FIELD TRIALS ON DICLOFOP-METHYL TOLERANT WILD OATS (*AVENA FATUA*)

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Summary. The tolerance of a population of wild oats to diclofop-methyl was confirmed by pot tests. Field trials then showed the population to NOT be cross-resistant to alternative herbicides. Of the alternative herbicides, post-emergence herbicides were more effective than pre-emergence herbicides, due to the delayed emergence of significant numbers of wild oats. Fluazifop and tralkoxydim were particularly efficacious. A herbicide rotation is suggested for wheat/lupin cropping systems to minimise the chances of resistance development.

INTRODUCTION

Hoegrass® (with 375 g/l of diclofop-methyl as the active ingredient) was released in Australia in 1978 for control of wild oats, *Avena* spp, and annual ryegrass, *Lolium rigidum*, in many broadacre crops and annual pasture. Its efficacy and crop safety ensured ready market acceptance and it has become widely used throughout southern Australia. By 1982 however ryegrass populations resistant to diclofop-methyl were recorded from Naracoorte, S.A. (2) and Esperence, W.A. (Piper, unpublished).

In 1985, wild oats in a paddock near York, W.A. were observed to be very poorly controlled by diclofop-methyl and the possibility of resistance was considered. The response of these wild oats (called "resistant" hereafter) to diclofop-methyl was compared to that of wild oats from a neighbouring paddock where control was much better (called "susceptible") in a pot trial to establish the presence of resistance. A series of field trials was then undertaken in 1986 to ascertain the response of the population to diclofop-methyl and a number of other herbicides.

METHODS

Pot trials. Wild oats from both "susceptible" and "resistant" collections were sown in 20cm pots of sandy loam (30 seeds/pot) in March 1986 and maintained in a shadehouse. A commercial complete fertilizer was applied just after emergence, and the pots sprayed with diclofop-methyl (as Hoegrass + 0.25% Howet) when the oldest plants reached Zadocks 13, using a moving belt sprayer applying 200L/ha spray volume at 200 KPa . Emergence at this stage was ca. 30%. Any later emerging plants were removed by hand. The pots were maintained until panicle emergence, when plant survival and plant height was recorded. Three pots of each population were treated at each rate.

Field trials. *Preamble.*Any field trials on the herbicide response of resistant weeds are necessarily flawed by the absence of the preferred "control" plots. Standard weed/herbicide trials compare growth responses of treated and untreated weeds, whereas in the investigation of resistant weeds the preferred comparison would be to the effect of the same herbicide treatment on a susceptible biotype of the same weed. Obviously this is not possible in the field , and these trials use the conventional unsprayed plots as controls.

The resistant paddock was sown to lupins in 1986, allowing a wide range of herbicides to be trialled. For convenience of trial layout these were divided into pre-plant incorporated, post-plant pre-emergence, and post-emergence use mode and separate trials conducted for each group. All trials were conducted as randomised block designs of 5m X 20m plots with 3 replicates; treatments were applied with a motorbike powered boom @ 70L/ha spray volume, and the lupin crop was sown at standard district rates (90kg lupins, 100kg superphosphate/ha) by the farmer.

RESULTS AND DISCUSSION

A) Pot trials.
The pot trials revealed a definite reduction in response of "resistant" wild oats compared to "susceptible", although the difference was not found to be great. Observation of the "susceptible" population since 1986 has shown the wild oats to be less and less responsive to diclofop-methyl. It would seem that the "susceptible" population was some 2-3 years behind the "resistant" population in the development of tolerance. An alternative source of control wild oats was not available. Wild oats from uncultivated areas (therefore unsprayed) in W.A. are invariably *Avena barbata* (4) and thus not a valid control.

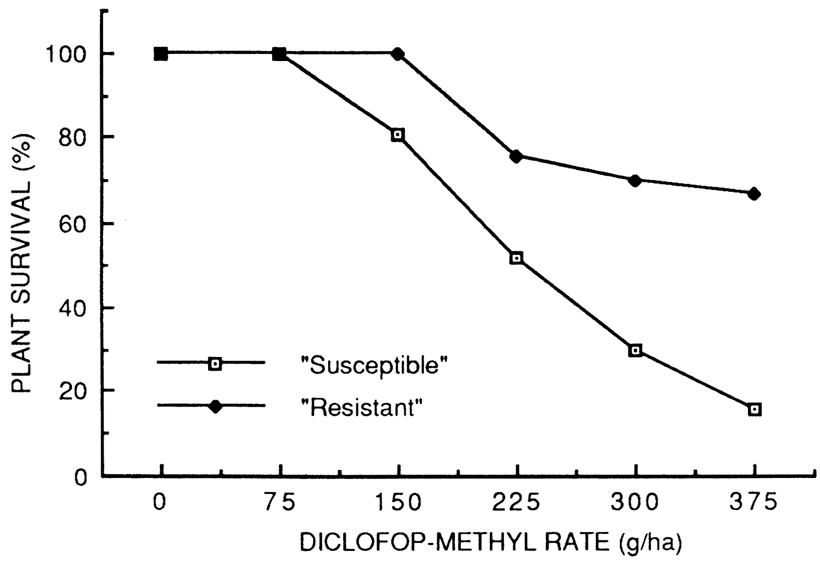

Figure 1. Comparative survival rates of two collections of wild oats after diclofop-methyl application

B) Field trials
Wild oat density over the site was very high, although not uniform. One feature noted in these trials was that diclofop-methyl stunted the wild oats rather than killing them. Thus mature plants produced panicles below rather than above the crop canopy. Although previous crops had appeared to have a low to medium burden of wild oats the actual numbers were probably much higher, leading to very high soil seed densities.

Table 1. Effects of various pre-plant incorporated herbicides on diclofop-methyl tolerant wild oats. (Seed counts were only made on treatments visually different from untreated)

Treatment (rate/ha)	Wild oat data 21/7/86 Plants /m^2	Wild oat data 21/7/86 Dry wt.g/m^2	W'oats /m^2 on 28/8/86	Lupin yield (kg/ha)
Triallate (840g)	369	76	755	1000
EPTC (1kg)	1055	141		860
Isoproturon (1.25kg)	1428	148		880
Simazine (750g)	341	15	1219	1064
Trifluralin (1.6kg)	270	70	713	1100
Untreated	1691	346	2367	672
Diclofop-methyl (562g)				1032
lsd	954	117	1000	218

Pre-emergence herbicides were not very effective for wild oat control (Table 1). Initial control from simazine, tri-allate and trifluralin was acceptable, but the herbicides did not persist long enough to cope with late germinating wild oats. In practical farming this would result in a rapid build-up in wild oat density. Counts were not made on the diclofop-methyl treated plots (they were only sprayed on 1/7/86) but wild oat survival was noted to be comparable with that recorded in Table 3. Despite the poor control, the diclofop-methyl treatment outyielded all the pre-plant incorporated herbicides. Suppression of all wild oats was evidently more advantageous than killing the first germinators.

Table 2. Effect of various post-plant pre-emergence herbicides on diclofop-methyl tolerant wild oats.

Treatment (rate/ha)	Wild oat data on 27/7/86		Lupin yield (kg/ha)
	Plants/m^2	Dry wt.g/m^2	
Metolachlor (1.44kg)	1319	345	720
Oxyfluorfen (480g)	257	48	933
Metribuzin (210g)	1382	268	733
Pendimethalin (495g)	814	264	907
Oryzalin (500g)	1612	267	787
Untreated	1265	263	760
Diclofop-methyl (562g)			1467
lsd	207	208	252

No post-plant pre-emergence herbicides gave acceptable control (Table 2). Oxyfluorfen reduced wild oat numbers significantly, but also caused unacceptable damage to the lupins. These eventually recovered to give a non-significant yield increase over the control plots, but the herbicide could not be recommended. Once again post-emergent diclofop proved a superior treatment.

Some of the post-emergent herbicides however gave much better results (Table 3). Fluazifop, tralkoxydim, and sethoxydim all reduced wild oats very significantly in early counts and virtually eliminated seed-set. Being applied six weeks after seeding their results were not impaired by late emerging wild oats.

The control obtained with fluazifop indicates that the development of diclofop-methyl tolerance in these wild oats does not seem to have resulted in cross-resistance to chemically similar herbicides, as has been observed in ryegrass (3). This fact will make control programs for these wild oats easier to devise.

Diclofop-methyl reduced early wild oat densities by only a third, and panicle numbers by only two thirds whereas tralkoxydim removed virtually all wild oats throughout the life of the crop, however the yield increases from both herbicides were equivalent. This illustrates the continuing ability of diclofop-methyl to suppress these wild oats and reduce their competitive potential, although it can no longer achieve total control. We feel justified therefore in classing the population as tolerant rather than resistant. It is likely that the farmer has gained an economic benefit from diclofop-methyl applications in previous years, even though control has been poor recently.These wild oats took 9 years to develop a tolerance to diclofop-methyl, compared to as little as 3 years for resistance to develop in ryegrass (2, Piper, unpublished). Wild oats have a high degree of seed dormancy resulting in a large carryover of seed into subsequent seasons, with seeds remaining viable for up to 6-9 years (1). They also exhibit staggered germination in any one year. Both factors delay the emergence of herbicide resistance and would explain the difference from ryegrass. Wild oats are also mostly self-pollinating, in contrast to ryegrass. This would reduce the genetic diversity within a population and may lessen the incidence of resistance genes.

In the years 1978-85 diclofop was the only herbicide available which would consistently control 95+% of wild oats within a crop. Consequently farmers were tempted to use it every year, in both wheat and lupin crops. Resistance had not been considered and there would have been hopes of complete eradication of wild oats.

Field experience subsequent to these trials has shown that haloxyfop and fenoxaprop will also give a high degree of control. This enables a rotational control program to be suggested to minimise the development of tolerance/resistance. Fenoxaprop and diclofop-methyl should be used in alternate wheat crops, with fluazifop, tralkoxydim and haloxyfop being alternated in lupin crops.

Table 3. Effect of various post-emergence herbicides on diclofop-methyl tolerant wild oats.

Treatment (rate/ha)	W'oats/m^2 28/8/86	Panicles/m^2 20/10/86	Lupin seed yield kg/ha	Lupin seed yield % of Untr
Cyanazine (250g)	1208		493	
Oxyfluorfen (480g)	437		600	
Metribuzin (210g)	1224		787	
Difenzoquat (747g)	1221	407	1013	
Flamprop-methyl (224g) + Barban (126g)	1829		1173	154
Propyzamide (750g)	925		1200	158
Tralkoxydim (200g)	85	0	1480	195
Sethoxydim (187g)	160	4	1560	205
Fluazifop-butyl (125g)	8	0	1707	225
Untreated	1616	970	976	100
Diclofop-methyl (562g)	1075	319	1427	188
lsd	922	247	260	

Panicles were only counted on treatments visually different from untreated.

ACKNOWLEDGEMENTS

This work was supported by Wheat Research Council funding, carried out with the technical support of Phillip Jenner and the farmer, John Hewitt.

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