GENETIC AND ENVIRONMENTAL FACTORS AFFECTED THE RESPONSE OF WHEAT CULTIVARS TO CHLORSULFURON

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Abstract. In glasshouse studies the rate of leaf extension (RLE) of the third leaf was used to differentiate between tolerant and sensitive cultivars when chlorsulfuron was applied at 40 $\mu g\ kg^{-1}$ of soil.The most tolerant cultivars were Timstein and Gabo, while the least tolerant were Sonora and Miling. The RLE of the third leaf was a simple, rapid and non-destructive method for assessing sensitivities and was correlated with effects on the dry matter of roots and shoots. A high correlation ($r = 0.87$) was found between percent reduction in RLE in the glasshouse and percent reduction in yield in the field in 1982 when the herbicide was applied at 30 g/ha after seeding. Yield components most affected by chlorsulfuron were ears m^{-2} and spikelets/ear 1982, and ears m^{-2} in 1983.

The difference in sensitivity of Timstein and Sonora to chlorsulfuron was not observed if the soil temperatures was held at 20°C; when the soil temperature was lowered to 13°C the reduction in RLE of Sonora increased from 10% to 43%, while the reduction in RLE of Timstein remained at 10%. The sensitivity of Sonora to chlorsulfuron increased as levels of soil nitrogen and phosphorus increased, while Timstein remained tolerant as N and P levels increased.

The genetics of tolerance was studied using F_1, F_2, F_3 and F_8 populations as well as chromosome substitution lines; tolerance was assessed based on the reduction of RLE to chlorsulfuron applied at 40 $\mu g\ kg^{-1}$ of soil. From a study of the F_1 generation it was found that the progeny of tolerant x sensitive cultivars were tolerant, while progeny of crosses amongst cultivars of intermediate tolerance were also tolerant. A heritability of ~ 0.85 was obtained for chlorsulfuron tolerance from a regression of offspring on mid-parent. Segregation of F_2 plants from tolerant/sensitive crosses indicated additive dominant effects with the environment contributing about 30% of the total variance of the F_2 generation. A minimum of 4 genes was considered necessary to explain the F_2 distribution. This was supported by the chromosome substitution line experiment where no major differences were observed amongst the substitution lines, though genes on chromosomes 3A, 4A, 6A and 4D of Timstein appeared to confer more tolerance than those on other chromosomes. Evaluation of 40 F_8 lines from Gabo x Sonora gave a distribution similar to the F_2 distribution from a tolerant/sensitive cross, with the majority of lines showing intermediate and high tolerance. Plants selected from an F_2 population of Timstein x Sonora for high, intermediate and low RLE were kept and the F_3 populations grown with or without chlorsulfuron. The progeny of F_2 plants selected for high RLE showed most tolerance to chlorsulfuron in the F_3 generation, while progeny from those selected for low RLE showed least tolerance.