Cultivar Herbicide Tolerance Trial Protocols

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Objective

Within many broad acre crop species, cultivars have been found to vary in sensitivity to commonly used herbicides and tank mixes, thereby resulting in potential grain yield loss, and hence reduced farm profit. With funding from GRDC and State Government Agencies across Australia, a series of cultivar by herbicide tolerance trials are conducted annually. The trials aim to provide grain growers and advisers with information on cultivar sensitivity to commonly used in-crop herbicides and tank mixes for a range of crop species including, wheat, barley, triticale oats, lupins, peas, lentils, chickpeas and faba beans. The intention is to provide data from at least two years of testing at the time of wide scale commercial propagation of a new cultivar.

Methodology

Trial locations, involving replicated small plots, are selected and managed to ensure:

- Zero or minimal weed competition so that response to herbicide treatment is a function of cultivar sensitivity and not cultivar competitiveness with weeds.
- Wide representation and uniform soil type within each Australian region

Trial assessments include:

- **Visual observations** - taken up to twice throughout the season, approximately 2-3 weeks after herbicide application and again (2 -3 weeks later) or as appropriate.
- **Normalised Difference Vegetative Index (NDVI)** [measures crop colour and biomass] measurements using a Greenseeker. These are collected in tandem with visual assessments at the time of collection generally aiming for approximately 21-30 days after treatment.
- **Grain Yield**
- **Climatic data** - eg. temperature and rainfall recorded by mobile weather stations in each paddock or where applicable, the nearest Bureau of Meteorology weather station.

Further information on these assessment techniques or resulting data can be accessed by contacting regional research trial managers.

Preliminary Evaluation (PE) Trials

Wheat and barley cultivars continuing beyond the first year of National Variety Trials (NVT) are automatically eligible for inclusion in the first stage of cultivar tolerance evaluation, namely Preliminary Evaluation (PE) Cultivar Herbicide Tolerance Trials. Within these trials, commonly used and often damaging herbicides/ tank mixes are applied to cultivars at rates above label recommendation in order to highlight cultivar intolerances. Within PE trials;

- Treatments are evaluated within very small plot or single row experiments,
- Herbicides/ tank mixes are selected according to the **Herbicide Selection Protocol,**
- Each cultivar by herbicide combination is evaluated across two seasons, unless the cultivar is discarded by the breeder after year one.
- Any treatment (herbicide cultivar combination) which incurs a significant yield penalty in at least one year of trial is progressed to Advanced Evaluation (AE) trials,
- If a cultivar by herbicide combination does not incur yield loss in either of the two years of PE testing it is given a safe rating within data summary tables.

Advanced Evaluation (AE) Trials

This second stage of cultivar tolerance evaluation, Advanced Evaluation (AE), aims to validate and supplement results from PE trials with data on tolerance and safety margins gathered from more detailed experiments. Within AE trials;

- Treatments are evaluated within replicated, large plot, split strip plot designed experiments,
- Only those herbicide by cultivar combinations which were found damaging within PE trials are evaluated,
- Herbicides are applied at the label recommended and higher than recommended rates to obtain data on both tolerance at label rates, and safety margin,
- All treatments (cultivar and herbicide) are evaluated across a minimum of two seasons to account for seasonal variation in cultivar response to herbicides.

NOTE: Within the pulse, oat and triticale species very few varieties are released annually and hence, only AE trials are implemented. Within these trials cultivar selection is based on collaboration with breeders, and herbicide selection is based on a combination of collaboration with regional agronomists, farmers and herbicide manufacturers with the objective to obtain at least two years data prior to wide scale commercial propagation of new varieties.

Herbicide Selection Protocol

The choice of herbicides used in the Preliminary Evaluation (PE) and Advanced Evaluation (AE) trials flow from consideration of;

1. Existing and widely used herbicides/tank mixtures with known variation in crop/cultivar safety, through consultation between research staff and sales agronomists within each region/State,

2. New or previously untested herbicides, following evaluation within supplementary New Chemistry (NC) trials conducted alongside the PE and AE trials. The New Chemistry trials allow for evaluation of a group of commonly grown varieties, to be tested against previously untested or newly released herbicides and those due for release within 1-2 years. If a new herbicide is found to be damaging AND there is expected to be significant farmer use, the herbicide is progressed to preliminary evaluation trials

Testing of specific herbicides is discontinued if found to have a stable level of crop safety/damage across a majority of cultivars over a period exceeding five years of testing.

Statistical Analysis and Data Interpretation

Cultivars are evaluated across multiple seasons to account for seasonal variability. Yield (grain weight) and Greenseeker NDVI measurements are statistically analysed using spatial analysis techniques in collaboration with the GRDC funded National Statistics Group. Data generated from herbicide treatments is related to untreated controls (often expressed as % of untreated), highlighting those treatments which resulted in significant reductions at the $P<0.05$ level.

Acknowledgements

GRDC for funding regional research projects in association with State Governments through SARDI, DEEDI, I&I and DAFWA.