QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF PLANT INDUSTRY BULLETIN No. 772

CONTROL OF HELIOTHIS ARMIGERA (HÜBNER) AND PHTHORIMAEA OPERCULELLA (ZELLER) IN TOMATOES IN SOUTH EASTERN QUEENSLAND 1971–1975

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SUMMARY

Thirteen insecticides were tested against two important pests of tomatoes, *Heliothis armigera* (Hübner) and *Phthorimaea operculella* (Zeller). The materials most effective against *H. armigera* were 0.1% acephate, 0.1% DDT, 0.075% endosulfan, 0.1% methamidophos, 0.05% methomyl, and 0.1% tetrachlorvinphos, and against *P. operculella* were 0.1% acephate, 0.05% azinphos-ehtyl, 0.1% methamidophos, and 0.5% methomyl.

To control *H. armigera*, a spray interval of 7 days was preferable to one of 10 or 14 days. Azinphos-ethyl was effective against *P. operculella* when applied at 14-day intervals, but with acephate, methamidophos and methomyl a 7-day interval was required.

Simultaneous control of both pests was given by acephate, methamidophos and methomyl used at 7-day intervals. However with DDT, endosulfan or tetrachlorvinphos, the addition of azinphos-ethyl in alternate sprays would be necessary.

I. INTRODUCTION

The corn ear worm (*Heliothis armigera* (Hübner)), and the potato moth (*Phthorimaea operculella* (Zeller)), are two of the most important pests of tomatoes in south eastern Queensland. *H. armigera* requires control measures during most of the year and *P. operculella* more sporadically in the autumn, spring or early summer (Smith 1977). For many years they were controlled with fortnightly applications of a 0·1% spray or a 2% dust of DDT (Smith 1957).

Champ and Shepherd (1965) demonstrated resistance to DDT in Queensland by *P. operculella.* Based on work in potatoes (Rossiter and Sabine 1966) and tobacco (Cunningham 1971), azinphos-ethyl replaced DDT for control of *P. operculella* in tomatoes. However, it was necessary to check the efficacy of this treatment on tomatoes and to test newer pesticides against both insects.

In the trials reported in this paper, various pesticides were tested during the period 1971-1975 against *H. armigera* and *P. operculella* using spray intervals of 7, 10 or 14 days.

II. MATERIALS

acephate	50% w/w wettable powder
azinphos-ethyl	40% w/v emulsifiable concentrate
Bacillus thuringiensis	Wettable powder containing 16 000 international units of potency per mg
carbaryl	80% w/w wettable powder
chlordimeform	81·8% w/w wettable powder
DDT	25% w/v emulsifiable concentrate
endosulfan	35% w/v emulsifiable concentrate
leptophos	45% w/w wettable powder
methamidophos	58% w/v emulsifiable concentrate
methomyl	90% w/w wettable powder, 35% w/v and 25% w/v emulsifiable concentrates
monocrotophos	60% w/v emulsifiable concentrate
tetrachlorvinphos	50% w/w wettable powder
trichlorofon	80% w/w wettable powder

III. METHODS

Six trials were conducted at the Maroochy Horticultural Research Station during the spring-early summer periods of 1971 to 1975 using mainly the variety Floradel. Randomized block layouts with four replications and plots of approximately 40 plants were used. The plants were trellised to a height of approximately 1 m. Sprays, which included the fungicides maneb and copper oxychloride, were applied to run-off by knapsack sprayer on a 7, 10 or 14-day schedule from flowering until the end of harvest.

Mature fruit were harvested weekly and the percentage of fruit damaged by each of the two pests was recorded. Total numbers of harvested fruit during the trials varied from 100 to 800 per plot. Numbers of *P. operculella* larvae in the fruit were also recorded.

IV. RESULTS AND DISCUSSION

H. armigera was active in all of the trials and *P. operculella* only in trials 1 to 4. For each pest, the efficacy of materials was regarded as satisfactory if less than 2·5% of the number of fruit were injured.

H. armigera

Fortnightly sprays were usually unsatisfactory for control of *H. armigera* (trials 1 to 3; table 1). Better control was achieved in trial 2 than in trials 1 and 3 but this resulted from lower pest activity.

Sprays of 0·1% acephate, 0·1% DDT, 0·75% endosulfan, 0·1% methamidophos, 0·5% methomyl and 0·1% tetrachlorvinphos, applied weekly or at 10-day intervals, gave satisfactory control in trials 2, 3 and 6.

TABLE 1

CONTROL OF *H. armigera* EXPRESSED AS PERCENTAGE DAMAGED FRUIT AT HARVEST

Treatment	Spray Interval in Days								
	14	7	14	7	10	14	10	7	7
	Trial 1	Trial 2		Trial 3			Trial 4	Trial 5	Trial 6
acephate 0·075%								7·0cd	
acephate 0·1%				0·0a	1·3ab		4·2ab	5·7bc	
azinphos-ethyl 0·05%	14·0ab	3·3cd	7·8e						
carbaryl 0·1%	12·1ab				0·4ab				
chlordimeform 0·04%									8·6b
chlordimeform 0·063%								1·7a	
chlordimeform 0·02% + B.t.*									1·4a
chlordimeform 0·01% + B.t.*									2·2a
DDT 0·1%	10·8ab	0·1a	0·9ab	0·0a	0·3ab	1·1ab			
DDT 0·1% + azinphos-ethyl 0·05%†					0·0a		2·6a	3·4a	
DDT 0·1% + azinphos-ethyl 0·05%						0·7ab			
endosulfan 0·075%	11·0ab	0·2a	0·4a	2·1ab	3·0b		5·4abc	2·6a	
leptophos 0·075%								7·5cd	
methamidophos 0·075%								9·3d	
methamidophos 0·1%				0·0a	0·7ab		6·8bc	6·0c	1·9a
methomyl 0·025%	17·0ab	1·1abc	5·0de	0·3ab	0·0a				
methomyl 0·05%	10·0a				0·3ab		8·2c	7·8cd	3·9ab
methomyl 0·0125% + B.t.*									5·2ab
monocrotophos 0·05%									1·6a
tetrachlorvinphos 0·1%	10·5a	0·4a	2·3bcd	0·6ab	2·1ab				
trichlorfon 0·1%	20·6b								
trichlorfon 0·15%					2·8b				
No treatment	38·4c	19·9f		44·2c			38·0d	50·1e	

† Azinphos-ethyl included in every second spray.

Treatments followed by the same letter within a trial are equivalent at the 5% level.

* B.t.—*Bacillus thuringiensis* at 0·25 g l^{-1}.

TABLE 2

CONTROL OF *P. operculella* EXPRESSED AS PERCENTAGE DAMAGED FRUIT AT HARVEST

Treatment	Spray Interval in Days						
	14	7	14	7	10	14	10
	Trial 1	Trial 2		Trial 3			Trial 4
acephate 0·1%				2·1a	2·0a		2·2a
azinphos-ethyl 0·05%	0·1a	0·0a	2·2b				
carbaryl 0·1%	5·2b				12·1bcdef		
DDT 0·1%	16·2c	9·4d	24·9efg	4·6def	13·7cdef	24f	
DDT 0·1% + azinphos-ethyl 0·05%*					3·7abc		5·7ab
DDT 0·1% + azinphos-ethyl 0·05%						3·2ab	
endosulfan 0·075%	9·3bc	8·9d	19·0ef	15·2ef	26·9f		8·3b
methamidophos 0·1%				2·0a	4·2abcd		5·5ab
methomyl 0·025%	9·6bc	4·0bc	18·0e	4·6abcde	14·6def		
methomyl 0·05%	4·4b				4·5abcde		6·8ab
tetrachlorvinphos 0·1%	6·5b	7·2cd	25·5fg	16·4f	19·8f		
trichlorfon 0·1%	11·2bc						
trichlorfon 0·15%					16·4f		
No treatment	7·7b	26·5g		24·8f			19·2c

* Azinphos-ethyl included in every second spray.

Treatments followed by the same letter within a trial are equivalent at the 5% level.

TABLE 3

CONTROL OF *P. operculella* EXPRESSED AS MEAN NUMBER OF LARVAE PER PLOT RECORDED ON THE FRUIT AT HARVEST

Treatment	Spray Interval in Days						
	14	7	14	7	10	14	10
	Trial 1	Trial 2		Trial 3			Trial 4
acephate 0·1%				0·0a	0·0a		0·0a
azinphos-ethyl 0·05%	0·0	0·0a	1·7ab				
carbaryl	2·8				7·0cd		
DDT 0·1%	4·0	17·5d	53·4e	2·1abc	6·0bcd	6·0bcd	
DDT 0·1% + azinphos-ethyl 0·05%*					1·5abc		3·1bc
DDT 0·1% + azinphos-ethyl 0·05%						2·0abc	
endosulfan 0·075%	5·2	15·5cd	41·0e	10·5de	26·1f		7·1cd
methamidophos 0·1%				0·0a	0·8ab		2·3ab
methomyl 0·025%	3·7	5·5bc	40·1e	2·1abc	7·1cd		
methomyl 0·05%	3·2				1·2abc		4·6bc
tetrachlorvinphos 0·1%	4·2	9·9cd	59·7e	18·0ef	15·0def		
trichlorfon 0·1%	3·0						
trichlorfon 0·15%					5·7bcd		
No treatment	3·0 N.A.	54·9e		11·1de			12·2d

* Azinphos-ethyl included in every second spray.

Treatments followed by the same letter within a trial are equivalent at the 5% level.

N.A.—not analysed

Differences between the weekly and 10-day spray applications in trial 3 were not significant. However, results from trials 4 and 5 indicate that with wet weather or heavy pest infestation, the shorter schedule is preferable. In trial 4, prolonged wet weather occurred and spraying at 10-day intervals did not give satisfactory control. In trial 5, particularly heavy *H. armigera* infestation occurred and most materials, even with weekly sprays failed to achieve control.

Promising results were given by 0·063% chlordimeform in trial 5, 0·01% and 0·02% chlordimeform plus *Bacillus thuringiensis* in trial 6, and 0·05% monocrotophos in trial 6 all with weekly sprayings, and by 0·1% carbaryl in trial 3 with 10-day sprayings.

P. operculella

Used weekly or fortnightly, 0·05% azinphos-ethyl was the most effective material against *P. operculella* (table 2 and 3) but extension of the spray interval beyond 14 days as in trial 4 was unsatisfactory. Other promising materials when used weekly were 0·1% acephate and 0·1% methamidophos. Methomyl at 0·5% was not applied weekly; however, it gave comparable control to methamidophos in trial 3 when sprayed at 10-day intervals.

V. CONCLUSION

H. armigera was the most important pest during this work and its control required weekly treatments. The most effective alternative pesticides to DDT were 0·1% acephate, 0·075% endosulfan, 0·1% methamidophos, 0·05% methomyl, and 0·1% tetrachlorvinphos. *P. operculella* was present in four of the six trials and was effectively controlled by 0·05% azinphos-ethyl applied fortnightly. Of the pesticides found effective against *H. armigera,* it was concluded that satisfactory control of *P. operculella* will also be given by weekly applications of 0·1% acephate, 0·1% methamidophos, and 0·05% methomyl. Where DDT, endosulfan or tetrachlorvinphos are used for *H. armigera* they will require supplementation in alternative sprays with 0·05% azinphos-ethyl when it is necessary to control *P. operculella* also.

VI. ACKNOWLEDGEMENT

Biometry Branch of the Department was responsible for the statistical analyses.

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(Received for publication 9 February 1978)

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