Crops

TOLERANCE OF FIELD BEANS TO HERBICIDES

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Summary

A number of herbicides were evaluated for use in field beans (*Vicia faba* var. *minor*). Yield responses of up to 16% in a moderately weedy crop were obtained. Tolerance trials suggested that crop tolerance was not large to the post-emergence materials as yield depressions were recorded following application of dinoseb acetate, dinoseb amine, bentazone, MCPB, MCPB plus bentazone and MCPB plus dinoseb acetate applied at two growth stages. It is suggested that where annual broadleaved weeds are anticipated pre-plant or pre-emergence herbicides should be used and that post-emergence herbicides be used only where subsequent weed competition is severe. The wild oat herbicide diclofop-methyl, difenzoquat and flamprop-methyl did not reduce seed yield when applied at the 10-12 node stage in a wild oat free crop.

INTRODUCTION

Interest in field beans (also known as tick beans, horse beans, faba beans) as a protein source for feed supplements has led to a number of farmers throughout Canterbury growing the crop (Newton and Hill 1978).

Because the crop is usually autumn or early spring sown and thus usually avoids moisture stress, and because the plants elongate rapidly shortly before and during flowering, it was expected that the low growing cool season annual weeds would seldom present a problem. However, the taller growing weeds, wild oats (*Avena* spp.), phalaris minor (*Phalaris minor*), Californian thistle (*Cirsium arvense*) and, in later sown crops, fathen (*Chenopodium album*) have been reported as troublesome and information on control measures requested. British recommendations for process broad beans (MAFF 1979) and Hawkes Bay recommendations (Stevenson 1979) include the use of simazine pre-emergence, dinoseb acetate pre- or post-emergence and bentazone post-emergence, while in Canada Drew (1976) states that MCPB warrants registration for use on faba beans. Some Canterbury growers have used simazine at 0.8 - 1.2 kg/ha as a precautionary measure, but wireweed (*Polygonum aviculare*) has been poorly controlled and in some cases has benefitted from removal of other annual weeds.

In the 1975-76 season at Lincoln small plot trials indicated that field beans had tolerance to post-emergence applications of MCPB 1.0 kg/ha, dinoseb acetate 3.0 kg/ha, bentazone 1.44 kg/ha, difenzoquat 1.0 kg/ha and diclofop-methyl 1.0 kg/ha. Post-emergence application of terbutryn 0.5 kg/ha, metribuzin 0.375 kg/ha and asulam 1.0 kg/ha all severely reduced yield.

This paper reports three sets of trials to investigate the tolerance, under field conditions, of field beans to the former group of chemicals.

METHOD

Table 1 sets out the trial locations, date of application of treatments and growth stages of the beans.

Two broad-leaved weed herbicide trials at Lincoln, one in the 1977-78 growing season and one in 1979-80 compared herbicides at rates and times listed in Tables 1 and 2. Because of foliage burn on dinoseb plots at the first time of treatment in 1977, the rate was lowered for the second time of treatment in both trials. The details of MCPB tolerance trials are set out in Tables 1 and 3. At Ashburton an infestation of couch

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Proc. 33rd N.Z. Weed and Pest Control Conf.

Crops

TABLE 1: Sites, application date and growth stages of field beans

Trial and site	pre-emergence	Spraying date (node stage)			
		1		2	
broad-leaved weed herbicides					
Lincoln Research	19.7.77	27.9.77	(5-6)	28.10.77	(12)
Lincoln mixed cropping	13.6.79	10.9.79	(6-7)	17.10.79	(10-11)
MCPB tolerance					
Lincoln mixed cropping		31.8.77	(5-6)	17.10.77	(10-12)
Annat		19.10.78	(5-6)	3.11.78	(10-11)
Ashburton		24.11.78	(5-6)	1.12.78	(8-10)
Lincoln mixed cropping		21.8.79	(5-6)	11.10.79	(10-11)
Wild oat herbicides					
Annat		-		3.11.78	(10-11)

(*Agropyron repens*) proved considerably more severe than expected from an initial inspection. Details of the wild oat herbicides tested are set out in Tables 1 and 4. No wild oats were present.

A randomized block design with 4 replicates and plots 10 m or 20 m long by 2 m wide was used in all cases. Two untreated plots per replicate were included in all trials except the 1977-78 broad-leaved herbicide trial, and all trials (with the same exception) were given a standard simazine treatment to block broad-leaved weed germination.

Treatments were applied with a bicycle wheel mounted, compressed air operated spray boom hand pushed at a speed calculated to deliver 200 litres/ha at 210 kPa pressure.

Plots were scored for herbicide effect (crop damage, weed control) at intervals and plots 1.5 m wide were direct headed with a Wintersteiger Seed Master harvester.

RESULTS AND DISCUSSION

Broad-leaved weed herbicide treatments

All post-emergent treatments had visible effects on the bean plants. MCPB and MCPB mixtures caused stem curvature and inrolling of leaves while bentazone and dinoseb formulations caused blackening of the leaf edges and dark mottling of leaf surfaces. The early sprayed plants tended to grow out of these damage symptoms but with the later time of spraying, MCPB curvature and the bentazone and dinoseb leaf damage was still evident at harvest time.

The sites differed markedly in weed population. More weeds than expected appeared in 1977-78 while in 1979-80 there were few weeds as a result of simazine treatment.

The principal weeds in the 1977-78 trial were shepherd's purse (*Capsella bursa-pastoris*), field pansy (*Viola arvensis*), wireweed (*Polygonum aviculare*) and spurrey (*Spergula arvensis*). A visual score for total weeds on 7.12.77 divided the post-emergence treatments clearly into two groups. Firstly the early treatments, other than MCPB, were not significantly more weedy than simazine 1.4 kg/ha. Secondly the later treatments, plus early MCPB, were significantly more weedy than simazine 1.4 kg/ha but, except for the late MCPB, not as weedy as untreated. With respect to the above weeds individually, none was satisfactorily controlled by the late treatment. While the overall effect of the early group of treatments was satisfactory there were differences in the response of individual weeds. Shepherd's purse was adequately controlled by all treatments except MCPB. Field pansy appeared best controlled by the MCPB plus dinoseb mixture. Spurrey was eliminated by bentazone but unaffected by MCPB. Wireweed control was the least satisfactory with some wireweed establishing in the simazine 1.4 kg/ha plots. Wireweed control was good with MCPB and dinoseb amine applied together but ineffective when applied separately.

Crops

TABLE 2: Yield of field beans as % of simazine treated (approx. weed-free)

Herbicide	Rate kg/ha	Days from sowing to treatment					
		1977-78			1979-80		
		1	71	102	1	89	126
simazine	1.4	100			100		
simazine	2.8	98					
bentazone	1.44		99	86		89	76
MCPB	1.2		90	88		87	-
dinoseb (acetate)	3.0		93			88	
dinoseb (acetate)	2.5			81			92
dinoseb (amine)	1.44		95			85	
dinoseb (amine)	1.2			81			84
MCPB + bentazone	1.2		95	88		85	77
MCPB + bentazone	1.44						
MCPB + dinoseb (amine)	1.2		86			85	
MCPB + dinoseb (amine)	1.44						
MCPB + dinoseb (amine)	1.2			92			78
untreated	1.2	86			-		
s.e. (mean)			4.2			5.6	
simazine yield		3.47 t/ha			2.14 t/ha		
CV%		9.4			13.7		

Because of the presence of weeds, crop tolerance effects, could not be separated from weed competitive effects in the 1977-78 results. The variation in yields (Table 2) was as would be expected with treatments giving different degrees of weed control. However, since the yields in the virtually weed free 1979-80 trial were in general depressed and the treatments caused visible damage, tolerance must be suspect, especially with treatments applied at the onset of flowering.

TABLE 3: Effect of time and rate of application of MCPB on yield of field beans (tonnes/ha)

MCPB kg/ha	Time of Appl.	Lincoln 1977-78	Annat 1978-79	Ashburton 1978-79	Lincoln 1979-80	Combined analysis
0.5	First	2.49	2.08	0.65	2.08	1.82
1.0	"	2.40	2.06	0.38	2.27	1.78
1.5	"	2.35	1.84	0.30	2.13	1.66
2.0	"	2.24	2.12	0.23	2.47	1.76
0.5	Second	2.29	2.44	0.62	2.10	1.85
1.0	"	2.41	2.08	0.55	2.15	1.79
1.5	"	2.26	2.24	0.52	2.23	1.80
2.0	"	2.13	2.17	0.47	2.05	1.69
not treated		2.49	2.46	0.92	2.44	2.07
s.e. (treated means)		0.22	0.34	0.18	0.15	0.076
not treated vs treated		*	**	**	*	**
Time		ns	**	**	ns	ns
Rates		*	ns	**	ns	ns
Time x rates interaction		ns	ns	ns	ns	ns
CV%		8	10	21	14	8

Crops

The 1977-78 trial indicated that moderate infestations of low growing annual weeds can affect field bean yields, in this instance a loss of 14% compared with the weed-free simazine treatment. This was contrary to expectations.

MCPB tolerance

The tolerance of field beans to MCPB was not as satisfactory as was suggested from overseas data (Drew 1976). Plants treated with MCPB became twisted and although they subsequently recovered there was an average yield reduction of 0.3 t/ha in the combined analysis of the four trials. With the higher rates stem curvature persisted until harvest and often plants were shorter by up to 5-10 cm. Some leaf burn also occurred. However, the effect of rate on yield was variable and not statistically significant. The effect of time was also variable and not significant. Optimum spraying stage for Californian thistle is most likely to occur in October (i.e. the later application date), but should not be delayed beyond first appearance of flowers. Application during flowering, tested in the pilot trials, caused pod abortion with serious loss of yield.

Wild oat herbicide treatments

Visual symptoms were slight and unlikely to cause concern. Diclofop-methyl caused some burning of upper and lower leaf surfaces, a slight inrolling of the upper leaves and occasional crumpling of leaf surfaces. Difenzoquat caused a slight leaf edge burn and caused the foliage to pale slightly. Leaf width was reduced very slightly. No visible damage was caused by flamprop-methyl.

There were no significant differences in yield between either the lower or higher rates of chemical and the untreated control, thus indicating adequate tolerance of field beans to the three chemicals. However, when analysed for main effects diclofop-methyl yielded significantly more than flamprop-methyl or difenzoquat. This suggests within the limits of precision of one trial, that field beans will tolerate more diclofop-methyl than flamprop-methyl or difenzoquat.

TABLE 4: Effect of wild oat herbicides on yield of field beans (tonnes/ha)

Herbicide	Rate kg/ha	Yield	Herbicide main effect
difenzoquat	0.75	1.78 b	1.74 b
difenzoquat	1.5	1.69 b	
diclofop-methyl	0.75	1.95 ab	2.01 a
diclofop-methyl	1.5	2.07 a	
flamprop-methyl	0.75	1.87 ab	1.79 b
flamprop-methyl	1.5	1.72 b	
not treated		1.89 ab	
s.e. (mean)		0.08	0.06
CV%		9.3	

CONCLUSION

Tolerance of field beans to broad-leaved herbicides is highest pre-emergence and decreases as the crop matures. Simazine could be used as a standard pre-emergence herbicide and post-emergence herbicides should only be needed where resistant weeds e.g. twin cress (*Coronopus didymus*) (Stevenson 1979) are present. Bentazone, dinoseb (both amine and acetate formulations), MCPB and MCPB mixtures will all cause damage symptoms, but overall yield is unlikely to be affected in the presence of weeds, provided treatment is not delayed after the 5-7 node stage. MCPB alone should only be used where Californian thistles are present and likely to decrease yield.

Field beans tolerate the rates of diclofop-methyl, flamprop-methyl and difenzoquat used to control wild oats.

Crops

ACKNOWLEDGEMENTS

The assistance of Messrs D.M. Leathwick, G.A. Hurrell, M. Langlands and the late T.J. Smallridge with field work is gratefully acknowledged, and to the farmers Messrs A.W. Bishel and J.T.H. Nicol, Lincoln College Research Farm and the Lincoln College Mixed Cropping Farm who let us apply herbicides to crops when crop tolerance could not be guaranteed.

REFERENCES

- Drew, B.N., 1976. Faba beans. *Canada Weed Committee Western Section Res. Rep.*: 166(a).
- MAFF, 1979. *Weed control in vegetables*. ADAS Leaflet HUG 28: Ministry of Agriculture, Fisheries and Food, London.
- Newton, S.D. and Hill, G.D., 1978. A survey of commercial field beans (*Vicia faba* L.) crops in Canterbury. *Proc. Agronomy Society of N.Z.*: 31-35.
- Stevenson, M.R., 1979. Evaluation of herbicides for broad beans. *Proc. 32nd N.Z. Weed and Pest Control Conf.*: 119-122.