QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 345

INSECTICIDAL CONTROL OF PHTHORIMAEA OPERCULELLA (ZELL.) IN CENTRAL QUEENSLAND

By P. D. ROSSITER and B. N. E. SABINE, B.Sc.*

SUMMARY

In two screening trials to determine suitable insecticides for the control of *P. operculella* in tomatoes and potatoes in Central Queensland, azinphos-methyl, isobenzan, carbaryl and endrin gave satisfactory control. BHC and diazinon gave good control in one trial each but gave only fair control in the other trial.

A dosage levels trial emphasized the phytotoxic effect of isobenzan on tomatoes and the need for thorough coverage with sprays to control an established population of *P. operculella*.

A field trial in potatoes demonstrated the suppression of leaf-mining and a yield increase of approximately 2 tons of first grade tubers per acre following three applications of azinphos-ethyl, isobenzan, carbaryl or endrin. The yield increase was of the order of 40%. Under the conditions of the trial, the percentage of tubers infested was not affected by these applications. Azinphos-ethyl and carbaryl did not give satisfactory control of Heliothis and aphids respectively.

DDT was ineffective for control of *P. operculella* in all trials.

I. INTRODUCTION

Satisfactory control of *Phthorimaea operculella* (Zell.) in both potatoes and tomatoes grown in Central Queensland coastal districts had been achieved until about 1958 with sprays containing DDT. From that time, however, control with DDT became increasingly difficult and heavy crop losses occurred despite increased rates and frequencies of applications.

Although insecticides may not be the complete answer to pest control, it was obvious that an insecticide more efficacious than DDT was required in this case. With this objective, four trials were carried out during 1960 and 1961. Trials 1 and 3 were screening trials in tomatoes and potatoes respectively. The more promising chemicals from trial 1 were further tested on tomatoes in a dosage levels trial (trial 2), and those suggested by the results of trial 3 were included in a field trial (trial 4) in potatoes.

* Division of Plant Industry, Queensland Department of Primary Industries.

II. MATERIALS

Azinphos-ethyl.—An emulsifiable concentrate containing 40% w/v active constituent.

Azinphos-methyl.—An emulsifiable concentrate containing 25% w/v active constituent.

BHC (*a*).—An emulsifiable concentrate containing 7% w/v gamma isomer in mixed isomers.

(*b*).—An emulsifiable concentrate containing 16% w/v gamma isomer as lindane.

Carbaryl.—A dispersible powder containing 50% w/w active constituent.

DDD (*TDE*).—An emulsion concentrate containing 20% w/v active constituent.

DDT (*a*).—An emulsion concentrate containing 25% w/v pp′isomer.

(*b*).—A dispersible china clay powder containing 50% w/w pp′isomer.

Diazinon.—An emulsifiable concentrate containing 16% w/v active constituent.

Dieldrin.—An emulsifiable concentrate containing 15% w/v active constituent.

Endosulphan.—An emulsion concentrate containing 35% w/v active constituent.

Endrin.—An emulsifiable concentrate containing 20% w/v active constituent.

Isobenzan (*a*).—An emulsifiable concentrate containing 15% active constituent (unknown formulation).

(*b*).—As above (Australian formulation).

(*c*).—As above (Dutch formulation).

Malathion.—An emulsifiable concentrate containing 50% w/v active constituent.

Parathion.—An emulsifiable concentrate containing 50% w/v active constituent.

Phosphamidon.—A concentrate containing 20% w/v active constituent.

III. TRIAL 1: TOMATOES, INSECTICIDE SCREENING

Methods.—Eleven insecticides were screened for kills of *Phthorimaea operculella* which were mining in the leaves of field-grown tomatoes. A 13 x 3 randomized block layout, which included two untreated check treatments, was used. A plot size of 30 plants allowed for the collection of three samples of leaflets per plot, each sample yielding an estimated 50 mines.

An area of young plants of the variety Manalucie, 9-12 in. in height, carrying the first hand of flowers and with a heavy infestation of *P. operculella* in the leaf-mining stage, was selected for the trial. Sprays were applied by knapsack on July 25, 1960. The insecticides and their respective dilutions used are shown in Table 1.

TABLE 1

TRIAL 1: TOMATOES, INSECTICIDE SCREENING: PERCENTAGE ACTIVE MINES PER PLOT

Treatment	Active Constituent (%)	Pretreatment		Post-treatment (48 hr)		Post-treatment (1 week)	
		Transformed Mean*	Equivalent Mean %	Transformed Mean*	Equivalent Mean %	Transformed Mean*	Equivalent Mean %
1. Isobenzan ..	0·1	54·5	66	10·2	3	2·7	0·2
2. BHC	0·04	54·0	65	8·2	2	3·8	0·4
3. Carbaryl	0·1	58·6	73	27·4	21	8·2	2
4. Endrin	0·05	50·4	59	36·4	35	14·9	7
5. DDD	0·1	54·0	65	41·5	44	16·9	8
6. Diazinon	0·05	57·4	71	29·6	24	24·8	18
7. Parathion ..	0·015	51·9	62	32·9	30	29·7	24
8. DDT	0·1	55·2	67	46·5	53	36·7	36
9. Malathion ..	0·01	55·2	67	49·7	58	40·8	43
10. Dieldrin	0·05	58·1	72	48·9	57	43·1	47
11. DDT	0·1	55·5	68	50·2	59	49·3	57
12, 13. Untreated ..	....	56·7	70	51·4	61	46·9	53
s.e.		±2·80	..	±3·54	..	±3·22	..
Necessary differences for significance 5%		8·2	..	10·3	..	9·4	..
Necessary differences for significance 1%		11·0	..	14·0	..	12·7	..
Check v. any other treatment 5%		7·1	..	8·9	..	8·1	..
Check v. any other treatment 1%		9·6	..	12·1	..	11·0	..
		N.S.D.		$1, 2 \ll$ rest; $3, 6 \ll$ 8, 9, 10, 11, check; $3 \ll 5$; $6 < 5 <$ check; $7 \ll$ 9, 10, 11, check; $7 < 8$; $4 \ll$ check; $4 <$ 9, 10, 11		$1, 2 \ll$ 5, 6, 7, 8, 9, 10, 11, check; $3, 4, 5 \ll$ 7, 8, 9, 10, 11, check; $3 \ll 6 \ll$ 9, 10, 11, check; $7 \ll$ 10, 11, check; $7 < 9$; $1, 2 < 4 < 6 < 8 <$ 11, check	

* Inverse sine transformation.

Leaflet samples were collected on July 25 (pretreatment), July 27 (approximately 48 hr after treatment), and August 1 (1 week after treatment). These were transferred to the laboratory, where each mine was examined over a strong light for the presence of larvae. The number of larvae (living or dead) per mine was recorded. From the data, the percentage of active mines per plot was calculated: an active mine was one containing one or more living larvae.

Results.—Table 1 records the mean percentage of active mines per plot on the three sampling dates.

IV. TRIAL 2: TOMATOES, INSECTICIDE DOSAGE LEVELS

Methods.—Two chemicals, isobenzan and BHC, from trial 1 were selected for further study in a dosage levels trial in which DDT and endrin treatments at standard dilutions were included for comparisons. In an attempt to overcome the phytotoxicity problem associated with isobenzan which was noted in Trial 1, two formulations of this chemical were used.

An 11 x 3 randomized block layout, with a plot size of 20 plants, was used. Treatments consisted of three levels each of isobenzan (Australian formulation) and BHC, isobenzan (Dutch formulation) at the highest dosage level, endrin and DDT at standard dilutions and two untreated check treatments. Sprays were applied on August 8, 1960, using knapsack spray units. Dilution rates are shown in Table 2.

On this occasion, untrellised tomato plants of the variety Grosse Lisse, reaching a height up to 2 ft and with the fruit of the first hand up to 2 in. in diameter, were used. A moderately heavy infestation of *P. operculella* was present in both leaves and fruit.

Results were assessed in terms of percentages of active leaf mines. These data were obtained in the same manner as the data in trial 1 from leaflet samples collected on August 8 (pretreatment), August 10 (approximately 48 hr after treatment), and August 15 (1 week after treatment).

Results.—The mean percentages of active leaf mines per plot on each of the three sampling dates are shown in Table 2.

TABLE 2

TRIAL 2: TOMATOES, INSECTICIDE DOSAGE LEVELS: PERCENTAGE ACTIVE MINES PER PLOT

Treatment	Active Con-stituent (%)	Pretreatment		Post-treatment (48 hr)		Post-treatment (1 week)	
		Trans-formed Mean*	Equivalent Mean %	Trans-formed Mean*	Equivalent Mean %	Trans-formed Mean*	Equivalent Mean %
1. Isobenzan (Dutch)	0·15	48·5	56	30·1	25	2·7	0·2
2. Isobenzan (Australian)	0·15	54·8	67	30·5	26	11·5	4
3. BHC (Lindane) ..	0·07	53·6	65	23·6	16	12·7	5
4. BHC (Lindane) ..	0·04	48·1	55	24·4	17	18·7	10
5. Isobenzan (Australian)	0·10	55·1	67	33·9	31	19·2	11
6. Isobenzan (Australian)	0·05	47·3	54	33·5	30	22·4	15
7. Endrin	0·05	48·5	56	48·2	56	31·5	27
8. BHC (Lindane) ..	0·01	49·6	58	44·2	49	34·4	32
9. DDT	0·10	49·7	58	46·2	52	46·9	53
10, 11. Untreated ..	..	51·4	61	48·1	55	49·1	57
s.e.		±2·84	..	±3·17	..	±2·51	..
Necessary differences for significance	5%	8·4	..	9·3	..	7·4	..
	1%	11·4	..	12·7	..	10·0	..
Check v. any other treatment	5%	7·2	..	8·1	..	6·4	..
	1%	9·8	..	11·0	..	8·7	..
		N.S.D.		1, 2, 3, 4≪ 7, 8, 9, check; 3, 4≪ 5, 6≪ 7, check; 6≪ 9; 5< 9; 5, 6< 8		1≪ 4, 5, 6, 7, 8, 9, check; 2, 3, 4, 5≪ 7, 8, 9, check; 2≪ 6≪ 8≪ 9, check; 7≪ 9, check; 1< 2< 5; 1< 3< 6< 7	

* Inverse sine transformation.

V. TRIAL 3: POTATOES, INSECTICIDE SCREENING

Methods.—A screening of insecticides for kills of *P. operculella* in potatoes was carried out in plants 9-12 in. in height and forming part of an early-autumn crop. A heavy infestation of *P. operculella* in the leaf-mining stage was present.

Thirteen insecticides and three untreated check treatments were incorporated in a 16 x 3 randomized block layout. A plot size of 50 plants was used.

Insecticides were applied on March 21, 1961, using knapsack spray units, and thorough plant coverage was achieved. The insecticides and their respective dilutions are shown in Table 3.

Leaf samples, sufficient to yield 50 mines per plot, were collected on three occasions, viz. March 21 (pretreatment), March 22 (approximately 24 hr after treatment), and March 28 (1 week after treatment). These were examined and the percentage of active mines calculated as in trial 1.

Results.—Table 3 records the mean percentage of active mines per plot of 11 of the spray treatments and the untreated checks at each of the post-treatment examinations. One plot of each of the treatments isobenzan and phosphamidon was inadvertently not sprayed. These treatments could not be included in the analysis of results. Table 4 records the actual percentage active mines recorded in each of the two remaining plots per treatment on each of the three sampling occasions.

TABLE 3

Trial 3: Potatoes, Insecticide Screening: Percentage Active Mines per Plot

Treatment	Active Constituent (%)	Post-treatment (24 hr)		Post-treatment (1 week)	
		Transformed Mean*	Equivalent Mean %	Transformed Mean*	Equivalent Mean %
1. Azinphos-methyl ..	0·05	0·0	0	0·0	0
2. Carbaryl	0·1	7·4	1·7	0·0	0
3. Diazinon	0·05	5·4	0·9	3·8	0·4
5. Endrin	0·05	25·4	18·4	11·7	4·1
6. Parathion	0·015	15·4	7·1	12·9	5·0
8. Endosulphan	0·1	10·0	3·0	15·6	7·2
9. BHC (Lindane) ..	0·04	15·4	7·1	18·4	10·0
10. Malathion	0·06	19·0	10·6	20·9	12·7
11. DDD	0·1	43·4	47·3	31·7	27·6
12. Dieldrin	0·05	44·3	48·8	38·8	39·3
13. DDT	0·1	43·0	46·5	46·8	53·1
14–16. Untreated	..	49·0	56·9	46·9	53·2
s.e.	..	±5·08	..	±5·86	..
Necessary differences for significance 5%		14·7	..	17·0	..
Necessary differences for significance 1%		19·9	..	22·9	..
		1, 3≪ 5, 11, 12, 13, check; 2, 6, 8, 9, 10,≪11, 12, 13, check; 5≪ check; 1< 6, 9, 10; 2, 8< 5; 5 <11, 12, 13		1, 2, 3≪ 11, 12, 13, check; 5, 6, 8≪12, 13, check; 9, 10≪ 13, check; 1, 2< 9, 10; 3< 10; 5, 6< 11; 9, 10< 12; 11< 13, check.	

Pretreatment Counts: Average .. .. 65·2%
Average checks .. 68·0%

Treatments 4 and 7 not included in analysis.

* Inverse sine transformation.

TABLE 4

TRIAL 3: POTATOES, INSECTICIDE SCREENING: PERCENTAGE ACTIVE MINES (TREATMENTS 4 AND 7)

Treatment	Active Constituent (%)	Block	Pretreatment	Post-treatment (24 hr)	Post-treatment (1 week)
4. Isobenzan	0·05	A	82	0	0
		B	54	0	2
7. Phosphamidon	0·02	A	76	2	4
		C	38	2	8

VI. TRIAL 4: POTATOES, FIELD TRIAL

Methods.—Four of the more promising insecticides suggested by the screening trials were carried through to a field trial in potatoes, where their efficacy in controlling *P. operculella* was compared with that of DDT and untreated check treatments.

A 6 x 4 randomized block layout was used in this trial. Plots comprised six rows, each 37 ft long and spaced 33 in. apart. All data were taken from the four inner rows of each plot.

The trial area was part of a spring crop of the variety Exton, which was planted in late July, 1961. The crop received irrigation as required, and hilling-up of the plants directed at preventing moth oviposition on exposed tubers was carried out in the period September 20–27.

The insecticides used in this trial were DDT emulsion (0·1%), endrin (0·05%), azinphos-ethyl (0·05%), isobenzan, Australian formulation (0·05%) and carbaryl (0·1%). Spraying was commenced after leaf-mining by *P. operculella* was noted, and applications were made on September 4, September 20 and October 3 at the rates of approximately 150, 180 and 260 gal/ac respectively, using a power spray unit, delivering through a twin-nozzled hand-lance.

Data relating to leaf mine counts, top weights of plants, tuber yields, Heliothis larval counts and insects trapped in net sweeps were obtained from each plot.

The number of leaf mines occurring in 50 terminals per plot was recorded weekly from September 4 to October 16. A terminal consisted of the top six leaves of the plant.

The weights of the aboveground portion of the plants were recorded in two lots, each of 25 plants, per plot on November 8 and November 9 in order to demonstrate the differences in plant growth due to treatments.

Harvesting of the trial crop was carried out on November 10 and November 24. The numbers and weights of first and seed grades of tubers were recorded from each datum row of each plot. In each grade the numbers and weights of uninfested tubers, moth-infested tubers and tubers damaged from other causes were recorded.

During the course of the trial, observations suggested differences among treatments for Heliothis control. On October 10 and October 16, therefore, the numbers of Heliothis larvae noted on 50 terminals per plot were recorded concurrently with leaf-mine counts.

To indicate the numbers of miscellaneous insects being harboured by the potato plants, a series of 50 sweeps with an entomological net were made over each plot at foliage level on October 10. The insects thus collected were placed in 50% alcohol and sorted at a later date.

Results.—The mean weekly leaf-mine counts per plot for each treatment are shown graphically in Figure 1.

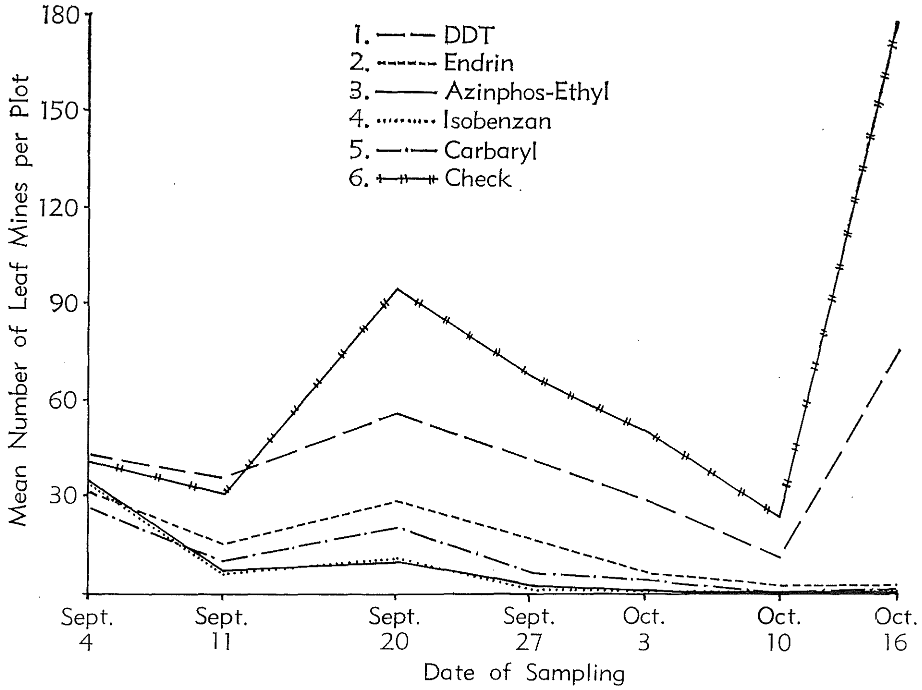

Fig. 1.—Mean numbers of leaf mines per plot (50 terminals).

The treatment means of the weights of tops per plot (50 plants) are shown in Table 5.

TABLE 5

TRIAL 4: POTATOES, FIELD TRIAL: WEIGHT OF TOPS AND YIELDS PER PLOT

Treatment	Weight of Tops (lb/plot)	Numbers of Tubers					
		Uninfested		Uninfested + infested		Total	Infested (%)
		1st Grade	1st + Seed Grades	1st Grade	1st + Seed Grades		
1. DDT	27·05	201	374	253	520	534	27·0
2. Endrin	35·95	262	473	342	666	691	27·5
3. Azinphos-ethyl ..	28·36	291	539	334	652	679	16·1
4. Isobenzan	30·50	262	478	324	630	655	22·9
5. Carbaryl	30·38	274	488	321	602	629	18·2
6. Untreated	23·88	196	404	230	491	503	16·9
s.e.	±4·49	±26·1	±28·5	±37·2	±39·5	±42·2	±4·31
Necessary differences for significance 5%		79	86	112	119	127	..
Necessary differences for significance 1%		109	119	155	165	176	..
	N.S.D.	N.S.D.	3≫ 1, 6; 2, 4, 5 >1		2≫ 6; 3, 4>6; 2, 3>1	2, 3≫6; 2, 3>1; 4> 6	N.S.D.

Heliothis numbers are tabulated in Table 7. As the numbers were low, the data are given on a per-treatment basis.

TABLE 7

TRIAL 4: POTATOES, FIELD TRIAL: NUMBERS OF HELIOTHIS LARVAE PER TREATMENT ON TERMINALS

50 terminals per plot

Treatment	October 10	October 16
1. DDT	Nil	Nil
2. Endrin	Nil	1
3. Azinphos-ethyl	9	6
4. Isobenzan	1	1
5. Carbaryl	1	1
6. Untreated	60	23

The treatment means of numbers of tubers per plot also are shown in Table 5. These are expressed in terms on uninfested tubers and uninfested plus moth-infested tubers in first grade and first plus seed grades, and total numbers of tubers, including those damaged from miscellaneous causes. The number of moth-infested tubers is expressed as a percentage of the total number. The treatment means of weights of tubers per plot are shown in Table 6, using the same categories as used in Table 5. Weights are expressed in the trial unit (lb/plot) and the commercial unit (tons/ac).

TABLE 6

TRIAL 4: POTATOES, FIELD TRIAL: YIELDS PER PLOT

Treatment	Uninfested				Uninfested + Infested				Total	
	1st Grade		1st + Seed Grades		1st Grade		1st + Seed Grades		lb/plot	tons/ac
	lb/plot	tons/ac	lb/plot	tons/ac	lb/plot	tons/ac	lb/plot	tons/ac		
1. DDT	66·9	3·20	87·4	4·17	82·9	3·96	112·9	5·39	116·4	5·56
2. Endrin	93·9	4·49	118·9	5·68	119·0	5·69	155·8	7·44	162·6	7·77
3. Azinphos-ethyl	100·9	4·82	129·5	6·19	113·9	5·44	149·9	7·16	155·9	7·45
4. Isobenzan	90·4	4·32	116·8	5·58	109·9	5·25	146·8	7·01	153·1	7·32
5. Carbaryl	97·0	4·63	121·5	5·81	112·4	5·37	144·2	6·89	150·6	7·19
6. Untreated	63·1	3·02	87·5	4·18	72·8	3·48	102·9	4·92	105·7	5·05
s.e.	±9·15	±0·437	±8·66	±0·414	±12·41	±0·593	±12·23	±0·584	±12·91	±0·617
Necessary differences for significance 5%	27·6	1·32	26·1	1·25	37·4	1·79	36·9	1·76	38·9	1·86
Necessary differences for significance 1%	38·1	1·82	36·1	1·72	51·7	2·47	51·0	2·44	53·8	2·57
	2, 3, 5>6; 3, 5>1		3≫1, 6; 2, 4, 5>1, 6		2, 3, 5>6		2≫6; 3, 4, 5>6; 2, 3>1		2≫6; 2>1; 3>1, 6; 4, 5>6	

The numbers of insects taken in net sweeps which could exert an effect on the potato crop and its pest fauna are shown, on a per-treatment basis, in Table 8. Most of the insects taken in this way were Diptera, particularly Drosophilidae.

TABLE 8

TRIAL 4: POTATOES, FIELD TRIAL: INSECTS TAKEN PER TREATMENT
50 net sweeps per plot

—	*P. operculella* (moths)	Leafhoppers	Ladybirds	Aphids
1. DDT	74	7	1	11
2. Endrin	101	5	3	0
3. Azinphos-ethyl	40	5	0	4
4. Isobenzan	71	4	7	0
5. Carbaryl	62	6	1	75
6. Untreated	151	13	0	139

VII. DISCUSSION

In the two screening trials 13 chemicals were tested for kills of *Phthorimaea operculella* in the leaf-mining stage. The most outstanding chemicals for the purpose were isobenzan and azinphos-methyl. Azinphos-methyl was used in the potato trial only. In this trial it provided rapid kills and maintained control over a period of 1 week. In the potato trial, performance of isobenzan (two plots) was comparable with results obtained in the tomato trial, where rapid kills and residual control were obtained.

Other chemicals which gave promising results in both trials, or in the potato trial when used in that trial only, were carbaryl, endrin, endosulphan and phosphamidon (two plots). BHC provided good control when used on tomatoes but when applied to potatoes the control was only fair. Good control in potatoes was obtained with diazinon, which provided only fair control in tomatoes. In both trials, DDT proved ineffective.

In the screening trial on tomatoes, isobenzan caused a severe leaf scorch and DDT emulsion caused a yellow chlorosis in younger leaves. The chlorosis was evident 1 week after application but disappeared later. The phytotoxic effects of isobenzan were evident also in the dosage levels trial, the most serious scorching being caused by the Dutch formulation. In this treatment, in which all plants were affected, the scorching extended up to one-quarter of the leaflet area. Scorching also occurred on leaflet petioles, floral sepals and petals, tips of terminal shoots and small auxiliary shoots, which were killed. The Australian formulation was much less severe and scorching was confined almost entirely to the leaflets. Most plants were affected at the high dosage level. At standard strength, very faint burns on odd leaves of occasional plants resulted. No scorch was evidenced by plants treated with the low level of isobenzan. No phytotoxicity occurred in potatoes, where isobenzan was used at 0·05% strength only. This strength did not produce any noticeable symptoms in tomatoes, yet it gave control of *P. operculella* almost equivalent to the higher dosages. The fact that such severe symptoms occurred at the higher dosages makes this chemical suspect for use on tomatoes and related crops, including potatoes.

Apart from its comparative failure in the screening trial on potatoes, BHC, the other chemical tested in the dosage levels trial, is suspect for widespread use on tomato crops owing to the possibility of undesirable side-effects such as tainting.

The control achieved in the dosage levels trial was not of the high standard obtained in the screening trial when considering the same chemicals at equal dilutions. This applied to the endrin treatment also, and may be related to the difficulty of getting thorough coverage of large plants.

The results of the screening trials formed the basis for selection of chemicals to be carried through to field testing of potatoes. Four chemicals—azinphos-ethyl, isobenzan, carbaryl and endrin—were selected for comparison with DDT and untreated check plots. Azinphos-ethyl was a new chemical at this time and was represented as superseding its methyl analogue. It therefore warranted inclusion in the trial.

All four chemicals significantly suppressed leaf-mining. Azinphos-ethyl and isobenzan were the most efficacious, while carbaryl and endrin were only slightly inferior. Leaf-mining in DDT-treated plots, however, was almost as severe as in untreated check plots.

The yields obtained demonstrate quite clearly that suppression of leaf-mining gives significant economic return for outlay on a suitable insecticide and its application. Increases of approximately 2 tons of first grade tubers per acre over DDT and untreated check plots were obtained with all four chemicals. Total yields were highest in endrin plots, but when only uninfested tubers were considered, azinphos-ethyl proved the most efficacious chemical. Significant differences were not obtained in percentages of moth-infested tubers.

Observations during the trial suggested that suppression of leaf-mining resulted in better plant growth. This result was not confirmed when tops were weighed, owing to the plant collapse caused by fungal attack.

The results of the trials showed that control of *P. operculella* as a leaf-mining pest had no effect on tuber infestation. The increased yields may be attributed to increased plant vigour following suppression of leaf-mining, but the percentage of tuber infestation remained fairly constant. This suggests that tuber infestation occurred after the cessation of spray applications, in this case 5 weeks before the commencement of harvest. Appropriate action by way of insecticide application and/or hilling is indicated.

The counts of Heliothis larvae suggest that azinphos-ethyl may not give adequate control of this pest in severe outbreaks. Similarly, as demonstrated by net sweeps over the foliage, aphids (particularly *Macrosiphum euphorbiae* (Thomas)) are not adequately controlled by carbaryl.

(Received for publication November 2, 1965)