Yield increases in cereals following control of two perennial weeds in South Australia.

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Summary.
Two perennial weeds, creeping knapweed (hardheads, *Acroptilon repens* (L.) DC CENRE) and hoary cress (*Cardaria draba* (L.) Desv. CADDR), were controlled in cereal crops with herbicides during late winter to early spring. There was little increase in crop yield in the year of first treatment but in subsequent seasons crop yield increased by 36 to 98%. It was concluded that the increased cost of applying maximum rates of herbicides which control perennial root systems could be compensated by increased yields from subsequent crops.

Introduction

Creeping knapweed and hoary cress are perennial weeds which produce shoots in winter and grow most actively during spring to early summer. They are controlled in cereals in late winter to spring to prevent interference with harvesting and to reduce seed-set, but competition with the crop is reduced too late to prevent yield losses. Farmers have found through experience that low rates of herbicides will often control the shoots, but not the roots, of perennial weeds, thus allowing the problem to recur annually.

Materials and methods

Experiment one commenced in 1984 near Georgetown, South Australia (Lat 33°S: Long 138°E; average annual rainfall 400 mm) on a red clay-loam soil (pH 7.1) infested with creeping knapweed. The site use was; 1984: barley; 1985: pasture; 1986: pasture and 1987: wheat. Herbicide treatments were applied on 29/8/84 and 30/9/85 when the creeping knapweed was in the mid-rosette stage (untreated shoot density, 1985, = 70.1 m^{-2}). Crop yield was measured on 17/12/84 and 10/12/87.

Experiment two commenced in 1985 at Turretfield Research Station, South Australia (Lat 34°S: Long 138°E; average annual rainfall 460 mm) on a clay-loam soil (pH 8.5) infested with hoary cress. The site use was; 1985: oats; 1986: oats and 1987: sown pasture. Herbicide treatments were applied on 19/8/85 and 15/7/86 (early treatments) and 6/9/85 and 30/7/86 (late treatments) when the hoary cress was in the early- and mid-rosette stages (untreated shoot density, 1986 = 59 $^{m-2}$). Crop yield was measured on 5/12/85 and 4/12/86.

The experiments had a randomised complete block design with four replicates. Plot sizes were 4 x 10 m (site 1) or 3 x 10 m (site 2). Herbicides were applied to the same plots in successive seasons through flat fan nozzles (110 degree) mounted on a hand-held, 2 m wide boom, pressurised by carbon dioxide and applied at a rate of 200 l ha^{-1}. Weed density was measured from four $1m^2$ (Expt. 1) or $0.07m^2$ (Expt. 2) quadrats. The standard EWRC scoring system (1) was used for visual assessment. Grain yield was measured from an area 10 x 1.25 m, harvested by a Hege small plot harvester.

Results

Table 1. Creeping knapweed control and barley yield in experiment 1.

Treatment	Rate (g a.i. ha^{-1})	Weed Density* 13 MAT1#	Weed Density* 24 MAT2	Crop Yield* 1984	Crop Yield* 1987
Clopyralid	600	18	30	92	186
Clopyralid	1200	0	35	82	198
Clopyralid + metsulfuron methyl	600 + 12	5	37	99	190
Clopyralid + 2,4-D amine	600 + 500	21	29	87	184
Clopyralid + MCPA amine	600 + 500	13	39	81	169
Clopyralid + dicamba	600 + 200	12	15	96	173
Untreated-	100	100	100	100	
lsd (P=0.05)		26	59	31	35

* % of untreated; # months after treatment 1 or 2.

Table 2. Hoary cress control and oat yield in experiment 2.

Treatment	Rate (g a.i. ha^{-1})	Weed Control EWRC Score** 7/10/85	Weed Control Shoot Density* 5/9/86	Crop Yield* 1985	Crop Yield* 1986
Early Crop Tillering treatments					
Chlorsulfuron	22.5	2.3	3	119	229
Triasulfuron	25.0	2.0	20	129	190
Late Crop Tillering treatments					
Fluroxypyr	250.0	2.8	0	102	179
Clopyralid /Fluroxypyr	60/180	2.8	8	96	136
Untreated	-	9.0	100	100	100
lsd (p=0.05)		-	73	23	43

*% of untreated;**EWRC visual rating system

Discussion

Large yield increases resulted from control of perennial weeds, but they did not occur in the year of herbicide application (Tables 1 and 2). In experiment one, control of creeping knapweed one year after the first treatment was very good, with shoot density ranging from 0 to 21% of the untreated plots (Table 1). Shoot density two years after the second herbicide application ranged from 15 to 39% of the untreated plots. There were no increases in barley yield in the first year, despite the high level of weed control achieved four months prior to harvest. Yield ranged from 81 to 99% of untreated plots, suggesting that the phytotoxic effects of the herbicides were greater than any reduction in weed competion. Two years after the second herbicide application there were large yield increases in wheat. All of the treatments had a yield significantly higher than the untreated, ranging from 169 to 198% of the untreated plots.

In experiment two control of hoary cress shoots in the first year was good, with EWRC visual score ratings ranging from 2.0 to 2.8 (Table 2). One to two months after the second herbicide application shoot densities ranged from 0 to 20% of the untreated plots. There was a significant increase in oat yield three to four months after the first treatments were applied from only one treatment, triasulfuron. One to two months after the second treatment all of the treatments except clopyralid/fluroxypyr gave large and significant yield increases.

In both experiments crop yield increases occurred in the season after weed control. Yield increases did not generally occur in the first year when weeds were controlled in late winter or spring because yield potential is mostly determined during the early stages of the crop. The yield increases in subsequent years probably resulted from reduced depletion of soil water and nutrients prior to sowing and the release of stored nutrients as the extensive weed root systems decomposed. Low herbicide rates can prevent harvesting problems and reduce seed-set, but kill few perennial root systems. As a result, the problem is as bad in the next year. The costs of applying maximum label rates of herbicides to perennial weeds may be compensated by increased yields from subsequent crops if significant numbers of root systems are killed.

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