COTTON PEST CONTROL TRIALS IN NORTHERN AND SOUTH-WESTERN QUEENSLAND

By J. J. DAVIS, B.Sc.*, T. H. KIRKPATRICK, B.Sc.*, and T. PASSLOW, M.Sc.Agr.†

SUMMARY

In 1959 two cotton pest trials were carried out in northern Queensland and during 1959-60 four in south-western Queensland. All trials were in irrigated crops. One involved fruit-form removal, three covered the effects of insecticide applications on yields, and two were screening trials for kills of *Earias huegeli* Rogen. In two of the insecticide trials fruit-form production studies were also made.

The trial concerned with fruit-form removal indicated that early season loss of fruit forms did not adversely affect yields in irrigated cotton in northern Queensland. Yield trial results showed that reasonable commercial control of the major pest species, *E. huegeli* and *Heliothis armigera* (Hubn.) in northern Queensland and *E. huegeli* and *H. punctigera* Wallengr. in the south-west, is possible by using DDT and endrin. The screening trials proved that of the materials tested, "Telodrin" is the only one likely to improve commercial control of *E. huegeli*.

Fruit-form production studies proved that although insecticides give considerable yield increases, the basic problem in both areas is the inability of the cotton varieties in use to produce regularly under current cultural conditions the fruit forms necessary for high potential yield.

I. INTRODUCTION

For many years the greater part of the Queensland cotton crop has been grown in Central Queensland. Experimental work on cotton pest control therefore has been largely confined to this area (see Passlow 1959). During recent seasons, serious attempts have been made to increase the area sown to cotton both in Central Queensland and in other parts of the State. For this reason, some attention has been given to insect control in areas other than the main production centre.

Although cotton has been grown for some years in the Burdekin district of North Queensland it has a record of unreliability. Due to rainfall distribution in this tropical area—heavy seasonal falls in the period January to March and dry conditions during the remainder of the year—the crop is sown during March. This allows maximum growth in early spring and permits harvesting before the onset of the following wet season. Cotton was grown for the first time at St. George in south-western Queensland during the 1958-59 season. Insect attack seriously reduced yields under the prevailing agronomic conditions. The major pest species involved were *Earais huegeli* Rogen. and *Heliothis armigera* (Hubn.) in North Queensland and *E. huegeli* and *H. punctigera* Wallengr. in the south-west. As these species are similar to those in Central Queensland, the experimental data from this area formed the basis for the following trials.

* Entomologists, Queensland Department of Agriculture and Stock

† Senior Entomologist, Queensland Department of Agriculture and Stock

Trial 1 at Ayr, in the Burdekin district, dealt with the manual removal of fruiting forms (see Passlow and Trudgian 1960), while Trials 2 at Millaroo, also on the Burdekin, and 3 and 4 at St. George were designed to investigate the feasibility of chemical control. Concurrently with Trials 3 and 4, two screening tests (Trials 5 and 6) at St. George were especially against the rough bollworm, *Earias huegeli*.

All plants in each trial were irrigated. D & PL14 variety was used in Trials 1 and 2 and Miller 43-9-0 in Trials 3 to 6.

II. MATERIALS

The following insecticides were used:—

BHC.—A miscible oil concentrate containing 6·5 per cent. w/v gamma isomer as active ingredient.

Chlordane.—An emulsifiable concentrate containing 80 per cent. w/v active ingredients.

DDD (TDE).—An emulsion concentrate containing 30 per cent. w/v *p.p'* isomer as active ingredient.

DDT.—An emulsion concentrate containing 25 per cent. w/v *p.p'* isomer as active ingredient.

Diazinon.—An emulsifiable concentrate containing 16 per cent. w/v active ingredient.

Dieldrin.—An emulsifiable concentrate containing 15 per cent. w/v active ingredient.

Endrin.—An emulsifiable concentrate containing 20 per cent. w/v active ingredient.

Azinphos methyl.—An emulsifiable concentrate containing 25 per cent. w/v active ingredient.

Malathion.—An emulsifiable concentrate containing 50 per cent. w/v active ingredient.

Parathion.—An emulsifiable concentrate containing 50 per cent. w/v active ingredient.

Carbaryl.—A dispersible powder containing 50 per cent. w/w active ingredient.

"Telodrin" (Octochloro-tetrahydro-methanophthalan).—An emulsifiable concentrate containing 15 per cent. w/v active ingredient.

Toxaphene.—An emulsifiable concentrate containing 80 per cent. w/v active ingredient.

III. METHODS

Trials 1–4 were planted in 1959 on April 6, March 4, October 12 and October 16 respectively. Trials 5 and 6 were in established cotton crops planted in the same period as Trials 3 and 4. Plot sizes were 2 rows each 20 ft long in

Trials 1 and 5; 9 rows each 39 ft in Trial 2 (one row being for observations only); 4 rows each 60 ft in Trials 3 and 4; and 2 rows each 25 ft in Trial 6. Rows were spaced 3 ft 6 in. apart.

In Trial 1 treatments were:—

A.—No removal of fruit forms.

B.—Removal of all fruit forms on June 26 and July 14.

C.—Removal of all fruit forms on June 26, July 14 and 28.

D.—Removal of all fruit forms on June 26, July 14 and 28 and August 10.

E.—Removal of all fruit forms on June 26, July 14 and 28 and August 10 and 20.

F.—No removal of fruit forms.

In Treatments B to E the first removal of fruit forms on June 26 was five weeks after the appearance of the first squares.

All treatments except F were sprayed nine times between June 17 and October 7, 1959, with a mixture of DDT 0·1 per cent., endrin 0·05 per cent. and parathion 0·01 per cent. Insecticides used in each of the Trials 2–6 are shown in Tables 2–6.

In Trial 2 applications were made seven times at fortnightly intervals from April 3. Four fortnightly applications were made in Trials 3 and 4 commencing on December 22 and December 24 respectively and one application was made of treatments in Trials 5 and 6 on February 23 and March 8, 1960, respectively. An application rate of approximately 100 gal per acre in each trial was sufficient to achieve thorough plant cover to run-off. Insecticides were applied by knapsack sprayer except in Trial 2, where a power-driven hand-operated unit was used.

Observations on attacks by insects were made in all trials and Heliothis egg counts were made in Trials 3 and 4 on five randomly selected groups of three terminals per plot at weekly intervals from December 15 to February 8.

In Trials 2 and 3 some attention was given to plant behaviour in relation to pest control.

All fallen fruit forms were collected each week from four inter-row areas each 10 ft in length per plot in Trial 2, and from three areas of 14 ft per plot in Trial 3; total forms, numbers damaged, and numbers of insects present were recorded. Prior to the commencement of squaring, five plants in Trial 2 and four in Trial 3 were selected in each plot and from these weekly records of numbers of squares, bolls and mature bolls were taken until September 15 and February 9 respectively. Production of forms was calculated from these data (see Passlow and Trudgian 1960). In addition, in Trial 2 50 fruit forms were removed at regular intervals from consecutive plants in the observation row. Numbers damaged and undamaged were recorded.

In Trials 5 and 6 sufficient fruit forms were examined to give a minimum count of 20 and 30 larvae respectively per plot in pretreatment counts and similar numbers of fruit forms were examined in post-treatment counts. Post-treatment counts were carried out 2 and 7 days after treatment in Trial 5 and 2, 7 and 14 days after treatment in Trial 6.

Trial 1 was harvested in four picks on October 8 and 26 and November 3 and 17, and numbers of pickable bolls and weight of seed cotton were recorded. Trials 2, 3 and 4 were each harvested in a single pick on September 30, from March 28 to April 3 and from April 9 to April 12 respectively. In addition to weight of seed cotton per plot, numbers of matured bolls and pickable bolls per fallen fruit form datum area were recorded in Trials 2 and 3.

Stand counts were carried out in all trials, and where necessary yields adjusted to an equal number of plants per plot are given in the results.

Trial layouts, details of treatments and insecticide dosage expressed as percentage of active ingredient and other relevant information are given with the results of each trial. Yields are expressed in the economic unit of pounds of seed cotton per acre.

IV. RESULTS

Trial 1. 6 *x* 4 *Randomized Block, Ayr.*—The insecticide schedule applied gave adequate control of the pests encountered. In the unsprayed plots *Earias huegeli* attacked both terminal growth and fruit forms and *Heliothis armigera* caused considerable losses. Yields for the trial are given in Table 1.

TABLE 1

TRIAL 1. YIELDS EXPRESSED AS PICKABLE BOLLS AND SEED COTTON

—	Plants per Plot	Pickable Bolls per Plot	Yield (lb/ac)	Adjusted Yield (lb/ac)
No fruit-form removal; sprayed	70·5	593	1,665	1,662
Removal, twice; sprayed ..	69·0	609	1,688	1,702
Removal, three times; sprayed	70·2	508	1,423	1,424
Removal, four times; sprayed ..	68·8	516	1,571	1,588
Removal, five times; sprayed ..	73·0	414	1,245	1,216
No removal; unsprayed ..	72·2	(172)	(451)	
Necessary differences for significance 5%		115	308	269
Necessary differences for significance 1%		161	432	379

Trial 2. 3 *x* 7 *Randomized Block, Millaroo.—E. huegeli* attack was severe throughout the growing season. Unsprayed plants were distorted and stunted by terminal loss. Sprayed plants, particularly in endrin-treated plots, made heavy vegetative growth, but fruit form production was poor. Pest observations and percentages of damaged forms on the plants show that both endrin and DDT applications gave reasonable control of boll-feeding larvae. Endrin usage, however, gave better control of terminal-damaging pests, principally *E. huegeli.* Yields, fruit-form production and other information are given in Table 2.

TABLE 2

TRIAL 2. FRUIT PRODUCTION, FALLEN FRUIT FORMS, DAMAGED TERMINALS, YIELDS OF SEED COTTON AND MATURE BOLLS

Treatment	Production Fruit Forms per Plant	Fallen Fruit Forms per Plot			Damaged Terminals per Plot		Yield Seed Cotton (lb/Ac.)	Mature Bolls per Fallen Fruit-Form Area per Plot (40 row-feet)	
		Total	Percentage Damaged						
			Transformed Mean	Equivalent Mean %	Transformed Mean	Equivalent Mean %		Pickable	Total
Endrin 0·05%	33·60	1,360	45·93	51·6	30·30	25·5	444	366	429
DDT 0·1%	29·23	1,348	40·89	42·8	44·37	48·9	440	382	470
Check	38·97	1,023	59·14	73·7	48·67	56·4	23	26	36
Necessary differences for significance 5%	6·01	181	2·90		3·61				
1%	8·42	254	4·07		5·06		NOT	ANALYSED	

TABLE 3

TRIAL 3. FRUIT FORM PRODUCTION, FALLEN FRUIT FORMS, YIELDS OF SEED COTTON, AND PICKABLE AND TOTAL MATURE BOLLS

Treatment	Production of Fruit Forms per Plant	Fallen Forms per Plot			Yields		Mature Bolls per Plant	
		Total	Percentage Damaged		lb./Plot	lb./Ac.	Pickable	Total
			Transformed Mean	Equivalent Mean %				
DDT 0·1% spray	10·6	455·3	48·32	55·8	9·88	512	1·93	3·56
Endrin 0·05% spray	10·3	433·2	54·18	65·8	12·35	640	2·10	3·12
DDT 0·1% plus endrin 0·05% ..	11·2	406·5	42·85	46·2	15·90	825	2·92	3·64
Check	11·7	442·5	59·60	74·4	5·81	301	1·28	2·77
Necessary difference for significance 5%	3·6	68·8	4·61		1·42		0·27	0·56
1%	5·0	95·1	6·38		1·96		0·38	0·78

Trial 3. 4 *x* 6 *Randomized Block, St. George.*—Heliothis egg counts were low throughout the trial; a mean maximum of 12·5 per 100 terminals was recorded on January 4. The mean count during January and February was 8·7 per 100 terminals. Observations and numbers of larvae in fallen forms showed that *H. punctigera* caused damage, particularly during January. *E. huegeli* populations were higher than those of Heliothis and caused greater damage. Yields, fruit form production and other information are given in Table 3.

Trial 4. 4 *x* 6 *Randomized Block, St. George.*—Heliothis egg counts were lower than those in Trial 3, with a maximum mean of 8·1 per 100 terminals on January 13. High populations of *E. huegeli* were again encountered. Yields are given in Table 4.

TABLE 4
TRIAL 4. YIELDS OF SEED COTTON

Treatment	Yield	
	lb/plot	lb/ac
DDT 0·1%	12·21	638
Endrin 0·05%	16·23	848
DDT 0·1% plus endrin 0·05% ..	17·39	909
Check	9·05	471
Necessary differences for significance { 5%	2·21	
Necessary differences for significance { 1%	3·09	

Trial 5. 16 *x* 3 *Randomized Block, St. George.*—Results are summarized in Table 5.

TABLE 5
TRIAL 5. *E. huegeli* LARVAE PER FRUIT FORM IN 20 FORMS PER PLOT

Treatment	Number at Pretreatment Feb. 22	Number at Post-treatment	
		Feb. 25	Mar. 1
"Telodrin" 0·1%	0·60	0·11	0·05
Azinphos methyl 0·05%	0·75	0·31	0·15
Endrin 0·05%	0·57	0·29	0·20
Diazinon 0·05%	0·49	0·37	0·23
DDD 0·1%	0·60	0·45	0·26
Carbaryl 0·1%	0·60	0·29	0·30
Dieldrin 0·05%	0·73	0·36	0·34
DDT 0·1%	0·41	0·45	0·36
Toxaphene 0·1%	0·51	0·34	0·38
Chlordane 0·1%	0·51	0·45	0·39
Parathion 0·015%	0·55	0·47	0·40
BHC 0·04% g.i.	0·53	0·46	0·53
Malathion 0·1%	0·54	0·35	0·60
Check (mean of 3)	0·60	0·45	0·45
Necessary differences for significance { 5%	No significant differences	0·15	0·19
Necessary differences for significance { 1%		0·20	0·25

Trial 6. 9 *x* 3 *Randomized Block, St. George.*—Results are summarized in Table 6.

TABLE 6

TRIAL 6. *E. huegeli* LARVAE PER FRUIT FORM IN 30 FORMS PER PLOT

Treatment	Number at Pretreatment Mar. 8	Number at Post-treatment		
		Mar. 10	Mar. 15	Mar. 22
" Telodrin " 0·15%	0·54	0·16	0·18	0·39
" Telodrin " 0·10%	0·60	0·24	0·23	0·45
" Telodrin " 0·05%	0·59	0·44	0·28	0·54
Endrin 0·15%	0·58	0·39	0·16	0·33
Endrin 0·10%	0·57	0·43	0·28	0·61
Endrin 0·05%	0·56	0·29	0·25	0·58
DDT 0·10%	0·59	0·54	0·56	1·05
Check (mean of 2)	0·51	0·56	0·66	1·31
Necessary differences for significance 5%	No significant differences	0·13	0·15	0·30
Necessary differences for significance 1%		0·18	0·21	0·42

V. DISCUSSION AND CONCLUSIONS

Yield data obtained in Trial 1 show that loss of the early-season fruit-form production was not important. This result is complementary to that of Passlow and Trudgian (1961) obtained in Central Queensland. Trials 1 and 2, however, both show that insects have an important effect on cotton yields in the Burdekin area under present agronomic conditions. The use of the insecticides in these trials resulted in spectacular yield increases over check plots and similarly yield increases were highly significant in Trials 3 and 4 at St. George.

Observations and trial data show that the major pest species are *E. huegeli* and *H. armigera* in northern Queensland and *E. huegeli* and *H. punctigera* in south-western Queensland and that reasonable control of these species is possible.

Trials 5 and 6 show that endrin gave fair kills of *E. huegeli* and that, of the materials tested, "Telodrin" showed the most promise of improving commercial control. Residual effect was poor in Trial 6 following a mean daily maximum temperature of 94°F during the first week after spraying and heavy rains early in the second week. Reinfestation from outside sources was severe, particularly during the second week.

Fruit-form production was poor at St. George. Actual production was equivalent to that obtained by Passlow (1961) under raingrown semi-drought conditions in Central Queensland. Despite irrigation, crop return was low and pest damage was consequently more severe than would have been expected in potentially high-yielding crops. This result proves that, although insect pests are of some consequence, the important factors in poor yields are of an agronomic nature.

At Millaroo in Trial 2 insect damage was severe in both fallen forms and terminals, and yields were poor despite seven applications of insecticides. Following nine applications at Ayr in Trial 1, yields were much better from smaller and less vegetative plants. These results show that pest control can be a factor in cotton production in the Burdekin area.

Although fruit-form production was better at Millaroo than at St. George it was not in proportion to the better type of plant produced. This fact and the variable nature of yields, irrespective of pest attack, since the inception of the industry in this area indicate that, although insects are important, other factors are also involved in the poor yield patterns obtained.

VI. ACKNOWLEDGEMENTS

Mr. P. B. McGovern, Chief Biometrician, was responsible for the analyses of the experimental data. Facilities for the trials were provided by the Departmental Research Stations at Ayr and Millaroo, the Irrigation and Water Supply Commission Farm at St. George, and by Messrs. K. Kelly and N. Marshall, farmers at St. George. This assistance is gratefully acknowledged.

REFERENCES

PASSLOW, T. (1959).—Heliothis as a pest of cotton in Central Queensland. *Qd J. Agric. Sci.* 16:165-76.

PASSLOW, T. (1961).—Insect pest control and yield patterns in Central Queensland cotton crops. *Qd J. Agric. Sci.* 18:269-86.

PASSLOW, T., and TRUDGIAN, K. G. (1960).—The effects of fruit form removals on cotton yields in Central Queensland. *Qd J. Agric. Sci.* 17:311-20.

(Received for publication December 12, 1962)