Glyphosate resistance in annual ryegrass

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Herbicide resistance in Australia has been a significant problem, particularly with respect to annual ryegrass (*Lolium rigidum*). All groups of herbicides selective to this species have developed resistance but, to this time, no records of resistance to the knockdown herbicides used for pre-sowing weed control have occurred in annual ryegrass although barley grass and capeweed have been recorded as resistant to the bipyridyl herbicides represented in Spray Seed. Resistance to glyphosate, however, has generally been considered unlikely through consideration of its biochemical role and how it is used in the cropping program.

Method

Annual ryegrass seed was collected from a paddock near Echuca at the end of the 1995 cropping season after it was noted that plants had survived the knockdown herbicide application pre-planting as well as the sowing operation. The seeds were stored to allow for dormancy to be overcome and then subjected to a screening process to test for resistance to glyphosate. Seeds were planted in aluminium trays and allowed to germinate, after which thinning of each tray to 10 plants per tray was effected. At the 3 to 5 leaf stage, glyphosate was applied through an automatic spray cabinet to the trays at rates equivalent to nil, 0.3, 0.6, 1.2, 2.4 and 4.8 L/ha of glyphosate with Hoult surfactant. The same treatments were applied to annual ryegrass known to be susceptible to glyphosate, in order to make valid comparisons.

Results and discussion

Figure 1 shows the effect of different rates of glyphosate on the percentage of survivors in both the known susceptible and in the suspected sample. There was a significant difference in the response curves with the suspected sample showing a substantial increase in tolerance to the herbicide. At the 0.6 L/ha rate 93% of plants survived, whilst at 1.2 L/ha 30% of plants were unaffected. Plants survived up to 4.8 L/ha of the glyphosate chemical. In the susceptible plants there were no survivors at the 1.2 L/ha rate of glyphosate.

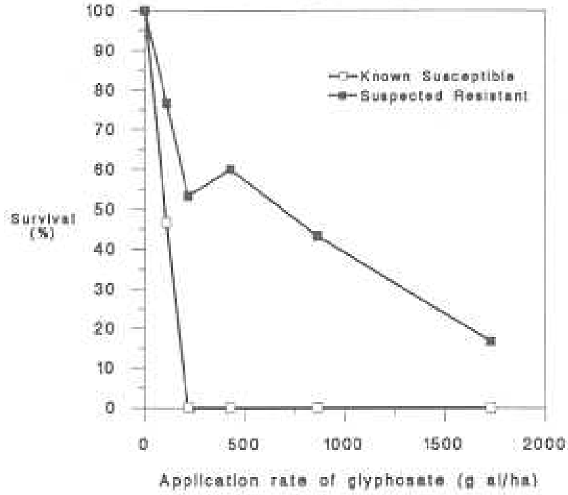

Figure 1. Effect of glyphosate (360 g a.i./L) plus Howet® (125 ml/100L of water) on annual ryegrass treated at the 3 leaf stage, 21 days post spray.

These results indicate that resistance to glyphosate is present. Further application of glyphosate will increase the extent of the resistance. The resistance has been brought about through regular use of the chemical since the early 1980s in a direct drill system of continuous crop production. About 10 applications of glyphosate have been used on this site.

The delay in the buildup of resistance in glyphosate, relative to other herbicides, would be due in part to its use pattern. As a pre-sowing knockdown, its failure for any reason to control plants can be masked if complete soil disturbance is achieved during sowing. Survivors of the sowing process may subsequently be controlled by the application of a selective post-emergent herbicide. A resistant plant therefore needs to survive a three phase process before it can add a seed supply to the soil for a new generation of resistant plants.

Farmers need to be diligent in observing and recording poor control. It is possible that such resistance may be an isolated occurrence or it may be that it has gone unnoticed. What is important is that we preserve the life of this very important chemical which is fundamental to our conservation farming systems. More attention needs to be given to implementing integrated weed strategies that consider the place of glyphosate.

Table 1. Effect of herbicides and time of application on ground cover (%) of wallaby grass (*Danthonia eriantha*).

Herbicide	Rate (L/ha)	Time of spraying W	Sp	Su	A
Roundup CT®	1	36.5ab	18.5bc	40.0ab	41.0a
	2	30.0ab	0.1e	9.2cd	8.2cd
Frenock®	1	3.2de	0.2e	1.4de	1.3de
	2	1.2de	1.4de	0.1e	0.2e
Control		45.0a			

Means not followed by a common letter differ significantly at P = 0.05; W = winter; Sp = spring; Su = summer; A = autumn.

Table 2. Effect of herbicides on ground cover (%) of native grasses (meaned for rate of herbicide and time of spraying).

Herbicide	Weeping grass	Threeawn peargrass	Redleg and kangaroo grass
At spraying	4.0a	8.0a	1.0b
At end of experiment on 12 February 1996			
Control	2.1a	7.8a	7.6a
Roundup CT®	3.5a	7.4a	2.2b
Frenock®	0.1b	1.8b	6.0a

Means in columns not followed by a common letter differ significantly at P =0.05

In our experiment wallaby grass tolerated low rates of Roundup CT® in summer, winter and autumn because plants were partly browned by frosts in winter and by dry conditions in summer and autumn. Lodge and McMillan (1994) showed low rates of Roundup CT® (0.4 to 0.8 L/ha) caused 20% to 40% phytotoxicity in wallaby grasses (D. richardsonii, D. linkii) 3 months after spraying, but high rates (1.2 to 3.2 L/ha) caused 60% to 90% phytotoxicity 3 months after spraying. Keys and Simpson (1993) found low (0.36 and 0.8 L/ha) and high rates (1.5 and 2.6 L/ha) of Roundup CT® caused severe plant losses in three wallaby grass species (*D.pilosa, D.racemosa, D.duttoniana*) when applied in autumn or spring which could be explained by plants having green leaves at spraying. They did not apply Roundup CT® in winter and summer in their experiment.

These results show that it is not possible to selectively kill serrated tussock, African love grass, Chilean needle grass or Giant Parramatta grass with Frenock® without severely damaging wallaby grasses, weeping grass or threeawn speargrass. However the above weeds could be selectively removed from redleg grass (using Frenock® at 2 L/ha) and from kangaroo grass or poa tussock (using Frenock® at 3 L/ha). If higher rates are used, or if an area is repeatedly sprayed, then even the tolerant grasses will be eliminated.

Roundup CT® (at 1 to 2 L/ha) could selectively remove weeds from a pasture containing weeping grass but not from one containing wallaby grasses. If applied in winter, after frosts have browned out redleg grass and kangaroo grass, Roundup CT® could remove weeds without damaging these grasses excessively, however, at other times of the year, when they have green leaves, Roundup CT® will severely damage them.

As there are many more useful native grasses than those cited above, research is needed to ascertain their tolerance to commonly used herbicides so that every effort can be made to retain them in the pasture after the weeds have been removed.

References

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