# Tolerance of barley to phenoxy herbicides

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## KEY MESSAGE

- Barley growers can better decide application times for phenoxy herbicides by using the information in Table 2. Leaf number at double ridge, plus one, is the earliest time at which higher rates of the phenoxy herbicides can be safely applied.
- Visual ear head deformity symptoms caused by phenoxy herbicides, are not a good indicator of yield penalty.

## AIM

To produce an up to date guide for optimum timing of phenoxy herbicides application on a range of current barley varieties.

## METHODS

Six barley varieties were seeded on 7 June 2001 using 60 kg/ha seed and 100 kg/ha Agras in 10 m wide parallel strips at Avondale. Herbicide treatments were arranged in three randomised blocks, sprayed in 3 m wide strips across the varieties. Dry conditions after seeding resulted in some uneven emergence. Herbicide treatments were applied when majority of the plants were at the nominal growth stage. Spraying was started at Z11-Z12 stage and subsequent spaying was done at approximately weekly intervals, except for the last spray at full flag emergence. At each time of treatment, five plants were selected randomly from each variety, the mean number of leaves on the main stem counted, and the plants dissected to determine the ear head development stages. Ear head deformities (missing spikelets and/or fused and super-numerary spikelets) were counted before harvest. Total heads from two randomly selected quadrants (30 x 17.5 cm each) per plot were counted to work out the per cent head deformed. Ninty-five per cent confidence interval was calculated by multiplying standard error due to mean leaf number to t value at 95 per cent level of confidence. Total rainfall received from seeding to harvesting the crop was 163.5 mm.

MCPA amine and ester up to 0.5 L/ha has been recommended to use from 3 leaf stage to flag leaf emergence (Z13-Z33) and from 0.5 L to 2.0L/ha at Z15-Z33. 2,4-D amine 50% up to 1.6 L and 2,4-D 80% up to 0.7 L/ha has been recommended to use from Z15 to Z33.

**Table 1. Timing of herbicide application**

| | Zadock's scale | Date |
|---|---|---|
| Timing 1-T1 | Z11-Z12 | 25 June 2001 |
| Timing 2-T2 | Z12-Z13 | 29 June 2001 |
| Timing 3-T3 | Z13-Z14 | 5 July 2001 |
| Timing 4-T4 | Z14-Z15 | 11 July 2001 |
| Timing 5-T5 | Z15-Z16 | 18 July 2001 |
| Timing 6-T6 | Z16-Z17 | 26 July 2001 |
| Timing 7-T7 | Z17-Z18 | 2 August 2001 |
| Timing 8-T8 | After full flag leaf emergence | |
| | Unicorn and Harrington | 3 September 2001 |
| | Stirling and Gairdner | 7 September 2001 |
| | Skiff | 17 September 2001 |

At T8, > 90% of the plants across all the varieties had flag leaf fully emerged.

## RESULTS AND CONCLUSIONS

**Table 2. The number of visible leaves on main stem at double ridge and terminal spikelet of different Barley varieties (95% confidence intervals also shown)**

| Variety | Leaf number at double ridge | 95% conf. interval | Leaf number at Awn primordium stage | 95% conf. interval |
|---|---|---|---|---|
| Unicorn | 4.5 | +/- 0.5 | 7.5 | +/- 0.8 |
| Stirling | 4.7 | +/- 0.2 | 7.6 | +/- 0.2 |
| Gairdner | 5.3 | +/- 0.3 | 7.5 | +/- 0.4 |
| Skiff | 5.3 | +/- 0.2 | 8.5 | +/- 0.3 |
| Harrington | 4.7 | +/- 0.6 | 8.4 | +/- 0.5 |

The double ridge is stage in the ear head development of cereals where the cells change from producing leaves and begins to form ear. The Awn primordium is stage where the barley embryo ear has its full complement of spikelet primordia and the initiation of all the structures within the median spikelet is complete. The 95% confidence interval (Table 2) alongside the leaf number indicate the variation associated with measuring main stem leaf number at double ridge and Awn primordium stage. For example: Unicorn's mean leaf number at double ridge is 4.5, with a confidence interval of 0.5. Therefore double ridge is most likely to occur in range of 4.0 to 5.0 leaves.

Application of phenoxy herbicides at or before the double ridge stage caused head deformities across all the varieties (Table 3). MCPA amine sprayed at Z11-Z12 did not cause any head deformities in any of the varieties, but MCPA ester caused slight deformities in all the varieties except Harrington.

Higher rates of both MCPA and 2,4-D ester applied at Z15-Z16 resulted in more head deformities than their lower rates. This trend was not consistent for MCPA or 2,4-D amine.

Application of both formulations of MCPA at Z11-Z12 caused no significant yield reduction in any of the variety except a > 10% yield reduction in Unicorn.

MCPA amine 0.5 L/ha applied at Z12-Z13 stage caused > 10% yield reduction in Gairdner and Skiff and its application at Z13-Z14 resulted in > 10% reduction in Stirling and Gairdner. However MCPA ester at same rate and timing was safe to all varieties. This goes against the accepted wisdom that amine formulations are softer than ester. Higher rate of MCPA ester (1.0L/ha) at Z13-Z14 caused > 10% yield reduction across all the varieties and reductions were significant in Gairdner and Harrington. MCPA amine 1.25 L/ha at same timing reduced the yield of Gairdner and Skiff. 2,4-D amine at Z13-Z14 also resulted in significant yield reductions in Skiff and > 10% in Harrington.

2,4-D ester 0.25 L/ha at Z14-Z15 reduced the yield of Harrington > 10%. The higher rate of 2,4-D ester 0.75 L/ha at Z15-Z16 caused > 10% reductions in Gairdner, Skiff and Harrington. The stages of herbicide application correspond to the double ridge stage in these varieties.

Both formulations of 2,4-D applied after full flag emergence seem to be safe on all the varieties except higher rate of 2,4-D ester caused 15% reductions in Gairdner.

Results of the trial indicated that barleys were more sensitive to phenoxy herbicide application up to double ridge. The addition of one leaf to the leaf number present at double ridge is the time at which higher rates particularly of 2,4-D can be applied with minimal head deformities.

Ear head deformities are not a good indicator of yield penalty from early phenoxy spraying. For example MCPA amine 0.5 and 1.25 L/ha caused > 10% yield reduction in Gairdner but resulted in no head deformities. Figures in bold are significantly different from untreated control.

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| | Herbicides/ha | | Unicorn | | Stirling | | Gairdner | | Skiff | | Harrington | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Yield | % Def | Yield | % Def | Yield | % Def | Yield | % Def | Yield | % Def |
| 1 | Untreated Control | | 3531 | 0 | 3466 | 0 | 3909 | 0 | 3848 | 0 | 3170 | 0 |
| 2 | MCPA amine 0.5 L | T1 | 88 | 0 | 103 | 0 | 91 | 0 | 94 | 0 | 125 | 0 |
| 3 | MCPA amine 0.5 L | T2 | 90 | 2 | 94 | 2 | **80** | 5 | **83** | 1 | 91 | 0 |
| 4 | MCPA amine 0.5 L | T3 | 93 | 4 | 89 | 1 | **81** | 0 | 92 | 2 | 102 | 3 |
| 5 | MCPA amine 1.25 L | T3 | 102 | 9 | 100 | 2 | 89 | 0 | 86 | 0 | 97 | 2 |
| 6 | MCPA amine 1.25 L | T4 | 95 | 6 | 98 | 2 | 96 | 1 | 114 | 2 | 98 | 1 |
| 7 | MCPA amine 1.25 L | T5 | 96 | 3 | 111 | 3 | 119 | 3 | 108 | 2 | 93 | 0 |
| 8 | MCPA Ester 0.5 L | T1 | 86 | 3 | 97 | 1 | 97 | 1 | 112 | 1 | 107 | 0 |
| 9 | MCPA Ester 0.5 L | T2 | 93 | 2 | 95 | 1 | 100 | 1 | 98 | 1 | 91 | 0 |
| 10 | MCPA Ester 0.5 L | T3 | 96 | 1 | 98 | 1 | 107 | 1 | 97 | 0 | 89 | 0 |
| 11 | MCPA Ester 1.0 L | T3 | 88 | 13 | 89 | 7 | **79** | 1 | 85 | 1 | **83** | 2 |
| 12 | MCPA Ester 1.0 L | T4 | 102 | 7 | 103 | 6 | 112 | 2 | 94 | 1 | 90 | 2 |
| 13 | MCPA Ester 1.0 L | T5 | 90 | 2 | 87 | 1 | 96 | 3 | 102 | 1 | 105 | 0 |
| 14 | 2,4-D amine 0.5 L | T3 | 90 | 13 | 96 | 2 | 93 | 2 | **84** | 3 | 89 | 0 |
| 15 | 2,4-D amine 0.5 L | T4 | 111 | 10 | 104 | 5 | 108 | 1 | 104 | 2 | 103 | 1 |
| 16 | 2,4-D amine 0.5 L | T5 | 105 | 7 | 100 | 2 | 99 | 3 | 97 | 1 | 97 | 1 |
| 17 | 2,4-D amine 1.0 L | T6 | 98 | 1 | 95 | 1 | 92 | 0 | 105 | 1 | 112 | 1 |
| 18 | 2,4-D amine 1.0 L | T7 | 88 | 1 | 101 | 0 | 96 | 1 | 100 | 1 | 104 | 0 |
| 19 | 2,4-D amine 1.0 L | T8 | 107 | 0 | 97 | 0 | 90 | 0 | 87 | 5 | 86 | 0 |
| 20 | 2,4-D amine 1.5 L | T5 | 96 | 5 | 107 | 5 | 105 | 3 | 101 | 3 | 100 | 1 |
| 21 | 2,4-D amine 1.5 L | T6 | 92 | 2 | 104 | 1 | 101 | 1 | **84** | 2 | 91 | 0 |
| 22 | 2,4-D amine 1.5 L | T7 | 102 | 0 | 86 | 1 | 91 | 0 | 88 | 2 | 90 | 0 |
| 23 | 2,4-D amine 1.5 L | T8 | 102 | 0 | 99 | 1 | 95 | 1 | 96 | 0 | 105 | 1 |
| 24 | 2,4-D Ester 0.25 L | T4 | 102 | 11 | 101 | 1 | 103 | 1 | 90 | 2 | 89 | 5 |
| 25 | 2,4-D Ester 0.5 L | T5 | 92 | 6 | 94 | 4 | 96 | 2 | 90 | 2 | 94 | 3 |
| 26 | 2,4-D Ester 0.5 L | T6 | 90 | 2 | 103 | 1 | 90 | 3 | 111 | 2 | 106 | 5 |
| 27 | 2,4-D Ester 0.5 L | T7 | 93 | 0 | 89 | 0 | **80** | 2 | 95 | 0 | 94 | 0 |
| 28 | 2,4-D Ester 0.5 L | T8 | 94 | 0 | 95 | 0 | 94 | 0 | 101 | 0 | 101 | 0 |
| 29 | 2,4-D Ester 0.75 L | T5 | 97 | 14 | 100 | 8 | 88 | 2 | 87 | 3 | 86 | 6 |
| 30 | 2,4-D Ester 0.75 L | T6 | 96 | 2 | 100 | 1 | 99 | 1 | 92 | 2 | 96 | 0 |
| 31 | 2,4-D Ester 0.75 L | T7 | 97 | 0 | 100 | 1 | 104 | 0 | 91 | 1 | 92 | 2 |
| 32 | 2,4-D Ester 0.75 L | T8 | 94 | 0 | 96 | 0 | 85 | 0 | 92 | 1 | 99 | 0 |
| | LSD (0.05) | | 15 | | 15 | | 17 | | 16 | | 16 | |
| | CV (%) | | 11 | | 11 | | 13 | | 12 | | 12 | |

Yield is the yield expressed as a percentage of the untreated control. Yields for the Untreated Control are expressed in kg/ha. No comparison should be made between yields of each variety, as the trial layout can bias toward a particular variety.

Per cent Def is the percentage of heads with some type of deformity.