LONG TERM PERSISTENCE OF HERBICIDES IN AUSTRALIAN WHEAT BELT SOILS

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Abstract. One of the most important impacts on Australian wheat production during the last decade has been the widespread use of new generation herbicides for weed control. Although the increased usage of herbicides has already benefitted cereal production immensely, wheat growers are questioning how repeated chemical applications are likely to affect their soils.

However, research has indicated that the intelligent use of herbicides can be of considerable benefit in crop management and soil conservation. The ever increasing use of techniques such as stubble retention, inclusion of legumes in rotational cropping, reduction of tillage through chemical weed control and direct drilling, can help to increase growers' incomes and improve soil structure.

This project is concerned with monitoring the fate of herbicides in the soil by chemical and bioassay techniques and comparing field residues with carefully controlled bioassays to determine the effects of these residues on subsequent germination and growth of wheat and other sensitive crops in wheat rotations.

Initially, three of the most common herbicides currently used in wheat farming are being examined, namely, chlorsulfuron (Glean*), trifluralin (Treflan*) and diclofop-methyl (Hoegrass*).

In 1983, replicated test plots were sown to wheat at three sites on soils typical of the Australian wheat belt viz. Wimmera (grey self mulching clay, pH 8.4), Mallee (Mallee sandy loam, pH 7.7) and the North East (non-calcic red brown earth, pH 5.8).

At the Wimmera site (Dooen), the three herbicides were applied at recommended levels in a wheat-fallow rotation using normal cultivation practices. This design was repeated at the Mallee site (Walpeup) but with added treatments at twice the recommended level. In the North East (Rutherglen), both levels of herbicides were applied to experimental plots in a wheat-wheat phase of a typical rotation. A direct drill experiment using chlorsulfuron and diclofop-methyl with glyphosate (Roundup*) as a knockdown herbicide was also conducted at Rutherglen. At all sites, the treatments involving the recommended levels of the three herbicides following cultivation were repeated with the addition of in-crop sprayings of bromoxynil/MCPA (Brominil M*) for broad leaf weed control.

Soil samples were taken at time of spraying in 1983 and before planting in 1984, to determine residue levels remaining at the end of the twelve month period.

Sensitive analytical procedures have been developed for detecting trace levels of trifluralin and diclofop-methyl in soils. A sensitive bioassay is being developed for chlorsulfuron as chemical procedures are not applicable to the expected residue levels of 0.5ng kg^{-1} or lower.

Analysis of forty individual cores taken in the trifluralin field sampling experiment show wide analytical variations between cores taken from individual plots at each site (CV % 56, 104, 135). This could be explained by the volatility of trifluralin or by uneven mixing during incorporation in the field. Although results are as yet incomplete, the analytical variations for diclofop-methyl (non-incorporated) appear to be much lower.

Growth cabinet experiments are currently underway to determine levels of the herbicides likely to cause damage to sensitive crops in typical rotations. Results from these experiments will be correlated with chemically determined field residues and with field bioassays.

Future work will include modelling experiments to determine the influence of soil parameters such as moisture, pH and temperature on herbicide degradation, movement of herbicides through soil profiles and development of suitable diagnostic methods to provide information of possible damage to sensitive crops.

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