CL was more pronounced in 2014 and 2015 compared to 2016.

Best suited:

- To environments with a potential below 3t/ha.
- To April sowing opportunities when sowing into non-Clearfield® wheat stubble.
- Where crown rot is a low risk.
- Where an imidazolinone herbicide was used last year or Sentry® / Intervix® is required this year.
- Where prompt harvesting once the crop is mature is possible (due to a high head loss risk).

Spartacus CL

Spartacus CL (Scope/4*Hindmarsh/HMVB0325-106) is a new imidazolinone tolerant barley with a similar grain yield, phenology and agronomic features to Hindmarsh and La Trobe. Its plants, however, lack the anthocyanin pigment present in Hindmarsh and La Trobe. Whilst both Spartacus CL and Scope CL can be sprayed with a registered imidazolinone herbicide (Intervix® and Sentry®) to control barley grass and brome in-crop, Spartacus CL has a higher grain yield than Scope CL. The overall advantage of Spartacus CL from 2014-2016 in WA barley NVT was 15% over Scope CL, despite performing poorly in 2016. Spartacus CL is likely to yield between 0.2-0.4t/ha better than Scope CL in the less than 3t/ha environments. Spartacus CL has been released as a feed barley, but is being evaluated by Barley Australia. It has passed Stage 1 and is currently being evaluated in Stage 2. An accreditation decision is possible as early as March 2018. It is important that growers do not ruin the integrity of La Trobe malt by contaminating them with Spartacus CL barley. The new seed fungicide Systiva® (fluxapyroxad) will likely be an important disease management tool, particularly when sowing Spartacus CL as a plant back option into Spartacus CL stubble. Due to its susceptibility to smut, every Spartacus CL seed should be treated with a good quality smuticide.

Best suited:

- To environments where Scope CL does not regularly meet grain quality targets allowing to be received as malt barley.
- Where an imidazolinone herbicide was used last year or Sentry® / Intervix® is required this year.
- Where STNB and barley leaf rust are not a risk.
- To May plantings in areas with a reduced frost risk.

Best management agronomy

Blakely Paynter, Raj Malik, Jeremy Curry and Georgia Trainor, DPIRD.

Over the last 20 years the barley agronomy team at DPIRD with co-funding from the GRDC has been assessing best management practices for barley production in WA. The aim of our research being to assist barley growers grow the right variety in the right environment with appropriate management to meet market demand.

In recent years we have focused on:

- Options to increase grain protein concentration without applying more nitrogen, and
- Determining the target density that optimises barley production (yield and quality).

Grain protein management

The malt barley protein window for receival as Malt1 is between 9.5-12.5%. If you typically deliver malt barley with less than 10% protein or get rejected because your malt barley is less than 9.5% protein then there are two management options that can help increase your grain protein concentration without requiring the addition of more fertiliser nitrogen (N). The options are:

- Variety choice – sow a higher protein variety like Bass or even Flinders (where suitable), and
- N timing – apply a starter N at seeding and at least $\frac{2}{3}$ (if not more) of your recommended N fertiliser rate at stem elongation.

Managing grain protein concentration with variety choice

Data from NVT trials and DPIRD-GRDC funded barley agronomy trials were combined to analyse the relationship between grain yield and grain protein concentration in commercially available barley varieties grown under similar management and environmental conditions in WA. There is a typical relationship whereby under the same level of inputs, as grain yield increases, grain protein concentration decreases (because of yield dilution). Deviations from this relationship between grain yield and grain protein were used to classify varieties for their grain protein deviation (Table 1) and determine relative levels of inherent grain protein concentration.

The following varietal differences in grain protein concentration were observed when differences in grain yield were removed. Varieties with a lower grain protein include Commander and Henley. Varieties with a higher grain protein include Bass and to a lesser extent Flinders. The protein difference between the low and high protein deviation groups was around 1%. So, if low protein is an issue then sowing Bass or even Flinders may increase your chances of meeting Malt1 grain protein specifications.

Table 1 Malt barley varietal rankings for grain protein concentration when differences in their grain yield are removed

Ranking malt barley varieties for their grain protein deviation				
Lower	Slightly Lower	Normal	Slightly Higher	Higher
-0.6 to -0.3%	-0.3 to -0.1%	-0.1 to +0.1%	+0.1 to +0.3%	+0.3 to +0.6%
Commander	Baudin	Flagship	Flinders	Bass
Henley	Buloke	Gairdner	Hamelin	Stirling
		Granger	Vlamingh	
		La Trobe	Wimmera	
		Scope CL		

Managing grain protein concentration with N timing

The other way in which grain protein concentration can be increased is to delay top up N until stem elongation. Research from 30 DPIRD-GRDC funded barley agronomy trials show that the strategy of applying some fertiliser N at seeding and the rest (at least two thirds) at stem elongation caused little or no reduction in grain yield with only minor negative effects on hectolitre weight and grain plumpness. This strategy, however, was shown to boost grain protein concentration by 0.5% compared to applying the same rate of top up N at mid tillering or splitting the top up application over two applications (mid tillering and stem elongation). Compared to the strategy of applying the N up-front, the delayed N strategy at stem elongation boosted grain protein concentration by nearly 1%. It is worth noting that in very dry seasons, the effect of the delayed N magnifies the effects on grain protein and other grain quality traits. In those situations, grain plumpness is likely to be the factor that causes a downgrade to feed with any N management strategy.

Applying higher rates of N fertiliser usually results in increased grain protein concentration in both barley and wheat (unless there is a significant grain yield increase). However, unlike in wheat, increasing N in barley increases the risk of delivering grain with high screenings. Where the fertiliser recommendation is for high rates of fertiliser N, choosing a variety with plump grain (for example Bass) will increase the probability

of meeting protein targets whilst still being inside the Malt1 limit for screenings (maximum of 20% through a 2.5mm slotted sieve).

Target plant density

Based on a study covering 75 DPIRD-GRDC barley agronomy trials where plant density was a management factor the following was observed:

- Barley cannot compensate from being sown at low plant densities (<100 plants/m²).
- A yield response to increasing plant density was observed in 85% of trials.
- Barley establishing at densities of 50 plants/m² will be lower yielding by around 10-12% than barley sown at 150 plants/m².
- Negative yield responses to increasing plant density can occur but are uncommon. When it did occur (in only five out of 75 trials), the average reduction in grain yield was less than 0.1t/ha.
- The actual change in grain quality associated with increasing plant density is much smaller than most growers think.
- Varieties react similarly to increasing plant density for grain yield, but differ in how their grain quality responds.
- Knowing how a variety responds to increasing N does not tell us how a variety might respond to increasing plant density.
- Yield potential does not alter the target plant density for barley crops at sites with a potential above 1.5t/ha.

Table 2 Target density (plants/m²) for each malt barley variety segregated in WA and for any feed barley variety and the likely seed rate (kg/ha) required to establish that density based on different kernel weights between 30g and 50g assuming 98% germination and 80% crop establishment

Target density	110 – 130 plants/m ²	150 – 180 plants/m ²	180 – 220 plants/m ²
Variety	Baudin Granger Scope CL	Bass Flinders La Trobe	Feed barley
1000 kernel weight	Seed rate (kg/ha) range for each variety/density group		
30g	42 – 50kg/ha	57 – 69kg/ha	69 – 84kg/ha
35g	49 – 58kg/ha	67 – 80kg/ha	80 – 98kg/ha
40g	56 – 66kg/ha	77 – 92 kg/ha	92 – 112kg/ha
45g	63 – 75kg/ha	86 – 103kg/ha	103 – 126kg/ha
50g	70 – 83kg/ha	96 – 115kg/ha	115 – 140kg/ha

- Delays in seeding by 2–3 weeks do not change the target plant density.
- Plant density in plants/m² is fixed by variety, whilst seed rate in kg/ha varies with variety, seed size and germination.

The target densities suggested for barley in WA are (Table 2):

- Baudin, Granger and Scope CL = 110-130 plants/m²
- Bass, Flinders and La Trobe = 150-180 plants/m²
- Any feed barley variety = 180-220 plants/m² (where weeds present) or 150-180 plants/m² (in weed-free situations)

For feed barley a higher target density is suggested to improve the competitiveness of the crop against weeds. Denser crops have a lower yield loss in the presence of weeds and a higher reduction in weed seed set. If growing feed barley in paddocks without weeds then the target density can be adjusted down to 150-180 plants/m².

To determine the seed rate in kg/ha use the following formula:



$$\text{seed rate (kg/ha)} = \frac{1000 \text{ kernel weight (g)} \times \text{target density (plants/m}^2\text{)}}{\text{germination \%} \times \text{establishment \%} \times 100}$$

For example, if growing La Trobe barley with a germination of 94%, a kernel weight of 42g per 1000 kernels at a target density of 150 plants/m² with an expected establishment of 80%, then the seed rate in kg/ha required to establish 150 plants/m² is:

$$\text{seed rate in kg/ha} = 84 \text{ kg/ha} = \frac{42 \text{ g} \times 150 \text{ plants/m}^2}{94\% \times 80\% \times 100}$$

Market feedback

GIWA Barley Council.

The long-term aim of the Western Australian barley industry is to rationalise the number of varieties segregated to two major malt varieties per port zone, with limited segregations on offer for minor, new or niche malt varieties. The benefits for growing and segregating fewer malt varieties include the ease of logistics, more segregations per variety and stronger demand from the trade who are currently unwilling to risk buying small, unsaleable parcels.

At the 2018/19 harvest:

- Bass, La Trobe and Scope CL will be the main malt barley varieties.
- Flinders has gained traction with international customers of Australian malt and Australian barley. Demand is expected to grow as volume grows.
- Granger is still new to the market with limited segregation opportunities to be expected until full market acceptance is achieved. Further international market feedback is needed to provide guidance to the Western

Australian barley industry on the expected future demand for this new malt variety.

- Baudin will have limited segregations at the 2018/19 harvest in the Esperance Port Zone. Growers in Kwinana-West and Albany-North port zones looking to grow Baudin for malt in 2018 should talk to their preferred acquirer to determine opportunities for contract production into a niche segregation before planting any seed.
- Segregation opportunities for Bass, Baudin, Flinders, Granger, La Trobe and Scope CL vary by port zone and within a port zone (Table 3).
- Varieties differ in their market preference which may influence the number of buyers and the pricing offered. Bass and Baudin are the preferred varieties for export as grain, Baudin for export as malt and Baudin and La Trobe for the manufacture of shochu in Japan.

The malt barley variety receipt recommendations made in this document are intended to be a guide for growers and consultants to help with the planning of the 2018 barley cropping program. The international market place is ever

Table 3 Western Australian malt and food barley industry variety recommendations by Port Zone for the 2018/19 harvest

Yes	This is a recommended variety for this production zone.
Limited	Limited segregations likely due to low production hectares, limited market demand, a new variety going through market development or phasing out an old variety.
Niche	Subject to availability. Niche segregation only available if a marketer has sufficient tonnage to supply to a domestic or international customer. Marketers will need to contact CBH to negotiate a niche segregation and growers will need to contact their preferred marketer for availability.
No	Variety has been phased out or marketers are not looking to accumulate this variety in this production zone.

Port Zone	Geraldton	Kwinana		Albany		Esperance	Comments
(~% total barley area)	~5%	40%		30%		25%	
		Western	Eastern	Northern	Southern		
Bass [Ⓛ]	NO	YES	NO	YES	YES	NO	Stable market demand
Baudin [Ⓛ]	NO	Niche	NO	Niche	NO	Limited	Preferred variety with stable market demand
Flinders [Ⓛ]	NO	Limited	NO	Limited	YES	Limited	Market development continuing with increasing domestic and export demand
Granger [Ⓛ]	NO	NO	NO	Niche	Limited	Limited	Market development continuing with no current export demand
La Trobe [Ⓛ]	Limited	YES	YES	YES	YES	YES	Stable market demand
Scope CL [Ⓛ]	Limited	YES	YES	YES	NO	NO	Stable market demand

evolving and the plan presented this spring will be reviewed again in autumn next year and any changes in demand presented to growers. The rationalisation process needs to be carefully managed to ensure we are not rationalising to the extent that we cannot meet market requirements.

Accreditation as a malt variety does not guarantee market success, but many international markets place value on the accreditation provided by Barley Australia. There is no guarantee that every international market will pay a premium for an accredited malt variety compared to a non-accredited variety.

Hindmarsh has been removed from the list of varieties that will be segregated in WA after the 2017/18 harvest. Production of Hindmarsh in 2018 will be directed into feed stacks. The removal of Hindmarsh from the segregated list will increase the demand for La Trobe in the shochu market in Japan as none of the other segregated varieties except Baudin are accepted into that market.

In the past the GIWA Barley Council has facilitated industry wide consultation on an annual basis, but had no control or influence on the actual segregations available in any port zone. In 2016 the GIWA Barley Council began working with the CBH operations division to provide guidance to growers as to what segregations would be offered within each of the port zones operated by CBH at an area and a site scale, rather than just at a port zone scale for the 2017/18 harvest. This process will be continuing for the 2018/19 harvest.

In order for CBH operations to manage whole of site harvest receival planning (that is segregation allocation) at each CBH site, it remains very important for growers to submit their annual planted hectares estimate to CBH on time. Attending pre-harvest meetings is also important to confirm varieties to be segregated at a site level at subsequent harvests based on the port zone recommendations in this document. Some sites can only offer a single malt barley segregation, whereas other sites may be able to offer two or more malt barley segregations.

Barley Australia and the GIWA Barley Council do not support the co-binning of segregated malt varieties, even if the varieties concerned have similar agronomic traits. The Australian barley industry works hard to uphold Australian malt variety traits to the end customer and the

reputation and integrity of Australian malt barley is at risk from co-binning and cannot in any way be condoned. Growers should not intentionally contaminate a malt barley stack with another variety. Correct variety declaration is a legal requirement under the Plant Breeders Rights Act and mis-declaration is a breach of the Bulk Handling Act 1967.

When developing agronomic management plans for each of the malt varieties listed in this document growers should be aware of international market signals indicating that Australian barley is generally too low in its grain protein concentration. Growers are encouraged to target producing malt barley grain between 10.5-11.0% protein, a maximum of 20% screenings through a 2.5mm sieve, a hectolitre weight above 64kg/hL with ryegrass ergot less than 3cm, no whole snails and no glyphosate use near harvest.

Malt barley varieties

Each malt barley variety grown in WA has unique and different malting attributes. As a consequence, brewers purchase varieties subject to their availability, their price, the style of beer they produce and the type and level of adjunct used in their brewing recipe.

In light of updated market information, discussions with industry and feedback on varietal demand, the GIWA Barley Council has reviewed its variety recommendations “Western Australian Malt and Food Barley Variety Receival Recommendations for the 2017/18 Harvest” published on 23 August 2016. The updated malt barley recommendations for the 2018 season are as follows:

Bass

- Bass is an approved malt barley suitable for export as grain and as malt.
- Not suitable for the manufacture of shochu in Japan.
- Bass is well recognised in the international malt barley market with stable demand.
- Bass is suited to markets where high levels of adjuncts are used in the brewing process.
- Bass will not be segregated in the Esperance Port Zone at the 2018/19 harvest.
- Target production zones in 2018 are Kwinana-West and Albany Port Zones.

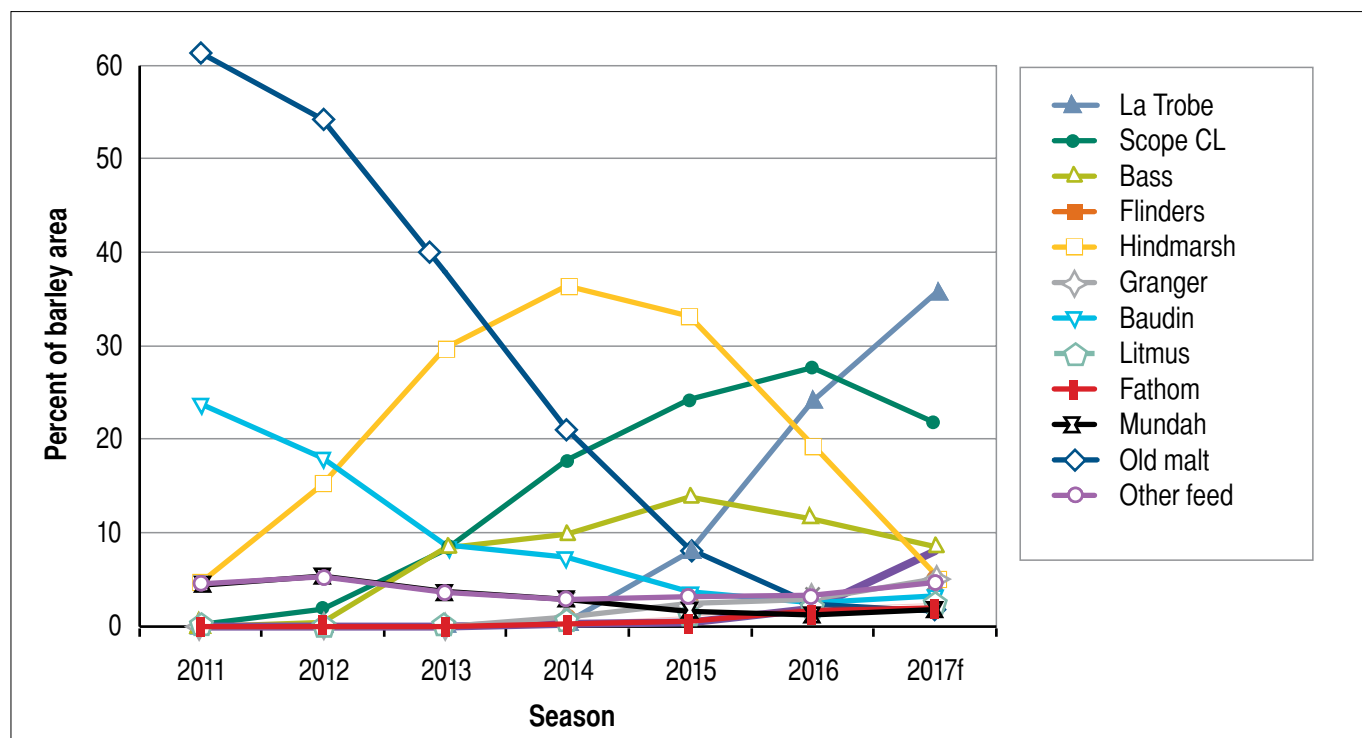


Figure 1 Popularity (per cent of barley area) of top 10 barley varieties (ranking based on forecast area sown in 2017 season) grown in WA over the last five seasons plus forecast for the 2017 season. Old malt includes Buloke, Commander, Gairdner, Hamelin, Stirling and Vlamingh. (source: figure based on grower estimates as provided to CBH for 2012-2016 and forecast area for 2017 estimated by Blakely Paynter, DPIRD)

Baudin

- Baudin is the 'market leader' for malt quality, but has inferior grain yield, grain plumpness and disease resistance to alternative malt varieties in the market place.
- There is international market demand for export as both grain and malt.
- Accepted for shochu production in Japan.
- Target production zone in 2018 is the Esperance Port Zone, whilst niche segregations may be available in Kwinana-West and Albany-North.

Flinders

- Flinders was accredited as a malt barley by Barley Australia in March 2015.
- Market development of Flinders is continuing with international market feedback indicating that Flinders is demonstrating processing qualities in line with market demand.
- Like Bass and Baudin, Flinders is performing well in markets where starch-adjunct brewing is undertaken.
- Target production zones in 2018 are Kwinana-West, Albany and Esperance Port Zones.

Granger

- Granger was accredited as a malt barley by Barley Australia in March 2013.
- Being assessed for export as grain. Granger is still in the early stages of international market development with the first shipment of grain from the Esperance Port Zone being used by international brewing customers during 2017.
- Not being assessed for export as malt or for shochu.
- Limited segregation opportunities are to be expected until full market acceptance is achieved.
- Target production zones in 2018 are Albany and Esperance Port Zones.

La Trobe

- La Trobe is suitable for export as grain and as malt and for the manufacture of shochu in Japan.
- La Trobe is now a recognised malt barley variety and is suitable for brewers seeking malt with a higher Kolbach Index (for example suited to markets where starch adjunct brewing is undertaken).
- At the 2018/19 harvest La Trobe will be the main variety purchased for the manufacture of shochu in Japan.
- Growers should not compromise the integrity of La Trobe malt stacks, or seed stocks, by contaminating them with either Hindmarsh or Spartacus CL barley or any other barley variety.
- Target production zones in 2018 are Geraldton, Kwinana, Albany and Esperance Port Zones.

Scope CL

- Scope CL is suitable for export as grain and as malt.
- Not suitable for the manufacture of shochu in Japan.
- Scope CL is recognised in the international malt barley market with stable demand.
- Growers should not compromise the integrity of Scope CL malt stacks, or seed stocks, by contaminating them with Buloke or Spartacus CL barley or any other barley variety.
- Do not use imidazolinone herbicides other than Intervix® or Sentry®.
- Target production zones in 2018 are Geraldton, Kwinana and Albany Port Zones.



Grain yield comparisons

Blakely Paynter (DPIRD).

Variety trials are conducted across Australia and are funded and overseen by the GRDC. The National Variety Trials (NVT) program was established in 2005 to provide a nationally independent means of assessing varietal performance to enable growers to select the best variety for their environment. The results of NVT trials are available as individual site reports or as multi-environment (MET) long term summaries. Both the individual and multi-year analyses are available at nvtonline.com.au. The MET analysis generates a table of performance values for each variety in comparison to the mean of the NVT site at which it was included. Growers and consultants can select the state, region, site or group of sites of their choice to assist in selecting the best variety for their environment. In addition to being accessible online at nvtonline.com.au, growers and consultants can download a version of the summaries on their portable devices for both Apple (via the iTunes app store) and Android (via Google play) devices. For this sowing guide, additional analysis is presented to that available on the NVT website.

Table 4 re-works the NVT long term MET analysis and presents the data against a reference variety, La Trobe, rather than against the site mean yield. It also presents the data based on Agzones. Agzones were developed by DPIRD through statistical analysis to group together environmental regions that give similar crop performance in WA (Figure 2). Data is presented for each year from 2012-2016 and as an overall MET for the period 2012-2016. Multi-year averages are only presented where there are four or more observations.

The main problem with single site analyses are that they only represent varietal performance under one specific set of seasonal and site conditions. The main problem with MET results based on Agzones is that they average varietal performance and mask variety by environment (GxE) interactions across the locations (and seasons) within the Agzone. For this reason the relative performance of varieties in each year for the period 2012 to 2016 assists with understanding the variability in relative varietal performance across seasons (Table 4).

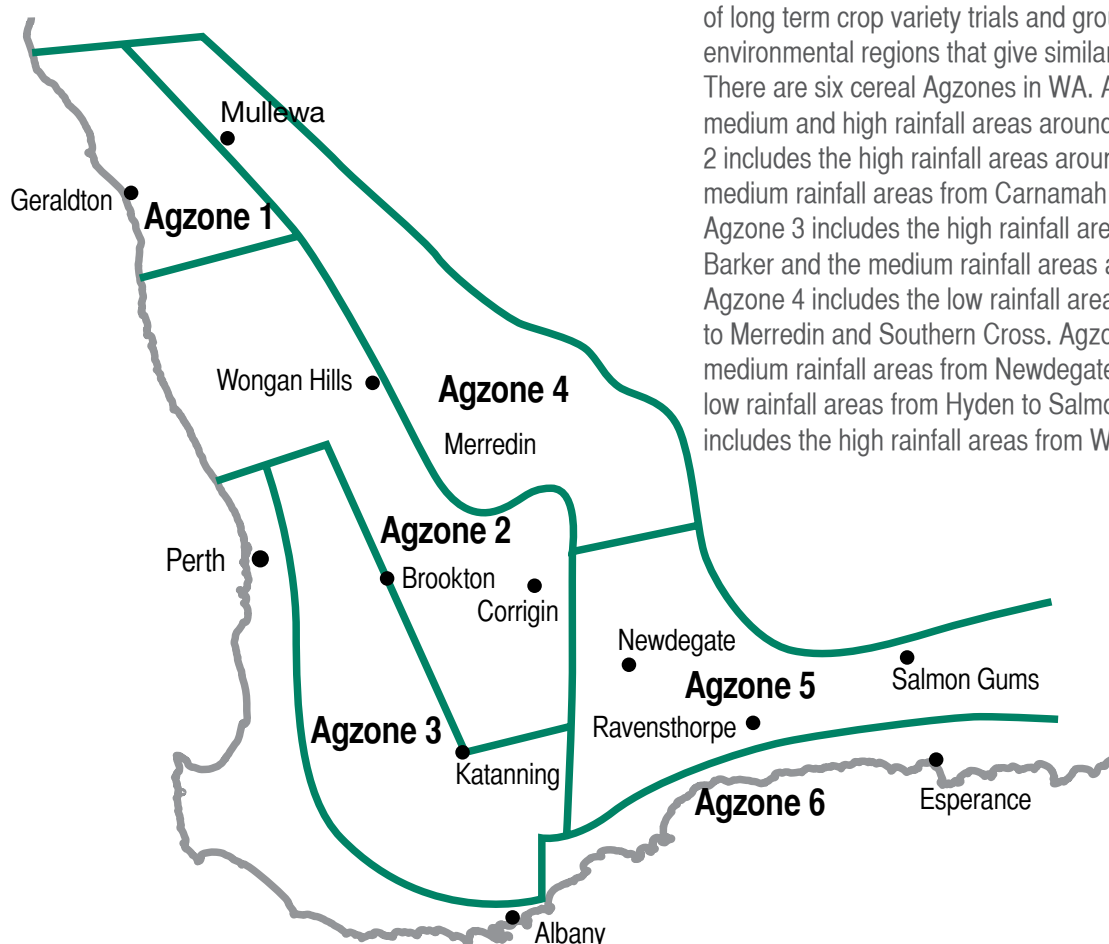


Figure 2 Agzone map of the south west corner of WA. Agzones have been developed through statistical analysis of long term crop variety trials and group together environmental regions that give similar crop performance. There are six cereal Agzones in WA. Agzone 1 includes the medium and high rainfall areas around Geraldton. Agzone 2 includes the high rainfall areas around Moora and the medium rainfall areas from Carnamah to Corrigin to Pingrup. Agzone 3 includes the high rainfall areas from Bolgart to Mt Barker and the medium rainfall areas around Gnowangerup. Agzone 4 includes the low rainfall areas from Mullewa to Merredin and Southern Cross. Agzone 5 includes the medium rainfall areas from Newdegate to Scaddan and the low rainfall areas from Hyden to Salmon Gums. Agzone 6 includes the high rainfall areas from Wellstead to Condingup.

Table 4 Grain yield of barley varieties in NVTs located in Agzones 1 to 6 expressed as a per cent of La Trobe. Data presented for each year and as an overall MET analysis (where there are four or more observations) (source: NVT Online nvtonline.com.au)

Table 4a Grain yield of varieties in NVTs located in Agzone 1 expressed as a per cent of La Trobe

Agzone 1	Single year (% La Trobe)					Multi-year (% La Trobe)	
Variety	2012	2013	2014	2015	2016	2012-2016	no. obs
Malt varieties							
Bass [Ⓛ]	88	79	91	83	94	90	6
Baudin [Ⓛ]	92	94	92	81	96	92	6
Flinders [Ⓛ]	93	105	93	94	–	98	4
Granger [Ⓛ]	84	104	90	94	–	95	4
La Trobe [Ⓛ]	100	100	100	100	100	100	6
Scope CL [Ⓛ]	103	97	91	93	99	98	6
Stage 2 malt accreditation							
Compass [Ⓛ]	118	107	98	103	109	108	6
Spartacus CL [Ⓛ]	–	–	101	104	98	100	4
Feed varieties							
Fathom [Ⓛ]	118	101	96	94	109	105	6
LG Maltstar [Ⓛ]	–	–	–	–	–	–	0
Litmus [Ⓛ]	117	111	82	115	104	106	6
Lockyer [Ⓛ]	113	113	97	91	–	106	4
Mundah	105	95	87	105	–	100	4
Oxford	80	105	90	83	99	93	5
RGT Planet [Ⓛ]	–	–	–	–	105	–	2
Rosalind [Ⓛ]	–	–	102	113	108	111	4
Yagan	–	–	–	–	–	–	0
La Trobe yield (t/ha)	1.62	1.78	1.29	1.94	4.26	2.55	6

Table 4b Grain yield of varieties in NVTs located in Agzone 2 expressed as a per cent of La Trobe

Agzone 2	Single year (% La Trobe)					Multi-year (% La Trobe)	
Variety	2012	2013	2014	2015	2016	2012-2016	no. obs
Malt varieties							
Bass [Ⓛ]	80	85	89	81	94	87	22
Baudin [Ⓛ]	85	88	90	77	105	89	23
Flinders [Ⓛ]	94	102	96	93	105	98	23
Granger [Ⓛ]	92	104	95	94	101	97	23
La Trobe [Ⓛ]	100	100	100	100	100	100	23
Scope CL [Ⓛ]	91	94	86	88	106	92	22
Stage 2 malt accreditation							
Compass [Ⓛ]	104	103	97	102	109	102	23
Spartacus CL [Ⓛ]	–	–	101	104	98	102	14
Feed varieties							
Fathom [Ⓛ]	97	96	94	92	110	97	23
LG Maltstar [Ⓛ]	86	98	95	86	100	92	23
Litmus [Ⓛ]	100	108	75	105	113	100	23
Lockyer [Ⓛ]	101	100	100	91	–	99	20
Mundah	92	97	78	95	–	92	20
Oxford	88	99	99	84	–	96	20
RGT Planet [Ⓛ]	–	–	–	–	107	–	3
Rosalind [Ⓛ]	–	–	107	114	110	113	14
Yagan	–	–	–	–	–	–	0
La Trobe yield (t/ha)	2.61	3.40	2.73	2.64	3.85	3.00	23

Table 4 Grain yield of barley varieties in NVTs located in Agzones 1 to 6 expressed as a per cent of La Trobe. Data presented for each year and as an overall MET analysis (where there are four or more observations) (source: NVT Online nvtonline.com.au).

Table 4c Grain yield of varieties in NVTs located in Agzone 3 expressed as a per cent of La Trobe

Agzone 3 Variety	Single year (% La Trobe)					Multi-year (% La Trobe)	
	2012	2013	2014	2015	2016	2012-2016	no. obs
Malt varieties							
Bass [Ⓛ]	92	99	95	95	94	95	21
Baudin [Ⓛ]	90	90	88	78	92	87	21
Flinders [Ⓛ]	94	97	97	98	102	97	21
Granger [Ⓛ]	92	97	99	102	103	98	21
La Trobe [Ⓛ]	100	100	100	100	100	100	21
Scope CL [Ⓛ]	95	91	89	86	97	91	21
Stage 2 malt accreditation							
Compass [Ⓛ]	105	102	99	104	105	102	21
Spartacus CL [Ⓛ]	–	–	102	100	100	101	11
Feed varieties							
Fathom [Ⓛ]	102	101	95	97	101	99	21
LG Maltstar [Ⓛ]	89	96	97	96	99	95	21
Litmus [Ⓛ]	101	87	86	91	107	92	21
Lockyer [Ⓛ]	99	98	95	94	–	97	20
Mundah	97	88	87	86	–	91	20
Oxford	88	97	98	96	100	95	21
RGT Planet [Ⓛ]	–	–	–	–	110	–	1
Rosalind [Ⓛ]	–	–	104	106	109	103	11
Yagan	–	–	–	–	–	–	0
La Trobe yield (t/ha)	4.24	5.89	5.47	4.02	3.63	4.85	21

Table 4d Grain yield of varieties in NVTs located in Agzone 4 expressed as a per cent of La Trobe

Agzone 4 Variety	Single year (% La Trobe)					Multi-year (% La Trobe)	
	2012	2013	2014	2015	2016	2012-2016	no. obs
Malt varieties							
Bass [Ⓛ]	–	81	59	84	–	75	6
Baudin [Ⓛ]	–	86	45	79	–	68	6
Flinders [Ⓛ]	–	93	59	90	–	79	6
Granger [Ⓛ]	–	89	54	90	–	78	6
La Trobe [Ⓛ]	–	100	100	100	–	100	6
Scope CL [Ⓛ]	–	89	72	88	–	81	6
Stage 2 malt accreditation							
Compass [Ⓛ]	–	103	94	100	–	96	6
Spartacus CL [Ⓛ]	–	–	112	104	–	106	4
Feed varieties							
Fathom [Ⓛ]	–	97	75	92	–	86	6
LG Maltstar [Ⓛ]	–	85	–	–	–	–	2
Litmus [Ⓛ]	–	92	97	98	–	95	6
Lockyer [Ⓛ]	–	101	55	89	–	80	6
Mundah	–	87	99	95	–	94	6
Oxford	–	87	22	80	–	67	6
RGT Planet [Ⓛ]	–	–	–	–	–	–	0
Rosalind [Ⓛ]	–	–	110	110	–	111	4
Yagan	–	–	–	–	–	–	0
La Trobe yield (t/ha)	–	1.91	0.56	3.16	–	2.06	6

Table 4 Grain yield of barley varieties in NVTs located in Agzones 1 to 6 expressed as a per cent of La Trobe. Data presented for each year and as an overall MET analysis (where there are four or more observations) (source: NVT Online nvtonline.com.au).

Table 4e Grain yield of varieties in NVTs located in Agzone 5 expressed as a per cent of La Trobe

Agzone 5	Single year (% La Trobe)					Multi-year (% La Trobe)	
Variety	2012	2013	2014	2015	2016	2012-2016	no. obs
Malt varieties							
Bass [Ⓛ]	78	93	88	88	97	89	17
Baudin [Ⓛ]	78	93	89	76	99	87	17
Flinders [Ⓛ]	83	102	94	90	–	92	16
Granger [Ⓛ]	78	102	93	91	118	92	17
La Trobe [Ⓛ]	100	100	100	100	100	100	17
Scope CL [Ⓛ]	83	91	86	81	97	87	17
Stage 2 malt accreditation							
Compass [Ⓛ]	98	103	100	98	99	97	17
Spartacus CL [Ⓛ]	–	–	101	103	102	100	9
Feed varieties							
Fathom [Ⓛ]	91	100	97	91	95	93	17
LG Maltstar [Ⓛ]	73	100	92	87	117	90	16
Litmus [Ⓛ]	81	86	74	79	101	85	17
Lockyer [Ⓛ]	88	106	103	89	105	95	17
Mundah	85	83	76	81	–	86	16
Oxford	70	105	96	86	–	91	16
RGT Planet [Ⓛ]	–	–	–	–	128	–	1
Rosalind [Ⓛ]	–	–	106	105	114	103	9
Yagan	–	–	–	–	–	–	0
La Trobe yield (t/ha)	3.05	3.79	3.67	3.85	2.48	3.53	17

Table 4f Grain yield of varieties in NVTs located in Agzone 6 expressed as a per cent of La Trobe

Agzone 6	Single year (% La Trobe)					Multi-year (% La Trobe)	
Variety	2012	2013	2014	2015	2016	2012-2016	no. obs
Malt varieties							
Bass [Ⓛ]	92	99	93	91	97	95	10
Baudin [Ⓛ]	97	77	101	88	92	94	10
Flinders [Ⓛ]	108	107	110	101	108	107	10
Granger [Ⓛ]	110	118	112	106	114	112	10
La Trobe [Ⓛ]	100	100	100	100	100	100	10
Scope CL [Ⓛ]	95	78	91	86	92	91	10
Stage 2 malt accreditation							
Compass [Ⓛ]	104	97	101	93	102	100	10
Spartacus CL [Ⓛ]	–	–	99	103	100	101	6
Feed varieties							
Fathom [Ⓛ]	100	88	100	88	98	96	10
LG Maltstar [Ⓛ]	108	114	114	105	111	111	10
Litmus [Ⓛ]	96	73	74	79	95	87	10
Lockyer [Ⓛ]	111	92	118	95	104	104	10
Mundah	88	70	71	80	–	86	8
Oxford	114	117	126	107	115	115	10
RGT Planet [Ⓛ]	–	–	–	–	130	–	2
Rosalind [Ⓛ]	–	–	113	108	110	110	6
Yagan	–	–	–	–	–	–	0
La Trobe yield (t/ha)	3.44	3.47	2.43	4.01	4.06	3.48	10

Table 5 is an alternative way of looking at the longer term MET analysis as it directly compares the grain yield of two selected varieties when they have occurred side by side in barley NVT trials in WA. The yield of variety B is compared against

variety A using the least significant difference for the site. Essentially Table 5 highlights the probability of one variety yielding less, the same or more than another variety when grown with the same agronomy.

Table 5 Comparisons between two varieties – how many times (as a per cent) was variety B (comparator variety) lower yielding, the same yield or higher yielding than variety A (base variety) when sown together in WA barley NVT? (source: NVT Online nvtonline.com.au)

Variety A	Variety B	Variety B lower yielding than Variety A	Variety B and Variety A same yield	Variety B higher yielding than Variety A	Comparison Years	Number of trials	Comparison
Comparisons with La Trobe							
La Trobe ^(b)	Bass ^(b)	58%	42%	0%	2011-2016	96	Bass ≤ La Trobe
La Trobe ^(b)	Baudin ^(b)	66%	31%	3%	2011-2016	97	Baudin ≤ La Trobe
La Trobe ^(b)	Compass ^(b)	18%	65%	18%	2012-2016	80	Compass = La Trobe
La Trobe ^(b)	Fathom ^(b)	31%	58%	11%	2011-2016	97	Fathom ≤ La Trobe
La Trobe ^(b)	Flinders ^(b)	33%	55%	12%	2011-2016	93	Flinders ≤ La Trobe
La Trobe ^(b)	Granger ^(b)	38%	53%	10%	2011-2016	93	Granger ≤ La Trobe
La Trobe ^(b)	LG Maltstar ^(b)	47%	43%	10%	2011-2016	86	LG Maltstar ≤ La Trobe
La Trobe ^(b)	Litmus ^(b)	46%	40%	14%	2011-2016	72	Litmus ≤ La Trobe
La Trobe ^(b)	Lockyer ^(b)	29%	54%	18%	2011-2016	84	Lockyer = La Trobe
La Trobe ^(b)	Mundah	69%	27%	3%	2011-2016	88	Mundah < La Trobe
La Trobe ^(b)	Oxford	53%	35%	12%	2011-2016	81	Oxford ≤ La Trobe
La Trobe ^(b)	RGT Planet ^(b)	0%	33%	67%	2016	9	RGT Planet ≥ La Trobe
La Trobe ^(b)	Rosalind ^(b)	2%	48%	50%	2014-2016	46	Rosalind ≥ La Trobe
La Trobe ^(b)	Scope CL ^(b)	55%	43%	2%	2011-2016	96	Scope CL ≤ La Trobe
La Trobe ^(b)	Spartacus CL ^(b)	7%	76%	17%	2014-2016	46	Spartacus CL = La Trobe
La Trobe ^(b)	Yagan	–	–	–	–	–	–
Compass, La Trobe, Scope CL and Spartacus CL comparisons							
Compass ^(b)	La Trobe ^(b)	11%	69%	20%	2014-2016	45	Compass = La Trobe
Compass ^(b)	Scope CL ^(b)	56%	38%	7%	2014-2016	45	Compass ≥ Scope CL
Compass ^(b)	Spartacus CL ^(b)	11%	69%	20%	2014-2016	45	Compass = Spartacus CL
La Trobe ^(b)	Scope CL ^(b)	64%	31%	4%	2014-2016	45	La Trobe ≥ Scope CL
La Trobe ^(b)	Spartacus CL ^(b)	7%	76%	18%	2014-2016	45	La Trobe = Spartacus CL
Scope CL ^(b)	Spartacus CL ^(b)	4%	24%	71%	2014-2016	45	Scope CL ≤ Spartacus CL
Bass, Flinders, Granger and LG Maltstar comparisons							
Bass ^(b)	Flinders ^(b)	2%	51%	46%	2011-2016	82	Bass ≤ Flinders
Bass ^(b)	Granger ^(b)	4%	52%	44%	2011-2016	82	Bass ≤ Granger
Bass ^(b)	LG Maltstar ^(b)	11%	52%	37%	2011-2016	82	Bass ≤ LG Maltstar
Flinders ^(b)	Granger ^(b)	13%	74%	12%	2011-2016	82	Flinders = Granger
Flinders ^(b)	LG Maltstar ^(b)	28%	62%	10%	2011-2016	82	Flinders ≥ LG Maltstar
Granger ^(b)	Maltstar ^(b)	26%	70%	5%	2011-2016	82	Granger ≥ LG Maltstar

Another way to look at grain yield data is to plot the relative grain yield of one variety at different grain yield levels achieved by another variety (Figures 3 and 4). Figures 3 and 4 combine and analyse through linear functional relationship modelling NVT grain yield data and DPIRD-GRDC (DAW00190 and DAW00224) agronomy grain yield data.

Being the most widely planted variety, La Trobe is the benchmark for varietal comparisons. When leaf diseases are controlled, the only variety that consistently out yields La Trobe in WA is Rosalind (Tables 4 and 5, Figures 3 and 4). Flinders, Granger, Lockyer and Oxford also have the potential to out-yield La Trobe but generally only in high yielding or longer season environments. Litmus will out yield La Trobe on soils where the sub-soil is below 4.8, while the yields of Compass and Spartacus CL are similar to that of La Trobe.

When deciding on which barley variety to sow grain yield results need to be balanced with knowledge of the agronomy, disease resistance, grain quality, segregation opportunities and market demand. Commonly grown varieties differ from each other in their disease resistance, agronomy, genetics and phenology (Tables 6 to 11), clearly demonstrating that there are many ways in which grain yield can be achieved. These phenotypic differences may favour one variety over another variety in some seasons but not in other seasons. Therefore it is important to look over seasons and across sites when assessing which variety to sow. Whilst RGT Planet had an exceptional year in 2016, it will be important to look at its performance over several years to determine its true yield potential and true agronomic performance in Australia. The results of one season of trials may therefore be misleading. Table 4 shows how relative varietal performance can vary from season to season.

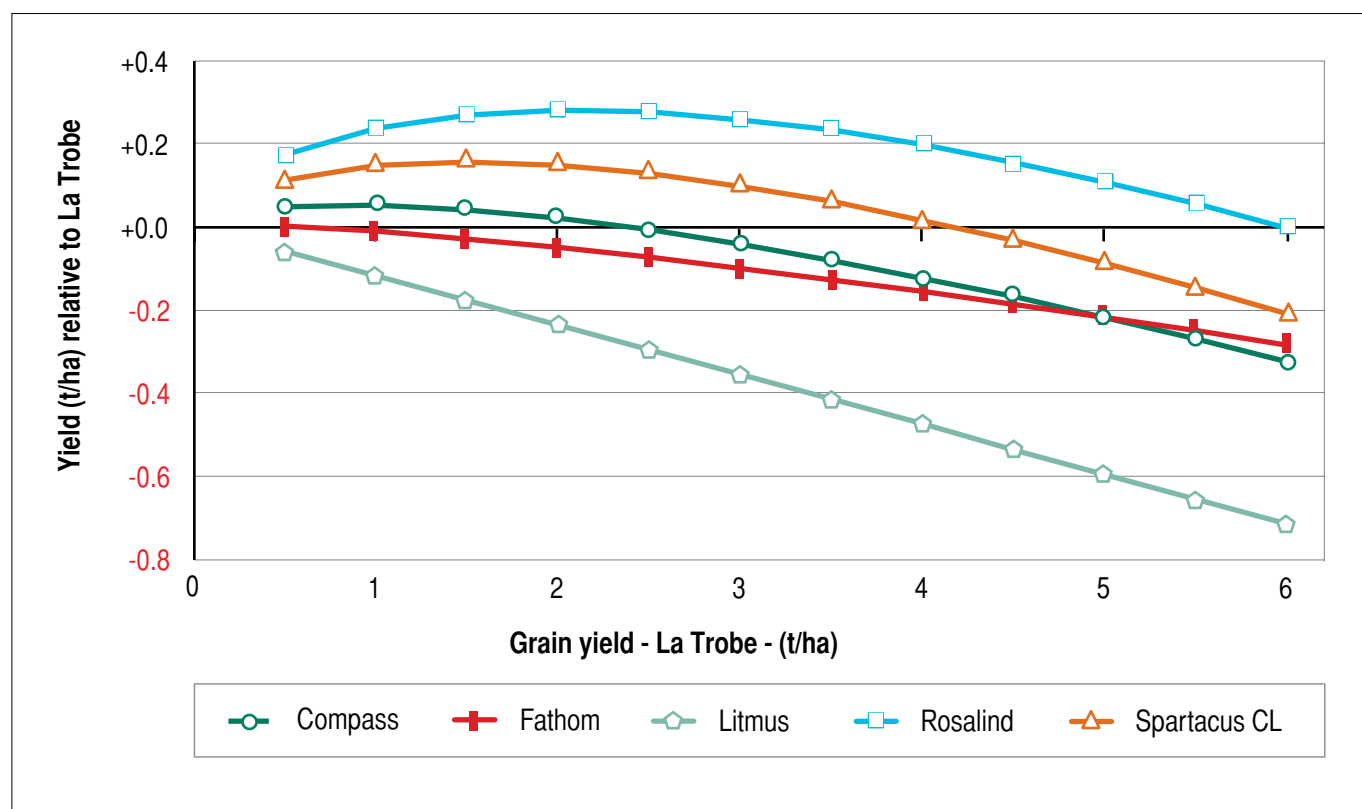


Figure 3 Relative grain yield of Compass ($r^2 = 0.96$), Fathom ($r^2 = 0.95$), Litmus ($r^2 = 0.82$), Rosalind ($r^2 = 0.95$) and Spartacus CL ($r^2 = 0.97$) at different grain yields achieved by La Trobe (source: data from 2016 DPIRD barley agronomy and 2014-2016 NVT trials. Each variety is sown in all 48 trial-years of data.)

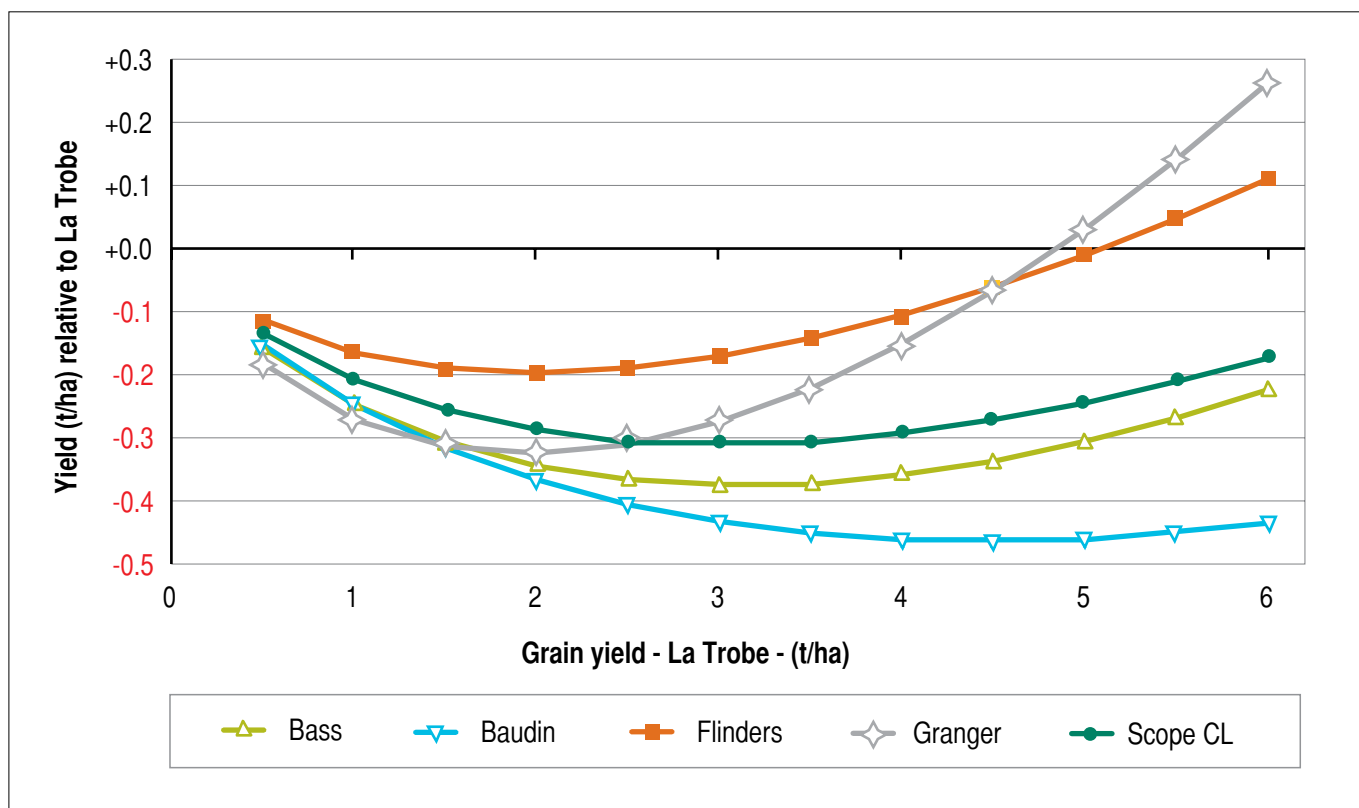


Figure 4 Relative grain yield of Bass ($r^2 = 0.92$), Baudin ($r^2 = 0.90$), Flinders ($r^2 = 0.93$), Granger ($r^2 = 0.94$) and Scope CL ($r^2 = 0.93$) at different grain yields achieved by La Trobe (source: data from 2010-2016 DPIRD barley agronomy and 2010-2016 NVT trials. Each variety is sown in all 283 trial-years of data.)



Disease resistance

Sanjiv Gupta (Murdoch), Blakely Paynter (DPIRD), Sarah Collins (DPIRD), Daniel Huberli (DPIRD), Geoff Thomas (DPIRD), Kith Jayasena (DPIRD), Andrea Hills (DPIRD) and Ryan Fowler (QDAFF).

- NTNB = net-type net blotch.
- STNB = spot-type net blotch.
- APR = adult plant resistance.

Disease resistance abbreviations:

- VS = very susceptible.
- SVS = susceptible to very susceptible.
- S = susceptible.
- MSS = moderately susceptible to susceptible.
- MS = moderately susceptible.
- MRMS = moderately resistant to moderately susceptible.
- MR = moderately resistant.
- RMR = resistant to moderately resistant.
- R = resistant.
- *p* = provisional rating.

Fungicide abbreviations:

- DMI = demethylation inhibitor.
- SDHI = succinate dehydrogenase.

Seedling and adult resistance

Disease, virus and nematode resistance data is presented in Tables 6 to 8. Leaf disease ratings in this guide include both seedling and adult stage resistance ratings for the foliar leaf diseases NTNB, STNB, powdery mildew and barley leaf rust. There is no seedling data for scald so only the adult stage resistance is tabulated. There is no adult data yet available for Skiff virulent NTNB so only the seedling stage data is tabulated.

Seedling ratings are applicable at early growth stages (2–3 leaf stage) and are important for making decisions on use of seed or fertiliser applied fungicide treatments and to know the likely response of a variety if there is early disease pressure. Seedling ratings are also important when assigning varieties to paddocks. Varieties susceptible to stubble borne diseases such as scald, NTNB and STNB are at a high risk of early infection if sown onto one or two year old barley stubble.

Adult plant ratings are applicable at later plant growth stages (after flag leaf emergence), but in some varieties and for some diseases the adult

ratings may be applicable as early as late tillering to stem elongation. Variation in the seedling and adult rating of a variety is most likely due to the presence or absence of resistance genes.

The ratings of varieties may vary over time and these are noted where observed. Seasonal changes occur with time mainly due to differences in disease pressure, spread of the disease in the region, changes in climatic conditions, stubble retention and development of new pathotypes/races.

Disease surveillance

Growers and consultants observing barley varieties rated as MRMS, MR or R to scald, NTNB, STNB, powdery mildew or barley leaf rust carrying significantly greater levels of disease than expected should collect infected material for pathotype identification. Samples should be collected before spraying the crop to ensure sample viability.

Infected scald, NTNB, STNB, powdery mildew and barley leaf rust leaf material must be sent in paper envelopes marked with location, variety, disease and date collected. Fold leaf in half so infected area is on the inside. Please do not wrap leaf material in plastic or send in plastic lined envelopes. Unlike other leaf diseases, it is necessary for powdery mildew infected individual leaves to be placed into agar tubing to maintain a live culture for pathotyping. This means sample collection kits for powdery mildew need to be arranged before sampling and therefore before spraying can be done.

Scald, NTNB and STNB infected leaf material (sent in paper envelopes) should be sent to the Department of Primary Industries and Regional Development, Locked Bag 4, Bentley Delivery Centre WA 6983 and marked attention Simon Rogers or Geoff Thomas. For more information contact Simon Rogers via email at simon.rogers@dpiird.wa.gov.au or phone +61 (0)8 9368 3445 or Geoff Thomas via email at geoff.j.thomas@dpiird.wa.gov.au or phone +61 (0)8 9368 3262.

Samples of powdery mildew infected leaf material (placed into agar tubing) should be forwarded to the Centre for Crop and Disease Management, Curtin University, Kent Street, Bentley, WA 6102. To arrange sample collection kits contact Simon Ellwood via email at simon.ellwood@curtin.edu.au or phone +61 (0)8 9266 9915.

Table 6 Seedling (2–3 leaf stage) leaf disease resistance profiles when grown in WA (source: Sanjiv Gupta and NVT Online nvtonline.com.au)

Disease ¹	Scald	Net-type net blotch ⁴	Net-type net blotch ⁴	Net-type net blotch ⁴	Spot-type net blotch	Powdery mildew ⁵	Barley leaf rust ⁶
Pathotype ²	Medina	Beecher virulent (95NB100)	Beecher avirulent (97NB1)	Skiff virulent	South Perth	South Perth	(5457 P-)
Growth Stage ³	Seedling	Seedling	Seedling	Seedling	Seedling	Seedling	Seedling
Malt varieties							
Bass ^(b)	–	MR	S	VSp	MRMS	MSS	SVS
Baudin ^(b)	–	S	S	Sp	MRMS	VS	SVS
Flinders ^(b)	–	MRMS	S	Sp	MS	R	S
Granger ^(b)	–	MS	MS	MRMSp	S	R	MSS
La Trobe ^(b)	–	MS	MRMS	Sp	S	MS	MS
Scope CL ^(b)	–	MR	MR	Sp	MS	R	S
Stage 2 malt accreditation							
Compass ^(b)	–	MRMS	S	SVSp	MRMS	MS	S
Spartacus CL ^(b)	–	MSS	MSS	Sp	SVS	MS	MS
Feed varieties							
Fathom ^(b)	–	MSS	S	VSp	MR	MS	S
LG Maltstar ^(b)	–	MRMS	RMR	MSp	MSS	R	S
Litmus ^(b)	–	S	S	Sp	S	MS	S
Lockyer ^(b)	–	MR	MR	Sp	S	MS	S
Mundah	–	S	MS	Sp	S	SVS	S
Oxford	–	RMR	MR	SVSp	S	R*	S
RGT Planet ^(b)	–	MRMSp	MRMSp	MSp	S	R	Sp
Rosalind ^(b)	–	MR	MR	SVSp	MS	MS	MRMS
Yagan	–	MRMS	MRMS	–	MRMS	MRMS	S

¹Resistance rating: VS = very susceptible, S = susceptible, MS = moderately susceptible, MRMS = intermediate, MR = moderately resistant, R = resistant, p = provisional rating, - = no data available.

²Pathotype: the strain of the pathogen used in evaluating the disease reaction of the different barley varieties which represents the most common pathotype present in WA. On farm reactions of varieties may therefore differ if the pathotype(s) present differs to the pathotype used in testing.

³Growth stage: the seedling resistance score reflects resistance at the 2–3 leaf stage (use data cautiously after four leaf stage). The adult resistance score reflects resistance after flag leaf emergence. Varieties with a VS or S rating at the seedling stage are at a greater risk of early infection. Appropriate cultural (that is rotation) and/or chemical (that is fungicide) disease management strategies should be considered to minimise the risk when planting those varieties.

⁴Net-type net blotch: there are three major pathotypes of NTN present in WA. South of the Great Eastern Highway the Beecher avirulent pathotype has been the dominant isolate, but the Skiff pathotype is becoming more common particularly on the south coast. North of the Great Eastern Highway both the Beecher virulent and avirulent pathotypes could be present, whilst the Skiff pathotype has not yet been detected.

⁵Powdery mildew: varieties with a VS or S rating at the seedling stage (Baudin and Mundah) should be treated with a seed dressing active against powdery mildew to prevent early infection during the tillering stage. Virulence against the *Ml/St* mildew gene present in Oxford has been detected in the Stirlings to Coast area. This means that Oxford may show a susceptible reaction where this virulence exists. Growers should closely monitor Oxford crops for powdery mildew. Where detected, infected leaf samples should be collected and sent to CCDM before spraying the crop with a fungicide.

⁶Barley leaf rust: a new pathotype (5457 P-) was detected in September 2013 virulent on the *Rph3* gene. This pathotype is now widespread in the state and has decreased the resistance scores of varieties carrying the *Rph3* gene. As Bass and Compass only carry the *Rph3* gene, they are susceptible in the presence of 5457 P-. Granger and Oxford carry an adult plant resistance gene *Rph20* in addition to the *Rph3* gene, conferring them adult resistance against pathotype 5457 P-, but not seedling resistance.

Barley leaf rust samples should be sent in paper envelopes directly to the ACRCP Annual Cereal Rust Survey, Plant Breeding Institute, Reply Paid 88076 Narellan NSW 2567. For more information contact Professor Robert Park via email at robert.park@sydney.edu.au or phone +61 (0)2 9351 8800.

Fungicide resistant isolates of both NTNB and powdery mildew have been detected in Western Australia. In situations of concern over disease response to fungicide control in barley crops, samples from any disease can be sent to the Centre for Crop and Disease Management, Curtin University, Kent Street, Bentley, WA 6102. Contact Fran Lopez-Ruiz via email at fran.lopezruiz@curtin.edu.au or phone +61 (0)8 9266 3061.

Scald

Scald starts as pale grey-green water-soaked blotches on older leaves. The blotches become elongated, often diamond shaped and bleached with a distinctive brown margin. Lesions usually join to form necrotic areas and eventually the entire leaf withers and dies. Scald is potentially very damaging in barley as an infection can kill leaves prematurely and reduce seed weight. Increased plantings of varieties with a susceptible rating will increase the prevalence of scald, especially with early sowing opportunities. A severe early infection can reduce head number and grain number. Yield losses of up to 45% are possible with associated quality defects. Scald can survive between seasons on infested stubble, barley grass and be carried through infected seed.

The varieties with the highest scald risk are Granger, LG Maltstar, Litmus, Mundah and Yagan.

Since the last sowing guide, the adult resistance score of Flinders has dropped slightly from MS to MSS, whilst Spartacus CL has increased slightly from MR to RMR.

Net-type net blotch

NTNB starts as pinpoint brown lesions that elongate and produce fine, dark brown streaks along and across the leaf blades, creating a distinctive net-like pattern. Older lesions continue to elongate along leaf veins. Double cropping of barley significantly increases the risk of infection. The CCDM has reported that it had discovered several populations of NTNB resistant to the

triazole based DMI fungicide tebuconazole and some other types of *triazole* fungicides. In these situations higher value DMI fungicides mixtures will be required to manage the disease when resistance in the variety is low or if there is a pathotype change. NTNB can reduce grain yield by 20-30% and impact on the quality of the grain produced.

Virulence of the NTNB pathogen can vary across time and regions depending on the varieties and resistance genes deployed. Historically, there were two distinct pathotypes of NTNB prevalent in WA, Beecher virulent (95NB100) and Beecher avirulent (97NB1). The Beecher avirulent (non-attacking) isolate was prevalent throughout the state, whereas the Beecher virulent (attacking) isolate was more common north of the Great Eastern Highway, but is now relatively uncommon. In recent seasons another pathotype has become evident, particularly in the Albany and Esperance port zones. This pathotype, known in the eastern states as the 'Skiff virulent' pathotype, is virulent on seedlings of most varieties except Granger. This pathotype is now relatively common on the south coast and therefore seedlings of most varieties may be at an increased risk when sown onto barley stubble. There are currently no resistance ratings for adult plants against the Skiff virulent pathotype, but research is underway to determine if varietal variability exists.

Baudin and Litmus are susceptible to all three major NTNB pathotypes present in WA. The other varieties grown in WA, however, can differ in their response to NTNB depending on which isolate is present in the paddock. The key message is that there are different pathotypes of NTNB present in WA. As a consequence varietal response will vary accordingly. If the Skiff virulent pathotype moves further north and becomes the dominant pathotype, then fungicide and rotation will become key tools in reducing the annual risk of NTNB due the lack of seedling resistance (adult resistance is unknown at this stage) present in commercially grown varieties.

Spot-type net blotch

STNB develops as small circular or elliptical dark brown spots becoming surrounded by a chlorotic zone of varying width. These spots do not elongate to the net-like pattern characteristic of NTNB. The spots may grow to 3-6mm in diameter. Double cropping of barley significantly

Table 7 Adult (after flag leaf emergence) leaf disease resistance profiles when grown in WA (source: Sanjiv Gupta and NVT Online nvtonline.com.au)

Disease ¹	Scald	Net-type net blotch ⁴	Net-type net blotch ⁴	Net-type net blotch ⁴	Spot-type net blotch	Powdery mildew ⁵	Barley leaf rust ⁶
Pathotype ²	Medina	Beecher virulent (95NB100)	Beecher avirulent (97NB1)	Skiff virulent	South Perth	South Perth	(5457 P-)
Growth Stage ³	Adult	Adult	Adult	Adult	Adult	Adult	Adult
Malt varieties							
Bass ^(b)	MRMS	MRMS	MSS	–	S	MS	SVS
Baudin ^(b)	MSS	S	S	–	MSS	VS	SVS
Flinders ^(b)	MSS	MS	MS	–	S	R	MRMS (APR)
Granger ^(b)	S	MS	MRMS	–	SVS	R	R (APR)
La Trobe ^(b)	MR	MS	MRMS	–	SVS	MRMS	S
Scope CL ^(b)	MS	MRMS	MRMS	–	S	R	S
Stage 2 malt accreditation							
Compass ^(b)	MS	MRMS	MS	–	MSS	MRMS	S
Spartacus CL ^(b)	RMR	MR	MRMS	–	S	MR	S
Feed varieties							
Fathom ^(b)	MR	MSS	MSS	–	MRMS	MS	R (late APR)
LG Maltstar ^(b)	–	MSS	MRMS	–	SVS	R	MSp
Litmus ^(b)	SVS	S	S	–	S	MRMS	S
Lockyer ^(b)	MRMS	MS	MRMS	–	S	MRMS	S
Mundah	S	S	MS	–	S	MSS	S
Oxford	MS	MRMS	MRMS	–	S	R*	MR (APR)
RGT Planet ^(b)	RMR	–	MRMS _p	–	SVS	R	R _p (late APR)
Rosalind ^(b)	MS	MS	MR	–	S	MS	MR
Yagan	VS	MSS	MRMS	–	S	MS	S

¹Resistance rating: VS = very susceptible, S = susceptible, MS = moderately susceptible, MRMS = intermediate, MR = moderately resistant, R = resistant, *p* = provisional rating, – = no data available.

²Pathotype: the strain of the pathogen used in evaluating the disease reaction of the different barley varieties which represents the most common pathotype present in WA. On farm reactions of varieties may therefore differ if the pathotype(s) present differs to the pathotype used in testing.

³Growth stage: the adult resistance score reflects resistance after flag leaf emergence. Varieties with a VS or S rating at the seedling stage are at a greater risk of early infection. Appropriate cultural (i.e. rotation) and/or chemical (i.e. fungicide) disease management strategies should be considered to minimise the risk when planting those varieties.

⁴Net-type net blotch: there are three major pathotypes of NTNB present in WA. South of the Great Eastern Highway the Beecher avirulent pathotype has been the dominant isolate, but the Skiff pathotype is becoming more common particularly on the south coast. North of the Great Eastern Highway both the Beecher virulent and avirulent pathotypes could be present, whilst the Skiff pathotype has not yet been detected.

⁵Powdery mildew: varieties with a VS or S rating at the seedling stage (Baudin and Mundah) should be treated with a seed dressing active against powdery mildew to prevent early infection during the tillering stage. Virulence against the *MI/St* mildew gene present in Oxford has been detected in the Stirlings to Coast area. This means that Oxford may show a susceptible reaction where that virulence exists. Growers should closely monitor Oxford crops for powdery mildew. Where detected, infected leaf samples should be collected and sent to CCDM before spraying the crop with a fungicide.

⁶Barley leaf rust: a new pathotype (5457 P-) was detected in September 2013 virulent on the *Rph3* gene. This pathotype is now widespread in the state and has decreased the resistance scores of varieties carrying the *Rph3* gene. As Bass and Compass only carry the *Rph3* gene, they are susceptible in the presence of 5457 P-. Granger and Oxford carry an adult plant resistance gene *Rph20* in addition to the *Rph3* gene, conferring them adult resistance against pathotype 5457 P-, but not seedling resistance.

increases the risk of infection. STNB can reduce grain yield by 10-50% and impact on the quality of the grain produced.

Most barley varieties are susceptible to STNB, particularly as adult plants. The varieties with the greatest seedling and adult STNB risk are Granger, La Trobe, Litmus, Lockyer, Mundah, RGT Planet and Spartacus CL.

Fathom (MR as a seedling and MRMS as an adult) has the best combined seedling and

adult resistance to STNB of the current varieties. Baudin (MRMS as seedling and MSS as adult) and Compass (MRMS as seedling and MSS as adult) also have some STNB tolerance.

Some varieties susceptible at the adult plant stage have some tolerance at the seedling stage. This reduces the likelihood of severe early infection but STNB can still infect varieties at the adult stage. Under high disease pressure, such as being sown onto barley stubble, these varieties may still exhibit significant levels of seedling disease.

Table 8 Crown rot yield loss and virus and nematode seedling and adult resistance profiles when grown in WA (source: viruses – Sanjiv Gupta and nematodes – Sarah Collins)

Disease ¹	Crown rot yield loss	Barley and cereal yellow dwarf ³	Root lesion nematode ⁴	Root lesion nematode ⁴	Cereal cyst nematode ⁵
Pathogen	<i>Fusarium pseudograminearum</i>		<i>Pratylenchus neglectus</i>	<i>Pratylenchus quasitereoides</i>	<i>Heterodera avenae</i>
Growth Stage ²	Seedling & Adult	Seedling & Adult	Seedling & Adult	Seedling & Adult	Seedling & Adult
Malt varieties					
Bass ^(b)	High	MS	MSS	MS	S
Baudin ^(b)	Moderate	MRMS	MSS	S	S
Flinders ^(b)	High	MRMS	MS _p	MSS	S
Granger ^(b)	High	MS	MS	MSS	R
La Trobe ^(b)	Moderate	S	MS	MSS	R
Scope CL ^(b)	High	MS	MSS	MS	S
Stage 2 malt accreditation					
Compass ^(b)	High	MSS	–	MSS	R
Spartacus CL ^(b)	Moderate	S	–	–	R
Feed varieties					
Fathom ^(b)	Moderate	MRMS	MS _p	MSS _p	R
LG Maltstar ^(b)	–	MRMS	–	–	–
Litmus ^(b)	Low	S	–	–	MS
Lockyer ^(b)	–	MSS	–	–	–
Mundah	Moderate	MS	–	MRMS _p	S
Oxford	–	MRMS	–	–	S
RGT Planet ^(b)	–	MRMS _p	–	–	–
Rosalind ^(b)	Moderate	MSS	–	–	R
Yagan	–	S	–	–	S

¹Crown rot yield loss: Low = <10% yield loss, Moderate = 10-20% yield loss, High = >20% yield loss, - = no data available. Nematode and virus resistance rating: VS = very susceptible, S = susceptible, MS = moderately susceptible, MRMS = intermediate, MR = moderately resistant, R = resistant, _p = provisional rating, - = no data available.

²Growth stage: the resistance to barley and cereal yellow dwarf virus and the varietal impacts on nematode numbers do not differ between growth stages, it applies equally throughout the life of the plant.

³Barley and cereal yellow dwarf: plants become infected from infected oat and corn leaf aphids. Varietal resistance reduces the impact of the virus on plant growth but does not reduce the impact of aphid feeding on plant growth.

⁴Root lesion nematode: barley varieties vary in the impact of root lesion nematode on their growth. A resistant variety retards nematode development, leading to lower nematode levels in the soil for subsequent crops. *Pratylenchus teres* has been renamed *Pratylenchus quasitereoides*.

⁵Cereal cyst nematode: all barley varieties are tolerant of cereal cyst nematode but a resistant variety retards nematode development, leading to lower nematode levels in the soil for subsequent crops.

Varieties susceptible at the adult stage but with some resistance at the seedling stage (seedling resistance in brackets) include Bass (MRMS), Flinders (MS), Rosalind (MS), Scope CL (MS) and Yagan (MRMS).

The adult STNB resistance score of Granger (S to SVS) has decreased slightly since the last sowing guide, whilst Spartacus CL (SVS to S) has increased slightly.

Powdery mildew

Powdery mildew appears as fluffy white growths on the surface of the leaf. The area surrounding the spores turns yellow as the fungus depletes the leaf nutrients. Older infections turn grey and may develop small black fruiting bodies. Early infection can cause yield losses of up to 25%, whereas yield losses at the end of stem elongation reduce yield by around 10%.

The variety with the highest risk of powdery mildew is Baudin, although Oxford may now be susceptible in lower great southern in the presence of the *MI(St)* virulent pathotype.

Genetic resistance is the best form of management against powdery mildew, especially since a mutation of the *CYP51* gene in powdery mildew has resulted in the compromised efficacy of many DMI fungicides (for example tebuconazole, triadimefon, flutriafol) in controlling powdery mildew at label rates. Higher value DMI fungicides and alternative modes of action, such as strobilurins (for example azoxystrobin and pyraclostrobin), SDHI (for example fluxapyroxad) and amines (spiroxamine) have uncompromised activity against powdery mildew.

Varieties grown in WA with intermediate resistance or above (MRMS, MR and R) to powdery mildew can be categorised into nine broad groups based on the postulated or known effective genes that control their resistance to powdery mildew. Only those varieties carrying the *mlo* gene like Granger and LG Maltstar have durable resistance to powdery mildew. RGT Planet is postulated to be carrying the *mlo* gene too. The rest of the varieties grown in WA are vulnerable to mutations of the powdery mildew fungus, but the diversity in resistance genes and the presence of multiple genes in some varieties means that not all varieties will be rendered susceptible at the same time if mutations occur or the known mutations become more widespread. Testing by the CCDM for powdery

mildew virulence on Oxford, suggests that the *MI(St)* gene in Oxford may be compromised, rendering a susceptible reaction in the presence of this mutation. Further research is undergoing to determine the extent of this new pathotype, but it is believed to be restricted to the south coast at the present time.

The nine broad groups separated by known or postulated effective genes (in brackets) include the following varieties:

- Group 1 (*MI Ga*) – Fathom and Fleet.
- Group 2 (*MI La*) – La Trobe, Lockyer, Rosalind and Spartacus CL.
- Group 3 (*MI Ga*, *MI La*) – Compass.
- Group 4 (*MI a7*, *MI La*) – Scope CL.
- Group 5 (*MI a7*, *MI La*, *MI k1*) – Dash.
- Group 6 (*MI (Ch)*, *MI ra*) – Yagan.
- Group 7 (*MI (St)*) – Oxford.
- Group 8 (*MI a1*) – Flinders.
- Group 9 (*mlo*) – Granger, LG Maltstar and RGT Planet.

Virulence to the *MI La* gene has been detected in barley growing in northern NSW and Queensland resulting in varieties such as Compass, Hindmarsh and La Trobe being more susceptible to mildew than in previous years. Field screening of varieties with different genes, however, has not yet found any significant regional variation in the field resistance of varieties to powdery mildew in WA, except for Oxford.

The seedling resistance score to powdery mildew of Oxford (S to SVS) and Yagan (R to MRMS) has decreased since the last sowing guide, whilst La Trobe (S to MS) has increased.

The adult mildew resistance scores of Fathom (MRMS to MS) and Yagan (MRMS to MS) have decreased since the last sowing guide.

Barley leaf rust

Barley leaf rust appears as small, circular to oval pustules with light brown powdery spores on the upper surface of leaves (rarely on the back of the leaf) and on leaf sheaths in cases of heavy infection. As the crop matures, pustules darken and produce black spores embedded in leaf tissue. Barley leaf rust can reduce grain yield by over 30% in severe infections.

Since the detection of a new pathotype (5457 P-) of barley leaf rust in 2013 with virulence for

the major resistance gene *Rph3*, none of the current barley varieties used in WA have total resistance to this disease and only varieties that carry an APR gene or genes (for example *Rph20* in Dash, Flinders, Granger and Oxford) have some resistance when this pathotype is present. APR genes usually provide moderate levels of resistance and are not strain specific so should not be impacted by any future pathotype changes. This resistance only develops fully at the adult plant stage, so there may still be a need to protect those varieties at early growth stages from early infection. The effectiveness of the *Rph20* gene is also influenced by temperature. Even though Flinders, Granger and Oxford all carry the *Rph20* gene, their field reaction may vary depending on which allele they have and other minor genes they may carry. The late APR resistance in Fathom only protects it late in the season, so it is still vulnerable to infections prior to heading.

Pathotype 5457 P- is now the dominant barley leaf rust pathotype present in WA. In addition to 5457P-, two new pathotypes have been detected. 5457P+ was detected in 2014 and recently in 2016, 5656P+ was detected in the Lakes area, lower great southern and around the Williams area and like 5457P- is also virulent against the *Rph3* gene. The new pathotype 5656P+ has migrated from eastern Australia, where it was first detected in South Australia in 2011. The new pathotype is not expected to pose any additional threat to the current suite of varieties being grown here.

Since the last sowing guide the seedling resistance of Bass (S to SVS), Flinders (MS to S) and Granger (MS to MSS) to barley leaf rust have decreased. The adult rust resistance score of Bass (S to SVS) has also decreased.

Crown rot

Crown rot (*Fusarium pseudograminearum*) is a fungal disease most common in continuous cereal rotations. It affects the sub crown internode, crown and lower stems and is usually not noticed until after heading when white heads are visible. Symptoms can include white heads scattered throughout the crop but not in distinct patches as would occur with take-all. In individual plants the infected tiller bases are honey-brown in colour especially under leaf sheaths and a pink discolouration often forms around or in the crown or under leaf sheaths. The browning at the base

of infected tillers is the most reliable indicator of crown rot as in seasons with good spring rain, whiteheads may not occur, even in infected crops. Significant yield losses can occur when high disease levels coincide with moisture stress during grain fill. Affected heads have shrivelled or no grain.

As there are no fungicide options once the crop has established to control crown rot, inoculum levels can be reduced by including non-cereals into the rotation (such as pulses, oilseed, lupin and grass-free pasture), inter-row seeding and maintaining good grass weed control in break crops and between crops. Varietal resistance and tolerance to crown rot is limited. Recent research in WA suggests that varietal differences in barley do exist but most barley varieties are susceptible and suffer yield loss to crown rot. Litmus has the lowest yield loss of the varieties tested in the presence of high crown rot.

Barley and cereal yellow dwarf virus

Both barley yellow dwarf (BYD) and cereal yellow dwarf (CYD) occur in WA. As the screening for varietal resistance occurs in the field the resistance score reflects the rating to both being present, although BYD is more frequent than CYD at a ratio of approximately 2:1. BYD can reduce grain yield by up to 80% with seedling infection and up to 20% with later infection. Barley plants primarily become infected from infected oat (*Rhopalosiphum padi*) or corn leaf (*Rhopalosiphum maidis*) aphids.

Varietal resistance reduces the impact of the virus on plant growth but does not reduce the impact of aphid feeding on plant growth. Varietal resistance to BYD and CYD therefore does not reduce the need to spray for aphids to prevent yield loss from feeding damage once they reach threshold levels in the crop (50% of tillers with 15 or more aphids).

The varietal virus resistance score of Bass (MRMS to MS) and Scope CL (MRMS to MS) have decreased since the last sowing guide, whilst Mundah (S to MS) has increased slightly.

Russian wheat aphid

Russian wheat aphid (*Diuraphis noxia*) (RWA) is a major pest of over 140 grasses worldwide. Wheat and barley are the most susceptible cereals, whilst triticale, rye and oats are less susceptible. In May 2016, RWA was detected in South Australia for the first time. Subsequent surveillance has found

the species across much of the eastern half of South Australia and western and central Victoria. As of 18th September 2017, RWA had not been detected in Western Australia but it is highly likely that RWA will arrive here at some time in the future. Around the world, the distribution of RWA is primarily associated with cereal production regions characterised by warmer, drier climates. It is generally less prevalent or non-existent in higher rainfall areas.

Unlike other cereal aphids that damage plants by removing nutrients, RWA also injects salivary toxins during feeding. These toxins can retard crop growth resulting in reduced grain yield and can even kill the plant with heavy infestations. Economic damage is mainly caused by direct feeding. Affected plants often show whitish, yellow and red leaf markings and rolling of leaves. The aphid is spread easily by the wind and on live plant material. There is no varietal resistance to RWA in commercial barley varieties currently grown in Western Australia or even Australia.

Chemical control is the main cultural means of reducing damage from RWA until varieties with resistance are released. An APVMA permit (PER81133) has been issued for the use of products containing 500g/L chlorpyrifos applied at 1.2L/ha with an LI700 surfactant applied at 240ml/ha; and products containing 500g/kg pirimicarb applied at 200-250g/ha to control RWA in cereals. High water volume (100-120L/ha) at seven bar pressure is advised to maximise coverage. It is important everyone adopts best-practice farm hygiene procedures to retard the spread of the pest between paddocks and adjacent properties. This includes keeping machinery out of affected areas and minimising movement in adjacent areas.

All RWA aphid activity (including surveillance resulting in no detection) should be reported using the MyPestGuide Reporter available for both Apple and Android smartphones and tablets. The MyPestGuide Reporter is a photographic reporting tool which lets users take up to four photos, map their pest observations and communicate directly with DPIRD.

Root lesion nematode

Root lesion nematodes (*Pratylenchus* spp) (RLN) are microscopic, worm-like animals that feed on plant roots causing yield loss in susceptible crops including wheat, barley and canola.

At least six million hectares (74%) of WA's broadacre cropping paddocks are infested with RLN, an increase of 11% since an initial state-wide survey conducted in 1997-98. 765 paddock samples assessed in the 2014-15 seasons showed at least 50% of infested paddocks had RLN at potentially yield limiting levels. *P. neglectus* was the most frequent RLN, occurring in at least 63% of infested paddocks. *P. quasitereoides* (formerly *P. teres*), unique to WA, was the next most common RLN at around 26% of infected paddocks surveyed.

Cereal yield losses due to RLN are seasonally dependant and are in the order of 5-30%, but can be higher. RLN species *Pratylenchus neglectus* and *P. quasitereoides* can cause losses of up to 18% in barley crops. The actual yield loss due to RLN in different barley varieties is not yet quantified, but the impact of different varieties on nematode populations varies (Table 8).

The *P. neglectus* and *P. quasitereoides* nematode resistance scores in this sowing guide only reflect WA based observations. The ratings are based on glasshouse trials between 2009-14 for both RLN species plus field trials in 2014-15 for *P. quasitereoides* (three trials) and 2015 for *P. neglectus* (three trials). Provisional ratings are given to varieties with fewer than three observations, or where there has been no field trial verification of the glasshouse rating.

Cereal cyst nematode

Cereal cyst nematode (*Heterodea avenae*) (CCN) is present in cropping regions around Geraldton and in the Avon Valley around Northam, but it can occur in any area. Unlike RLN, barley varieties are tolerant to CCN, so yield loss is limited even when infection does occur. The planting of CCN resistant varieties retards nematode development, leading to lower nematode levels in the soil for subsequent crops.

There has been no change in nematode resistance scores since the last sowing guide.

Agronomic attributes

Blakely Paynter and Ben Biddulph (DPIRD).

Table 9 describes agronomic characteristics (for example coleoptile length, frost ranking based on floret sterility, straw strength and plant height). Frost risk based on frost induced sterility (FIS) has been included and is an interpretation of the NFI frost graphs which can be found at nvtonline.com.au/frost. According to the NFI, frost values (FV) have been developed for wheat and barley varieties to rank their relative susceptibility to reproductive frost. This information can be used to manage frost risk and fine tune variety selection after first selecting for local adaptation, yield, flowering time, and other key target traits.

The relative ranking of frost susceptibility has been expressed as a FV for each variety in each environment. FV's are presented as positive or negative differences relative to the average FIS of all varieties in the current data-set for a given year and site. Lower values are better (less frost induced sterility). The units of measurement for FV's relate to the transformed FIS but are not important in terms of variety selection because selection decisions are based on comparative performance of varieties. Therefore, it is the difference between FV's that is critical. When using FV's for selection decisions it is recommended that growers and advisors consider not just a single environment/year, but a number of relevant environments. This allows examination of the stability of a variety over a range of environments which are prone to frost. FV's are displayed graphically for the chosen varieties at nvtonline.com.au/frost. As these graphs are difficult to present in this sowing guide the graphs have been interpreted to provide a rating as either:

- lower risk (less floret sterility under frost),
- normal (standard floret sterility under frost), and
- higher risk (more floret sterility under frost).

The rankings are based on varietal variation in the ability to maintain grain number under minor reproductive frosts. Under reproductive/floret or head frosts this is the main component of yield affected when yield is a function of grain size and grain number. However this may not be the case if there is variation in the length of season and the ability of varieties to compensate due

to late tillers, synchronisation of flowering time and plasticity of grain number. Further research is ongoing within the GRDC NFI to validate the yield relationship with FIS (DAW00234) and also compensation ability (CSP00180).

Growers and consultants are advised to use the rankings in Table 9 as a guide but should consult the graphs available at nvtonline.com.au/frost to compare the sensitivity levels of varieties over different seasons relative to one another.

It can be very difficult to distinguish between varieties once they are sown in the paddock. Table 10 attempts to provide some visual guides as to how one might use plant traits to separate varieties or to identify contaminated seed. Some of the questions you might ask include:

- What did the crop look like at 8-10 weeks after seeding (prostrate or erect)?
- Does it have red auricles at the base of the leaf blade where it wraps around the stem?
- Does the head have red awns?
- How long are the awns?
- Is the head near maturity fanned (tapered) or straight (parallel) in shape?
- When you look at the furrow at the germ end of the grain through a magnifying glass what length is the rachilla (white, rod-shaped organ) and how long are the hairs on the rachilla?

For more advice on what differences to look for consult DAFWA Bulletin 4765 'Maintaining variety purity in the WA malting barley industry' by Jeff Russell and Blakely Paynter. If visual cues are not enough then the grain will need to be tested at an accredited laboratory for varietal purity. The most common method used to determine varietal purity is based on mass spectrometry analysis of protein profiles in grains, but newer methods such as deoxyribonucleic acid (DNA) microsatellites and diversified array technology (DArT) are also available and being used.

DDLS Seed Testing and Certification (formally AGWEST Plant Laboratories) (agric.wa.gov.au/n/1766) offers a mass spectrometry test that compares the protein profile of a combined sample of 30 individual seeds or of 150 individual seeds. Higher levels of accuracy can be obtained by analysing more seeds, but the price also increases as more seeds are done. The mass spectrometry tests range from \$137–\$706 to conduct. They also offer a DNA microsatellite

Table 9 Agronomic characteristics of a range of barley varieties when grown in WA (source: Blakely Paynter, Raj Malik, Jeremy Curry, Ben Biddulph and David Moody)

Agronomic trait	Coleoptile length ¹	Maturity with late May sowing ²	Frost risk (florete sterility) ³	Boron leaf symptoms	Straw strength	Head loss risk ⁴	Plant height at maturity ⁵	Grain plumpness
Malt varieties								
Bass [Ⓓ]	Medium	Medium	Normal	Medium	Very good	Medium	Short	Good
Baudin [Ⓓ]	Medium	Medium	Normal	Medium	Very good	Low	Short	Fair
Flinders [Ⓓ]	Short	Medium	Lower	Medium	Very good	Low	Short	Mod. good
Granger [Ⓓ]	Medium	Medium	Higher	Low	Good	Low	Medium	Mod. good
La Trobe [Ⓓ]	Short	Early	Higher	Medium	Mod. good	Medium	Medium	Mod. good
Scope CL [Ⓓ]	Short	Medium	Normal	Low	Fair	High	Tall	Fair
Stage 2 malt accreditation								
Compass [Ⓓ]	Medium	Medium	Normal	Low	Fair	Medium	Medium	Good
Spartacus CL [Ⓓ]	Short	Early	–	Medium	Good	Low	Medium	Mod. good
Feed varieties								
Fathom [Ⓓ]	Medium	Medium	Normal	Medium	Fair	Low	Tall	Good
LG Maltstar [Ⓓ]	–	Medium	–	Low	–	–	Short	–
Litmus [Ⓓ]	Short	Early	Normal	Medium	Fair	Medium	Tall	Mod. good
Lockyer [Ⓓ]	Medium	Late	–	Medium	Mod. good	Low	Short	Poor
Mundah	Medium	Very early	Normal	Medium	Fair	Medium	Medium	Very good
Oxford	Medium	Late	Higher	–	Very good	Low	Short	Very poor
RGT Planet [Ⓓ]	–	Medium	–	Low	–	–	Medium	–
Rosalind [Ⓓ]	Short	Medium	–	Medium	Good	Low	Medium	Mod. good
Yagan	Medium	Very early	–	Medium	Fair	Medium	Medium	Very good

¹Coleoptile length: short (40-60mm), medium (60-80mm) and long (80-100mm).

²Maturity: very early (-15 to -4 days), early (-3 to +3 days), medium (+4 to +10 days) and late (+11 to +17 days) maturity (days to awn emergence) relative to Stirling when sown in late May. Maturity ranking with a late May sowing differs to the maturity ranking when sown in April or after mid-June.

³Frost risk: ratings based on graphs produced by NFI available at nvtonline.com.au/frost. Varieties are rated as being lower risk (less florete sterility under frost), normal (standard florete sterility under frost) and higher risk (more florete sterility under frost) based on florete sterility which is separate from potential loss in grain yield. Some varieties may be able to compensate more than others depending on the severity and timing of the frost, plasticity of their growth and synchronicity of their flowering. For more detailed analysis growers and consultants should consult the NFI graphs when comparing varieties.

⁴Head loss risk: under adverse conditions barley varieties differ in their risk of shedding. Head loss risk is based on counting heads post-harvest at sites where high levels of head loss has been recorded in high risk varieties.

⁵Plant height at maturity: very short (<45 cm), short (45-55cm), medium (55-65cm) and tall (65-75cm) relative to Stirling and Buloke at sites where their straw (ground to base of ear) was between 65-75cm long.

Table 10 Visual characteristics of a range of barley varieties when grown in WA (source: DAFWA Bulletin 4765, breeding companies and IP Australia Plant Breeders Rights database – pericles.ipaustralia.gov.au/pbr_db/search.cfm)

Characteristic	Early growth habit	Redness of flag leaf auricle	Redness of awns during grain fill	Awn length	Ear shape	Rachilla length	Rachilla hair length
Malt varieties							
Bass ^(b)	Prostrate	Present	Weakly present	Long	Parallel	Short-medium	Long
Baudin ^(b)	Prostrate	Strongly present	Present	Medium	Parallel	Short-medium	Long
Flinders ^(b)	Prostrate	Strongly present	Present	Medium	Parallel	Medium-long	Short
Granger ^(b)	Prostrate	Present	Weakly present	Medium	Parallel	Medium	Short
La Trobe ^(b)	Erect	Present	Present	Medium	Parallel	Medium-long	Short
Scope CL ^(b)	Semi-erect	Weakly present	Absent	Medium	Tapering	Medium	Long
Stage 2 malt accreditation							
Compass ^(b)	Semi-erect	Present	Weakly present	Long	Tapering	Medium-long	Long
Spartacus CL ^(b)	Erect	Absent	Absent	Medium	Parallel	–	Short
Feed varieties							
Fathom ^(b)	Erect	Weakly present	Weakly present	Very long	Parallel	Medium	Long
LG Maltstar ^(b)	Prostrate	Present	Present	–	Tapering	–	Short
Litmus ^(b)	Erect	Weakly present	Weakly present	Long	Parallel	Medium	Long
Lockyer ^(b)	Prostrate	Weakly present	Present	Long	Parallel	Medium	Long
Mundah	Erect	Weakly present	Weakly present	Long	Parallel	Medium	Short
Oxford	Prostrate	Present	Present	Long	Parallel	Medium	Long
RGT Planet ^(b)	Prostrate	–	–	–	–	–	–
Rosalind ^(b)	Erect	Present	Present	Medium	Tapering	–	Long
Yagan	Erect	Present	Present	–	Tapering	–	Short



Table 11 Breeding, seed trading and end point royalty status for barley varieties when grown in WA (source: breeding companies and Variety Central – varietycentral.com.au)

Licence information	Variety owner or licensee	Year released	Seed licensee	Farmer to farmer trading	End point royalty ²	Pedigree
Malt varieties						
Bass ^(b)	InterGrain	2012	Free to trade	Yes	\$3.50	WABAR2023/Alexis
Baudin ^(b)	InterGrain	2003	Free to trade	Yes	\$3.00 / \$1.00	Stirling/Franklin
Flinders ^(b)	InterGrain	2014	Free to trade	Yes	\$3.80	Baudin/Cooper
Granger ^(b)	Limagrains	2013	Free to trade	Yes	\$2.95	Braemar/Adonis
La Trobe ^(b)	InterGrain	2013	Free to trade	Yes	\$4.00	Dash/VB9409
Scope CL ^(b)	AgVic Services	2010	SeedNet	No	\$3.50	Franklin/VB9104/VB9104
Food varieties						
Compass ^(b)	University of Adelaide	2015	SeedNet	No ¹	\$3.80	County/Commander// Commander
Spartacus CL ^(b)	InterGrain	2015	Syngenta	No	\$4.25	Scope/4*Hindmarsh// HMVB0325-106
Feed varieties						
Fathom ^(b)	University of Adelaide	2011	SeedNet	No ¹	\$2.00	JE013D-020/WI3806-1
LG Maltstar ^(b)	Limagrains	2017	Elders	No	\$3.00	Henley/Sebastian
Litmus ^(b)	InterGrain	2013	Free to trade	Yes	\$3.80	WB229/2*Baudin// WABAR2238
Lockyer ^(b)	InterGrain	2007	Free to trade	Yes	\$1.50	Tantangara/VB9104
Mundah	InterGrain	1995	Free to trade	Yes	–	Yagan/O'Connor
Oxford	Limagrains	2010	Free to trade	Yes	\$2.50	Tavern/Chime
RGT Planet ^(b)	RAGT Semences	2017	Seed Force	No	\$4.00	Tamtam/Concerto
Rosalind ^(b)	InterGrain	2015	Free to trade	Yes	\$3.50	Lockyer/Dash
Yagan	InterGrain	1989	Free to trade	Yes	–	Unknown pedigree

¹Compass and Fathom may be included in the SeedNet Authorised Grower Distribution Scheme from the 2017-18 harvest. Growers looking to purchase Compass and Fathom should check with SeedNet closer to harvest before purchasing any seed.

²End point royalties (EPR) (\$/t) are quoted excluding GST. EPR for Baudin received as malt is \$3/t and as feed \$1/t.

test for \$303. For more information or access to forms, contact DDLS Seed Testing & Certification on +61 (0)8 9368 3721 or email: DDLS-STAC@agric.wa.gov.au.

Table 11 covers information about who bred the variety, who to see about buying seed, how much you will pay when you deliver the grain (end point royalties) and what the pedigree of the variety is.

Figures 5 and 6 combine and analyse through linear functional relationship modelling the NVT grain quality data and DPIRD-GRDC (DAW00190 and DAW00224) agronomy grain quality data. Figure 5 compares the grain plumpness (%<2.5mm) of different malt varieties relative to La Trobe. Figure 6 compares the grain brightness (Minolta 'L*') of different malt varieties relative to La Trobe.

The benchmark malt variety for grain plumpness is Bass (Figure 5). All the newer malt varieties have a grain plumpness which is better than Baudin, but not as good as Bass. Bass is plumper than Flinders and Granger. Flinders and Granger are slightly plumper than La Trobe up to 30% screenings, with Flinders slightly plumper than Granger. Scope CL is not as plump as La Trobe.

At grain brightness levels between 52 and 59 'L*', the benchmark malt variety is Baudin (Figure 6). Within this range the grain brightness of Bass and Flinders is similar to or slightly darker than Baudin. La Trobe is about 0.6 to 0.7 'L*' darker, Scope CL 0.7 to 0.9 'L*' darker and Granger about 0.8 to 1.3 'L*' darker in that grain brightness range. There is no evidence that Granger weathers more than other varieties, it just has a naturally darker kernel than all the other malt barley varieties currently segregated in WA.

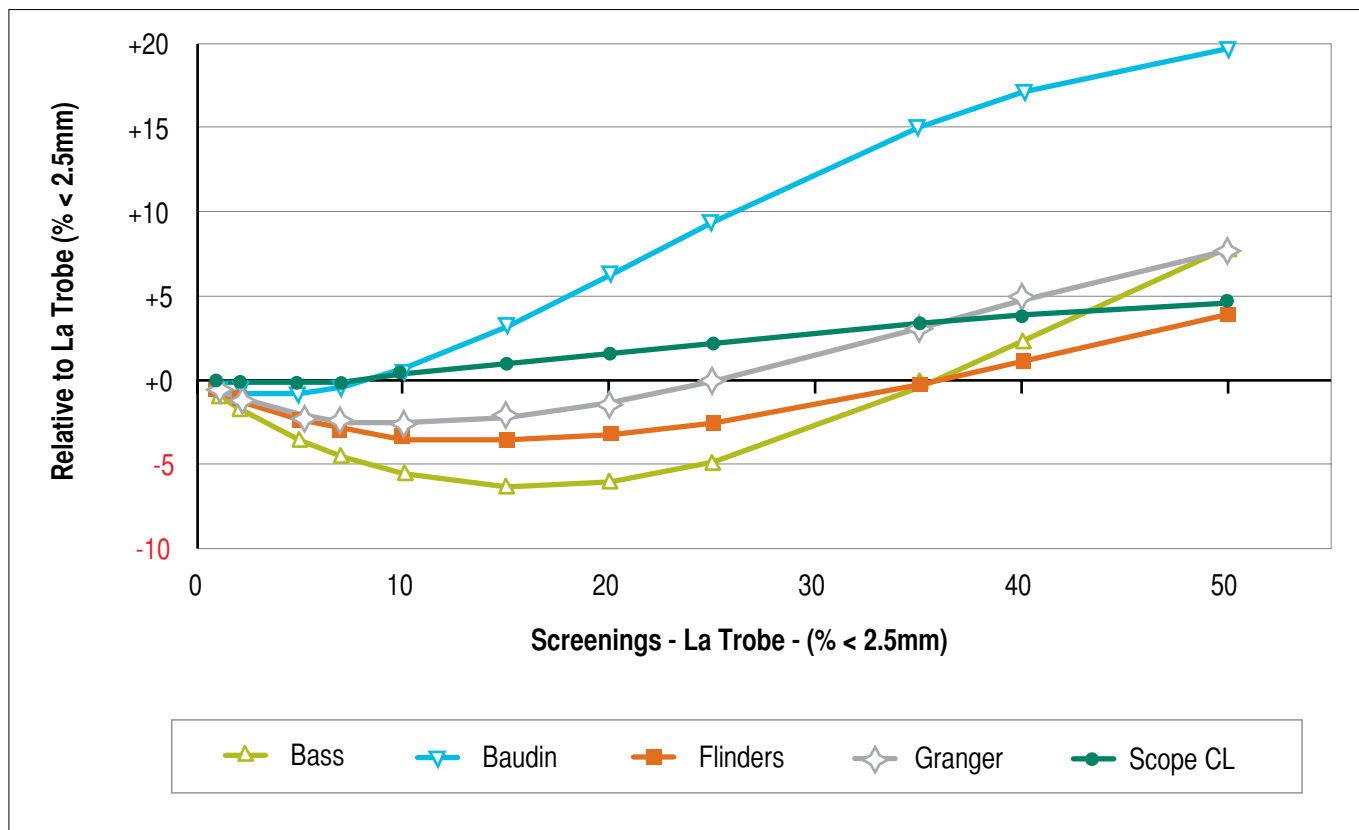


Figure 5 Relative screenings of Bass ($r^2 = 0.73$), Baudin ($r^2 = 0.77$), Flinders ($r^2 = 0.78$), Granger ($r^2 = 0.74$) and Scope CL ($r^2 = 0.76$) at different screenings achieved by La Trobe (source: data from 2010-2016 DPIRD barley agronomy and 2010-2016 NVT trials. Each variety is sown in all 282 trial-years of data.)

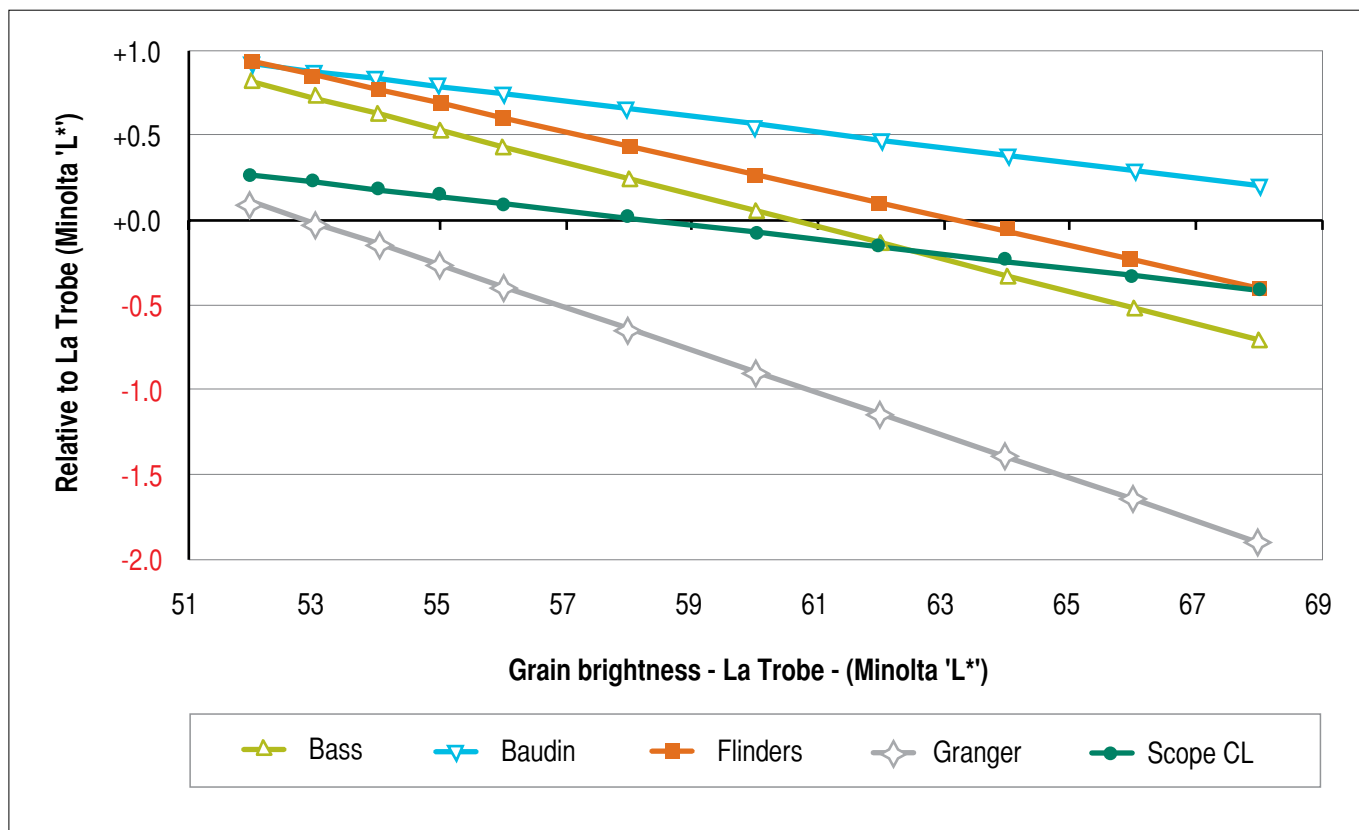


Figure 6 Relative grain brightness of Bass ($r^2 = 0.82$), Baudin ($r^2 = 0.81$), Flinders ($r^2 = 0.84$), Granger ($r^2 = 0.82$) and Scope CL ($r^2 = 0.85$) at different levels of grain brightness achieved by La Trobe (source: data from 2010-2016 DPIRD barley agronomy and 2010-2016 NVT trials. Each variety is sown in all 271 trial-years of data.)

Herbicide tolerance

Harmohinder Dhammu and Blakely Paynter, DPIRD.

Herbicide timing abbreviations:

- IBS = incorporated by seeding
- PSPE = post sowing pre-emergent.
- Z12 = Zadoks growth score 12, 2 leaves emerged on the mainstem.
- Z13 = Zadoks growth score 13, 3 leaves emerged on the mainstem.
- Z14 = Zadoks growth score 14, 4 leaves emerged on the mainstem.
- Z15 = Zadoks growth score 15, 5 leaves emerged on the mainstem.
- Z16 = Zadoks growth score 16, 6 leaves emerged on the mainstem.

Herbicide tolerance trials conducted over the last 17 years in WA indicate that some barley varieties are more susceptible to damage from certain herbicides than others. The variation in tolerance may be due to differences in morphological or physiological characters and/or internal ear development stages among the varieties. The level of tolerance amongst varieties varies with the rate of herbicide, the environmental conditions when the herbicide is applied, and the stage of the crop growth. The sensitivity of important malt, food and feed barley varieties to herbicides registered for use on barley can be found in the factsheets at the end of this sowing guide. The full list of varieties tested in herbicide tolerance trials can be found at nvtonline.com.au/herbicide-tolerance.

Seasonal variability makes it essential to test herbicide and variety interaction over several seasons and locations. The risk of crop damage from a herbicide should be balanced against the potential yield loss from both the weed competition and the number of weed seeds returning to the soil seed bank. Small yield reductions due to herbicide damage in sensitive varieties may not be easily detected at the paddock level, but over larger areas can be of great economic importance.

From 2009-2015 advanced breeding lines and commercial varieties were tested for herbicide tolerance in small plot (1.6m x 1.5m) screening trials at Katanning. In those screenings trials the following herbicides (which provided consistent

damage to barley or were commonly used by WA barley growers) were tested at higher than label rates:

- Axial[®] (pinoxadin).
- Achieve[®] (tralkoxydim).
- Affinity[®] + MCPA (carfentrazone-ethyl + MCPA).
- Ally[®] (metsulfuron).
- Boxer[®] Gold (s-metolachlor + prosulfocarb).
- Broadside[®] (bromoxynil + MCPA + dicamba).
- Decision[®] (diclofop + sethoxydim) [2015].
- Diuron + MCPA (diuron + MCPA).
- Hoegrass[®] (diclofop-methyl) [2009-2014 only].
- Triflur[®] X (trifluralin).
- Triflur[®] 400 + Lexone[®] (trifluralin + metribuzin).
- Tigrex[®] (diflufenican + MCPA) [2009-2014 only].
- Triathlon[®] (diflufenican + bromoxynil + MCPA) [2015].
- 2,4-D LVE 680 (2,4-D).

Any variety by herbicide combination that caused a significant yield reduction in the screening trial was then further tested in larger plot (10m x 1m) advanced trials. In the advanced trials, the varieties were assessed against label and higher than label rates for at least two years to validate the results and to minimise seasonal influences on the herbicide tolerance responses.

Quite a few barley varieties have shown some sensitivity (yield loss) to at least one herbicide at label rate in the herbicide tolerance trials, but no barley variety tested has yet to demonstrate consistent yield loss due to herbicide application. However, Diuron + MCPA and Hoegrass[®] (diclofop-methyl) at higher than label rate consistently reduced the grain yield of Flinders and La Trobe, respectively. Of the recommended varieties, only Baudin, Hindmarsh and Lockyer have shown sensitivity to two or more herbicides at label rates.

Several of the herbicides tested have caused yield loss in two or more varieties. Growers should be cautious when using those products with new varieties. Sensitivity at label rates has been noted in at least two varieties for these products:

- Achieve® (tralkoxydim) at Z13-Z15.
- Diuron + MCPA (diuron + MCPA) at Z13-Z15.

A narrow safety margin was also noted in at least two varieties when these products were applied at above labels rates, but not at label rates:

- Ally® (metsulfuron) at Z13-Z14.
- Barrel® / Broadside® (bromoxynil + MCPA + dicamba) at Z13-Z14.
- Boxer® Gold (s-metolachlor + prosulfocarb) IBS.
- Hoegrass® (diclofop-methyl) at Z13-Z15.
- Velocity® (bromoxynil + pyrasulfotole) at Z12-Z15.

When using pre-emergent herbicides like trifluralin, Boxer® Gold (s-metolachlor + prosulfocarb) and Diuron + Dual® Gold (diuron + s-metolachlor), ensure the sown seed is placed below the herbicide treated soil band as the crop safety is mainly due to seed placement. If sowing with knife points and using higher label rates, ensure that treated soil does not get thrown, blown or washed into the furrows.

A commonly used herbicide brew of Diuron 900 (diuron) at 0.2kg/ha + Metribuzin 750 (metribuzin) at 120g/ha + TriflurX® (trifluralin) at 2L/ha + Avadex® Xtra (tri-allate) at 1L/ha was tolerated well with crop safety margin by Compass, La Trobe, Flinders and Spartacus CL during 2016 at Katanning on a loamy sand soil.

Pre-emergent split application (IBS + PSPE) and post-emergent use of Boxer Gold® (s-metolachlor + prosulfocarb) is now registered on barley for control of ryegrass. The following comments should be noted:

- Boxer Gold® (s-metolachlor + prosulfocarb) at 1.75L/ha IBS followed by 0.75L/ha PSPE caused significant yield loss in Compass on a loamy sand soil at Katanning during 2015.
- In 2015, Pre-emergent TriflurX® (trifluralin) at 3L/ha followed by Boxer Gold® (s-metolachlor + prosulfocarb) at 2.5L/ha at Z12-Z13 and Boxer Gold® (s-metolachlor + prosulfocarb) at 2.5L/ha alone applied at Z12-Z13 was tolerated well by Bass, Compass, La Trobe and Scope CL at Katanning.
- In 2016, Boxer Gold® (s-metolachlor + prosulfocarb) at 2.5L/ha applied at Z12-Z13 caused significant yield loss in Spartacus CL at Katanning, but it was tolerated well by Compass, La Trobe and Flinders.

The new herbicides Terbyne® Xtreme® (terbuthylazine) applied before seeding and Aptitude® (metribuzin + carfentrazone-ethyl) + MCPA (amine) at Z13-Z14 at the label rates were tolerated well by Bass, Compass, La Trobe and Scope CL with good crop safety margin. For crop safety, when using Terbyne® Xtreme® (terbuthylazine), target a seed depth of 3-4cm and maintain slow to moderate seeding speed to avoid leaving deep furrows and avoid throwing soil into adjacent furrows.

Terbyne® Xtreme® (terbuthylazine) at 1.2kg/ha + TriflurX® (trifluralin) at 3L/ha + Avadex® at 2L/ha (tri-allate) applied before crop seeding and Ally® (metsulfuron) at 7 g/ha + BS100 0.25% sprayed at Z13-Z14 caused significant yield loss in Spartacus CL during 2016 at Katanning, but these herbicides were tolerated well by Compass, La Trobe and Flinders.

Limited data suggests that Compass may be sensitive to Howitzer® (diflufenican + bromoxynil + MCPA) at 1L/ha and a new herbicide Talinor® (bicyclopyrone + bromoxynil) at 1.2L/ha applied at Z13-Z15. However, Flinders, La Trobe and Spartacus CL tolerated those herbicides quite well.

Phenoxy herbicides (2,4-D and MCPA) are commonly applied in barley as late post-emergence treatments and to reduce the seed set of wild radish, wild mustard, wild turnip and lupins. Application timing for phenoxy herbicides is more critical than for other herbicides. Barley is most sensitive to phenoxy herbicides at the double ridge stage of ear development (the point at which the ear first starts to form). It is critically important to correctly identify the crop development stage to avoid damaging the crop when spraying with phenoxy herbicides.

Application of phenoxy herbicides during the double ridge stage usually results in distorted or twisted heads later in the season when the heads emerge from the boot. This is normally accompanied by some missing grains in the head and these ear abnormalities could lead to grain yield losses. Double ridge usually occurs when there is between three to four leaves on the mainstem in varieties like Hindmarsh, La Trobe and Spartacus CL, three to five leaves for Scope CL and between four to five leaves in varieties like Bass, Baudin, Compass, Flinders and Granger.

The best time to apply a phenoxy herbicide is to wait until at least one leaf after the double ridge

stage and before booting. Application of phenoxy herbicides between flag leaf emergence and the soft dough stage on any barley variety can cause serious yield losses due to effects on pollen development.

It is important to remember that herbicides are only one of the tools in which we can manage weeds. Herbicides are only a useful tool when part of an integrated weed management plan (IWM). An IWM plan should include an element from each of the following five tactics:

- Tactic 1 – deplete weed seed in the target area soil seed bank.
- Tactic 2 – kill weeds (seedlings) in the target area.
- Tactic 3 – stop weed seed set.
- Tactic 4 – prevent viable weed seeds from being added to the soil seed bank.
- Tactic 5 – prevent introduction of viable weed seed from external sources.

When using herbicides to control weeds it is important to rotate between different mode-of-action groups to reduce weed numbers, stop replenishment of the seed bank and minimise the risk of developing herbicide resistant weeds.



Bass ^(b)					
Malt variety					
Comments					
Bass is a medium spring, semi-dwarf, malt barley acceptable for export as grain and as malt but not for shochu. Best suited to environments with a yield potential above 3t/ha. It has a moderate yield potential combined with good hectolitre weight, high grain plumpness and a high probability of receival as malt barley. Its grain is generally 0.5% higher in grain protein than varieties such as Baudin and La Trobe at the same yield. Can show a moderate head loss risk in the Esperance Port Zone, but not in other Port Zones. Fungicides will be required to manage NTNB, STNB, powdery mildew and barley leaf rust. As a seedling VSp to the new Skiff pathotype of NTNB. Weed competitiveness similar to other semi-dwarf varieties. Market demand exists for the malt quality profile of Bass. Target production zones in 2018 are Kwinana and Albany Port Zones.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	88	79	91	83	94
Agzone 2	80	85	89	81	94
Agzone 3	92	99	95	95	94
Agzone 4	–	81	59	84	–
Agzone 5	78	93	88	88	97
Agzone 6	92	99	93	91	97
Disease resistance		Seedling		Adult	
Scald		–		MRMS	
NTNB (Beecher virulent)		MR		MRMS	
NTNB (Beecher avirulent)		S		MSS	
NTNB (Skiff virulent)		VSp		–	
STNB		MRMS		S	
Powdery mildew		MSS		MS	
Leaf rust (5457P-)		SVS		SVS	
BYD and CYD		MS		MS	
RLN (<i>P. neglectus</i>)		MSS		MSS	
RLN (<i>P. quasitereoides</i>)		MS		MS	
CCN		S		S	
Crown rot		High yield loss (>20%)			
Flowering (days to Z49)	rel. Scope CL		rel. Hindmarsh		
late April	-6 to -4		+4 to +7		
late May	-3 to -2		+4 to +6		
early July	0 to +1		+7 to +8		
Agronomic traits					
Coleoptile length		Medium			
Target plant density		150-180 plants/m ²			
Plant height		Short			
Straw strength		Very good			
Head loss risk		Medium			
Herbicide tolerance					
Has shown no sensitivity to a range of herbicides / herbicide mixtures at label rates in herbicide tolerance trials conducted in WA.					
Variety information					
Pedigree		WABAR2023/Alexis			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$3.50			

Baudin ^(b)					
Malt variety					
Comments					
Baudin is a medium spring, semi-dwarf, malt barley that is acceptable for export as grain, as malt and as a shochu barley. Baudin is still the 'market leader' for the Chinese, south-east Asian and Japanese brewing markets. Best suited to environments with a yield potential above 3t/ha and where leaf diseases can be promptly sprayed before they reach 5% of leaf area affected. When growing Baudin, an integrated disease management plan needs to be implemented as it is susceptible to NTNB (including the Skiff pathotype), STNB, powdery mildew and barley leaf rust. Vigorous Baudin crops have reasonable weed competitiveness despite their short height. Target production zone in 2018 is the Esperance Port Zone, whilst niche segregations may be available in Kwinana-West and Albany-North.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	92	94	92	81	96
Agzone 2	85	88	90	77	105
Agzone 3	90	90	88	78	92
Agzone 4	–	86	45	79	–
Agzone 5	78	93	89	76	99
Agzone 6	97	77	101	88	92
Disease resistance		Seedling		Adult	
Scald		–		MSS	
NTNB (Beecher virulent)		S		S	
NTNB (Beecher avirulent)		S		S	
NTNB (Skiff virulent)		Sp		–	
STNB		MRMS		MSS	
Powdery mildew		VS		VS	
Leaf rust (5457P-)		SVS		SVS	
BYD and CYD		MRMS		MRMS	
RLN (<i>P. neglectus</i>)		MSS		MSS	
RLN (<i>P. quasitereoides</i>)		S		S	
CCN		S		S	
Crown rot		Moderate yield		loss (10-20%)	
Flowering (days to Z49)	rel. Scope CL		rel. Hindmarsh		
late April	+3 to +5		+12 to +17		
late May	+2 to +3		+9 to +11		
early July	-4 to -2		+3 to +4		
Agronomic traits					
Coleoptile length		Medium			
Target plant density		110-130 plants/m ²			
Plant height		Short			
Straw strength		Very good			
Head loss risk		Low			
Herbicide tolerance					
May be sensitive to label rate applications of Paragon [®] (picolinafen + MCPA) and Tigrex [®] (diflufenican + MCPA) sprayed at Z13-Z14.					
Variety information					
Pedigree		Stirling/Franklin			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$3.00 - malt/\$1.00 - feed			

Flinders ^(b)					
Malt variety					
Comments					
Flinders is a medium spring, semi-dwarf, malt barley derived from Baudin with improved powdery mildew (non- <i>m/o</i>) and barley leaf rust (due to APR, <i>Rph20</i>) resistance. Flinders is being assessed for export as grain and as malt, with positive feedback to date. Best suited to environments with a yield potential above 3t/ha. Flinders is a higher yielding option than La Trobe in environments with a potential above 5t/ha (for example Agzone 6). Grain plumpness of Flinders is an improvement over Baudin, La Trobe and Scope CL with a grain brightness between Bass and Baudin. Fungicides will be required to manage NTNB and STNB. As a seedling it is <i>Sp</i> to the new Skiff pathotype of NTNB. Whilst Flinders has APR for leaf rust, it is late acting meaning that Flinders crops will still require treatment for rust. Weed competitiveness is similar to other semi-dwarf varieties. Target production zones in 2018 are Kwinana-West, Albany and Esperance Port Zones.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	93	105	93	94	–
Agzone 2	94	102	96	93	105
Agzone 3	94	97	97	98	102
Agzone 4	–	93	59	90	–
Agzone 5	83	102	94	90	–
Agzone 6	108	107	110	101	108
Disease resistance		Seedling		Adult	
Scald		–		MSS	
NTNB (Beecher virulent)		MRMS		MS	
NTNB (Beecher avirulent)		S		MS	
NTNB (Skiff virulent)		<i>Sp</i>		–	
STNB		MS		S	
Powdery mildew		R		R	
Leaf rust (5457P-)		S		MRMS (APR)	
BYD and CYD		MRMS		MRMS	
RLN (<i>P. neglectus</i>)		MS <i>Sp</i>		MS <i>Sp</i>	
RLN (<i>P. quasitereoides</i>)		MSS		MSS	
CCN		S		S	
Crown rot		High yield loss (>20%)			
Flowering (days to Z49)	rel. Scope CL	rel. Hindmarsh			
late April	-3 to 0	+7 to +9			
late May	0 to +2	+8 to +10			
early July	+2 to +3	+8 to +10			
Agronomic traits					
Coleoptile length		Short			
Target plant density		150-180 plants/m ²			
Plant height		Short			
Straw strength		Very good			
Head loss risk		Low			
Herbicide tolerance					
May be sensitive to a label rate application of Achieve® (tralkoxydim) sprayed at Z13-Z15					
Variety information					
Pedigree		Baudin/Cooper			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$3.80			

Granger ^(b)					
Malt variety					
Comments					
Granger is a medium spring, semi-dwarf, malt variety being assessed for export as grain but not as malt or for shochu. A shipment of Granger grain to international customers will occur during 2017. Best suited to environments with a yield potential above 3t/ha. Granger is a higher yielding option than La Trobe in environments with a potential above 5t/ha (for example Agzone 6). Granger appears to be sensitive to frost during flowering and grain filling. Granger's grain is plumper than that of Baudin, but not as plump as Bass. Grain brightness is expected to be an issue in coastal areas as it has a naturally darker kernel than other malt varieties. Fungicides will be required to manage scald, STNB and early infections of barley leaf rust. As a seedling it is MRMSp to the new Skiff pathotype of NTNB. Has durable resistance to powdery mildew (<i>mlo</i> resistance). Target production zones in 2018 are Albany and Esperance Port Zones.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	84	104	90	94	–
Agzone 2	92	104	95	94	101
Agzone 3	92	97	99	102	103
Agzone 4	–	89	54	90	–
Agzone 5	78	102	93	91	118
Agzone 6	110	118	112	106	114
Disease resistance		Seedling		Adult	
Scald		–		S	
NTNB (Beecher virulent)		MS		MS	
NTNB (Beecher avirulent)		MS		MRMS	
NTNB (Skiff virulent)		MRMSp		–	
STNB		S		SVS	
Powdery mildew		R		R	
Leaf rust (5457P-)		MSS		R (APR)	
BYD and CYD		MS		MS	
RLN (<i>P. neglectus</i>)		MS		MS	
RLN (<i>P. quasitereoides</i>)		MSS		MSS	
CCN		R		R	
Crown rot		High yield loss (>20%)			
Flowering (days to Z49)		rel. Scope CL		rel. Hindmarsh	
late April		-2 to +2		+7 to +13	
late May		-2 to 0		+6 to +8	
early July		+1 to +3		+7 to +9	
Agronomic traits					
Coleoptile length		Medium			
Target plant density		110-130 plants/m ²			
Plant height		Medium			
Straw strength		Good			
Head loss risk		Low			
Herbicide tolerance					
Has shown no sensitivity to a range of herbicides / herbicide mixtures at label rates in herbicide tolerance trials conducted in WA.					
Variety information					
Pedigree		Braemar/Adonis			
Breeder / Seed licensee		Limagrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$2.95			

La Trobe [Ⓛ]					
Malt variety					
Comments					
La Trobe is an early spring, semi-dwarf, CCN resistant, malt barley. It is suitable for export as grain, as malt and for use in the manufacture of shochu in Japan. La Trobe replaces Hindmarsh as its agronomic performance is almost identical to Hindmarsh. La Trobe is the most yield responsive malt variety to nitrogen. Whilst the National Frost Initiative trials suggest La Trobe is sensitive to flowering frost, it appears to yield similarly to other varieties when frosted. Every La Trobe seed should be treated with a good quality smuticide before sowing. Fungicides will be required to manage STNB and barley leaf rust. As a seedling it is <i>Sp</i> to the new Skiff pathotype of NTNB. Do not ruin the integrity of La Trobe malt stacks by contaminating them with Hindmarsh or Spartacus CL barley. Target production zones in 2018 are Geraldton, Kwinana, Albany and Esperance Port Zones.					
Yield (% Scope CL)	2012	2013	2014	2015	2016
Agzone 1	97	103	110	108	101
Agzone 2	110	106	116	113	94
Agzone 3	105	109	113	116	103
Agzone 4	–	112	140	113	–
Agzone 5	120	110	116	123	103
Agzone 6	105	128	110	117	109
Disease resistance		Seedling		Adult	
Scald		–		MR	
NTNB (Beecher virulent)		MS		MS	
NTNB (Beecher avirulent)		MRMS		MRMS	
NTNB (Skiff virulent)		<i>Sp</i>		–	
STNB		S		SVS	
Powdery mildew		MS		MRMS	
Leaf rust (5457P-)		MS		S	
BYD and CYD		S		S	
RLN (<i>P. neglectus</i>)		MS		MS	
RLN (<i>P. quasitereoides</i>)		MSS		MSS	
CCN		R		R	
Crown rot		Moderate yield loss (10-20%)			
Flowering (days to Z49)	rel. Scope CL	rel. Hindmarsh			
late April	-12 to -7	0 to +1			
late May	-8 to -7	0 to +1			
early July	-7 to -5	0 to +1			
Agronomic traits					
Coleoptile length		Short			
Target plant density		150-180 plants/m ²			
Plant height		Medium			
Straw strength		Moderately good			
Head loss risk		Medium			
Herbicide tolerance					
May be sensitive to a label rate application of Diuron + MCPA (diuron + MCPA) sprayed at Z13-Z14.					
Variety information					
Pedigree		Dash/VB9409			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$4.00			

Scope CL [Ⓛ]					
Malt variety					
Comments					
Scope CL is a medium spring, tall height, malt variety suitable for export as grain and as malt but not for shochu. Scope CL is best suited to environments where brome and barley grass are a problem or where there is imidazolinone residues. Fungicides will be required to manage STNB and barley leaf rust. As a seedling, <i>Sp</i> to the new Skiff pathotype of NTNB. It should be harvested when ripe due to a high head loss risk. Scope CL is registered for use with the imidazolinone chemistry herbicides Intervix® and Sentry®. Do not use other imidazolinone herbicides on Scope CL. Do not ruin the integrity of Scope CL malt stacks by contaminating them with Buloke barley. Target production zones in 2018 are Geraldton, Kwinana and Albany Port Zones.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	103	97	91	93	99
Agzone 2	91	94	86	88	106
Agzone 3	95	91	89	86	97
Agzone 4	—	89	72	88	—
Agzone 5	83	91	86	81	97
Agzone 6	95	78	91	86	92
Disease resistance		Seedling		Adult	
Scald		—		MS	
NTNB (Beecher virulent)		MR		MRMS	
NTNB (Beecher avirulent)		MR		MRMS	
NTNB (Skiff virulent)		<i>Sp</i>		—	
STNB		MS		S	
Powdery mildew		R		R	
Leaf rust (5457P-)		S		S	
BYD and CYD		MS		MS	
RLN (<i>P. neglectus</i>)		MSS		MSS	
RLN (<i>P. quasitereoides</i>)		MS		MS	
CCN		S		S	
Crown rot		High yield loss (>20%)			
Flowering (days to Z49)	rel. Baudin	rel. Hindmarsh			
late April	-5 to -3	+8 to +12			
late May	-3 to -2	+7 to +8			
early July	+2 to +4	+6 to +7			
Agronomic traits					
Coleoptile length		Short			
Target plant density		110-130 plants/m ²			
Plant height		Tall			
Straw strength		Fair			
Head loss risk		High			
Herbicide tolerance					
Has shown no sensitivity to a range of herbicides / herbicide mixtures at label rates in herbicide tolerance trials conducted in WA.					
Variety information					
Pedigree		Franklin/VB9104//VB9104			
Breeder / Seed licensee		AgVic Services / SeedNet			
Access to seed		SeedNet			
EPR (\$/t, excl GST)		\$3.50			

Compass ^(b)					
Stage 2 Malt Accreditation					
Comments					
New medium spring, medium height, CCN resistant, feed barley derived from Commander, but with a higher yield potential. Best suited to environments with a yield potential below 4t/ha. Compass has a similar grain yield potential to Hindmarsh, La Trobe and Spartacus CL in Western Australia. Compass is susceptible to lodging, particularly in high yielding situations. Fungicides will be required to manage barley leaf rust. As a seedling it is SVSp to the new Skiff pathotype of NTNB. Compass is one of the more weed competitive barley varieties. Passed Stage 1, now undergoing Stage 2 of Barley Australia testing in 2017 with malt accreditation possible in March 2018.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	118	107	98	103	109
Agzone 2	104	103	97	102	109
Agzone 3	105	102	99	104	105
Agzone 4	–	103	94	100	–
Agzone 5	98	103	100	98	99
Agzone 6	104	97	101	93	102
Disease resistance		Seedling		Adult	
Scald		–		MS	
NTNB (Beecher virulent)		MRMS		MRMS	
NTNB (Beecher avirulent)		S		MS	
NTNB (Skiff virulent)		SVSp		–	
STNB		MRMS		MSS	
Powdery mildew		MS		MRMS	
Leaf rust (5457P-)		S		S	
BYD and CYD		MSS		MSS	
RLN (<i>P. neglectus</i>)		–		–	
RLN (<i>P. quasitereoides</i>)		MSS		MSS	
CCN		R		R	
Crown rot		High yield loss (>20%)			
Flowering (days to Z49)	rel. Scope CL		rel. Hindmarsh		
late April	-4 to -5		+2 to +5		
late May	-6 to -4		+2 to +4		
early July	-2 to -1		+5 to +7		
Agronomic traits					
Coleoptile length		Medium			
Target plant density		180-220 plants/m ²			
Plant height		Medium			
Straw strength		Fair			
Head loss risk		Medium			
Herbicide tolerance					
May be sensitive to label rate split application of Boxer Gold® (s-metolachlor + prosulfocarb) at 1.75L/ha IBS and 0.75L/ha PSPE, Talinor® (bicyclopyrone + bromoxynil) at 1.2L/ha sprayed at Z13-Z15 and label rate application of Howitzer® (diflufenican + bromoxynil + MCPA) sprayed at Z13-Z15.					
Variety information					
Pedigree		County/Commander//Commander			
Breeder / Seed licensee		University of Adelaide / SeedNet			
Access to seed		SeedNet			
EPR (\$/t. excl GST)		\$3.80			

Spartacus CL ^(b)					
Stage 2 Malt Accreditation					
Comments					
Spartacus CL (tested as IGB1334T) is a new early spring, imidazolinone tolerant feed barley. It is agronomically similar to La Trobe but lacks the red anthocyanin pigmentation present in Hindmarsh and La Trobe plants. Has a similar grain yield to Compass, Hindmarsh and La Trobe and is higher yielding than Scope CL in WA. Spartacus CL is registered for use with the imidazolinone chemistry herbicides Intervix [®] and Sentry [®] . Do not ruin the integrity of La Trobe malt or Hindmarsh food stacks by contaminating them with Spartacus CL barley. Every seed should be treated with a good quality smuticide before sowing. Fungicides will be required to manage STNB and barley leaf rust. As a seedling it is Sp to the new Skiff pathotype of NTNB. Passed Stage 1, now in Stage 2 of Barley Australia testing in 2017 with malt accreditation possible in March 2018.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	–	–	101	104	98
Agzone 2	–	–	101	104	98
Agzone 3	–	–	102	100	100
Agzone 4	–	–	112	104	–
Agzone 5	–	–	101	103	102
Agzone 6	–	–	99	103	100
Disease resistance		Seedling		Adult	
Scald		–		RMR	
NTNB (Beecher virulent)		MSS		MR	
NTNB (Beecher avirulent)		MSS		MRMS	
NTNB (Skiff virulent)		Sp		–	
STNB		SVS		S	
Powdery mildew		MS		MR	
Leaf rust (5457P-)		MS		S	
BYD and CYD		S		S	
RLN (<i>P. neglectus</i>)		–		–	
RLN (<i>P. quasitereoides</i>)		–		–	
CCN		R		R	
Crown rot		Moderate yield		loss (10-20%)	
Flowering (days to Z49)	rel. Scope CL		rel. Hindmarsh		
late April	-12 to -7		-1 to +1		
late May	-9 to -7		-2 to 0		
early July	-7 to -5		0 to +1		
Agronomic traits					
Coleoptile length		Short			
Target plant density		180-220 plants/m ²			
Plant height		Medium			
Straw strength		Good			
Head loss risk		Low			
Herbicide tolerance					
May be sensitive to a label rate application of Terbyne [®] Xtreme [®] + Triflur [®] X + Avadex [®] (terbuthylazine + trifluralin + tri-alleate) sprayed before crop seeding, Boxer Gold [®] sprayed at Z12-Z13 and Ally [®] sprayed at Z13-Z14.					
Variety information					
Pedigree		Scope/4*Hindmarsh//HMBV0325-106			
Breeder / Seed licensee		InterGrain / Syngenta			
Access to seed		Syngenta			
EPR (\$/t, excl GST)		\$4.25			

Fathom [Ⓛ]					
Feed variety					
Comments					
Medium spring, tall height, CCN resistant feed barley. Best suited to environments with a yield potential below 3t/ha and where there is a high risk of STNB. Similar to or slightly below the grain yield of Compass, Hindmarsh, La Trobe and Spartacus CL. Fungicides will be required to manage early infections of NTNB and barley leaf rust. As a seedling it is VSp to the new Skiff pathotype of NTNB. Fathom has the highest level of resistance to STNB of current varieties. It is mixed for its head colour, having green and waxy green heads. Fathom is one of the more weed competitive barley varieties being similar to Compass in Eastern states trials.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	118	101	96	94	109
Agzone 2	97	96	94	92	110
Agzone 3	102	101	95	97	101
Agzone 4	–	97	75	92	–
Agzone 5	91	100	97	91	95
Agzone 6	100	88	100	88	98
Disease resistance		Seedling		Adult	
Scald		–		MR	
NTNB (Beecher virulent)		MSS		MSS	
NTNB (Beecher avirulent)		S		MSS	
NTNB (Skiff virulent)		VSp		–	
STNB		MR		MRMS	
Powdery mildew		MS		MS	
Leaf rust (5457P-)		S		R (late APR)	
BYD and CYD		MRMS		MRMS	
RLN (<i>P. neglectus</i>)		MSp		MSp	
RLN (<i>P. quasitereoides</i>)		MSSp		MSSp	
CCN		R		R	
Crown rot		Moderate yield loss (10-20%)			
Flowering (days to Z49)		rel. Scope CL		rel. Hindmarsh	
late April		-3 to +1		+7 to +12	
late May		-3 to -2		+5 to +6	
early July		-6 to -4		0 to +2	
Agronomic traits					
Coleoptile length		Medium			
Target plant density		180-220 plants/m ²			
Plant height		Tall			
Straw strength		Fair			
Head loss risk		Low			
Herbicide tolerance					
May be sensitive to a label rate application of Diuron + MCPA (diuron + MCPA) sprayed at Z13-Z14.					
Variety information					
Pedigree		JE013D-020/WI3806-1			
Breeder / Seed licensee		University of Adelaide / SeedNet			
Access to seed		SeedNet			
EPR (\$/t, excl GST)		\$2.00			

LG Maltstar [Ⓛ]					
Feed variety					
Comments					
LG Maltstar (tested as SMBA11-1771) is a medium spring, medium height, semi-dwarf barley from the same breeding company as Granger and Oxford. LG Maltstar is reported to be a white aleurone variety unlike one of its parents Henley which has a blue aleurone. Like Granger, LG Maltstar carries the <i>mlo</i> gene (conferring resistance to powdery mildew) and the APR barley leaf rust gene <i>Rph20</i> . Fungicides will be required to manage scald, STNB and early infections of barley leaf rust. LG Maltstar has shown variable reactions in WA disease nurseries to barley leaf rust despite carrying the APR gene <i>Rph20</i> . As a seedling it is MSp to the new Skiff pathotype of NTNB. In 2017 LG Maltstar was accepted into malt accreditation trials with Barley Australia and will enter Stage 1 in 2018. The earliest possible accreditation date is autumn 2020.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	—	—	—	—	—
Agzone 2	86	98	95	86	100
Agzone 3	89	96	97	96	99
Agzone 4	—	85	—	—	—
Agzone 5	73	100	92	87	117
Agzone 6	108	114	114	105	111
Disease resistance		Seedling		Adult	
Scald		—		SVS	
NTNB (Beecher virulent)		MRMS		MSS	
NTNB (Beecher avirulent)		RMR		MRMS	
NTNB (Skiff virulent)		MSp		—	
STNB		MSS		SVS	
Powdery mildew		R		R	
Leaf rust (5457P-)		S		MSp	
BYD and CYD		MRMS		MRMS	
RLN (<i>P. neglectus</i>)		—		—	
RLN (<i>P. quasitereoides</i>)		—		—	
CCN		—		—	
Crown rot		—		—	
Flowering (days to Z49)		rel. Scope CL		rel. Hindmarsh	
late April		—		—	
late May		0 to +2		+8 to +9	
early July		+2 to +4		+9 to +10	
Agronomic traits					
Coleoptile length		—			
Target plant density		180-220 plants/m ²			
Plant height		Short			
Straw strength		—			
Head loss risk		—			
Herbicide tolerance					
Has not been tested for its sensitivity to label rate applications of herbicides registered for use in Western Australia.					
Variety information					
Pedigree		Henley/Sebastian			
Breeder / Seed licensee		Limagrain / Elders			
Access to seed		Elders			
EPR (\$/t, excl GST)		\$3.00			

Litmus ^{db}					
Feed variety					
Comments					
Early spring, tall height, feed barley with improved tolerance to low soil pH and high soil Al. Best suited to environments with a yield potential below 2t/ha where the sub-soil (10-30cm) has a pH _{Ca} below 4.8. Carries <i>Alt1</i> gene which allows its roots to excrete citrate reducing the toxicity of Al in the soil, resulting in increased grain yield relative to traditional barley varieties on acidic soils. Litmus provides growers with an option to diversify their wheat phase on acidic soils, but does not ameliorate the soil as lime is required to ameliorate soil with a low pH. Litmus has poor straw strength, is susceptible to all leaf diseases, but has the lowest yield loss in the presence of crown rot. As a seedling it is <i>Sp</i> to the new Skiff pathotype of NTNB. Litmus has been submitted to Barley Australia for evaluation as a malt barley but due to the presence of blue aleurone in its grain its future is uncertain.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	117	111	82	115	104
Agzone 2	100	108	75	105	113
Agzone 3	101	87	86	91	107
Agzone 4	–	92	97	98	–
Agzone 5	81	86	74	79	101
Agzone 6	96	73	74	79	95
Disease resistance		Seedling		Adult	
Scald		–		SVS	
NTNB (Beecher virulent)		S		S	
NTNB (Beecher avirulent)		S		S	
NTNB (Skiff virulent)		<i>Sp</i>		–	
STNB		S		S	
Powdery mildew		MS		MRMS	
Leaf rust (5457P-)		S		S	
BYD and CYD		S		S	
RLN (<i>P. neglectus</i>)		–		–	
RLN (<i>P. quasitereoides</i>)		–		–	
CCN		MS		MS	
Crown rot		Low yield loss (<10%)			
Flowering (days to Z49)	rel. Scope CL	rel. Hindmarsh			
late April	-15 to -10	-4 to -1			
late May	-11 to -8	-3 to 0			
early July	-8 to -6	-1 to +1			
Agronomic traits					
Coleoptile length		Short			
Target plant density		180-220 plants/m ²			
Plant height		Tall			
Straw strength		Fair			
Head loss risk		Medium			
Herbicide tolerance					
Has shown no sensitivity to a range of herbicides / herbicide mixtures at label rates in herbicide tolerance trials conducted in WA.					
Variety information					
Pedigree		WB229/2*Baudin//WABAR2238			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$3.80			

Lockyer ^(b)						
Feed variety						
Comments						
Longer seasoned, semi-dwarf, short height, high yielding, feed barley. Best suited to environments with a yield potential above 3t/ha. Lockyer is higher yielding than Compass, Hindmarsh and La Trobe in Agzone 6 and in environments with a yield potential above 4t/ha. Rosalind out-yields Lockyer in all Agzones except Agzone 6. Relative to Oxford, Lockyer can maintain its grain yield as seeding is delayed into June and July. With April planting, Lockyer has one of the longest durations to awn peep of commercial varieties. Fungicides will be required to manage STNB and barley leaf rust. As a seedling it is <i>Sp</i> to the new Skiff pathotype of NTNB. Weed competitiveness not tested.						
Yield (% La Trobe)	2012	2013	2014	2015	2016	
Agzone 1	113	113	97	91	–	
Agzone 2	101	100	100	91	–	
Agzone 3	99	98	95	94	–	
Agzone 4	–	101	55	89	–	
Agzone 5	88	106	103	89	105	
Agzone 6	111	92	118	95	104	
Disease resistance		Seedling		Adult		
Scald		–		MRMS		
NTNB (Beecher virulent)		MR		MS		
NTNB (Beecher avirulent)		MR		MRMS		
NTNB (Skiff virulent)		<i>Sp</i>		–		
STNB		S		S		
Powdery mildew		MS		MRMS		
Leaf rust (5457P-)		S		S		
BYD and CYD		MSS		MSS		
RLN (<i>P. neglectus</i>)		–		–		
RLN (<i>P. quasitereoides</i>)		–		–		
CCN		–		–		
Crown rot		–		–		
Flowering (days to Z49)		rel. Scope CL		rel. Hindmarsh		
late April		+3 to +5		+13 to +15		
late May		+2 to +4		+10 to +11		
early July		-1 to 0		+5 to +6		
Agronomic traits						
Coleoptile length		Medium				
Target plant density		180-220 plants/m ²				
Plant height		Short				
Straw strength		Moderately good				
Head loss risk		Low				
Herbicide tolerance						
May be sensitive to label rate applications of Achieve [®] (tralkoxydim), Eclipse [®] + MCPA LVE (metosulam + MCPA) and Hoegrass [®] (diclofop-methyl) sprayed at Z13-Z14 and to 2,4-D Amine 625 sprayed at Z15-Z16.						
Variety information						
Pedigree		Tantangara/VB9104				
Breeder / Seed licensee		InterGrain				
Access to seed		Free to trade				
EPR (\$/t, excl GST)		\$1.50				

Mundah					
Feed variety					
Comments					
Very early spring, medium height, feed barley. Best suited to environments with a yield potential below 2t/ha and later sowing systems where early season weed control is necessary. Mundah is now outclassed by Fathom, Spartacus CL and Rosalind. Lower yielding than all the newer feed varieties including Compass, Fathom, Lockyer, Roe and Rosalind. Mundah can suffer from severe head loss and lodging. Fungicides required to manage scald, NTNB (Beecher virulent), STNB, powdery mildew and barley leaf rust. As a seedling it is <i>Sp</i> to the new Skiff pathotype of NTNB. Mundah is one of the more weed competitive barley varieties.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	105	95	87	105	–
Agzone 2	92	97	78	95	–
Agzone 3	97	88	87	86	–
Agzone 4	–	87	99	95	–
Agzone 5	85	83	76	81	–
Agzone 6	88	70	71	80	–
Disease resistance		Seedling		Adult	
Scald		–		S	
NTNB (Beecher virulent)		S		S	
NTNB (Beecher avirulent)		MS		MS	
NTNB (Skiff virulent)		<i>Sp</i>		–	
STNB		S		S	
Powdery mildew		SVS		MSS	
Leaf rust (5457P-)		S		S	
BYD and CYD		MS		MS	
RLN (<i>P. neglectus</i>)		–		–	
RLN (<i>P. quasitereoides</i>)		MRMS_{Sp}		MRMS_{Sp}	
CCN		S		S	
Crown rot		Moderate yield loss (10-20%)			
Flowering (days to Z49)	rel. Scope CL	rel. Hindmarsh			
late April	-19 to -17	-10 to -7			
late May	-15 to -13	-8 to -5			
early July	-9 to -6	-2 to 0			
Agronomic traits					
Coleoptile length		Medium			
Target plant density		180-220 plants/m ²			
Plant height		Medium			
Straw strength		Fair			
Head loss risk		Medium			
Herbicide tolerance					
May be sensitive to a label rate application of Wildcat [®] (fenoxaprop-P-ethyl) sprayed at Z13-Z14.					
Variety information					
Pedigree		Yagan/O'Connor			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		No EPR payable			

Oxford					
Feed variety					
Comments					
Long seasoned, semi-dwarf, short height, feed barley. Best suited to environments with a yield potential above 4t/ha (for example Agzone 6). Oxford performs best with late April or early May planting but its yield potential falls rapidly as seeding is delayed. In those situations Oxford is often higher yielding than Compass, Hindmarsh and La Trobe. Rosalind out-yields Oxford in all Agzones except Agzone 6. Oxford appears to be sensitive to flowering frost. Fungicides will be required to manage STNB and early season barley leaf rust. There is evidence of increasing virulence of NTNB and powdery mildew on Oxford barley, mainly on the south coast. Growers should collect infected NTNB and powdery mildew leaf samples from unsprayed crops and send to DPIRD for pathotyping. As a seedling it is SVSp to the new Skiff pathotype of NTNB. Weed competitiveness is similar to other semi-dwarf varieties.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	80	105	90	83	99
Agzone 2	88	99	99	84	–
Agzone 3	88	97	98	96	100
Agzone 4	–	87	22	80	–
Agzone 5	70	105	96	86	–
Agzone 6	114	117	126	107	115
Disease resistance		Seedling		Adult	
Scald		–		MS	
NTNB (Beecher virulent)		RMR		MRMS	
NTNB (Beecher avirulent)		MR		MRMS	
NTNB (Skiff virulent)		SVSp		–	
STNB		S		S	
Powdery mildew		R*		R*	
Leaf rust (5457P-)		S		MR (APR)	
BYD and CYD		MRMS		MRMS	
RLN (<i>P. neglectus</i>)		–		–	
RLN (<i>P. quasitereoides</i>)		–		–	
CCN		S		S	
Crown rot		–		–	
Flowering (days to Z49)	rel. Scope CL		rel. Hindmarsh		
late April	-1 to +3		+9 to +13		
late May	+2 to +3		+10 to +11		
early July	+2 to +4		+9 to +10		
Agronomic traits					
Coleoptile length		Medium			
Target plant density		180-220 plants/m ²			
Plant height		Short			
Straw strength		Very good			
Head loss risk		Low			
Herbicide tolerance					
Has shown no sensitivity to a range of herbicides / herbicide mixtures at label rates in herbicide tolerance trials conducted in WA.					
Variety information					
Pedigree		Tavern/Chime			
Breeder / Seed licensee		Limagrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$2.50			

RGT Planet ^(b)					
Feed variety					
Comments					
RGT Planet (tested as SFR85-014) is a direct introduction from Europe and was bred by RAGT Semences. 2016 was the first year that RGT Planet was grown in WA. Should the results from 2016 be repeated in subsequent years then RGT Planet is likely to be a new yield benchmark for barley in WA. Until there are more years and locations of data available, growers and consultants should exercise caution in reading too much into the 2016 NVT results. Carries <i>m/o</i> gene, conferring resistance to powdery mildew and APR to barley leaf rust. Fungicides will be required to manage STNB and early infections of barley leaf rust. As a seedling it is <i>MSp</i> to the new Skiff pathotype of NTNB. RGT Planet has been accepted by Barley Australia for inclusion in their malting and brewing accreditation process and is currently being evaluated in Stage 1 in 2017. Subject to successful completion of Stage 1 and the availability of grain suitable for evaluation RGT Planet will enter Stage 2 in 2018. The earliest possible accreditation date is March 2019.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	–	–	–	–	105
Agzone 2	–	–	–	–	107
Agzone 3	–	–	–	–	110
Agzone 4	–	–	–	–	–
Agzone 5	–	–	–	–	128
Agzone 6	–	–	–	–	130
Disease resistance		Seedling		Adult	
Scald		–		RMR	
NTNB (Beecher virulent)		MRMSp		–	
NTNB (Beecher avirulent)		MRMSp		MRMSp	
NTNB (Skiff virulent)		MSp		–	
STNB		S		SVS	
Powdery mildew		R		R	
Leaf rust (5457P-)		Sp		Rp (late APR)	
BYD and CYD		MRMSp		MSS	
RLN (<i>P. neglectus</i>)		–		MS	
RLN (<i>P. quasitereoides</i>)		–		S	
CCN		–		–	
Crown rot		–		–	
Flowering (days to Z49)		rel. Scope CL		rel. Hindmarsh	
late April		–		–	
late May		–		–	
early July		–		–	
Agronomic traits					
Coleoptile length		–			
Target plant density		180-220 plants/m ²			
Plant height		Medium			
Straw strength		–			
Head loss risk		–			
Herbicide tolerance					
Has not been tested for its sensitivity to label rate applications of herbicides registered for use in Western Australia.					
Variety information					
Pedigree		Tamtam/Concerto			
Breeder / Seed licensee		RAGT Semences / Seed Force			
Access to seed		Seed Force			
EPR (\$/t, excl GST)		\$4.00			

Rosalind ^(b)					
Feed variety					
Comments					
Rosalind (tested as IGB1302) is a new medium spring, medium height, CCN resistant, feed barley derived from Dash and Lockyer with a high grain yield potential. Suited to all environments where there is a low probability of delivering malt grade barley. Rosalind, first tested in NVT in 2014, is a yield benchmark for barley in WA, out-yielding La Trobe by 2-14% depending on year and Agzone. Has good straw strength and head retention. Fungicides will be required to manage STNB. There is evidence of increased virulence of NTNB on Rosalind barley growing on the south coast and as a seedling is rated as SVSp to the new Skiff pathotype of NTNB. Based on its plant architecture (particularly larger leaf size) Rosalind is expected to have a good level of weed competitiveness, but it has not been tested.					
Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	–	–	102	113	108
Agzone 2	–	–	107	114	110
Agzone 3	–	–	104	106	109
Agzone 4	–	–	110	110	–
Agzone 5	–	–	106	105	114
Agzone 6	–	–	113	108	110
Disease resistance		Seedling		Adult	
Scald		–		MS	
NTNB (Beecher virulent)		MR		MS	
NTNB (Beecher avirulent)		MR		MR	
NTNB (Skiff virulent)		SVSp		–	
STNB		MS		S	
Powdery mildew		MS		MS	
Leaf rust (5457P-)		MRMS		MR	
BYD and CYD		MSS		MSS	
RLN (<i>P. neglectus</i>)		–		–	
RLN (<i>P. quasitereoides</i>)		–		–	
CCN		R		R	
Crown rot		Moderate yield loss (10-20%)			
Flowering (days to Z49)	rel. Scope CL	rel. Hindmarsh			
late April	-12 to -7	-2 to +2			
late May	-9 to -3	-2 to +2			
early July	-5 to -3	-1 to +2			
Agronomic traits					
Coleoptile length		Short			
Target plant density		180-220 plants/m ²			
Plant height		Medium			
Straw strength		Good			
Head loss risk		Low			
Herbicide tolerance					
Showed no sensitivity to a range of herbicides / herbicide mixtures at label rates in a herbicide tolerance trial conducted in WA during 2015.					
Variety information					
Pedigree		Lockyer/Dash			
Breeder / Seed licensee		InterGrain			
Access to seed		Free to trade			
EPR (\$/t, excl GST)		\$3.50			

Yagan

Feed variety

Comments

Very early spring, medium height, feed barley. Best suited to environments with a yield potential below 2t/ha or in weed management situations for late sowing or short seasons. Reaches awn peep 12-16 days earlier than Mundah and 14-20 days earlier than Hindmarsh with late May sowing. As Yagan has not been sown in NVT trials since 2003, there is no current NVT MET data available. Results from DPIRD barley agronomy time of sowing trials suggest that Fleet, Hindmarsh and Lockyer are all higher yielding than Yagan. Hindmarsh also has improved hectolitre weight and grain brightness relative to Yagan. Fungicides may be required to manage scald, STNB and barley leaf rust. Weed competitiveness not tested.

Yield (% La Trobe)	2012	2013	2014	2015	2016
Agzone 1	—	—	—	—	—
Agzone 2	—	—	—	—	—
Agzone 3	—	—	—	—	—
Agzone 4	—	—	—	—	—
Agzone 5	—	—	—	—	—
Agzone 6	—	—	—	—	—

Disease resistance	Seedling	Adult
Scald	—	VS
NTNB (Beecher virulent)	MRMS	MSS
NTNB (Beecher avirulent)	MRMS	MRMS
STNB	MRMS	S
Powdery mildew	MRMS	MS
Leaf rust (5457P-)	S	S
BYD and CYD	S	S
RLN (<i>P. neglectus</i>)	—	—
RLN (<i>P. quasitereoides</i>)	—	—
CCN	S	S
Crown rot	—	—

Flowering (days to Z49)	rel. Scope CL	rel. Hindmarsh
late April	-33 to -29	-22 to -16
late May	-26 to -21	-20 to -14
early July	-16 to -12	-11 to -7

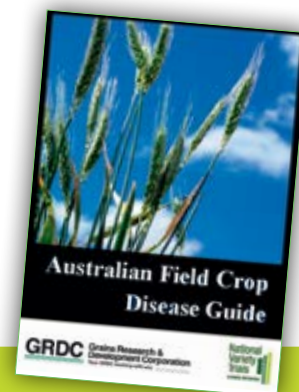
Agronomic traits	
Coleoptile length	Medium
Target plant density	180-220 plants/m ²
Plant height	Medium
Straw strength	Fair
Head loss risk	Medium

Herbicide tolerance
May be sensitive to a label rate application of Eclipse [®] (metosulam + MCPA) and Glean [®] (chlorsulfuron) sprayed at Z13-Z14.

Variety information	
Pedigree	Unknown pedigree
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR (\$/t, excl GST)	No EPR payable

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The CROP DISEASE AU application has been developed by the Australian National Variety Trials program (NVT) and funded by the GRDC. It provides access to up-to-date variety information from the NVT database, as well as current disease-resistance ratings, disease information and an extensive disease image library.