TRIAZINE HERBICIDES FOR WEED CONTROL IN BROAD BEANS

W. R. BOYCE

Department of Agriculture, Levin

Summary

Simazine, atrazine, ipazine, propazine, trietazine, G34698, and simetryne, ametryne and G34360 were tested for pre-emergence weed control in autumn-sown broad beans (*Vicia faba* L.) on Levin silt loam. Rates (a.i. per acre) of 0.5, 1.0 and 2.0 lb were applied one day after sowing in mid-May, 1961. At 0.5 lb all herbicides were as good as hand-weeding and ametryne better. There were no differences at 1.0 lb. At 2.0 lb atrazine, simazine and propazine seriously reduced yields; ametryne was better than, the rest as good as hand-weeding. The best treatments were ametryne 1 and 2 lb, ipazine 1 and 2 lb, and simazine 0.5 and 1 lb.

INTRODUCTION

At THE Fourteenth N.Z. Weed Control Conference, Gregory (1961) referred to Elliott's (1958) and Gregory's (1960) work with simazine on field beans and to unpublished work of Roberts on broad beans. More recently Roberts and Wilson (1962) have reported their work in England. Chemical weed control in this crop has not been used or investigated to any great extent in New Zealand.

In the 1960-61 season, some 400 acres of broad beans were grown in this country, 340 acres for process crops and 60 acres for markets.

Because broad beans stand six months in the field and grow through the winter months when conditions are frequently not suited to cultivation, they are an obvious case for the application of chemical weed control. Large, deeply sown seeds provide the right conditions for the use after sowing of pre-em. weedkillers with long-lasting effects.

Six chloro-triazines were tested, and three methylmercapto compounds were included for comparison.

At the conclusion of the trial wheat, oats and barley were sown as indicator plants, after shallow rotary-hoeing of the plots, to check for residual toxicity.

EXPERIMENTAL

The trial compared nine triazine herbicides applied at rates of 0.5, 1.0 and 2.0 lb a.i. per acre with hand-weeded controls. (Subsequent references to rates of application are also given as a.i. per acre.) The design used enabled comparisons to be made among the different herbicides used at the same rate but not between different rates of these materials. There were three replications of ten treatments. The soil type was Levin Silt Loam.

Plots 12 ft by 6 ft were sown with three rows of broad beans 24 in. apart. Seed was placed by hand in drills 3 in. deep at a measured spacing of 3 in. between seed. Seedlings were later thinned to 6 in. apart. Care was taken in covering of seed to maintain an even depth of soil over it. Sowing was done on May 16, with the variety Exhibition Long Pod.

The soil was moist at the time of sowing and weedicide application. Soil temperatures ranged from 15 to 21°C at 1 in. depth. Heavy rain fell 10 days after the application of herbicides. Weed seedlings,

Fig. 1: Relationship of rainfall to herbicide action

mainly spurrey (*Spergula arvensis*) were germinating 7 days from sowing. Bean seedlings commenced emerging 14 days after sowing.

Figure 1 shows rainfall and relates it to the appearance of weedicide damage. Symptoms of damage on the broad beans were characteristic dark blackened lesions affecting the margins and tips of the leaves. Severe damage caused loss of plants (Fig. 2).

Differences in weed growth and weed populations on treated plots were noticeable 9 days after weedicide applications. Reaction to the herbicides followed the established pattern. Weeds germinated, emerged and made some growth before showing symptoms of yellowing at the margins and tips of leaves, followed by the death of susceptible seedlings. Spurrey was the first weed to germinate and the first to succumb, an excellent indicator of triazine activity.

Control plots were hand-weeded on May 30, 1961, August 14, 1961, and October 10, 1961.

The crop was harvested on November 16 and 23, 181 days after sowing, in two main pickings. Pods were graded into marketable and reject.

RESULTS

YIELDS

Yields of complete pods of saleable beans and of shelled beans are shown in Tables 2 and 3.

TABLE 1: NUMBERS OF PLOTS IN WHICH WEEDS WERE RECORDED OUT OF 30 AT EACH RATE OF APPLICATION

Weed Species	Recorded May 29, 1961			Recorded Aug. 29, 1961			Recorded Nov. 15, 1961		
	0.5 lb	1.0 lb	2.0 lb	0.5 lb	1.0 lb	2.0 lb	0.5 lb	1.0 lb	2.0 lb
Annuals:									
<i>Polygonum persicaria</i>	0	0	0	3	2	2	5	7	9
<i>Rumex obtusifolius</i>	3	3	1	12	7	2	5	9	3
<i>Sonchus</i> sp.	30	30	27	13	5	1	0	0	0
<i>Senecio vulgaris</i>	0	0	0	13	2	3	0	0	0
<i>Taraxacum officinale</i>	0	0	0	0	1	1	0	1	1
<i>Cirsium lanceolatum</i>	0	0	0	0	0	0	5	4	0
<i>Coronopus didymus</i>	30	30	30	26	19	2	19	25	17
<i>Sisymbrium officinale</i>	0	0	0	0	0	0	11	9	7
<i>Stellaria media</i>	30	30	30	9	3	1	0	0	0
<i>Spergula arvensis</i>	30	30	30	2	2	0	0	0	0
<i>Geranium</i> spp.	9	9	11	9	5	2	0	0	0
<i>Ranunculus sardous</i>	0	0	0	0	0	0	8	7	5
<i>Trifolium</i> spp.	13	9	13	0	0	0	3	10	5
<i>Chenopodium album</i>	5	6	3	0	0	0	2	3	4
<i>Veronica arvensis</i>	0	0	0	5	0	0	0	0	0
<i>Fumaria muralis</i>	3	17	8	0	0	0	1	0	0
<i>Solanum nigrum</i>	30	30	30	0	0	0	0	0	0
<i>Plantago major</i>	1	3	5	6	5	2	11	15	9
<i>Poa annua</i>	17	16	11	13	7	5	0	0	0
Perennials:									
<i>Agropyron repens</i>	29	30	29	28	23	25	26	25	25
<i>Ranunculus repens</i>	8	7	6	25	22	16	17	15	19
<i>Rumex obtusifolius</i> (regrowth)	0	0	1	—	—	—	—	—	—
<i>Rumex acetosella</i>	26	21	27	26	13	14	6	13	16

TABLE 2: YIELDS OF COMPLETE PODS — SALEABLE
(tons per ac.)

Herbicide	0.5 lb		Rates 1.0 lb		2.0 lb	
Simazine	8.15 ab	A	7.04 a		5.09 c	CD
Atrazine	9.12 ab	A	7.52 a		3.02 d	D
Ipazine	7.86 ab	A	8.71 a		7.95 b	AB
Propazine	8.42 ab	A	7.70 a		5.00 c	CD
Trietazine	9.34 ab	A	8.69 a		7.56 b	B
Simetryne	7.97 ab	A	8.26 a		7.97 b	AB
Ametryne	9.75 a	A	7.88 a		10.08 a	A
G34360	7.90 ab	A	8.51 a		8.42 ab	AB
G34698	7.31 b	A	7.70 a		6.62 bc	BC
HWC	7.54 b	A	6.66 a		7.61 b	AB
C. V. 13.9%						

Comparisons should be made within columns only.

Fig. 2: Atrazine at 2 lb gave excellent weed control — even holding couch in control — for the duration of the trial but as the photograph taken 10 weeks after sowing and herbicide application shows it caused severe damage and reduction in numbers of beans. An undamaged row in an adjoining plot is shown on the left-hand side.

TABLE 3: YIELD OF SHELLED BEANS FROM SALEABLE PODS
(tons per ac.)

Herbicide	0.5 lb	Rates 1.0 lb	2.0 lb	
Simazine	2.72 a	2.55 a	1.83 cd	BCD
Atrazine	2.81 a	2.55 a	1.01 e	D
Ipazine	2.64 a	2.74 a	2.61 ab	AB
Propazine	2.80 a	2.44 a	1.60 de	CD
Trietazine	3.14 a	2.85 a	2.51 bc	ABC
Simetryne	2.62 a	2.76 a	2.69 ab	AB
Ametryne	3.18 a	2.45 a	3.26 a	A
G34360	2.65 a	2.69 a	2.72 ab	AB
G34698	2.42 a	2.56 a	2.27 bcd	BC
HWC	2.56 a	2.18 a	2.63 ab	AB
C.V. 15.9%				

Comparisons should be made within columns only.

CROP TOLERANCE

The number of herbicide-damaged beans are given in Table 4.

WEEDS AND WEED CONTROL

The presence of the principal weeds recorded on the trial area is listed in Table 1. The first recording done 12 days after weedicide application lists species which germinated rapidly, such as spurrey, black nightshade (*Solanum nigrum*), milk thistle (*Sonchus* sp.)

and had not been eliminated by the weedkillers at that time. Later recordings list persistent weeds and ones which made their appearance later in the season. The degree of weed control obtained is shown in Table 5.

RESIDUAL TOXICITIES

After the broad bean crop had been removed, the soil was given a shallow rotary-hoeing to a depth of 3 in. and the plots were cross-sown in December, 1962, with rows of oats, wheat, and barley which are sensitive indicator plants for the presence of triazine residues.

The sowings were damaged by birds rather severely but sufficient plants remained to indicate the residual activity of the herbicides six to nine months after the original application.

Observations were made on the cereals and the new growth of weeds on February 16, 1962. These showed that residues of simazine, atrazine and propazine, particularly at the highest rate of application, 2 lb, were still active in the soil, and had not been dispersed by shallow rotary-hoeing.

DISCUSSION

The average yields of 7.7 tons per acre of saleable complete pods and 2.6 tons per acre of shelled beans were about double normal commercial yields. A closer than normal spacing of 2 ft between rows was used to provide a larger number of plants per plot for the observation of weedicide effects.

WEED CONTROL

Annual Weeds

Growth of annual weeds was kept in check by all materials at all three rates in the early stages of the trial. Hand-weeded control plots suffered by comparison when poor weather conditions made it impossible to obtain a kill of *Poa annua* with the first hand-weeding and delayed follow-up weedings. The contrast with ametryne and ipazine treated plots was marked.

Later annual weeds established on plots treated with less active material at the lower rate. Although weed competition did not develop sufficiently to reduce yields, there were indications that control was breaking down. Immediately before harvesting commenced, the following materials at the 0.5 lb rate were considered to have maintained barely adequate weed control — simetryne,

TABLE 4: NUMBER OF DAMAGED BEANS RECORDED AT 48 AND 123 DAYS AFTER SOWING FROM A TOTAL OF 216 BEANS

Treatment	Solubility in p.p.m.		48 days			123 days		
	0.5 lb	1.0 lb	0.5 lb	1.0 lb	2.0 lb	0.5 lb	1.0 lb	2.0 lb*
Simazine	5	1	5	38	4	20	—	—
Propazine	9	0	8	84	6	23	—	—
Atrazine	90	0	22	138	4	34	—	—
Ipazine	40	2	0	21†	0	2	—	—
Trietrazine	20	0	0	4	0	1	—	—
Simetryne	45	0	0	1	0	0	—	—
Ametryne	185	1	1	2	1	0	—	—
G34698	120	1	1	23	7	56	—	—
G34360	580	0	1	1	3	0	—	—
HWC	0	2	0	0	0	0	—	—

* Numbers not recorded on 2 lb plots because of the lesser numbers of beans which survived after the first recorded damage.

† Possibly some increase in damage on one ipazine-treated plot from adjacent atrazine and propazine treatments.

TABLE 5: WEED SCORES RECORDED IN AUGUST AND NOVEMBER BEFORE HARVEST

Treatment	Recorded August 29, 1961			Recorded November 15, 1961		
	0.5 lb	1.0 lb	2.0 lb	0.5 lb	1.0 lb	2.0 lb
Simazine	2.7	1.0	2.0	2.7	2.0	1.7
Propazine	1.7	1.7	1.7	2.3	3.0	1.0
Atrazine	1.0	0.3	1.7	2.0	1.0	1.0
Ipazine	2.0	1.3	1.7	4.0	2.3	2.0
Trietazine	3.0	1.3	2.0	3.0	3.0	3.0
Simetryne	3.3	2.3	2.3	4.3	3.7	3.7
Ametryne	2.0	1.0	2.0	3.0	2.7	3.0
G34698	2.7	1.3	1.3	3.7	3.3	3.0
G34360	3.3	1.7	2.0	4.0	3.3	3.3
HWC	4.0	4.0	4.0	1.0	0.7	2.0

Scores: 0 = no weeds;
1 = few;
2 = some;
3 = many;
4 = partial cover;
5 = complete cover.

G34360, trietazine, G34698. Simazine and ametryne maintained adequate control up to harvesting and of the remaining materials, propazine and ipazine gave good control and atrazine very good control to the end.

At the 1 lb rate all materials with the exception of G34360 maintained control which was adequate or better, and at the 2 lb rate, simetryne was the only material which did not give completely satisfactory control of annual weeds.

The most troublesome annual weeds were seedling docks (*Rumex obtusifolius*), buttercups (*Ranunculus* sp.) and twin cress (*Coronopus didymus*).

Perennial Weeds

Couch (*Agropyron repens*) heavily infested part of the trial area. Atrazine and propazine checked the growth of couch particularly at the 1 lb and 2 lb rates. Ametryne and ipazine appeared to check it at the 2 lb rate. Simazine was less effective. The uneven distribution of couch hindered more precise comparisons being made.

None of the materials used were particularly effective against regrowth of *Rumex* spp. docks, although atrazine and propazine did have some retarding effect.

RESIDUAL EFFECTS

Six months after weedicide application, residues of simazine, propazine and atrazine applied at 2 lb rate were still sufficiently active to retard the growth of oats, wheat and barley sown on the trial area, and volunteer growth of seedlings of annual weeds. Observations on the residual effect of other materials were not clear-cut. There are good grounds for advocating deep ploughing of land treated with the higher rates of the more active and persistent triazines, before crops susceptible to these materials are sown or planted, particularly if this occurs within 12 months of the original weedicide application.

CONCLUSIONS

From the triazine herbicides tested in this trial, for winter weed control in broad beans, ametryne 1 to 2 lb, ipazine 1 to 2 lb and simazine ½ to 1 lb are selected as the most promising materials, on the grounds of crop tolerance and satisfactory weed control. Immediate commercial availability favours simazine.

Atrazine and propazine gave good weed control and satisfactory crop tolerance at rates of $\frac{1}{2}$ and 1 lb, but above 1 lb these materials could do serious damage to, or eliminate the crop.

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