

## QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF PLANT INDUSTRY BULLETIN No. 804

**INSECTICIDES FOR CONTROL OF TOMATO GRUB  
HELIOTHIS ARMIGERA (HÜBNER), AND POTATO  
MOTH, PHTHORIMAEA OPERCULELLA (ZELLER),  
IN TOMATOES**

By J. R. HARGREAVES, B.Sc. and L. P. COOPER

**SUMMARY**

During 1976 to 1977, nine insecticides were tested at Ormiston. The most effective insecticide in reducing damage to tomato fruit by *Heliothis armigera* (Hübner) and *Phthorimaea operculella* (Zeller) was sulphophos at 0.072%. Other chemicals which gave satisfactory results were methamidophos at 0.11%, acephate at 0.075%, chlordimeform at 0.05%, chlorpyrifos at 0.1%, endosulfan at 0.067%, monocrotophos at 0.1% and prothiofos at 0.15%.

**I. INTRODUCTION**

The tomato grub, *Heliothis armigera* (Hübner), and potato moth, *Phthorimaea operculella* (Zeller) are serious pests of tomatoes grown in south-east Queensland. Fruit damaged by the larvae either rot and fall from the plant or are rendered unmarketable. Early control measures were based on lead arsenate (Veitch 1935) and later DDT (Smith 1957). However, with changing attitudes towards DDT and the development of DDT resistance by *P. operculella* (Champ and Shepherd 1965) DDT has been increasingly replaced by other insecticides. Smith (1978) demonstrated that weekly applications of methamidophos, acephate or methomyl were required for control of infestations of both *H. armigera* and *P. operculella*.

The present investigations were designed to test further the relative efficacies of these and a range of alternative chemicals under conditions of severe infestation pressure.

**II. MATERIALS AND METHODS**

The insecticides used, percentages of active constituent and types of formulation were as follows:

acephate	75%	w/w	soluble powder
chlordimeform	97%	w/w	soluble powder
chlorpyrifos	50%	w/v	emulsifiable concentrate
endosulfan	35%	w/v	emulsifiable concentrate
methamidophos	58%	w/v	emulsifiable concentrate

methomyl	22.5% w/v	emulsifiable concentrate
monocrotophos	40% w/v	emulsifiable concentrate
prothiophos*	72% w/v	emulsifiable concentrate
(proposed name)		
sulprophos**	72% w/v	emulsifiable concentrate
(proposed name)		
* prothiophos	O-2,4-dichlorophenyl	O-ethyl
	S-propyl	phosphorodithioate
** sulprophos	O-ethyl	O-4-methylthiophenyl
		S-propyl phosphorodithioate

Because of its wide usage in tomato growing areas 0.11% methamidophos was taken as the standard. A non-ionic wetting agent ("Agral 60") at 0.1% was used with all treatments.

Two trials each involving 700 m<sup>2</sup> were carried out at the Redlands Horticultural Research Station, Ormiston using the cultivar Strobelee. Both were undertaken in mid-summer (trial 1, September 1976 to January 1977; and trial 2, October 1976 to January 1977), to co-incide with expected high pest populations, although the usual growing seasons in the area are in spring and autumn.

Each trial included six treatments with five replications in completely randomised designs (details of treatment are given with the tabulated results). The plot size throughout was 28 plants grown on 14 m of trellised row, rows being 1.6 m apart.

All insecticides were applied by knapsack spray to run-off. Applications were made at weekly intervals, 13 applications being used in trial 1 and 12 in trial 2.

Fruit were harvested weekly from the first showing of colour and both yield and quality were recorded. Four quality grades were used of which the first three, Fancy, Standard and Plain (Queensland Tomato Grade Standards, Anon. 1967) relate progressively to fruit quality in terms of size and proportion of superficial blemish. The fourth grade, Rejects, comprised unmarketable fruit. Insect induced blemish was initially ignored in the grading but assessed later within the grade. Data from successive harvests were bulked and expressed as percentage of fruit damaged within each grade and treatment, the damage being ascribed to relevant pest species. *Heliothis* larvae were collected periodically and reared for species determination.

### III. RESULTS AND DISCUSSION

*H. armigera* (Hübner) was the only species bred from larvae in the trials although Kirkpatrick (1961) also recorded *H. punctigera* Wallengren from tomatoes.

The results obtained are summarised in tables 1, 2 and 3. Both yield and quality were considerably better in all insecticide treatments than in the untreated controls in both trials. These marked differences are a reflection of efficacy standards and the large infestations experienced. Sulprophos at 0.072% outyielded and gave better control of both pests than 0.11% methamidophos. All other treatments, with the exception of 0.05% methomyl gave similar control to 0.11% methamidophos. Chlordimeform was withdrawn from sale in 1976, by the manufacturers.

TABLE 1  
TRIALS 1 AND 2: MEAN YIELDS OF TOMATO FRUIT EXPRESSED AS WEIGHT AND NUMBER PER PLOT

Treatment	Total Yield		Fancy Grade	Standard Grade	Plain Grade	Reject Grade
	kg per Plot	No. Fruits per Plot	No. Fruits per Plot	No. Fruits per Plot	No. Fruits per Plot	No. Fruits per Plot
<b>TRIAL 1</b>						
untreated .. .. .	6.0a	120.8a	10.0	7.4	14.4	89.2
chlordimeform 0.05% .. .. .	66.5c	686.6c	122.2	157.4	193.8	213.2
chlorpyrifos 0.1% .. .. .	48.4bc	531.6bc	80.2	113.4	142.0	196.0
methamidophos 0.11% .. .. .	57.6c	556.2c	117.4	129.4	168.8	140.6
methomyl 0.05% .. .. .	37.4b	366.0b	77.8	92.8	94.0	101.4
prothiophos 0.15% .. .. .	57.8c	649.6c	91.0	130.8	204.6	223.2
<b>TRIAL 2</b>						
untreated .. .. .	15.8a	185.4a	11.8	21.6	46.0	106.0
acephate 0.075% .. .. .	23.8c	309.8b	12.0	35.0	62.8	200.0
endosulfan 0.067% .. .. .	22.1b	360.0bc	14.4	27.6	55.0	263.0
methamidophos 0.11% .. .. .	23.0b	295.0b	17.8	32.6	62.0	182.6
monocrotophos 0.1% .. .. .	30.8d	401.2c	24.4	44.2	80.8	251.8
sulprophos 0.072% .. .. .	36.2e	547.0d	27.6	48.0	101.2	370.2

Values followed by the same letter do not differ at the  $P = 0.05$  level of probability.

TABLE 2  
TRIAL 1—PERCENTAGES OF TOMATO FRUIT DAMAGED BY *H. armigera* AND *P. operculella* PER PLOT

Treatment	Fancy Grade		Standard Grade		Plain Grade		Reject Grade		Total of all Grades	
	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean
Effects attributable to <i>Heliothis armigera</i>										
untreated .. .. .	†	52.0	†	48.0	†	19.8	0.68a	39.9	0.69a	40.9
chlordimeform 0.05% ..	0.25a	6.1	0.32	10.2	0.39	14.4	0.43bc	17.1	0.36bc	12.5
chlorpyrifos 0.1% ..	0.12b	1.4	0.28	7.5	0.38	13.8	0.52b	24.9	0.39bc	14.3
methamidophos 0.11% ..	0.23a	5.3	0.27	7.1	0.31	9.3	0.47b	20.7	0.33c	10.7
methomyl 0.05% ..	0.28a	7.5	0.39	14.4	0.41	16.0	0.46ab	29.1	0.42b	17.2
prothiophos 0.15% ..	0.21ab	4.4	0.30	8.6	0.32	9.3	0.41bc	15.6	0.34c	11.0
			n.s.		n.s.					
Effects attributable to <i>Phthorimaea operculella</i>										
untreated .. .. .	†	24.1	†	28.9	†	53.3	0.50a	22.8	0.54a	26.5
chlordimeform 0.05% ..	0.28	7.4	0.34	10.9	0.39b	14.7	0.36b	12.5	0.37c	12.9
chlorpyrifos 0.1% ..	0.28	7.9	0.35	11.6	0.44ab	18.3	0.41ab	15.7	0.42b	16.6
methamidophos 0.11% ..	0.26	6.7	0.32	10.1	0.36b	12.7	0.40ab	14.9	0.34c	11.3
methomyl 0.05% ..	0.36	12.3	0.41	15.6	0.53a	25.5	0.50a	22.6	0.45b	18.9
prothiophos 0.15% ..	0.26	6.9	0.33	10.4	0.38b	13.7	0.34b	11.2	0.34c	11.1
	n.s.		n.s.							

Values followed by the same letter do not differ at the  $P = 0.05$  level of probability. Comparisons may only be made within columns.

\* = Inverse sine transformation.

† = Significantly ( $P = 0.01$ ) more of the fruit from the untreated plots were of the reject grade and this treatment was excluded from the analysis.

n.s. = No significant differences at  $P = 0.05$  level of probability.

TABLE 3  
TRIAL 2—PERCENTAGES OF TOMATO FRUIT DAMAGED BY *H. armigera* AND *P. operculella* PER PLOT

Treatment	Fancy Grade		Standard Grade		Plain Grade		Reject Grade		Total of all Grades	
	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean	Trans* Mean	Equiv Mean
Effects attributable to <i>Heliothis armigera</i>										
untreated .. ..	0.48a	21.0	0.70a	41.9	0.73a	44.7	0.81a	52.5	0.76a	47.1
acephate 0.075% .. ..	0.39a	14.8	0.34bc	11.4	0.44b	18.9	0.46bc	19.4	0.44b	17.9
endosulfan 0.067% .. ..	0.29ab	8.5	0.41b	16.3	0.47b	20.7	0.49b	22.2	0.47b	20.7
methamidophos 0.11% .. ..	0.30ab	8.9	0.39bc	14.7	0.42b	17.0	0.51b	24.2	0.47b	20.8
monocrotophos 0.1% .. ..	0.28ab	7.9	0.35bc	12.8	0.39b	14.4	0.47b	20.3	0.43bc	17.4
sulprophos 0.072% .. ..	0.15b	2.3	0.25c	5.9	0.30c	8.9	0.38c	13.6	0.35c	11.8
Effects attributable to <i>Phthorimaea operculella</i>										
untreated .. ..	0.76a	47.8	0.76a	47.8	0.66a	38.0	0.53a	25.5	0.60a	32.3
acephate 0.075% .. ..	0.38b	14.2	0.42	16.4	0.52b	24.7	0.44bc	17.9	0.47b	19.9
endosulfan 0.067% .. ..	0.43b	17.6	0.51b	24.0	0.59ab	30.9	0.47ab	20.7	0.49b	22.6
methamidophos 0.11% .. ..	0.25b	6.1	0.39bc	14.4	0.50b	23.4	0.39cd	14.4	0.41c	15.7
monocrotophos 0.1% .. ..	0.28b	7.7	0.40bc	15.3	0.42bc	16.6	0.39cd	14.5	0.39c	14.6
sulprophos 0.072% .. ..	0.32b	10.0	0.24c	5.8	0.33c	10.7	0.32d	10.2	0.32d	10.0

Values followed by the same letter do not differ at the  $P = 0.05$  level of probability. Comparisons may be made only within columns.

\* = Inverse sine transformation.

## REFERENCES

- ANON. (1967).—Tomato grade standards—*Queensland Government Gazette*, 18 March 1967: 1039.
- CHAMP, B. R., and SHEPHERD, R. C. H. (1965).—Insecticide resistance in *Phthorimaea operculella* (Zeller) with particular reference to DDT. *Queensland Journal of Agricultural Science* 22:101-105.
- KIRKPATRICK, T. H. (1961).—Queensland distribution and host records for *Heliothis* species (Lepidoptera:Noctuidae). *Queensland Journal of Agricultural Science* 18:195-202.
- SMITH, D. (1978).—Control of *Heliothis armigera* and *Phthorimaea operculella* in tomatoes in south-eastern Queensland 1971-1975. *Queensland Journal of Agricultural & Animal Sciences* 35:47-52.
- SMITH, W. A. (1957).—Tomato pest control. *Queensland Agricultural Journal* 83:375-380.
- VEITCH, R. (1938).—'Insect Pests and Their Control'. (Government Printer, Brisbane).

(Received for publication 27 July 1978)

The authors are officers of Entomology Branch, Queensland Department of Primary Industries and are stationed at Ormiston, Q. 4163.