

RESPONSE OF BARLEY TO GLEAN (CHLORSULFURON)

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Introduction

Chlorsulfuron is the active ingredient in the herbicide Glean. It is a selective herbicide used for broadleaf weed control in cereals. Glean has a very high herbicidal activity and therefore can be applied at very low rates. The recommended rate for wheat and barley is 15 - 30 g/ha. Glean has both soil and foliar activity. Barley is tolerant to post-emergence application (Hageman and Behrens, 1981) but a differential response of cultivars has been reported to pre-emergence application and from soil residues (Foley, 1985).

Breeding for herbicide resistance using either conventional breeding methods or via tissue culture techniques of in vitro selection, requires a knowledge of how the plant is affected by the herbicide and the rate at which injury occurs. The effect of chlorsulfuron on barley was studied to determine if varieties respond differentially, and at which rate the herbicide could be used to screen genotypes for increased tolerance or resistance.

Rate Experiment

Methods and Materials

Greenhouse experiments were conducted during the Summer of 1987. To evaluate differential affects, a rate experiment consisting of six barley varieties grown at four Glean rates was undertaken. The barley varieties included: 2-row: Abee, Deuce, Harrington, 6-row: Argyle, Heartland and Samson. Susceptible checks included Westar canola and Vimy flax.

Glean was applied to the soil at rates of 14, 29, 43 and 93 g ai/ha, corresponding to 19, 38, 57 and 124 g of product/ha respectively. Soil, sand and vermiculite (2:1:1) were mixed together in a cement mixer for 20 minutes. During the mixing period, a 200 ml solution of the required chlorsulfuron concentration and water was sprayed on to the soil. The soil was placed in boxes. An untreated soil mixture was used for the

control. The soil type was a loamy sand at pH 6.5 with 3.3% organic matter. The soil was watered to 40% field capacity and maintained at this level for three weeks before planting to allow the herbicide to metabolize.

Five pregerminated seeds were planted in a row. A split plot design with 12 replications was utilized.

Emergence date and heading date were recorded. Plant height and visual symptoms of injury were observed at weekly intervals for the seedling stage until maturity. Plants were harvested at maturity and dry matter production was measured. The canola and flax were harvested 25 days after planting as they were outgrowing the barley in the control and dying in the treated soil.

Results and Discussion

Rate Experiment

Soil incorporated chlorsulfuron affected the growth of all barley varieties and checks. Compared to the control, emergence date and heading date were delayed and plant height and dry matter production per plant were reduced.

Emergence date

Emergence was delayed for all varieties by all herbicide rates (Fig. 1). The 2-row variety, Abee was affected more by the Glean than the other varieties. At the highest rate the delay was three days, compared to a one to two day delay of the other varieties.

Heading date

The heading date of all varieties was delayed by the herbicide (Fig. 2). The large difference between Abee and the other varieties observed at emergence was not observed at heading. There was, however, a 13 to 14 day delay for the 2-row varieties Abee, Deuce and Harrington grown at the highest herbicide rate when compared to the control. The 6-row varieties Argyle and Samson had delays of 10 to 11 days. As with emergence date, Heartland was least affected with a seven day delay observed between the control and the highest Glean application.

Plant height

The plant height of all varieties decreased as the Glean rate increased (Fig. 3). This was observed at the seedling stage and at maturity. At the lowest herbicide rate (14 g ai/ha) plant height ranged from 60 to 83% of the control, while at the highest herbicide rate (93 g ai/ha) it ranged from 45 to 59% of the control. The 6-row varieties appeared to be more affected than the 2-row varieties, at all the herbicide rates.

GLEAN RATE EXPT.

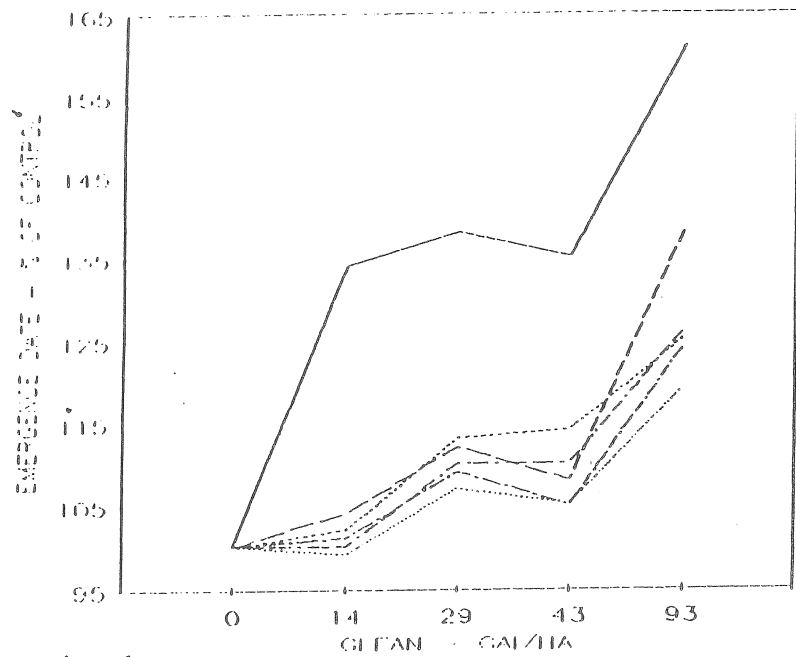


Fig. 1

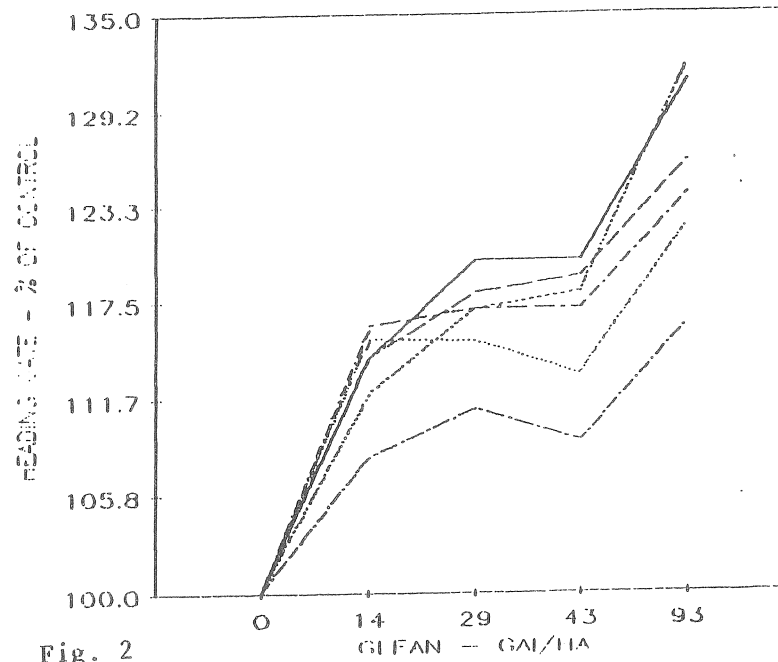


Fig. 2

LEGEND

- Abee
- - Deuce
- Harrington
- · - · Argyle
- Samson
- · - · Heartland

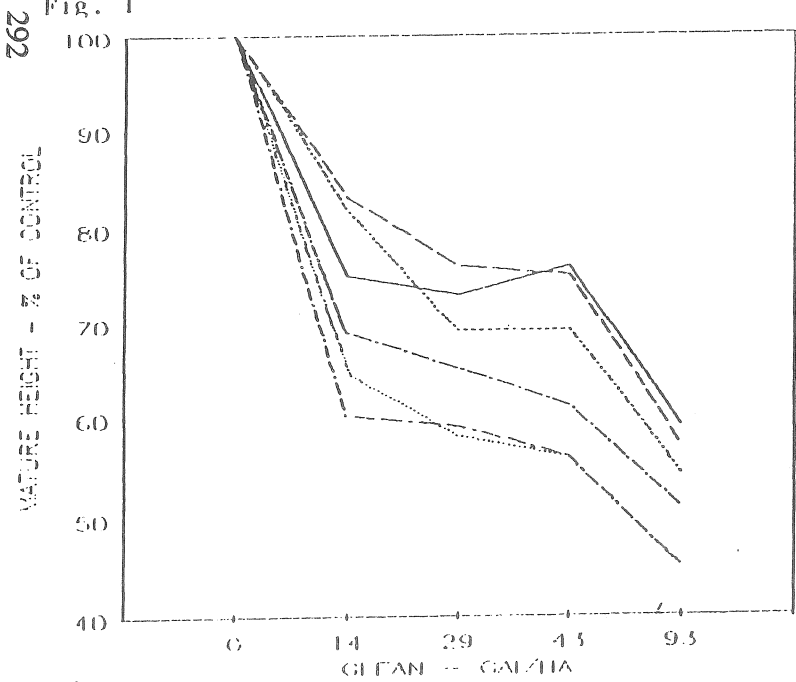


Fig. 3

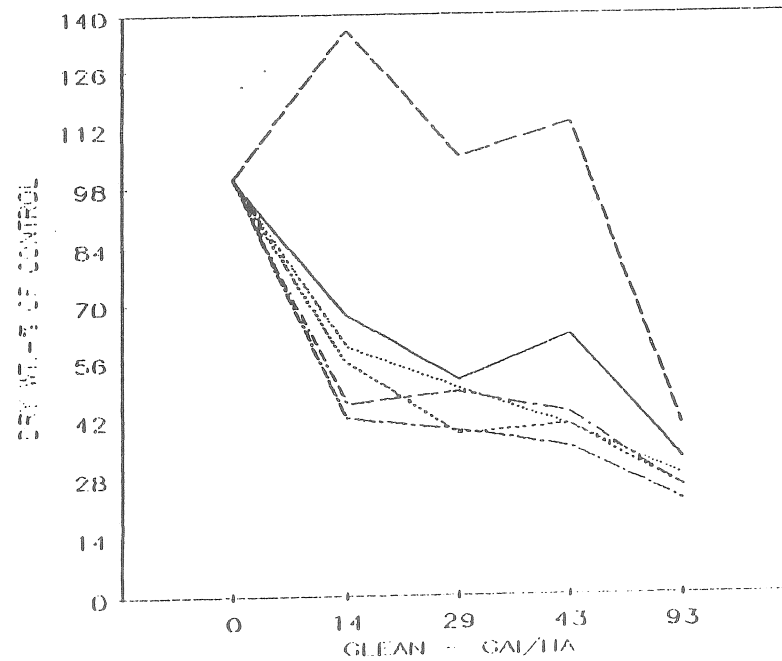


Fig. 4

Effect of Glean on the growth of barley as a % of Control for the parameters:

Fig. 1 - Emergence date; Fig. 2 - Heading date; Fig. 3 - Maturity height at maturity;

Herbicide injury symptoms

The susceptible species used in this experiment were canola and flax. Both were severely affected by the Glean application. Injury symptoms of stunting, chlorosis, necrosis and some purpling of the leaves were observed even at the lowest herbicide rate.

The barley varieties exhibited different herbicide injury symptoms. Argyle, Heartland and Samson showed chlorosis when compared to the control. Abee showed both chlorosis and necrosis, whereas, Deuce had very little chlorosis and looked much like the control plants. The variety Harrington showed purple colouration which was followed by necrosis.

Dry matter production

Dry matter production per plant was lower on the Glean treated soil than on the control (Fig. 4). At the lowest herbicide rate (14 g ai/ha), dry matter production of all varieties except Deuce ranged from 42 to 67% of the control. At the highest herbicide rate the values ranged from 22 to 32% of the control.

The variety Deuce did not follow this pattern. Dry matter production per plant of Deuce was higher than the control for all herbicide rates except for the highest rate, where it was 40% of the control. This may have been due to the poor emergence of the variety which generally resulted in fewer plants per row. As pre-germinated seeds were planted, poor germination was not the cause. Those plants that did grow may have been more vigorous because of less competition with other plants in the row, however, this does not completely explain the lack of symptoms and loss.

Root Experiment

Methods and Materials

As mentioned, barley cultivars have shown a differential response to soil applied and soil residues of Glean. Barley roots are not as tolerant as wheat roots. To evaluate the effect of Glean on the root system of barley, a similar experiment to the herbicide rate/variety comparison was conducted.

Four varieties were evaluated: Argyle, Heartland, Deuce and Harrington. Susceptible checks included Westar canola and Vimy flax. Glean was applied to the soil at four rates 0, 14, 43 and 93 g ai/ha. Untreated soil was used as the control. The Glean was applied as described for the previous experiment.

One pregerminated seed was sown in a pot containing a sandy loam soil at pH 7.3 with 1.7% organic matter. The soil mixture consisted of 50% soil and sand and 50% perlite. The pots were set up in a factorial

design with 10 replications.

Plants were harvested 42 days after planting. Shoot fresh weight and dry weight, and root fresh weight and maximum length were recorded. Total root length was recorded using a delta-T image analysis system.

Results and Discussion

All parameters measured, plant height, shoot dry weight, root fresh weight, root length and total root length were affected by soil incorporated chlorsulfuron.

Height

As with the previous experiment, plant height decreased with an increase in herbicide concentration (Fig. 5). As with the rate experiment, the 2-row variety Deuce was least affected while the 6-row variety Argyle was more affected. At the lowest herbicide rate (14 g ai/ha) height as a percent of control was 95% for Deuce and 63% for Argyle. At the highest herbicide rate (93 g ai/ha) these values were 54% and 33% respectively.

Shoot dry weight

The lowest Glean rate reduced shoot dry weight of all varieties to 26 to 58% of the control (Fig. 6). The susceptible checks, flax and canola, had shoot dry weights of 7 and 8% of the untreated plants respectively. At the highest rate, barley shoot dry weights ranged from 7 to 11% of the controls. Even though dry weight was severely affected for all varieties, Deuce was significantly different from Argyle, Harrington and Heartland. This was observed in the previous experiment.

Root length

The 2-row varieties were affected by the Glean application but not as severely as the 6-row varieties. This 2-row - 6-row difference occurred at all herbicide rates (Fig. 7). At the highest rate, Argyle and Heartland were 10 and 12% of the control, whereas, Deuce and Harrington were 25 and 22% respectively. At the lowest herbicide rate, the total root length of canola was 7% of the control and for flax it was 1%.

Similar results for barley and the checks were observed for root fresh weight.

Conclusion

The objectives of this study were to determine the effect of Glean on barley, if varieties respond differentially, and to determine the herbicide rate which could be used in screening genotypes for increased tolerance or resistance.

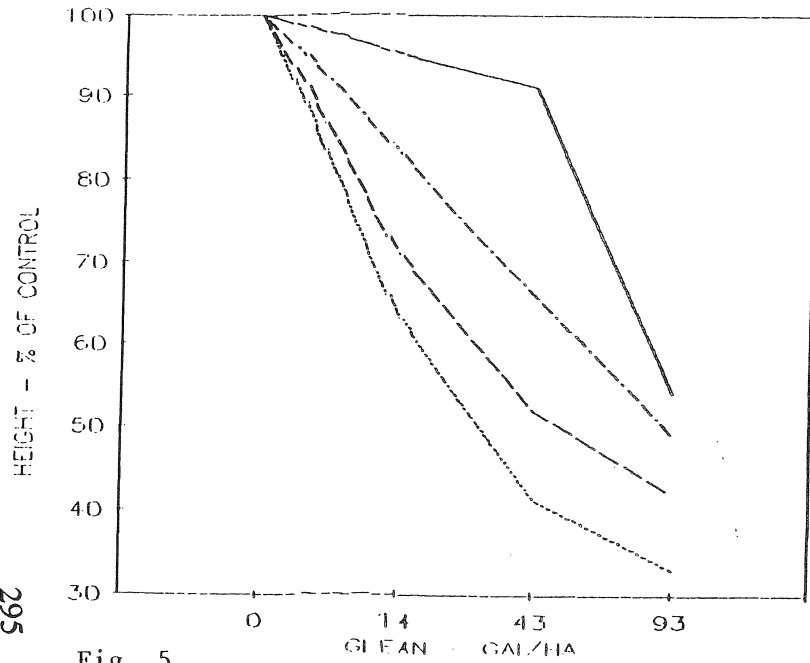


Fig. 5

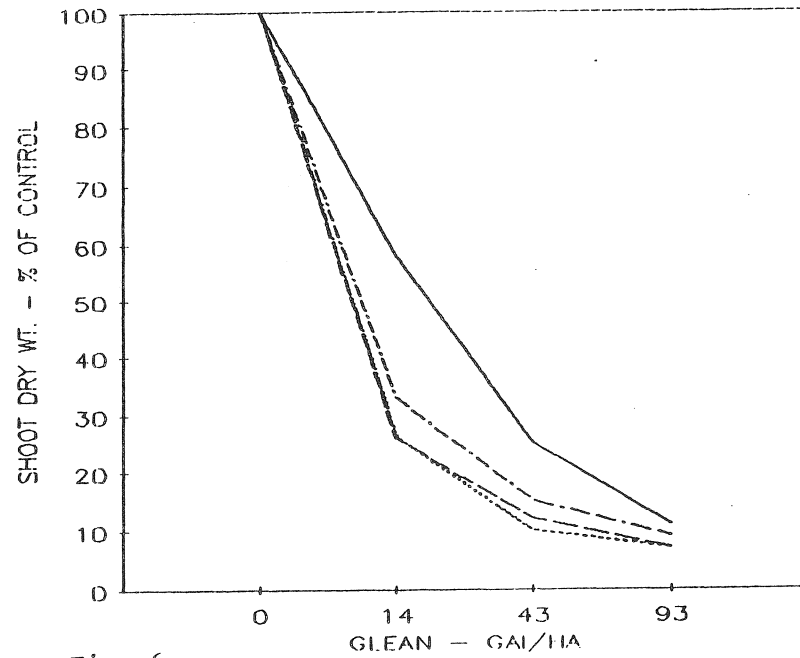


Fig. 6

LEGEND

— Deuce
 - - - Harrington
 Argyle
 - - - Heartland

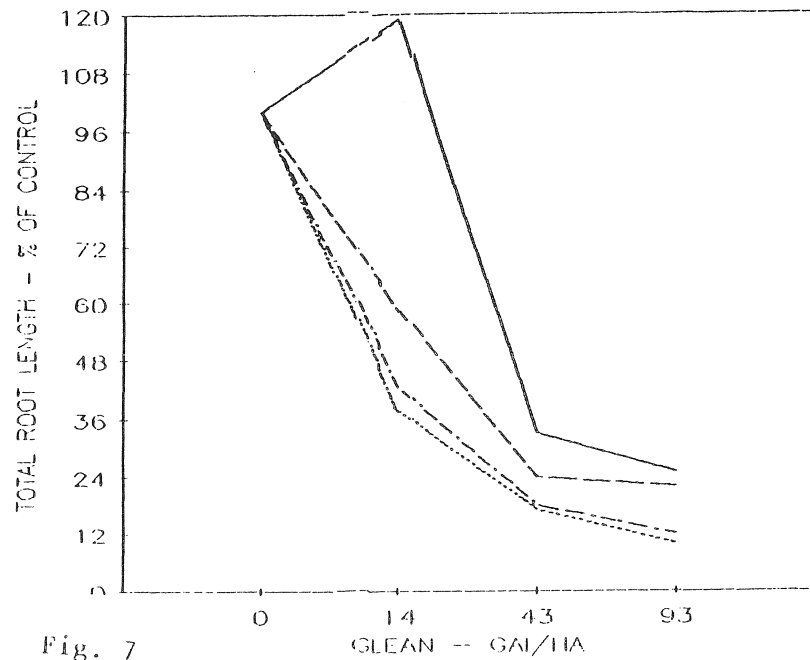


Fig. 7

Effect of Glean on the growth of barley, as a % of control for the parameters:

Fig. 5 Plant Height

Fig. 6 Shoot dry matter production per plant

Fig. 7 Total root length.

Soil applied Glean affected emergence date, heading date, plant height, dry matter production, root fresh weight and root length.

In general, the 2-row varieties appeared to be less affected by soil applied Glean than the 6-row varieties. However, there was variation within each group, Harrington and Argyle seemed to be more affected by Glean, whereas, Deuce and Heartland were least affected.

To clarify these results, a varietal trial as well as a genotype screening trial will be undertaken during Summer 1988 at a soil application rate of 60 g Glean/ha.

References

- Foley, M.E. 1985. Response differences of wheat (Triticum aestivum) and barley (Hordeum vulgare) to chorsulfuron. *Weed Sci.* 34:17-21.
- Hageman, L.H., and Behrens, R. 1981. Response of small-grain cultivars to chlorsulfuron. *Weed Sci.* 29:414-420.