EXPERIENCES WITH SELECTIVE HERBICIDES WHEN DEVELOPING COMPLETE MECHANIZATION TECHNIQUES FOR GROWING FODDER BEET

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Summary

In a complete mechanization trial on fodder beet, using fresh and stale seed-bed techniques with pyrazon and lenacil, the highest yields were obtained from early sowings on fresh seed-bed plots following a combined pre-emergent pyrazon/lenacil application and multiple applications of pyrazon. Weed populations were appreciably less on all stale seed-bed plots but yield suffered because of the delayed drilling. Pre-emergent pyrazon/lenacil and lenacil alone gave the best weed control and yield on a later sown fresh seed-bed trial when compared with increased rates of pyrazon. The prevailing weed throughout both trial areas was fathen (*Chenopodium album*).

INTRODUCTION

If fodder beet could be grown without the need of hand labour for thinning and weeding, it is likely that the acreage under this valuable crop would increase appreciably. The New Zealand Agricultural Engineering Institute had this in mind when a programme to devise a completely mechanized system of growing fodder beet was undertaken.

It was planned to eliminate the need for hand-thinning by the use of rubbed and graded seed of known germination in conjunction with a precision spacing drill set to produce between 25,000 and 50,000 beet per acre. Weeds growing between the rows were to be controlled mechanically with a tractor-mounted multi-row steerage hoe.

To determine the efficiency of possible methods of weed control within the row, as a necessary part of the overall system, the following two trials were undertaken using fresh and stale seed-bed techniques together with the herbicides lenacil and pyrazon.

EXPERIMENTAL

TRIAL A

A 4½ acre area of Temuka silt loam was prepared for sowing on September 13, 1967, using a shallow seed-bed technique following winter ploughing. Fresh seed-bed treatment plots (F) were sown with Yellow Daeno fodder beet on the same day using a five-row Stanhay precision drill set to sow at a 5½ in. spacing in 20 in. rows. Stale seed-bed treatment plots (S) were sown similarly on October 18, after a good emergence of weeds had occurred, without further soil movement.

All weeds on the "S" plots were desiccated by an overall application of paraquat (8 oz/acre plus wetting agent) on October 27 before the best seedlings emerged.

Selective herbicide treatments on all plots were applied as a 5 in. wide band directly over the row using a simple boom carrying five matched Spraying Systems No. 730231 nozzles.

A tractor-mounted five-row steerage hoe equipped with concave discs and set to leave a 2½ in. wide unhoed strip was used for inter-row weed control.

No hand-hoeing, thinning or weeding was given to any plot other than to remove an occasional dock (*Rumex* sp.) or Californian thistle plant (*Cirsium arvense*).

Applications (in lb a.i./acre) and their date of application on each type of seed-bed were as follows:

Application Code	Application	Date Applied	
		Fresh Seed-bed Plots	Stale Seed-bed Plots
P	pyrazon pre-emergence 4	13 Sept.	18 Oct.
A	pyrazon post-emergence 4.8	11 Oct.	29 Oct.
L	pyrazon late post-emergence 4.8	3 Nov.	Not applied
V	lenacil pre-emergence 1.6	14 Sept.	18 Oct.

Alkylaryl polyglycol ether at 1.25 as a wetting agent was applied with all post-emergent applications of pyrazon.

Applications were combined on some plots to give seven treatments on each seed-bed type as follows:

On fresh seed-bed plots:

FP
FA
FPA
FPAL
FAL
FV
FPV

On stale seed-bed plots:

SP
SA
SPA
SPAL*
SAL
SV
SPV

*The L application was not given as the plants were too big.

There were thus 14 treatments in the trial. All plots were five rows wide and approximately 200 yd long. Treatments were replicated three times to give a total of 42 plots.

TRIAL B

Pyrazon and lenacil were applied singly and in combination on fresh seed-bed plots prepared and sown on October 27 on land adjacent to Trial A. Plot width and length were as in Trial A and there were again three replications.

Six treatments were given as follows:

Treatment Code	Application	Date Applied	
		Pre-emergent	Post-emergent
P4	pyrazon 4	Oct. 27	Dec. 6
P5.6	pyrazon 5.6	Oct. 27	Dec. 6
P6.4	pyrazon 6.4	Oct. 27	Dec. 6
Post 4.8	pyrazon 4.8	Nov. 29	Nov. 29
V	lenacil 1.6	Nov. 3	
PV	pyrazon 4/lenacil 1.6	Nov. 3	

Alkylaryl polyglycol ether at 1.25 as a wetting agent was applied with all post-emergent applications of pyrazon.

Initial Population Counts

On both trials, population counts of beet-containing inches on three random 66 ft lengths per plot were made soon after crop establishment on the following dates:

Trial A: Fresh seed-bed plots, Oct. 11. No post-emergent treatments applied at time of counting.

Trial A: Stale seed-bed plots, Nov. 20. All treatments completed three weeks before counting.

Trial B: Nov. 22. No post-emergent treatments applied at time of counting.

Harvesting

The yield of roots and tops was assessed at harvest by pulling five 25 ft sample lengths of row at random within the centre three rows of each plot. The weight of all roots with a diameter greater than 1¼ in. was determined after screwing off the tops by hand as close to the crown as possible and scraping each root quite clean of any adhering soil. All smaller beet in each sample were counted and cleaned but included with the tops when these were weighed.

The only weed of note in the crop was fathen. A measure of the weed population was obtained by counting the number of fathen stalks originating within the row — *i.e.*, a 4 in. width containing the beet, on each 25 ft sample length at harvest.

Rainfall

Rainfall amounts during the crop establishment period and the dates on which rain fell were as follows:

Total Rainfall (in.)			Occurring on the following dates
September		3.05	2-7, 10-12, 28
October		1.53	5, 21-22, 29-30
November		4.85	mainly 15-19, but 13 rain days in month

RESULTS

The numbers of beet-containing inches per acre soon after emergence are given in Table 1.

TABLE 1: BEET-CONTAINING INCHES/ACRE

Treatment Code	Counted Oct. 11 1967	Treatment Code	Counted Nov. 20 1967	Treatment Code	Counted Nov. 22 1967
FP	33,400	SP	32,600	P4	33,700
FA	32,100	SA	31,300	P5.6	36,700
FPA	30,800	SPA	32,800	P6.4	36,600
FPAL	34,400	SPAL*	30,200	Post 4.8	34,800
FAL	32,500	SAL	31,200	V	34,400
FV	33,400	SV	27,200	PV	33,000
FPV	32,800	SPV	27,700		

*L application not given.

TABLE 2: YIELD OF CLEAN BEET, TONS/ACRE

Treatment Code	Trial A		Trial B	
	Fresh Seed-bed	Treatment Code	Stale Seed-bed	Treatment Code
FP	41.7 deCDE	SP	39.4 eDE	P4
FA	42.0 deCDE	SA	41.4 deDE	P5.6
FPA	48.2 abAB	SPA	41.9 deCDE	P6.4
FPAL	47.9 bab	SPAL*	40.5 deDE	Post 4.8
FAL	45.6 bcBC	SAL	38.3 eE	V
FV	43.1 cdCD	SV	43.4 cdCD	PV
FPV	50.8 aA	SPV	43.2 cdCD	
CV %		3.6		3.1

*L application not given.

TABLE 3: TOTAL POPULATION OF BEET/ACRE AT HARVEST TIME

Treatment Code	Trial A		Trial B	
	Fresh Seed-bed	Treatment Code	Stale Seed-bed	Treatment Code
FP	54,700 aA	SP	47,900 bcdBC	P4
FA	51,200 abcABC	SA	50,700 abcABC	P5.6
FPA	52,500 abAB	SPA	47,400 cdBC	P6.4
FPAL	51,400 abcABC	SPAL*	48,600 bcdABC	Post 4.8
FAL	54,500 aA	SAL	47,500 cdBC	V
FV	52,300 abAB	SV	47,400 cdBC	PV
FPV	51,900 abcABC	SPV	45,400 dC	
% Δ		5.0		6.4

*L application not given.

TABLE 4: POPULATION OF FATHEN PLANTS/ACRE AT HARVEST TIME

Treatment Code	Trial A		Trial B	
	Fresh Seed-bed	Treatment Code	Stale Seed-bed	Treatment Code
FP	24,400 aA	SP	5,500 defBCD	P4
FA	25,000 aA	SA	5,100 efBCD	P5.6
FPA	11,300 cB	SPA	4,200 efBCD	P6.4
FPAL	9,300 cdeBC	SPAL*	3,300 fCD	Post 4.8
FAL	18,300 bA	SAL	6,600 cdefBCD	V
FV	10,400 cdBC	SV	1,500 fD	PV
FPV	3,800 fCD	SPV	1,300 fD	
CV %		29.9		50.3

*L application not given.

The various pre-emergent treatments had little or no effect on initial plant populations except for those including lenacil on the stale seed-bed plots. Some temporary yellowing of the plants occurred on these and a small number of weakly plants died. A slight yellowing was observed on lenacil plots in Trial B but not on the fresh seed-bed plots of Trial A.

Pyrazon had no visible effect on any beet seedlings except for some marginal leaf scorch following post-emergence applications at the two highest rates (P5.6 and P6.4) in Trial B.

The yield of beet from each treatment with the respective beet and weed population is given in Tables 2, 3 and 4.

In Trial A, the combined pyrazon/lenacil fresh seed-bed treatment significantly out-yielded all other treatments with the exception of FPA and FPAL at the 1% level; FPAL was out-yielded at the 5% level.

On the stale seed-bed plots, the single lenacil treatment equalled the yield of the combined pyrazon/lenacil treatment and they both out-yielded any other treatment although not significantly except in the case of SP and SAL.

In Trial B, the single lenacil treatment almost equalled the yield from the combined pyrazon/lenacil treatment which was significantly better than other treatments except for the combined pre- and post-emergent pyrazon 5.6.

Single pyrazon applications, whether applied pre- or post-emergent were significantly out-yielded by the multiple applications. Good weed control was obtained by single treatments but did not persist beyond four to five weeks. Fresh weeds emerged and established themselves.

The combined pyrazon/lenacil treatment reduced total beet populations at harvest time on both the stale seed-bed of Trial A and in Trial B. However, this was not significant except when compared with SA in Trial A and P5.6 and P6.4 in Trial B. There was no significant difference between any of the treatments on the fresh seed-bed in Trial A.

The effect of the stale seed-bed technique on the fathen population was dramatic. Only the combined pyrazon/lenacil treatment, which gave a control significantly better at the 1% level than any other treatment on the fresh seed-bed, showed a population lower than the highest population recorded on any of the stale plots.

There was no significant difference in numbers of fathen between any of the treatments on the stale seed-bed plots, although both lenacil on its own and in combination with pyrazon were noticeably better than the others.

In Trial B, the combined pyrazon/lenacil treatment gave the greatest control, followed closely by the single lenacil treatment, but the results were not significant except in comparison with the single pyrazon treatment (1%) and the lowest pre- and post-emergent pyrazon treatment P4. Better control was achieved by using higher rates of pyrazon although this improvement was not significant.

DISCUSSION

If weed control had been the only criterion in assessing the comparative merits of the different treatments in the two trials, the stale seed-bed would undoubtedly have been worthy of consideration.

However, this is not the case, and a yield difference between fresh and stale seed-bed plots of approximately 7 tons/acre is apparent when similar

treatments, where the selective herbicides have effected a reasonable degree of weed control, are compared. This yield loss may be accounted for entirely by the later sowing date of the stale seed-bed plots.

In trials at Lincoln and elsewhere, it has been shown that beet yield is reduced by 1 to 1½ tons/acre for every week's delay in sowing over the period from September to December. Growth in the beet crop is not terminated by maturity in its first year and will continue as long as conditions are suitable. There is every reason, therefore, for early sowing. Beet seed is quite co-operative in this and germinates satisfactorily at soil temperatures as low as 40° F.

Where early drilling of beet crops is practised, there is little point in applying short-lived pre-emergence herbicides. Their effectiveness is beginning to wane by the time the soil temperature has risen sufficiently to induce weed-seed germination. This is particularly so with fathen which rarely emerges in the Lincoln area before the middle or latter part of October (soil temperature approximately 50° F).

In the trials, lenacil was more persistent than pyrazon, although it too, on its own, was not particularly effective following the earliest drilling. Why lenacil plus pyrazon applied at this time gave such an effective control is not clear.

Although lenacil, or lenacil and pyrazon together, effected good control and produced, in almost all plots, the highest yields for their respective drilling dates, weather during the spring of 1967 was kind and rain fell conveniently. This is not always so and pre-emergent treatment cannot be recommended with any certainty of success, particularly in Canterbury.

The alternative with existing materials is to apply pyrazon (with wetting agent) as a post-emergent and repeat the treatment whenever a fresh weed emergence occurs. A limit to this is reached when beet foliage fouls the nozzles and prevents the spray from penetrating to the weed seedlings. However, by this time, beet seedlings under conditions of good husbandry are beginning to develop more quickly. Provided a full plant population is maintained, an overall leaf canopy soon develops and this in itself helps to deter further weed growth. This technique worked well on several commercial crops in Canterbury during the 1967-8 season.

The benefit of the excellent standard of mechanical inter-row weed control in these trials should not be overlooked. Beet in plots carrying high fathen populations had the appearance of being smothered but there was room for their foliage to spread unhindered between the rows. As a consequence, yields were quite acceptable. Had the herbicide treatments been applied as overall applications and no inter-row hoeing done, weed populations would have been at least five times as high. The effect on yield may be imagined.

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