QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

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CONTROL OF BLACK PIGWEED (TRIANTHEMA PORTULACASTRUM) WITH TRIFLURALIN FOR PASTURE LEGUME ESTABLISHMENT

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SUMMARY

Trifluralin was tested for the control of black pigweed in establishing stands of a range of pasture legumes. Increasing the rate of herbicide up to 1 lb/ac active ingredient increasingly depressed the stand and dry-matter yield of black pigweed, the most effective rates being ¼ and ½ lb/ac. Legume populations were only weakly influenced by trifluralin rate but yield reaction varied with species. Siratro and Hunter River lucerne, and to a lesser extent *Clitoria ternatea,* reacted favourably to reduced black pigweed stand. Cooper glycine, Archer axillaris and Peru leucaena were not affected by the control of black pigweed.

Depth of cultivation after application had no major effect. The main effect was highly significant on black pigweed yield and stand but was of minor importance compared with rate of application.

I. INTRODUCTION

Black or giant pigweed (*Trianthema portulacastrum*) is widely distributed in Queensland as a weed of cultivated land. It is an especially serious pest in the Callide and Lockyer Valleys, where its ability to form a dense mat following spring and summer rains allows it to strongly suppress other plants (Everist 1957). It has been particularly troublesome at the Department of Primary Industries Biloela Research Station during establishment of a number of experiments associated with the testing of new pasture legumes. Grasses planted in these experiments have established satisfactorily but whenever pigweed was dense very poor legume stands resulted (Cameron and Mullaly 1969).

The selective, soil-incorporated, pre-emergence herbicide trifluralin has been reported by Goyne (1967) as giving very good control of weedy grasses and black pigweed in experiments with cotton at Biloela. It is now in general use in district cotton crops. In these it is noticeable that several annual legumes, especially *Phaseolus lathyroides* cv. Murray and *Sesbania aculeata* (sesbania pea), are not controlled by trifluralin.

The present experiment was established to study the effects of trifluralin on the establishment of a range of legumes when these were sown under conditions where a heavy black pigweed stand could be expected.

II. MATERIALS AND METHODS

The site chosen was an old cultivation paddock on the grey brown, clay loam soils of the flood plain of Callide Creek. It is mapped as Kroombit Land System, Unit 5 by Perry (1968).

Four rates of trifluralin were applied to 30 lk × 30 lk main plots arranged as randomized blocks. Three replications were used. The required quantity of trifluralin for each plot, as "Treflan E.C." 40·0% w/v, was mixed with ½ gal water and applied with a hand spray, repeatedly working over the plot from several directions. Immediately after a replicate had been sprayed, three 30 lk × 10 lk sub-plots in each main plot were cultivated to different depths. Each sub-plot was then further split into six 5 lk × 10 lk areas into each of which 250 viable seeds of one of six legumes was sown.

The rates of active ingredient of herbicide, depth of cultivation and legumes used were:—

Rates of trifluralin.—R0, nil; R1, ¼ lb/ac a.i.; R2, ½ lb/ac a.i.; R3, 1 lb/ac a.i.

Depth and method of cultivation.—D1, ¾ in., using a set of light harrows; D2, 1½ in., using a rigid-tine cultivator plus the harrows; D3, 3 in., using a rigid-tine cultivator plus the harrows.

Legume species and cultivars.—*Phaseolus atropurpureus* cv. Siratro (siratro); *Glycine wightii* cv. Cooper (Cooper glycine); *Medicago sativa* cv. Hunter River (Hunter River lucerne); *Leucaena leucocephala* cv. Peru (Peru leucaena); *Dolichos axillaris* cv. Archer (Archer axillaris); *Clitoria ternatea* Q5455 (Clitoria).

The legume seed was inoculated with an appropriate rhizobium, mixed with a large quantity of moistened sawdust, spread by hand and covered with a heavy rake with several rows of widely spaced prongs.

Planting was carried out on March 28, 1969. Thirty points (0·30 in.) of rain had been received the day before planting, and a further 0·21 in. was recorded the following morning. To ensure germination of both pigweed and legumes, a 3 in. spray irrigation was applied on March 29. Rainfall over the subsequent 5 months is shown in Table 1. Except for May, this was far drier than normal.

TABLE 1

MONTHLY RAINFALL TOTALS AND MAJOR FALLS

—	April	May	June	July	August
Date and amount (in.) of major falls		12th–0·93 15th–0·73	20th–0·21	22nd–0·26	22nd–0·16
No. of days and total other rain (in.)	2/0·09	6/0·28	2/0·14	2/0·03	3/0·04

TABLE 2

ANALYSIS OF VARIANCE FOR TOTAL DRY-MATTER YIELD AND YIELD COMPONENTS; PERCENTAGE LEGUME AND PERCENTAGE BLACK PIGWEED ON A DRY-MATTER BASIS; POPULATIONS OF SOWN LEGUMES AND WEEDS IN APRIL AND AUGUST; AND PERCENTAGE CHANGE IN LEGUME POPULATION

Significance of F ratios for main effects and interactions

Date	Parameter	Component	Main Effects			1st Order Interaction			2nd Order Interaction
			Rate	Depth	Legume	R x D	R x L	D x L	R x D x L
3.vi.69	Dry-matter yield	Legume	**	—	**	—	**	—	—
		Black pigweed ..	**	**	**	—	—	—	—
		Other species	*	—	—	—	—	—	—
		Total	**	**	*	*	—	—	—
		% legume	**	—	**	—	*	—	—
		% black pigweed ..	**	—	**	—	*	—	—
15.iv.69	Population ..	Legume	—	—	**	—	—	—	—
		Black pigweed ..	**	**	—	*	—	—	—
1.viii.69	Population ..	Legume	*	—	**	—	**	—	—
		Weed (total)	—	—	—	—	—	—	—
15.iv. to 1.viii.69 ..	Population ..	% change legume ..	—	—	**	—	**	—	—

* Significant 5% level.
** Significant 1% level.

Treatment effects were assessed on three occasions. Plant populations were recorded on April 15 (18 days after planting) in one 5 lk × 2 lk quadrat in each legume sub-plot, legume, black pigweed, grass and other plants being counted separately. On August 1 a 42 in. × 21 in. quadrat was used to record populations of legume and live weed plants. The black pigweed by this stage was dead. Dry-matter yields of black pigweed, legume, and other weeds were measured from a 42 in. × 21 in. quadrat per sub-plot cut with hand shears at ½ in. height on June 3 and 4.

III. RESULTS

The significance levels of the F ratios for main effects and interactions are shown in Table 2. These show rate of application and legume sown as the most important treatments.

Plant populations.—There was a significant interaction of rate by depth on black pigweed population 18 days after planting, but Figure 1 shows this to be of a minor nature. The strong effect of increasing rate on black pigweed population is noticeable.

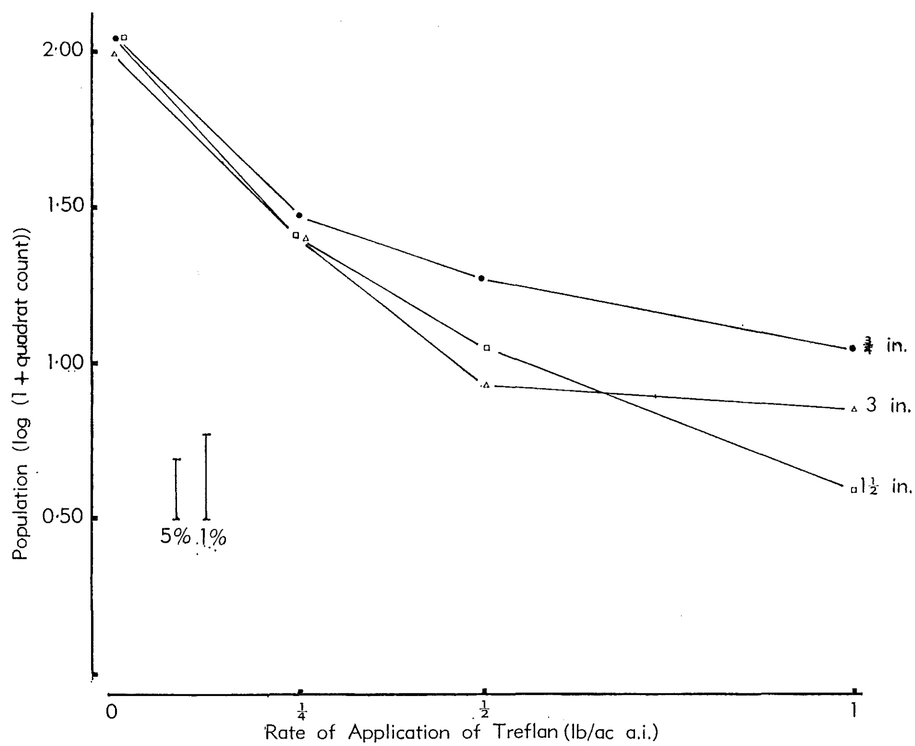

Fig. 1.—Interaction of rate and depth of incorporation of trifluralin on black pigweed population 18 days later. Transformed data (log (1 + quadrat count)) plotted.

Initially, legume species was the only factor significantly influencing legume stand, but by August rate and rate × legume interaction were also operative. Legume was also the only main effect determining the percentage change in legume stand from April to August, but there was a highly significant rate × legume interaction. Results for legume stand are presented in Figure 2 and Table 3.

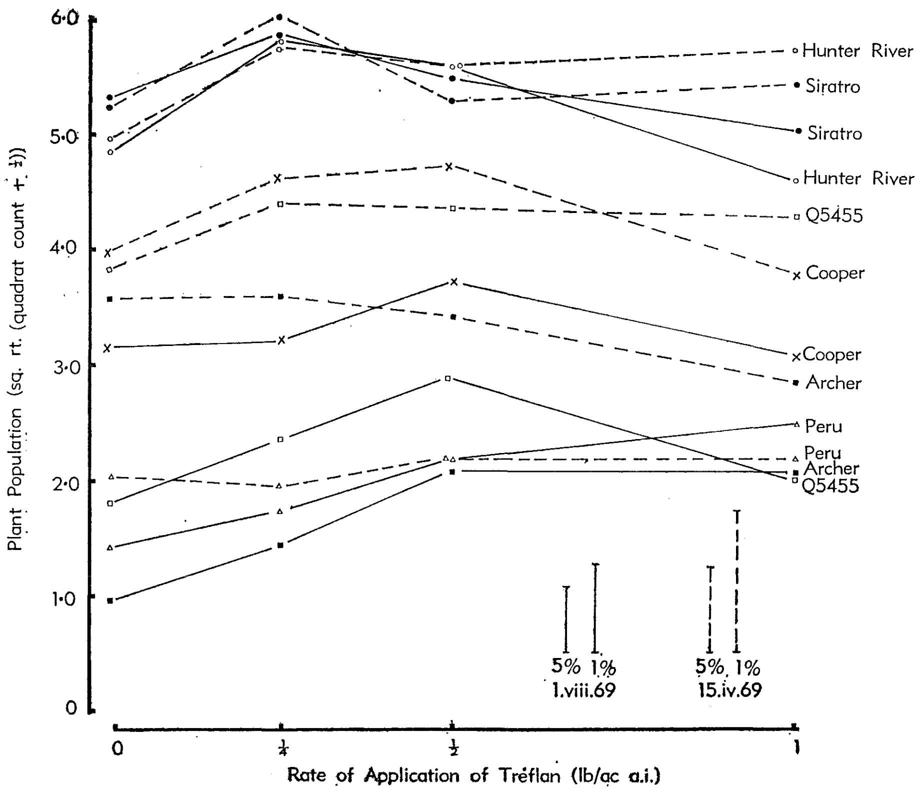

Fig. 2.—Interaction of rate and legume species on legume populations at the April count (dotted line) and at the beginning of August (solid line). Transformed data (sq. rt (quadrat count + ½)) plotted.

TABLE 3

PERCENTAGE CHANGE IN LEGUME POPULATIONS FROM APRIL TO AUGUST

$$\frac{\text{April–August} \times 100}{\text{April}}$$

Rate	Siratro	Lucerne	Glycine	Clitoria	Dolichos	Leucaena
R0	23·9	25·7	52·8	83·2	92·1	53·9
R1	31·1	25·3	64·4	79·3	89·7	34·5
R2	11·9	28·3	51·2	68·6	73·6	22·6
R3	38·0	53·1	38·9	85·9	53·7	−14·9

L.S.D. 5% = 27·7
L.S.D. 1% = 36·7

These data separate the legumes into three groups:

(a) Siratro and lucerne had the best stands. In August their highest plant density was at R1. The percentage change from April to August was not significantly affected by rate and was in the 20–50% range.

(b) Cooper glycine and Clitoria had their best stand at R2 and were intermediate in stand density, with rate not influencing change. This was higher than in the first group, with stands 50–80% lower in August.

(c) Peru leucaena and Archer axillaris showed continuing increases in stand with increasing rate of application, although only R2 and R3 were significantly higher than R0. They also showed significantly less change between April and August at R4 than at R0.

Dry-matter yields.—The strongest influence on total dry-matter yield seen in Figure 3 is the major reductions in black pigweed yield with increasing rate. This allowed minor but significant increases in both legume and other species main effects.

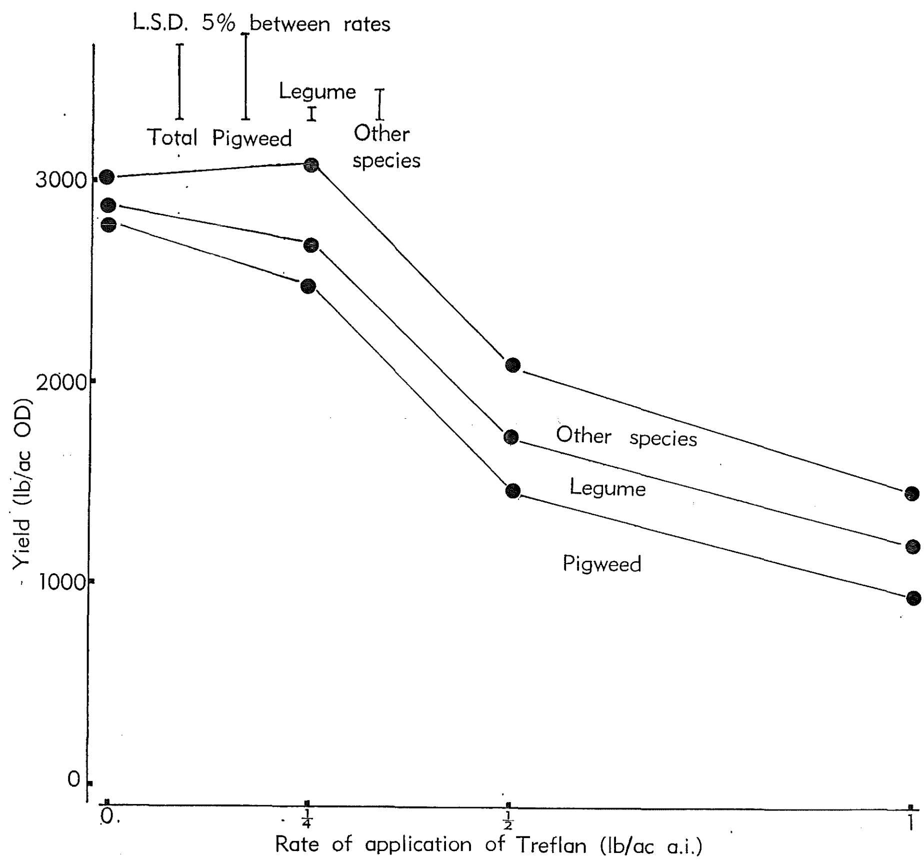

Fig. 3.—Main effects of rate on total yield of dry matter and the components of yield with the latter plotted cumulatively.

The interaction of rate $\times$ legume on legume yield is shown in Figure 4. Siratro, lucerne and Clitoria showed significant increases in yield with increasing rate of trifluralin. On the other hand, Cooper glycine, Archer axillaris and Peru leucaena yields were not influenced by rate.

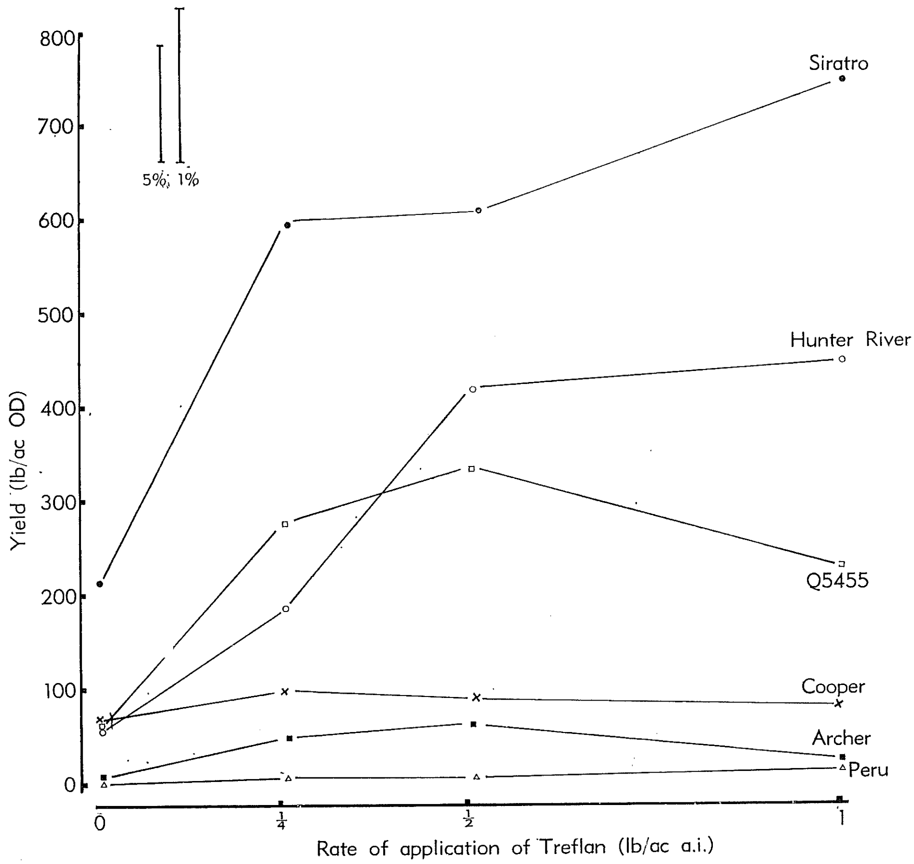

Fig. 4.—Interaction of rate and legume species on legume yield.

Total yield and black pigweed yield were weakly influenced by rate $\times$ depth interaction. Figure 5, however, shows this to be of a minor nature and similar to the effect on black pigweed stand in April. The interaction was only significant for total yield. The over-riding influence on both parameters was the effect of increasing rate.

IV. DISCUSSION

The manufacturer's instructions for effective use of Treflan with field crops state that ¾ lb/ac a.i. should be used on medium-textured soils. This should then be rapidly incorporated in the soil to a depth of 2–3 in. to prevent photo-decomposition. In the present experiment, varying depths of cultivation after application were used. It was considered that normal field crop depth may be too deep for the shallow-sown, small-seeded legumes.

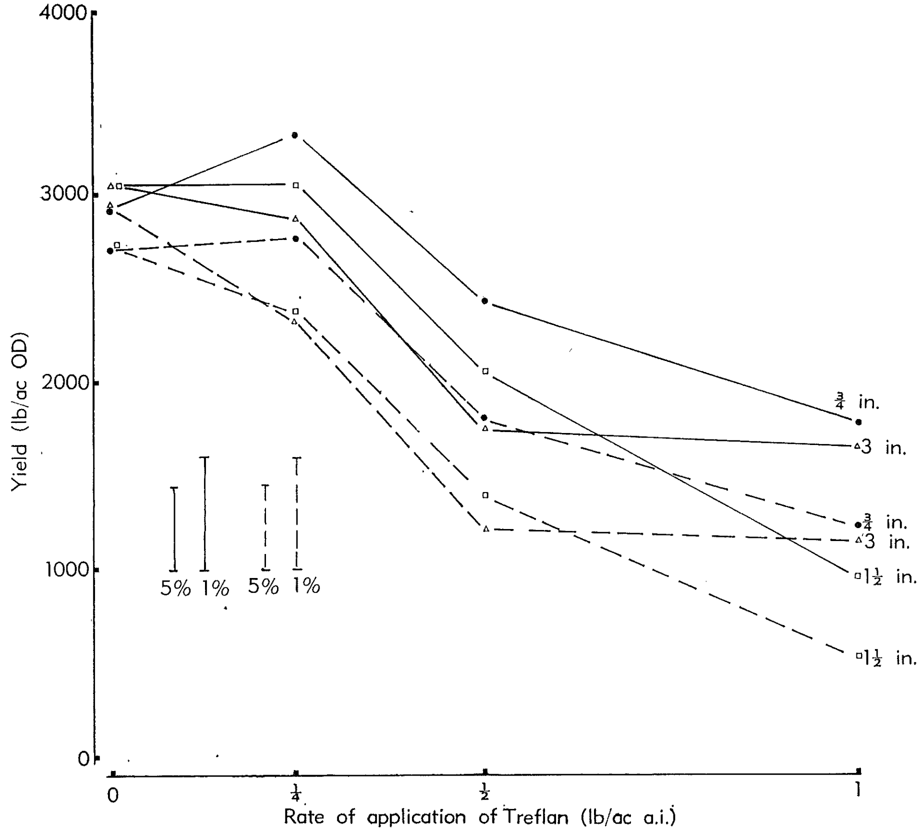

Fig. 5.—Interaction of depth and rate on total dry-matter yield (solid lines) and black pigweed yield (dotted lines).

Depth of cultivation, however, has not proved of major importance. There was a significant reduction of black pigweed stand yield due to the two deeper cultivations, but this was not reflected in legume yield or stand. The significantly greater number of black pigweed seedlings and yield of the weed at 1 lb/ac a.i. when cultivated to 3 in. compared with 1 lb/ac a.i. at 1½ in. cultivation cannot be explained. The change-over is, however, consistent for both for April population count and for early June dry-matter yield.

The major response measured has been the effective control of black pigweed population with increasing rate of trifluralin. This was most effective from control to ¼ lb/ac a.i. and ¼ lb/ac a.i. to ½ lb/ac a.i. The final increment to 1 lb/ac a.i. did not reduce black pigweed populations to the same extent and was not significant. At this rate there were still 65,000 black pigweed seedlings per acre 18 days after treatment, compared with a control population of 1,078,000 seedlings per acre.

The yield of black pigweed in June does not show the same drop from control to ¼ lb/ac a.i. This was almost certainly due to the effects of a differential attack on the control plots by larvae of cotton web spinner (*Loxostege affinitalis*). Black pigweed is a major host for this insect's larvae (Sloan 1936) and they regularly attack plants late in the growth cycle. On this occasion they had almost completely defoliated the black pigweed in the control plots (only stems and leaf skeletons could be harvested) but they had ignored the younger black pigweed plants in all treated plots, these being still lush and vegetative.

The segregation of the legumes into three groups on their reaction to increasing rate of trifluralin can be explained on the basis of the local adaptation of the species and their seedling vigour. Siratro and lucerne are the best adapted of the six legumes and were able to take fullest advantage of the opportunity offered by control of the black pigweed. Cooper glycine and Clitoria are moderately well adapted, but under the dry conditions stands deteriorated badly between the two population counts. The better-grown siratro and lucerne plants present in June would have been better able to withstand the normally dry late winter and spring.

On the other hand, Peru leucaena germinated slowly and initial stand was low. Later germinations were observed as the season progressed but all seedlings remained small and weak. The initial stand of Archer axillaris was better but this is a poorly adapted plant (Cameron and Mullaly 1969) and along with Peru leucaena it benefited from the reduced competition resulting from the control of black pigweed.

A point which does not come out of these results but which was observed was the upsurge in growth of individual plants of some of the other weedy species following control of the black pigweed. In April, populations of these species were too erratic plot by plot to warrant statistical analysis of the data collected. This, howevér, is interesting enough to present in Table 4. For comparison, black pigweed plant numbers have been presented on the same basis.

TABLE 4

MAIN EFFECT OF RATE AND DEPTH ON OTHER WEEDS STANDS IN APRIL AND AUGUST—UNANALYSED

Plants/sq lk

—	15.iv.69				1.viii.69
	Black Pigweed	Grasses	Other Weeds	Grasses + Others	Grasses + Others
Rate (lb/ac)					
Nil	109·5	2·8	0·7	3·5	0·6
¼	27·4	1·1	1·6	2·7	0·8
½	15·5	0·1	1·2	1·3	0·9
1	7·4	0·0	0·6	0·6	0·9
Depth (in.)					
¾	43·1	1·3	1·1	2·4	0·7
1½	51·1	1·2	1·1	2·3	0·9
3	35·4	0·6	1·8	2·4	0·9

In April the effect of trifluralin in controlling the weedy annual grasses present is clearly shown. These were mainly *Urochloa panicoides* and *Eragrostis cilianensis*. By August the residual taprooted weeds, whose stand was not influenced by any factor, were particularly well grown in the treated plots and insignificant in the control plots. These plants were mainly *Sonchus oleraceus* (milk thistle) and a mustard weed (probably *Sisymbrium thellungii*).

The complete control of the annual grasses suggests that difficulty may also be experienced in establishing perennial pasture grasses where trifluralin is used. It may as a result be necessary to establish the legume stands with trifluralin initially and then to plant the better adapted and hardier grasses into this stand the following season. Autumn planting of lucerne/grass pastures can be used to avoid the full effects of black pigweed competition, but it has less value for the establishment of more frost-sensitive subtropical legumes.

The testing of a wider range of weedicides is necessary to overcome the weaknesses exposed in trifluralin by the failure to control other weedy plants and the likelihood that grass establishment concurrently with the legume may not be possible.

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