CONTROL OF SOLANACEOUS WEEDS IN PROCESS SNAP BEANS

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SUMMARY

The almost exclusive use of the herbicide trifluralin coupled with the lack of adequate crop rotation has led to a predominance of solanaceous weeds in the major process bean growing areas of New Zealand. A series of five trials were carried out in Hawkes Bay during the 1983-85 seasons evaluating pre-planting and pre-emergence treatments. Metolachlor gave little nightshade control, EPTC at recommended rates gave variable and poor results while alachlor or dinitramine alone or trifluralin plus either alachlor or chloramben gave good control. Hairy nightshade was only controlled by dinitramine while thornapple was controlled by dinitramine and chloramben plus alachlor.

INTRODUCTION

Snap beans (*Phaseolus vulgaris*) are grown for processing on over 600 ha annually in Hawkes Bay and some 2000 ha nationally. The most common weeds encountered are black nightshade (*Solanum nigrum*), hairy nightshade (*Solanum sarrachoides*), fathen (*Chenopodium album*), redroot (*Amaranthus retroflexus*) and, to a lesser extent, thornapple (*Datura stramonium*).

Applying a soil incorporated herbicide prior to planting has given the best control (Stevenson 1975). Because of their reliability and convenient time of application these herbicides, currently trifluralin and EPTC, have become standard treatments. Soil incorporation is usually followed by one or two cultivations during the early growing stages of the crop prior to flowering. Where necessary, a post emergent application of bentazone is made at the second trifoliate leaf stage. Nightshades have become a bigger problem in recent years as the current herbicide programme has failed to adequately control the two species. Crop rotation could assist control, but growers have insufficient land to allow even a 3 to 4 year rotation period.

Processing companies are becoming more concerned at the levels of nightshade in the harvested crop, as the seeds stick to the bean pods throughout the factory process. Because of the high cost of removing nightshade seeds at the factory companies have a nil tolerance for nightshade, with the likely rejection of the crop where the weed is present. This has led to the re-introduction of hand-weeding by growers to give total weed control. Hence there is a need to further evaluate herbicides to give a high level of weed control and reduce grower costs. No new post-emergence herbicides evaluated (Geelen unpublished) have proved superior to bentazone, and thus the current series of trials concentrated on pre-planting and pre-emergence application periods. Differences in varietal herbicide tolerance, particularly by yellow beans, led to several trials including both yellow and green cultivars.

METHOD

Five trials were set up in the Hastings district during 1983-85. Details of site locations and soil types together with agronomic, application, rainfall and assessment data are in Table 1. Trials consisted of plots 2 m wide and from 5 m to 10 m long. Treatments were replicated three times (four times in Trial 1) in a randomised complete block design.

Herbicide applications were made with a hand-held modified Oxford CO₂ knapsack sprayer delivering 300 litres/ha at 210 kPa. Soil incorporated treatments were applied 1-3 days prior to sowing and incorporated immediately, either to 7-10 cm using *Proc. 39th N.Z. Weed and Pest Control Conf.*

TABLE 1: Experimental Information.

Trial No.	I	II	III	IV	V
Location	Mangatere- tere	Mangatere- tere	Tomoana	Mangatere- tere	Pakowhai
Soil type	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Silt loam
Organic matter %	3.8	3.8	—	3.9	4.2
Variety					
1. Green	G50 ¹	G50	EG ²	G50, EG,	G50
2. Yellow	Majestic	Majestic	—	Majestic, Wax 216	—
Sowing date	9.12.83	31.10.84	6.11.84	12.11.85	6.12.85
Equipment	Planet Junior	Planet Junior	Nodet	Cone Seeder	Nodet
Herbicide applications					
1. Pre-plant	6.12.83	30.12.84	31.10.84	8.11.85	6.12.85
2. Pre-emergence	—	2.11.84	8.11.84	14.11.85	12.12.85
Rain at planting	7/11.11.83	1/3.11.84	1/3.11.84	2/3.11.85	3/8.12.85
Amount of rain	14 mm, 5.5 mm	16 mm	16 mm	12 mm 4 mm	44 mm 2 mm
Weed counts	9.1.84	13.12.84	7.12.84	6.12.85	7.1.86
Weed scores	21.12.83	29.11.84	29.11.84	3.12.85	7.1.86

¹G50 = Gallatin 50 ²EG = Early Gallatin

a rotary hoe, or to 3-5 cm with two passes of a rotatiller in different directions. Pre-emergence treatments were applied with the same sprayer and raked in immediately after application. In Trial V the grower had incorporated trifluralin over the whole area 2 weeks prior to the trial treatments being applied.

Sites which were heavily infested with solanaceous weeds were selected. Black nightshade was the dominant weed in most of the trials but in Trial III thornapple was predominant. Hairy nightshade was common in Trial V. Other weeds varied between trials but solanaceous weeds represented 67% in Trial I, 94% in Trial II, 84% in Trial III, 72% in Trial IV and 99% in Trial V. Detailed weed counts were made about 1 month after sowing from two 0.25 m² quadrats taken at random from the middle area of each plot. Individual plots were also given an overall weed control score. Assessments of crop damage caused by the herbicides were made at the same time as the weed score.

Trial IV was the only trial harvested and was hand weeded after the weed assessments to ensure yield differences at harvest related to the herbicide and not weed pressure. Each of the four varieties (Gallatin 50, Early Gallatin, Majestic and Wax 216) were harvested from 2 m of the row in the centre of each plot.

RESULTS AND DISCUSSION

Control of black nightshade was only effective with alachlor (Lasso 50 EC) either at 2.5 kg ai or 3.0 kg ai/ha (Tables 1 and 2). EPTC+ (Eradicane Super) and trifluralin (Treflan 40EC) failed to give adequate control although EPTC+ occasionally caused some initial suppression of nightshade similar to that reported by Cox (1971). Trifluralin gives excellent control of grasses and a range of broadleaf weeds. Thus for broad spectrum weed control, especially of redroot and fathen, alachlor must be combined with trifluralin (Kean pers. comm.). Later trials therefore concentrated on evaluating this combination as a tank mixture.

In Trial II, under the very high weed pressure, only the pre-plant soil incorporated treatments significantly decreased black nightshade levels (Table 3). These included

TABLE 2: Black Nightshade control in Trial I.

Treatment	Rate (kg ai/ha)	Timing & equipment	% Black nightshade control	Weed* score
alachlor	3.0	PPSI, ¹ r/tiller	91a ²	1.4
alachlor	2.5	PPSI, r/tiller	93a	0.4
+ trifluralin	0.8	r/tiller		
EPTC + ³	5.8	PPSI, r/tiller	24b	3.4
trifluralin	1.0	PPSI, r/tiller	43b	5.0
untreated	—	r/tiller	0b (163)†	10.0
C.V.%			43	

* Weed score 0-10 scale where 10 is 100% ground cover by weeds.

† Weed numbers/m².

¹ PPSI = pre-plant soil incorporated.

² Means within columns with common letters are not significantly different at the 5% level using Duncan's Modified Multiple Range Test, and based on transformation of original data by $x = \sqrt{x + 0.5}$.

³ EPTC+ in all trials is EPTC + R - 25788 (antidote) + R - 33865 (extender)

alachlor at 2.5 or 3.0 kg ai/ha rolatiller incorporated, chloramben (Amiben DS) at 4.2 kg ai/ha or in combination with alachlor. Pendimethalin (Stomp 330EC) combined with alachlor proved far more effective than when applied alone. In Trial III black nightshade was present only at a low level and most treatments gave significant control of the weed (Table 3). The most common weed present, thornapple, accounted for 80% of the total weeds present and although the weed counts show alachlor and chloramben, dinitramine (Cobex 24EC) and pendimethalin all gave significant control, the weed scores point to dinitramine being the only product to give convincing control of this increasingly widespread weed. Dinitramine has not been commercially available for several years but moves to re-introduce the product are being made. However at 1 kg ai/ha it has been found to reduce yields of yellow beans (Stevenson 1975). Because dinitramine was not evaluated on yellow beans in these trials further work is necessary before this material can be recommended.

Under the very high weed pressure in Trial IV the individual weed counts should be seen in conjunction with the weed scores for each treatment (Table 4). When these are viewed together, alachlor at 2.0 or 2.5 kg ai/ha either alone or combined with trifluralin and incorporated with a rolatiller gave excellent control. Deep incorporation failed to control the weed possibly because nightshade is a shallow germinator. Metolachlor (Dual 720EC) alone at 3.6 kg ai/ha gave no control but at 2.2 kg ai/ha in combination with trifluralin provided very good control. At the high rate metolachlor caused severe leaf burn on all bean varieties, especially Majestic, and this effect was still noticeable at harvest. The lower rate had no adverse effect on the crop.

All four varieties were harvested from this trial and no significant differences in seed length and number of plants per length of row were evident from any treatments in any variety. The only treatment to significantly reduce the yield below untreated was alachlor 1.5 kg ai/ha PE. This (reduction 3.2%) only occurred in the variety Early Gallatin.

Trifluralin, incorporated by the grower two weeks prior to sowing, failed completely to control the two nightshade species and despite later inter-row cultivation and hand-weeding the entire 10 ha crop was rejected for harvest because of the high weed population. In Trial V alachlor and dinitramine gave excellent black nightshade control. Control of hairy nightshade by dinitramine at 1.0 kg ai/ha and alachlor at 2.5 kg ai/ha was 100% and 64% respectively.

TABLE 3: Nightshade and thornapple control.

Treatment	Rate kg ai/ha	Timing & equipment	Trial II	Trial III		Weed score
			B. nightshade control (%)	B. nightshade control (%)	Thornapple control score	
alachlor	1.5	PPSI, r/tiller	0b	76ab	19bc	7.9
alachlor	3.0	PPSI, r/tiller	77a	90.a	51abc	5.4
alachlor	3.0	PE*	54ab	79ab	49abc	6.7
alachlor	1.5	PPSI,	61a	100a	76a	6.9
+ chloramben	2.1	r/tiller				
alachlor	1.5	PPSI,	57a	62abc	41abc	8.2
+ pendimethalin	1.7	r/tiller				
alachlor	2.5	PPSI,	54ab	90a	0c	10.0
+ trifluralin	0.8	hoe				
alachlor	2.5	PPSI,	76a	79ab	56abc	9.6
+ trifluralin	0.8	r/tiller				
chloramben	4.2	PPSI, r/tiller	62a	29bc	46abc	5.4
dinitramine	1.0	PPSI, r/tiller	—	90a	67ab	0.9
EPTC +	5.8	PPSI, hoe	36ab	67abc	11c	5.6
pendimethalin	1.7	PPSI, r/tiller	0b	76ab	72ab	3.9
pendimethalin	1.7	PE	28ab	—	—	—
untreated	—	r/tiller	0b(225.4) ¹	0c(28.0)	0c(117.3)	10.0
C.V. %			32	38	25	

— Treatment not included ¹ Weed numbers/m² * PE pre-emergence

TABLE 4: Black nightshade control in Trial IV.

Treatment	Rate kg/ha	Timing & equipment	% Black nightshade control	Weed score
alachlor	1.5	PE	61bc	8.5
alachlor	2.5	PPSI, r/tiller	87a	2.2
alachlor	2.0	PPSI,	76ab	1.4
+ trifluralin	0.8	r/tiller		
alachlor	2.5	PPSI,	47c	5.7
+ trifluralin	0.8	hoe		
alachlor	2.5	PPSI,	86a	1.5
+ trifluralin	0.8	r/tiller		
EPTC +	5.8	PPSI, hoe	0d	7.3
metolachlor	3.6	PPSI, r/tiller	0d	7.5
metolachlor	2.2	PPSI,	70abc	2.7
+ trifluralin	0.8	r/tiller		
untreated	—	r/tiller	0d(274.9)	9.7
C.V. %			20.3	

CONCLUSIONS

Trifluralin can occasionally give some reduction in black nightshade but can be regarded as ineffective. EPTC+ is an alternative product used commercially but these trial results show variable and generally poor control. Black nightshade was best

controlled with dinitramine (1 kg ai/ha) and alachlor (2-3 kg ai/ha) and with the combination of alachlor plus chloramben or pendimethalin. Shallow incorporation was essential for good control.

Dinitramine gave the best control of hairy nightshade although alachlor at 2.5 kg ai/ha gave reasonable control. Dinitramine also gave good control of thornapple.

Metolachlor (3.6 kg ai/ha) was the only treatment to adversely affect snap beans. Dinitramine was not evaluated on yellow beans in any of these trials and therefore further data is necessary before this material can be recommended for use on this crop.

ACKNOWLEDGEMENTS

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REFERENCES

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