DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

AGRONOMY BRANCH REPORT

ALTERNATIVES TO DDT FOR THE CONTROL OF CLIMBING CUTWORM, *HELIOTHIS PUNCTIGERA* WALLENGR. IN FIELD PEAS

FIELD TRIAL, NORTHFIELD, 1971

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SUMMARY

A field trial at Northfield in 1971 tested a range of insecticides as possible alternatives to DDT for the control of *Heliothis* caterpillars in field peas. Although only a relatively low level of infestation occurred, it was concluded that endosulfan at 0.35 kg/ha can be used for controlling *Heliothis* in field peas. Fenitrothion, diazinon and chlorpyrifos were promising chemicals but were not economic at 1971 prices.

INTRODUCTION

The climbing cutworm, *Heliothis punctigera* Wallengr., is the larva of a native moth which has adapted itself to feed on a wide range of economic crops including peas, lucerne, clover, medic, linseed, beans, tomatoes, rape and, on occasion, cereals, stone fruits and pome fruits. Its preference for buds, flowers and fruit make it an important pest of those crops whose values lie in these parts. The pest is very widespread throughout Australia. Its control has relied on the use of DDT but, with concern over the use of this insecticide, it is necessary to seek alternative insecticides to control this pest.

In 1968 a field trial conducted at Northfield, using endosulfan, trichlorphon, azinphos ethyl, chlorfenvinphos and methidathion, showed that endosulfan and methidathion were promising alternatives to DDT for controlling climbing cutworm in peas. Trichlorphon did not perform well although trials by the manufacturers showed that it was effective for controlling climbing cutworm in lucerne.

Diazinon, chlorpyrifos, fenitrothion and methoxychlor, which have shown promise against other lepidopterous pests, have not been tested against climbing cutworm.

AIMS

(a) To determine whether endosulfan, known to be effective at 0.49 kg ai/ha can be used at lower rates to control climbing cutworm.

(b) To determine whether diazinon, chlorpyrifos, fenitrothion, methoxychlor and trichlorphon can be used to control climbing cutworm in field peas.

(c) To compare the above treatments with DDT.

METHODS

(a) Treatments

No.	Insecticide	kg ai/ha	Product	Formulation	litres/ha
1.	Endosulfan	0.35	"Thiodan"	35% E.C.	1.0
2.	Endosulfan	0.28	"Thiodan"	35% E.C.	0.8
3.	Endosulfan	0.21	"Thiodan"	35% E.C.	0.6
4.	Diazinon	0.56	"Gesapon"	80% E.C.	0.7
5.	Chlorpyrifos	0.24	"Dursban"	48% E.C.	0.5
6.	Fenitrothion	0.50	"Accothion"	50% E.C.	1.0
7.	Fenitrothion	0.35	"Accothion"	50% E.C.	0.7
8.	Methoxychlor	0.96	"Methoxychlor"	24% E.C.	4.0
9.	Trichlorphon	0.41	"Dipterex"	50% E.C.	0.7
10.	DDT	0.70	DDT	25% E.C.	2.8
11.	Nil				

(b) Site and Design

A strip of "Early Dun" field peas was grown at Northfield. A randomised block design was used. There were three replicates of eleven treatments. Each treatment plot was 4 m x 25 m.

(c) Application

Insecticide treatments were applied by boomspray at the rate of 100 l/ha on 23 November, 1971 at 5.00 p.m. when there was very little wind.

(d) Sampling

Treatment plots were divided into three sections for stratified random sampling of larvae and peas. Larvae were sampled with a sweepnet, eight sweeps being made in each section of each plot. The pre-spray assessment was made on 22 November, 1971. The post-spary assessment of larvae was made on 25 Novmeber, 1971.

To assess damaged peas, 500 peas were taken at random from each section of each plot on 20 and 21 December, 1971. To obtain a random sample several armfuls of vine were taken from the middle of each section, placed in a wheelbarrow and trampled on to free the peas from the pods. Pea straw and pod shells were blown away with a vacuum cleaner and 500 peas counted for the sample with a pea counting frame. Damaged peas were determined by visual examination of individual peas.

Yield samples were taken from 22 to 24 December, 1971 using a flail mower to cut a one metre swath through the length of the treatment plot. There was only one yeild sample per plot. The material collected by the flail mower, a mixture of weeds, pea straw, clods of earth, snails and peas, was flown with a vacuum cleaner to remove dried grass and straw. A coarse sieve was used to remove large clods of earth, larger weed fragments and snails. The remaining material was washed to remove earth and then dried at 80°C in a glasshouse for 48 hours and weighed.

(e) Statistical analyses

For analysis, pre-spray and post-spray larval counts were transformed to square root x where x is the number of larvae per sample. This was also done in the analysis of covariance where post-spray larval counts were adjusted for pre-spray counts. Damaged pea and yield assessments were analysed without transformation. In the analysis of numbers of damaged peas and unadjusted and adjusted post-spray larval counts the nil (check) treatment was discarded because the mean and the variance were very different from the other treatments.

To calculate percentage survival and percentage control using Abbot's (1925) formula, the squares of the transformed means used as measures of post-spray population means.

RESULTS

Table 1 is a summary of the results of the two larval assessments and the damaged pea and yield assessments. Detailed results are given in Appendix 1.

Larval numbers

Analysis of variance on transformed values for the pre-spray assessment showed no significant differences in the treatment plots up to $p = 0.2$. The estimated grand mean was 13.5 larvae per eight sweeps.

Table 1 Climbing Cutworm Trial, Northfield, 1971

Total numbers of larvae, damaged peas and yield assessed in 3 replicates of each treatment

Treatment and rate			Larval numbers		No. of damaged peas	Yield (grams per 75 sq.m.)
No.	Insecticide	kg ai/ha	Pre-spray	Post-spray		
1.	Endosulfan	0.35	202	23	108	2 135
2.	Endosulfan	0.28	81	22	83	2 258
3.	Endosulfan	0.21	157	17	101	2 345
4.	Diazinon	0.56	95	22	135	1 675
5.	Chlorpyrifos	0.24	161	34	115	2 270
6.	Fenitrothion	0.50	104	22	119	1 970
7.	Fenitrothion	0.35	124	47	117	2 103
8.	Methoxychlor	0.96	154	50	100	2 158
9.	Trichlorphon	0.41	143	44	108	2 281
10.	DDT	0.70	178	10	111	2 792
11.	Nil	-	123	83	76	2 337

The results of analysis of variance on post-spray larval assessments including estimates of percentage survival and percentage control are shown in Table 2.

Damaged peas

Analysis of variance on numbers of damaged peas showed no significant differences between treatments. Percentage of peas damaged, however slightly, are shown in Table 2.

Yields

Analysis of variance on yields showed no significant differences between treatments. The yields converted to kg/ha are shown in Table 2.

Table 2 Climbing Cutworm Trial, Northfield, 1971

Means of larval numbers, percentage survival and percentage control after spray: percentage of peas damaged and yield in each treatment

Treatment and Rate			Larvae			Peas	Yield
No.	Insecticide	kg ai/ha	Mean No. after spray	Percent Survival	Percent Control	Percent Damaged	kg/ha
1.	Endosulfan	0.35	1.69 (1.30)*	12.5	74.3	21.6	284
2.	Endosulfan	0.28	2.32 (1.52)	17.1	64.7	16.6	301
3.	Endosulfan	0.21	1.41 (1.19)	10.5	78.5	20.2	313
4.	Diazinon	0.56	1.99 (1.41)	14.7	69.7	27.0	223
5.	Chlorpyrifos	0.24	2.74 (1.65)	20.2	58.3	23.0	303
6.	Fenitrothion	0.50	1.73 (1.31)	12.8	73.7	23.8	263
7.	Fenitrothion	0.35	4.63 (2.15)	34.2	29.6	23.4	280
8.	Methoxychlor	0.96	5.09 (2.26)	37.6	22.5	20.0	288
9.	Trichlorphon	0.41	4.27 (2.07)	31.5	35.1	21.6	304
10.	DDT	0.70	0.47 (0.68)	3.4	92.9	22.2	373
11.	Nil	-	6.57 (2.56)	48.6	0	15.2	311

L.S.D.
p = 0.2 (0.57)
p = 0.1 (0.75)
p = 0.05 (0.91)

*Means of transformed data where x = number of larvae per 8 sweeps)

DISCUSSION

Effect of treatments on larvae. *Heliothis* larvae was controlled best by the DDT treatment at 92.9% control. At p = 0.1, endosulfan at 0.21 kg/ha and 0.35 kg/ha gave 78.5% and 74.3% control and was not significantly different from the DDT treatment. Fenitrothion at 0.50 kg/ha giving 73.7% control and diazinon at 0.56 kg/ha giving 69.7% control were also not significantly different. Endosulfan at 0.28 kg/ha was significantly inferior to DDT at 0.70 kg/ha, giving 64.7% control although not significantly different to the other two endosulfan treatments, the fenitrothion and diazinon treatments already mentioned and chlorpyrifos at 0.24 kg/ha which gave 58.3% control. Trichlorphon at 0.41 kg/ha, fenitrothion at 0.35 kg/ha and methoxychlor at 0.96 kg/ha gave 35.1%, 29.6% and 22.5% control respectively.

Effect of treatments on numbers of peas damaged. There was no significant difference between treatments. The percentage of peas damaged varied from 15.2% in the nil treatment to 27.0% in the diazinon treatment. Even pinhole damage was counted though these peas would not be lost during processing. The larval infestation before spray was comparatively light as can be seen from Table 1 and Appendix 1a. The estimated grand mean of 13.52 larvae for the pre-spray assessments showed there were less than 2 larvae per sweep. At this level of infestation, not much difference could be expected in degree of damage to peas. In a commercial crop, this level of infestation would not warrant treatment.

Effect of treatments on yields. There was no significant difference in yields. Yields varied from 223 kg/ha to 373 kg/ha for the different treatments and were extremely variable in each plot. The 1971 season was such that no weed kill was possible at the time of seeding and early growth stages and yields were probably more dependent on weed growth than the light *Heliothis* infestation.

CONCLUSIONS

From the effect on larvae, DDT at 0.70 kg/ha was the most effective treatment. Endosulfan used at 0.35 kg/ha gave lower, though not a significantly different degree of control and costs about $2-76 per hectare. Fenitrothion at 0.5 kg/ha looks promising but the poor results given when used at 0.35 kg/ha casts some doubt on its effectiveness. This chemical would warrant further trial if the price drops to a more economic level. At the time this trial was completed, treatment with fenitrothion at 0.5 kg/ha would cost about $4-00/ha. Chlorpyrifos at 0.24 kg/ha gave 58.3% control and its price would make higher application rates prohibitive. Methoxychlor and trichlorphon do not appear promising for *Heliothis* control in peas.

RECOMMENDATIONS

1. Endosulfan at 0.35 kg/ha can be recommended for *Heliothis* control in field peas.

2. As the treatment is not as effective as the present DDT treatment the latter recommendation cannot yet be dropped.

3. The similar performance of endosulfan at the three rates tested indicate that lower rates of endosulfan could be used. Further trials should be conducted to test lower rates for more economic control.

4. No further testing of fenitrothion, diazinon and chloropyrifos is worthwhile unless prices drop to an economic level.

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REFERENCES

Abbott, W.S. (1925) A method of computing the effectiveness of an insecticide. J. econ. Ent. 18 : 265-267.

(a) Climbing Cutworm Trial, Northfield, 1971

Larval numbers in each treatment in pre-spray assessment, 22/11/71

Treatment and Rate			Larval numbers									
No.	Insecticide	kg ai/ha	Replicate 1			Replicate 2			Replicate 3			Total
			Sections			Sections			Sections			
			a	b	c	a	b	c	a	b	c	
1.	Endosulfan	0.35	33	63	50	12	8	4	10	10	12	202
2.	Endosulfan	0.28	12	4	3	19	12	5	6	8	12	81
3.	Endosulfan	0.21	14	31	50	6	4	7	9	24	12	157
4.	Diazinon	0.56	9	14	13	16	13	2	8	16	4	95
5.	Chlorpyrifos	0.24	12	44	55	5	9	7	9	11	9	161
6.	Fenitrothion	0.50	6	24	22	5	13	7	7	10	10	104
7.	Fenitrothion	0.35	23	11	17	14	14	6	12	11	16	124
8.	Methoxychlor	0.96	24	33	25	5	8	10	12	17	20	154
9.	Trichlorphon	0.41	28	33	33	9	9	3	7	13	8	143
10.	DDT	0.70	20	51	22	13	9	15	7	23	18	178
11.	Nil	-	20	37	16	6	14	16	6	2	6	123

(b) Climbing Cutworm Trial, Northfield, 1971

Larval numbers in each treatment in post-spray assessment, 25/11/71

Treatment and Rate			Larval numbers									
No.	Insecticide	kg ai/ha	Replicate 1			Replicate 2			Replicate 3			Total
			Sections			Sections			Sections			
			a	b	c	a	b	c	a	b	c	
1.	Endosulfan	0.35	1	9	6	2	2	0	1	0	2	23
2.	Endosulfan	0.28	4	3	3	2	2	1	2	4	1	22
3.	Endosulfan	0.21	2	2	0	4	2	0	3	3	1	17
4.	Diazinon	0.56	5	3	1	3	4	0	1	1	4	22
5.	Chlorphyrifos	0.24	1	0	14	1	3	3	1	5	6	34
6.	Fenitrothion	0.50	1	2	3	0	4	1	6	0	5	22
7.	Fenitrothion	0.35	2	6	2	13	7	7	1	2	3	47
8.	Methoxychlor	0.96	6	11	7	3	6	1	2	7	7	50
9.	Trichlorphon	0.41	5	14	9	2	3	3	1	4	3	44
10.	DDT	0.70	0	0	0	1	3	0	4	0	2	10
11.	Nil	-	17	17	17	1	10	7	4	6	4	83

(c) Climbing Cutworm Trial, Northfield, 1971

Number of damaged peas in each treatment. Samples taken on 20 & 21/12/71

Treatment and Rate			Number of damaged peas									
No.	Insecticide	kg ai/ha	Replicate 1			Replicate 2			Replicate 3			Total
			Sections			Sections			Sections			
			a	b	c	a	b	c	a	b	c	
1.	Endosulfan	0.35	6	16	7	5	13	23	10	12	16	108
2.	Endosulfan	0.28	3	11	6	6	7	6	10	21	13	83
3.	Endosulfan	0.21	4	16	11	7	9	19	7	15	13	101
4.	Diazinon	0.56	8	11	7	14	11	22	9	34	19	135
5.	Chlorpyrifos	0.24	21	13	14	14	6	19	10	4	14	115
6.	Fenitrothion	0.50	9	10	14	11	13	16	11	12	23	119
7.	Fenitrothion	0.35	21	12	12	6	14	16	18	11	7	117
8.	Methoxychlor	0.96	21	8	3	14	14	10	13	12	5	100
9.	Trichlorphon	0.41	16	8	6	17	18	13	2	9	19	108
10.	DDT	0.70	12	12	17	7	15	11	10	14	13	111
11.	Nil	-	8	10	10	20	7	4	2	7	8	76

(d) Climbing Cutworm Trial, Northfield, 1971

Weight of Yield Samples in Each Treatment. Samples Taken 22 to 24/12/71

Treatment and Rate			Weight in Grams of Peas			
No.	Insecticide	kg ai/ha	Replicate 1	Replicate 2	Replicate 3	Total
1.	Endosulfan	0.35	265	956	838	2 135
2.	Endosulfan	0.28	301	1 178	779	2 258
3.	Endosulfan	0.21	588	846	911	2 345
4.	Diazinon	0.56	414	776	485	1 675
5.	Chlorpyrifos	0.24	573	1 009	688	2 270
6.	Fenitrothion	0.50	246	999	725	1 970
7.	Fenitrothion	0.35	423	942	738	2 103
8.	Methoxychlor	0.96	374	988	796	2 158
9.	Trichlorphon	0.41	576	1 035	670	2 281
10.	DDT	0.70	839	941	1 012	2 792
11.	Nil	-	268	865	1 204	2 337