Screening for differential herbicide tolerance in cultivars of winter cereals in NR

Summary
This project identified differential herbicide tolerance in many of the important northern-region (NR) wheat and barley cultivars.

Forty-seven wheat and 13 barley cultivars and breeding lines were tested for tolerance to 37 and 25 wheat and barley herbicides respectively. The data from this and the previous project (DAQ527) were summarised into a herbicide tolerance guide that has been distributed widely.

Overall, 64-70% of the cultivar x herbicide combinations resulted in no significant yield losses at both recommended and double rates. However, 9-10% of the cultivar x herbicide combinations had significant yield losses at the recommended rate in one or more trials.

Access to this information means growers and agronomists can now select safer herbicide options.

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Conclusions

1. Recommended herbicides can be safely used for weed control for approximately two thirds of all possible cultivar x herbicide combinations for wheat and barley.
2. There is a narrow margin of crop safety for approximately 25% of all cultivar x herbicide combinations, with research applications of double the recommended rate resulting in significant yield losses in these combinations.
3. Wheat herbicides that had no adverse impact on yield at the recommended rate across all cultivars were Achieve®, Axial®, Hotshot®, MCPA amine®, Tordon 75D®+2,4-D, and Wildcat®.
4. Barley herbicides that had no adverse impact on yield at the recommended rate across all cultivars were Ally®+MCPA®, Axial, and Hotshot.
5. Yields of wheat cultivars EGA Hume® and Kennedy® were not adversely affected by any tested herbicide at the recommended rate.
6. Yields of barley cultivars Fitzroy®®, Gairdner®®, Groat®®, Kaputar®®, Skiff®®, and Tantangara®® were not adversely affected by any tested herbicide at the recommended rate.
7. There is a probability of significant yield loss for 9-10% of the cultivar x herbicide combinations when the herbicide is applied at the recommended rate and crop growth stage.
8. Herbicides having the greatest impact on wheat cultivars were Ally, Cadence®, Clean®, Hussar®, and Mataven®.
9. Herbicides having the greatest impact on barley cultivars were Bromicide 200®, Cadence, MCPA LVE®, and Tristar Advance®.
10. Wheat cultivars most affected were Cunningham (Ally), Ellison (Mataven), Giles® (Ally), Petrie® (Ally), Qalbis® (Ally), Sunlin® (Mataven), Ventura® (Ally and Clean), Wollaroi® (Mataven) and Yallaroin® (Ally), with significant yield losses in two or more trials.
11. Barley cultivars most affected were Grimmett® (Cadence) and Mackay® (Cadence, MCPA LVE, and Tristar Advance), with significant yield losses in two or more trials.
12. Wheat and barley cultivar responses to herbicides differed between the centres for testing in Toowoomba compared with that at Wagga Wagga for 50% of common cultivar x herbicide combinations. In general, crop damage was greater in southern New South Wales (NSW) than in Queensland (QLD).

Recommendations

1. Growers and advisers need to consult the susceptibility guide before making decisions on cultivar and herbicide choice.
2. If the preferred cultivar x herbicide combination is one of the 25% that have been recorded as having significant yield
losses at the double rate, then growers need to take care to ensure that spraying is done under ideal conditions, using minimum recommended rate and without any spraying overlap.

3. If the preferred cultivar x herbicide combination is one of the 10% that have been recorded as having significant yield losses at the recommended rate, then growers need to consider using either an alternative herbicide or sowing a safer cultivar for the preferred herbicide.

4. Research on this topic needs to continue with an emphasis on screening advanced breeding lines with a standard set of widely-used herbicides and exposing recently-released cultivars to a wider range of herbicides.

Outcomes

This project and its predecessor (DAQ527) have clearly shown that herbicides applied at recommended rates can be used safely for weed control for approximately two thirds of all possible cultivar x herbicide combinations under the environmental conditions of the NR.

There is a narrow margin of crop safety for approximately 25% of all cultivar x herbicide combinations, indicating that growers need to ensure spraying is done under ideal conditions, using the minimum recommended rate, and without any spraying overlap.

Herbicides with no or limited adverse yield impact on wheat cultivars were Achieve®, Axial®, Hotshot®, MCPA amine®, Tordon 75D®+2,4-D, and Wildcat®. Similarly, the safer barley herbicides were Ally®, MCPA®, Axial and Hotshot.

The barley cultivars Fitzroy®, Gairdner®, Grout®, Kaputar®, Skiff® and Tantangara® were less affected by any tested herbicide than other cultivars. Of the wheat cultivars tested, only EGA Hume® and Kennedy® were not adversely affected by any herbicide.

Care is needed with the 9-10% of the cultivar x herbicide combinations where there is a probability of significant yield loss with the herbicide applied at the recommended rate and crop growth stage. Yield losses ranged from 5 to 30% in barley cultivars and 6 to 65% in wheat cultivars. Herbicides having the greatest impact on wheat cultivars were Ally, Cadence®, Clean®, Hussar®#, and Mataven®#. Similarly, the barley herbicides with greatest impact were Bromeocide 200®, Cadence, MCPA LVE®, and Tristar Advance®#. The cultivars most affected were Cunningham® (Ally, Ellison® (Mataven), Giles® (Ally), Petrie® (Ally), Qalb® (Ally), Sunlin® (Mataven), Ventura® (Ally and Clean), Wollaroi® (Mataven) and Yallaroin® (Ally) for wheat, and Grimmett® (Cadence) and Mackay® (Cadence, MCPA LVE, and Tristar Advance) for barley. These cultivars had significant yield reductions in two or more trials when treated with these herbicides. In these situations, alternate herbicides should be used or other cultivars grown.

Achievements/Benefits

This project (DAQ00027) and its predecessor project (DAQ527) have clearly shown there is differential herbicide tolerance in many of the important wheat and barley cultivars grown in the NR. All main cultivars and many of the new cultivars have been rated for their levels of tolerance to the majority of herbicides used in NR, based on this research.

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Extensive distribution of the information on cultivar sensitivity to herbicides has enabled growers and agronomists to minimise the risk of the adverse impacts of herbicides on winter cereal productivity. They have the choice of selecting safer herbicide options for their sown cultivars or selecting more tolerant cultivars for their important herbicides

During this project, 47 wheat cultivars/breeding lines were tested, including the widely-grown cultivars Batavia 2®, Baxter®, Cunningham®, Giles®, Hartog®, Kamilaroi®, Kennedy®, Lang®, Leichhardt, Petrie®, Strzelecki®, Sunbr®, Sunbrook®, Sunco®, Sunlin® Sunstate®, Sunvale®, Wollaroi®, and Yallaroin® plus the recently-released cultivars Braewood®, EGA Gregory®*, EGA Hume®, EGA Bellaroi®, EGA Wentworth®, EGA Wylie®, Ellison®, CBA Combai®, CBA Sapphir®, CBA Hunter®, QALBis®, Rees and Ventura®. Fifteen unnamed lines were also tested.

The following 37 wheat herbicides were screened: Achieve®, Achieve+NUL1320®, Ally®, Ally+MCPA LVE®, Amicide 500®, Amicide 625®, Atlantis®, Axial®, Broadside®, Bromicide 200®, Bromicide MA®, Cadence®, Dow GF100®, Dow GF1204®, Dow GF1442®, Dow GF1674®, Dow Radicare®, Clean®, Hotshot®, Hussar®#, Hussar OD®, Logran B-power®, Mataven 90®, Mataven 90 as SST®, Mataven 90+NUL1370 as SST, MCPA 500®, MCPA LVE, Nufarm Comet®, Silverado OD®, Starane 200®, Syngenta A14429B pre-plant®, Syngenta A14429B pre-emergent®, Topik 240EC®, Tordon 242®, Trifluralin®, Tristar Advance®# and Wildcat®#.

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Thirteen barley cultivar/breeding lines were also tested: Gairdner, Gilbert, Grimmett, Kaputar, Lindwall, Tallon and Tantangara, the newly-released cultivars Binalong, Cowabbie, Mackay, Grout and Fitzroy, plus one unnamed line.

The following 25 barley herbicides were screened: Achieve, Achieve+NUL132, Ally, Amicide 500, Amicide 625, Bromicide 200, Bromicide MA, Cadence, Decision, Decision Plus®, Decision Plus MD 3.75®, Decision+Widecat, Decision+Zinc, Dow Radicape, Hotshot, Hussar, MCPA 500, MCPA LVE, Starane 200, Syngenta A14429B pre-plant, Syngenta A14429B pre-emergent, Tordon 75®+2,4-D, Tordon 242, Tristar Advance and Wildcat.

The information package on herbicide tolerance produced as part of this project is a collation of the yield responses of the tested wheat and barley cultivars currently recommended by QLD DPI&F and NSW DPI to registered herbicides screened in both projects. The summary has 735 cultivar x herbicide combinations. This does not include cultivars no longer recommended, unnamed cultivars or unregistered herbicides.

In summary, 70% of the wheat x herbicide combinations and 64% of the barley x herbicide combinations had no significant yield losses at both the recommended and double rates. However, 20% and 27% of the wheat and barley x herbicide combinations had significant yield losses at the double rate but not at the recommended rate and 9-10% of the cultivar x herbicide combinations had significant yield losses at the recommended rate in one or more trials.

Significant yield reductions at the recommended rate were recorded for the following barley herbicides:

- **Bromicide 200**: Binalong, 11% in 1 of 4 trials; Gilbert, 10% in 1 of 3 trials; Grimmett, 13% in 1 of 4 trials.
- **Cadence**: Binalong, 11% in 1 of 4 trials; Grimmett, 11-15% in 2 of 4 trials; Mackay, 7-13% in 2 of 4 trials; Tallon, 8% in 1 of 4 trials.
- **MCPA LVE**: Cowabbie, 12% in 1 of 3 trials, Grimmett, 16% in 1 of 7 trials; Mackay, 5-16% in 2 of 6 trials; Tallon, 13% in 1 of 7 trials.
- **Starane®**: Binalong, 12% in 1 of 6 trials.
- **Tordon 242**: Grimmett, 15% in 1 of 6 trials.
- **Tordon 75D®+2,4-D**: Lindwall, 10% in 1 of 4 trials.

Significant yield reductions at the recommended rate were recorded for the following wheat herbicides:

- **Ally**: Cunningham, 16-21% in 2 of 5 trials; Ellison, 8% in 1 of 4 trials; Giles, 18-21% in 2 of 5 trials; Lang, 8% in 1 of 5 trials; Petrie, 7-11% in 2 of 5 trials; QALBs, 12-14% in 2 of 3 trials; Rees, 11% in 1 of 2 trials; Sunco, 17% in 1 of 5 trials; Ventura, 6-10% in 2 of 4 trials; Yallaroi, 12% in 1 of 6 trials.
- **Ally+MCPA LVE**: EGA Bellaroi, 9% in 1 of 2 trials.
- **Amicide (2,4-D)**: Hartog, 9% in 1 of 5 trials.
- **Atlantis**: Kamilaroi, 15% in 1 of 2 trials.
- **Bromicide 200**: Baxter 28% and Yallaroi 29% in 1 (very dry season) of 4 trials.
- **Cadence**: Braewood, 18% in 1 of 2 trials; Ventura, 13% in 1 of 3 trials; Hartog 37%, Leichhardt 36%, Strzelecki 38%, Sunstate 38%, and Yallaroi 23% in 1 (very dry season) of 3-5 trials.
- **Clean post-emergence**: Petrie, 19% in 1 of 2 trials; Rees, 16% in 1 of 2 trials; Ventura, 15-19% in 2 of 4 trials.
- **Hussar**: an overall significant yield reduction of 5% across all cultivars in one trial, with greater yield reductions for Baxter, Hartog, Leichhardt, Strzelecki, Sunbrook, Sunco, Sunlin and Sunstate; Lang, 14% in 1 of 5 trials; Wollaroi, 15% in 1 of 4 trials.
- **Mataven 90 applied mid-tillering**: Hartog, 7% in 1 of 3 trials; Sunlin, 9% in 1 of 3 trials.
- **Mataven 90 applied at the late stage for selective spray topping**: Cunningham, 14% in 1 of 3 trials; EGA Wylie, 9% in 1 of 1 trial; Ellson, 14-21% in 2 of 3 trials; Kamilaroi, 28% in 1 of 3 trials; Leichhardt, 11% in 1 of 3 trials; Rees, 7% in 1 of 3 trials; Sunbri, 35% in 1 of 2 trials; Sunlin, 14-65% in 5 of 5 trials; Wollaroi, 14-18% in 3 of 4 trials; Yallaroi, 14% in 1 of 5 trials.
- **MCPA LVE**: EGA Wylie, 22% in 1 of 1 trial; GBA Hunter, 17% in 1 of 1 trial.
- **Topik®**: Sunvale, 13% in 1 of 4 trials.
- **Tordon 242**: Petrie, 16% in 1 of 7 trials and substantial but not significant losses in two other trials.

This information was regularly extended to the chemical and grains industries in a variety of media. Each year, individual reports were sent to each sponsoring chemical company with detailed information on the cultivar responses to their products. The cereal breeding teams were provided with detailed information on the herbicide response of their breeding lines. A full report of approximately 50 pages was sent to all stakeholders with detailed information on the registered herbicides and released cultivars that were tested in each year.
The cultivar tolerance guide was updated annually and published on the QLD DPI&F 'Wheat variety guide' brochure and 'Winter crop management notes' CD, in the NSW DPI 'Weed control in winter crops' booklet and on the QLD DPI&F and NSW DPI websites. Various herbicide and cultivar commercial promotional packages were also developed.

This information enables growers and agronomists to make better-informed decisions for safer herbicide use in wheat and barley.

Other research

The current project DAQ00027 has highlighted the need to continue to test the herbicide tolerance of all advanced breeding lines and newly released cultivars. This will be undertaken in the newly-negotiated project DAQ00106.

The national meetings held in 2004 and 2006 have instigated improvements in synergy between all crop-tolerance projects. The appointment of a national chair, Rob Wheeler, will ensure this continues to develop in all new and current projects.

Additional information

Additional information is provided as an attachment to this report.

Attachment DAQ00027 Sensitivity of barley and wheat cultivars to herbicides (1999-2005)

More recent research may be available at NVT websites.