CONTROL OF *THRIPS TABACI* LIND. IN ONION CROPS IN THE LOCKYER VALLEY

By T. PASSLOW, B.Sc.Agr., Entomologist, Science Branch, Division of Plant Industry.

SUMMARY.

Thrips tabaci **Lind. is normally present in bulb and seed onion crops in the Lockyer Valley, the major commercial onion district in Queensland.**

During 1951-55 an investigation of the pest status of this insect included 11 screening and field trials under irrigated conditions, using 14 insecticides. Thrips populations were reduced satisfactorily by several insecticides, but parallel yield increases were not obtained consistently.

In irrigated plantings, unthrifty onion plants, rather than vigorous ones, carry large thrips populations, and are also more susceptible to thrips damage. Irrigation of onion crops in the Lockyer Valley, as carried out over the past decade, has in effect reduced the status of thrips as a pest, and has forestalled the benefits which might have been derived from the use of modern insecticides under the older dry-farming conditions.

I. INTRODUCTION.

Commercial onion growing in Queensland is confined almost entirely to the south-eastern corner of the State, particularly the Lockyer Valley, and most crops receive some supplementary watering.

Thrips tabaci Lind. is normally present in onion crops, and populations are sometimes sufficiently large to cause plant injury. The thrips feed by rasping the tissues and extracting sap; most feeding occurs on the newly formed leaves. The feeding punctures expand with plant growth and elongate to form small whitish spots and streaks which are the typical symptoms of thrips attack. Following intense pest activity the older leaves present a silvery-white stippled appearance (Fig. 1).

Thrips tabaci as a pest of onions has received attention in many countries.

In general, workers in the United States of America have used heavy insecticide loads. Sleesman (1946), for example, obtained significant increases in bulb yields with four weekly applications of 2 lb. DDT per acre. Peay and Sorensen (1946), using 5 per cent. and 10 per cent. DDT dusts, trebled seed yields after two applications. Wilcox and Howland (1948) and Wilcox, Howland and Campbell (1949) also increased bulb and seed yields with weekly and fortnightly applications of both DDT dusts and sprays.

Harrison and Jacks (1952) and Jacks and Harrison (1953) reported experiments with a number of materials in several combinations against *T. tabaci* in New Zealand, and recommended applications of DDT emulsion at the rate of 1 lb. p.p.i. per 100 gal. made at intervals of 10 days from early

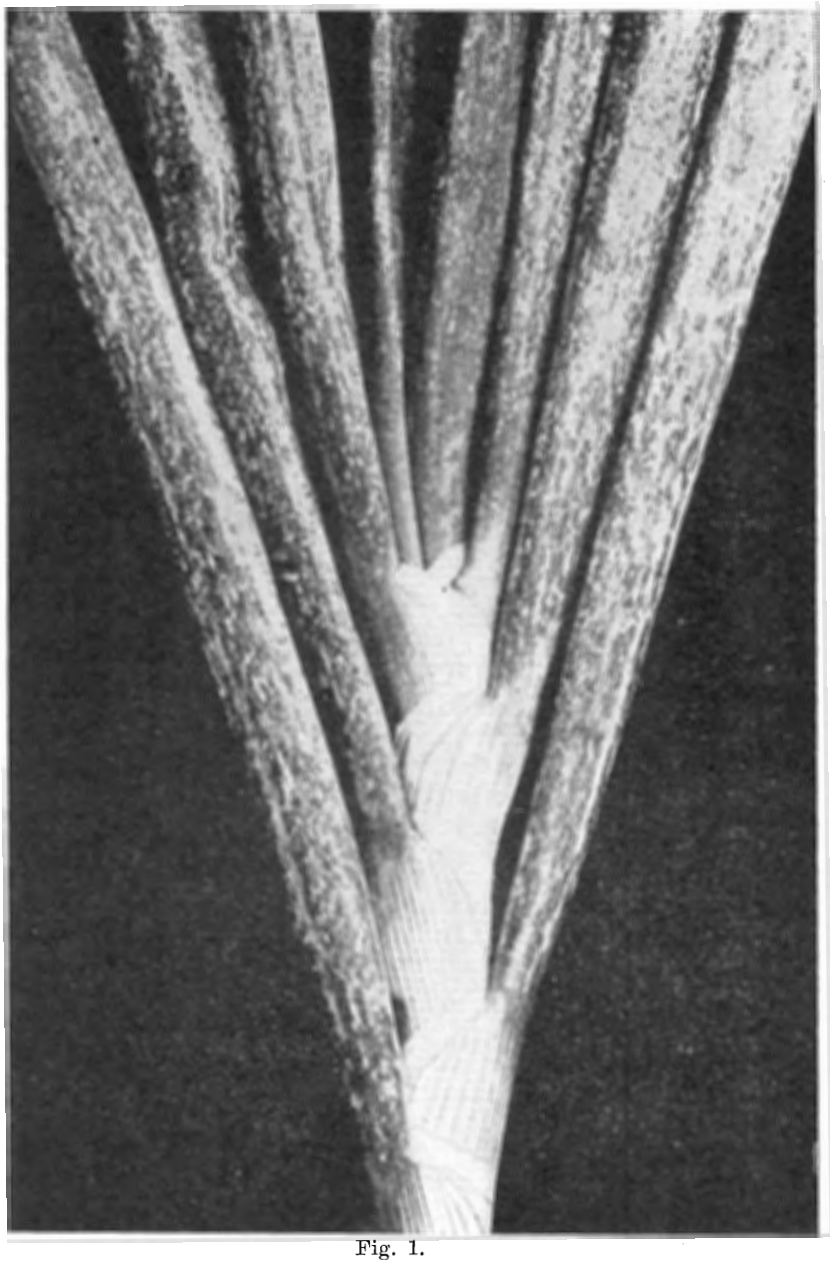

Fig. 1.

Symptoms of Thrips Injury to Maturing Onion Leaves.

November until 14 days before harvest. At this rate of application DDT emulsion gave better control of *T. tabaci* than the other promising materials such as parathion (E605), Isopestox, TEPP, and lindane.

In New South Wales, Hely (1945) found that a 0.1 per cent. DDT emulsion at 96 gal. per acre was more effective in controlling thrips numbers than either a 1.0 per cent. DDT dust at 32 lb. per acre or a tartar emetic bait spray at 48 gal. per acre. DDT emulsion was outstanding and gave economic increases in yields.

From early work in Queensland, Summerville (1933) and Veitch (1938) recommended derris dust in preference to nicotine for reducing thrips numbers on onions, and in the Queensland Agricultural and Pastoral Handbook (officers of the Department of Agriculture and Stock 1951) DDT as a 0.1 per cent. spray is mentioned as a control.

In the Lockyer Valley, winter temperatures usually restrict thrips breeding, so early crops can be harvested during spring before pest injury occurs. The combination of a mild dry winter and a hot dry spring often results in thrips injury to both bulb and seed crops. Although thrips control is not routine procedure in bulb crops, insecticides are sometimes used, with indifferent results. The opinion of growers is that thrips are probably a more important pest in seed crops, but there is a general reluctance to use insecticides after commencement of flowering. The present investigation was undertaken to clarify the problem of thrips as a pest of onions in this district.

II. BULB CROP TRIAL.

Two screening trials were carried out in 1950 and one in 1951. Two field trials were conducted each year in 1951, 1952 and 1955. All trials were irrigated.

In screening trials, thorough plant cover was obtained by using small continuous hand atomisers and hand dusters. In field trials, treatments were applied by knapsack at approximately 100 gal. wet spray and 50 lb. dust per acre. Strengths and dosages are expressed as active ingredients. The details of treatments and relevant comments are given with the results of trials.

Downy mildew (*Peronospora destructor* (Berk) Coop.) was active in the 1952 Gatton trial and during 1955. Infection was light in 1952, and copper oxychloride-detergent was applied three times at fortnightly intervals. In 1955 the Grantham trial received three applications and the Gatton trial two applications of zineb dispersible powder.

(1) Materials.

Aldrin.—An emulsifiable preparation containing 20 per cent. w/v active ingredient.

BHC.—A 50 per cent. dispersible china clay powder containing 6·5 per cent. gamma isomer.

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

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

A dispersible china clay powder containing 50 per cent. *p.p'* isomer.

A kaolin dust containing 2·0 per cent. *p.p'* isomer.

Derris.—A talc dust containing 0·75 per cent. active ingredients.

Dieldrin.—An emulsifiable preparation containing 16 per cent. w/v active ingredient.

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

Nicotine.—A concentrate containing 40 per cent. nicotine as nicotine sulphate.

Parathion (E605).—An emulsifiable preparation containing 25 per cent. w/v active ingredient.

A dust containing 1·5 per cent. active ingredient.

Pyrethrum.—A proprietary dust containing 0·24 per cent. pyrethrins and 1·2 per cent. technical piperonyl butoxide.

Sodium fluoroacetate (1080).—A concentrate powder containing not less than 90 per cent. sodium fluoroacetate.

Systox.—An emulsifiable preparation containing 50 per cent. w/v active ingredients.

Toxaphene.—An emulsifiable preparation containing 60 per cent. w/v active ingredient.

A kaolin dust containing 2 per cent. active ingredient.

Tartar emetic.—A spray containing 1 oz. tartar emetic and 4 oz. sugar to 4 gal. water.

(2) Designs of Trials.

Randomised blocks were used in all trials. Plot size for screening trials varied from 21 ft. to 35 ft. of row, and for field trials was 1/200 acre.

(3) Assessing Results.

(a) Pest Populations.

Counts of mature thrips visible on the five inner leaves were made in the 1950 trials; these were carried out immediately prior to and 1 day and 7 days after treatments (unless otherwise mentioned) on 10 plants taken at random on

Table 1.

REDUCTION IN PEST NUMBERS.

(1950, Gatton Trial A.)

Treatment.	First Application.					Second Application.				
	Pre-treatment Mean*. Aug. 30.	1 Day After Treatment.		7 Days After Treatment.		Pre-treatment Mean. Sept. 13.	1 Day After Treatment.		7 Days After Treatment.	
		Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.		Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.
(1) BHC 0·1%	49·0	78·3	95·9	51·8	61·8	51·7	75·0	93·3	54·0	65·4
(2) Toxaphene dust 2·0%	39·7	76·0	94·1	46·5	52·6	51·3	73·3	91·7	47·1	53·7
(3) DDT emulsion 0·1%	46·0	73·3	91·7	59·0	73·5	51·0	73·9	92·3	60·5	75·8
(4) Chlordane dust 2·0%	46·7	73·2	91·7	45·9	51·6	52·3	72·1	90·6	48·9	56·8
(5) Parathion 0·0125% ..	44·0	64·0	80·8	51·0	60·4	52·7	70·2	88·6	41·0	43·1
(6) Nicotine spray 0·064%	40·0	53·8	65·1	−11·4	−3·9	70·0	60·4	78·5	31·8	27·8
(7) DDT dust 2·0% ..	51·3	47·6	54·6	42·1	45·0	80·7	72·9	91·4	46·4	52·4
(8) DDT dispersible powder 0·1%	51·7	34·2	31·6	37·7	37·4	75·7	68·2	86·2	44·0	48·3
(9) Tartar emetic ..	38·7	17·5	9·0	−4·5	−0·6	61·7	61·7	77·5	47·0	53·5
(10) Check	46·0	−11·5	−4·0	·1	0	79·3	36·1	34·7	30·1	25·2
Necessary differences for significance 5%	..	28·6	..	36·5	..	..	7·1	..	17·4	..
Necessary differences for significance 1%	..	39·2	..	50·1	..	..	9·8	..	23·8	..

* Based on counts from 10 plants per plot.

each counting date from the central row in each plot. Analysis of the data from the 10 x 3 screening trial of 1950 indicated that an improvement in method was necessary. In later work, therefore, where detailed information on pest kills was sought the plants necessary to obtain a datum number of thrips, at least 150, were counted in the check plots and a similar number was then examined in each treated plot. A new plant number was determined when the interval between counts exceeded two days.

Except for the small trial at Gatton, using systemic insecticides, results are given as the pre-treatment mean numbers of thrips per plot, the post-treatment transformed means per plot and the equivalent percentage reduction based on the appropriate pre-treatment count. Thrips numbers were transformed by means of the inverse sine transformation: negative values indicate a population increase between counts.

(b) Yields.

At harvesting the number and the weight of trimmed mature bulbs were recorded from a datum area in each plot.

(4) Results of Screening Trials.

(a) 1950, Gatton Trial A, 10 x 3 Randomised Block.

Three applications, commencing on Aug. 30, were made at intervals of two and three weeks, and thrips counts were associated with the first two. The results are given in Table 1. On the basis of these, tartar emetic, nicotine, DDT dust and DDT dispersible powder were discarded.

(b) 1950, Gatton Trial B, 6 x 3 Randomised Block.

Results were assessed as plot population counts nine days after the first application on Sept. 21 and eight days after the second on Oct. 6; they are summarised in Table 2. None of the other insecticides, at the dosages used, compared favourably with 0·1 per cent. DDT emulsion.

Table 2.

THRIPS POPULATIONS.
(1950, Gatton Trial B.)

Treatment.	Pre-treatment Sept. 20.	Post-treatment Sept. 30.	Pre-treatment Oct. 5.	Post-treatment Oct. 14.
(1) DDT emulsion 0·1%	73·3	41·7	34·0	14·3
(2) Parathion spray 0·0125% ..	44·7	66·0	36·7	29·3
(3) Systox spray 0·1%	49·3	79·3	48·0	28·7
(4) Systox spray 0·2%	66·7	89·7	42·3	26·0
(5) Sodium fluoroacetate spray 0·01%	44·0	88·3	49·3	33·3
(6) Check	44·7	97·0	48·7	35·0

Table 3.

REDUCTIONS IN PEST NUMBERS.

(1951, Forest Hill.)

Treatment.	First Application.			Second Application.				
	Pre-treatment Mean*. Aug. 28.	7 Days After Treatment.		Pre-treatment Mean†. Sept. 10.	1 Day After Treatment.		7 Days After Treatment.	
		Transformed Mean.	Equiv. % Reduction.		Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.
(1) DDT emulsion 0·1% ..	58·3	28·8	23·2	120·0	87·5	99·8	63·3	79·8
(2) Chlordane spray 0·1% ..	58·7	10·9	3·6	102·7	84·5	99·1	49·6	58·1
(3) BHC 0·05%	53·0	16·2	7·8	110·7	88·2	99·9	53·2	64·1
(4) Toxaphene spray 0·1% ..	64·0	12·1	4·4	115·0	66·1	82·2	37·3	36·8
(5) Aldrin 0·1%	62·0	30·7	26·1	85·7	83·5	98·7	38·2	38·2
(6) Dieldrin 0·1%	56·0	44·2	48·5	66·3	81·0	97·6	55·4	67·8
(7) Derris	57·7	11·3	3·8	117·3	64·1	80·9	40·0	41·3
(8) Chlordane dust 2·0% ..	54·7	−2·6	−0·2	104·7	81·8	98·0	47·3	54·1
(9) Toxaphene dust 2·0% ..	60·7	31·9	27·9	111·7	80·1	97·0	44·6	49·4
(10) Check	53·3	−32·9	−29·5	126·0	6·6	1·3	4·5	0·6
Necessary differences for significance 5%	..	42·0	..	..	14·7	..	20·6	..
Necessary differences for significance 1%	..	57·5	..	..	20·2	..	28·2	..

* Based on counts from 10 plants per plot.

† Based on counts from 15 plants per plot.

Table 4.

REDUCTIONS IN PEST NUMBERS, AND YIELDS.

(1951, Forest Hill Trial A.)

Treatment.	First Application.			Second Application.			Yields.	
	Pre-treatment Mean*. Aug. 27.	7 Days After Treatment.		Pre-treatment Mean†. Sept. 11.	7 Days After Treatment.		Mean Number of Bulbs.	Weight. (lb./Plot.)
		Transformed Mean.	Equiv. % Reduction.		Transformed Mean.	Equiv. % Reduction.		
(1) DDT emulsion 1·25 lb./acre	161	33·1	29·8	166	50·8	60·0	514·0	93·7
(2) DDT emulsion 0·53 lb./acre	156	33·1	29·8	175	54·3	65·9	496·8	93·0
(3) BHC 0·21 lb./acre ..	170	20·6	12·3	172	34·1	31·4	529·0	92·9
(4) Chlordane dust 0·82 lb./acre	156	−2·1	−0·13	168	46·7	53·0	485·0	92·2
(5) Toxaphene dust 0·76 lb./acre	167	−1·3	−0·05	207	39·8	41·0	494·5	88·6
(6) Check	165	−46·1	−51·9	230	−8·7	−2·3	497·0	89·6
Necessary differences for significance 5%	..	38·6	..	..	19·2	..	37·8	4·8
Necessary differences for significance 1%	..	53·4	..	..	26·5	..	52·3	6·6

* Based on counts from 23 plants per plot.

† Based on counts from 15 plants per plot.

(c) 1951, Forest Hill, 10 x 3 Randomised Block.

In this trial the more promising materials of earlier trials and several newer insecticides were used. Two applications were made at an interval of two weeks. Population assessments were made one week after the first application, and 1 day and 7 days after the second. The results are set out in Table 3. The most persistent kills were obtained with dieldrin and DDT.

(5) Results of Field Trials.

(a) 1951, Forest Hill Trial A, 6 x 4 Randomised Block.

Two applications of insecticides were made at an interval of two weeks. Population assessments were made in association with both applications and harvesting was on Oct. 22-24. The results are given in Table 4. The efficacy of DDT was not impaired by reducing the dosage to 0·53 lb. per acre.

(b) 1951, Forest Hill Trial B, 6 x 4 Randomised Block.

Two applications of the insecticides were made at an interval of three weeks. Population assessments were made in association with the first application and a pre-treatment count was taken before the second. Harvesting was on Nov. 1 and 2. The results are given in Table 5. As in the previous trial, best kills were obtained with DDT. The addition of parathion to the weaker DDT strengths did not increase efficacy.

(c) Comments on 1951 Forest Hill Trials.

Both 1951 Forest Hill trials were adequately irrigated in the early stages but were somewhat neglected during the final month. Treated plots, particularly in Trial B, were much less injured than check plots. Differences in leaf stippling were not reflected in yields.

(d) 1952, Grantham, 4 x 6 Randomised Block.

Four applications averaging 100 gal. per acre were made at fortnightly intervals commencing on Sept. 2. Detailed data on pest kills were not taken, only pre-treatment counts being made before the first, second and fourth applications. The mean counts in check plots were 16·6, 23·2 and 18·9 thrips per plant for the first, second and fourth pre-treatments. There were no significant differences among treatments. Harvesting was on Nov. 26 and 27. Yields are given in Table 6.

Table 5.

REDUCTIONS IN PEST NUMBERS, AND YIELDS.

(1951, Forest Hill Trial B.)

Treatment.	First Application.			Second Application.	Yields.	
	Pre-treatment Mean*. Sept. 19.	9 Days After Treatment.		Pre-treatment Mean*. Oct. 11.	Mean Number of Bulbs.	Weight. (lb./Plot.)
		Transformed Mean.	Equiv. % Reduction.			
(1) DDT emulsion 1·17 lb./acre	214·0	57·2	70·7	234·0	502·2	72·4
(2) DDT emulsion 0·54 lb./acre	208·0	49·7	58·1	252·0	505·0	72·2
(3) BHC 0·221 lb./acre	197·5	42·2	45·2	252·5	516·2	74·9
(4) Parathion spray 0·11 lb./acre	181·5	42·0	44·9	245·0	505·0	77·2
(5) Parathion spray 0·06 lb. plus DDT emulsion 0·57 lb./acre	197·0	50·9	60·2	250·0	513·2	73·6
(6) Check	179·0	−12·0	−4·4	301·0	505·2	69·4
Necessary differences for significance 5%	..	16·3	..	..	46·6	6·2
Necessary differences for significance 1%	..	22·6	..	..	64·5	8·6

* Based on counts from 15 plants per plot on each date.

Table 6.

YIELDS.

(1952, Grantham.)

Treatment.	Table Grade.		Pickling Grade.		Total Bulbs.	
	Plot Mean.	Weight. (tons/ac.)	Plot Mean.	Weight. (tons/ac.)	Plot Mean.	Weight. (tons/ac.)
(1) DDT emulsion ½ lb./acre	389·8	13·75	112·0	1·07	501·8	14·80
(2) Parathion spray 1/10 lb./acre ..	404·3	13·82	102·5	1·04	506·8	14·85
(3) Dieldrin ½ lb./acre	409·8	16·58	68·3	·75	478·2	17·33
(4) Check	394·5	13·00	106·3	1·02	500·8	14·02
Necessary differences for significance 5%	55·1	1·42	38·8	·32	88·2	1·45
Necessary differences for significance 1%	76·2	1·96	53·7	·44	122·0	2·01

(e) 1952, Gatton, 4 x 6 Randomised Block.

Four applications, commencing on Sept. 16, were made at fortnightly intervals. Detailed data on pest kills were not taken, only pre-treatment counts being made before the first, third and fourth applications. The mean counts in the check plots were 11·5, 8·9 and 4·7 thrips per plant for the first, third and fourth pre-treatments. There were no significant differences between treatments. Harvesting was on Nov. 29. Yields are given in Table 7.

Table 7.

YIELDS.

(1952, Gatton.)

Treatment.	Table Grade.		Pickling Grade.		Total Bulbs.		
	Plot Mean.	Weight. (tons/ac.)	Plot Mean.	Weight. (tons/ac.)	Plot Mean.	Weight. (tons/ac.).	
						Observed.	Adjusted.
(1) DDT emulsion ½ lb./acre	392·7	13·5	41·3	·50	434·0	14·00	14·29
(2) Parathion spray 1/10 lb./acre	375·7	13·2	39·2	·50	414·8	13·75	14·53
(3) Dieldrin ½ lb./acre ..	413·5	15·3	48·7	·60	462·2	15·95	15·52
(4) Check	418·3	13·5	52·5	·63	470·8	14·12	13·47
Necessary differences for significance 5%	65·2	2·1	13·3	·18	64·7	..	1·36
Necessary differences for significance 1%	90·1	2·9	18·4	·24	89·5	..	1·89 (approx.)

Table 8.

REDUCTIONS IN PEST NUMBERS, AND YIELDS.

(1955, Grantham.)

Treatment.	First Application.							Second Application.	Yields.		
	Pre-treatment Mean*. Oct. 3.	1 Day After Treatment.		7 Days After Treatment.		14 Days After Treatment.		Pre-treatment Mean†. Oct. 20.	Mean Number of Bulbs.	Weight.	
		Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.			Observed Mean. (lb./Plot.)	Adjusted Mean. (lb./Plot.)
(1) DDT emulsion ½ lb./acre	176·5	80·3	97·2	65·0	82·1	59·9	74·8	44·5	447·8	56·9	53·0
(2) Dieldrin ½ lb./acre	172·0	89·0	100·0	75·7	93·9	67·7	85·6	25·5	415·8	56·2	56·0
(3) Dieldrin ¼ lb./acre + white oil 1 : 100 (wetting agent)	195·0	84·1	98·9	68·9	87·0	68·4	86·4	28·0	401·2	51·5	53·1
(4) Endrin ½ lb./acre	168·5	83·9	98·9	69·5	87·7	63·3	79·8	36·0	400·0	52·2	53·9
(5) Endrin ¼ lb./acre + white oil 1 : 100 (wetting agent)	181·0	81·6	97·9	71·7	90·1	60·6	76·0	45·0	377·0	51·1	55·5
(6) Check	136·5	(29·5)	24·3	35·0	32·9	55·4	67·7	44·0	445·0	51·6	48·0
Necessary differences for significance 5%	..	7·3	..	19·9	..	11·4	..	..	69·0	10·9	7·4 (approx.)
Necessary differences for significance 1%	..	10·2	..	27·5	..	15·8	..	..	95·4	15·0	10·3

* Based on counts from 10 plants per plot.

† Based on counts from 20 plants per plot.

Yield increases followed the application of dieldrin in both 1952 trials.

Irrigation and cultural routine were controlled in both trials, and there were no growth checks. The beneficial effects of dieldrin were apparent from shortly after the first treatments in both trials: the plants were a better colour but stippling was not severe in the check plots. The yield increases therefore were not due to thrips kills. This fact was supported by the lack of significant differences amongst treatments in the pre-treatment numbers of thrips.

(f) 1955, Grantham, 6 x 4 Randomised Block.

Two applications, commencing on Oct. 4, were made at an interval of two weeks. Population assessments were made in association with the first application. Harvesting was from Nov. 28 to Dec. 1. The results are given in Table 8.

(g) 1955, Gatton, 6 x 4 Randomised Block.

Three applications, commencing on Oct. 5, were made at intervals of two and three weeks. Population assessments were made in association with the first application. Harvesting was on Dec. 6. The results are given in Table 9.

The 1955 trials received adequate irrigation, and there were no growth checks.

Pest kills by the lower dosages of dieldrin and endrin, with the addition of white oil, were as good as those by the higher dosages of these materials.

(5) Discussion.

Most insecticides tested in field trials considerably reduced thrips populations. Dieldrin, endrin, DDT, parathion, BHC, chlordane and toxaphene were all efficacious, in that order.

Significant yield increases were obtained in the 1952 trials following four applications of dieldrin spray at $\frac{1}{2}$ lb. per acre. The check pre-treatment counts were 16·6, 23·2 and 18·9 thrips per plant for the first, second and fourth applications in the Grantham trial. In the Gatton trial these counts were 11·5, 8·9 and 4·7 for the first, third and fourth applications. There were no significant differences between these figures and counts in treated plots.

In the 1951 Forest Hill trials, where two applications were applied, the pre-treatment check populations were 7·2 and 15·3 thrips per plant in Trial A and 11·9 and 20·1 in Trial B. In the 1955 Grantham trial, where two applications were made, pre-treatment populations were 13·7 and 2·2 thrips

Table 9.

REDUCTION IN PEST NUMBERS, AND YIELDS.

(1955, Gatton.)

Treatment.	First Application.				Second Application.	Yields.		
	Pre-treatment Mean*. Oct. 3.	1 Day After Treatment.	7 Days After Treatment.		Pre-treatment Mean†.	Mean Number of Bulbs.	Weight.	
		Mean Number of Thrips*.	Transformed Mean.	Equiv. % Reduction.			Observed Mean. (lb./Plot.)	Adjusted Mean. (lb./Plot.)
(1) DDT emulsion ½ lb./acre ..	134	3·5	54·4	66·0	135·0	398·5	51·8	51·4
(2) Dieldrin ½ lb./acre	154	0·25	63·4	80·0	90·0	422·5	55·8	53·3
(3) Dieldrin ¼ lb./acre + white oil 1 : 100 (wetting agent) ..	156	2·0	65·1	82·2	83·0	380·8	49·5	50·7
(4) Endrin ½ lb./acre	162	0·5	62·6	78·9	80·0	429·5	57·2	54·2
(5) Endrin ¼ lb./acre + white oil 1 : 100 (wetting agent) ..	125	1·25	57·2	70·6	85·5	380·5	48·0	49·2
(6) Check	166	(155·5)	17·2	8·7	134·0	353·2	43·2	46·7
Necessary differences for significance 5%	..	..	22·2	..	..	125·7	13·2	7·8 (approx.)
Necessary differences for significance 1%	..	..	30·7	..	..	173·9	18·3	10·8

* Based on counts from 15 plants per plot on each date.

† Based on counts from 20 plants per plot.

per plant. In the Gatton trial in the same year three applications were made and pre-treatment populations for the first two were 11·1 and 6·7 thrips per plant. In all these trials, except for dieldrin in the 1955 Grantham trial there were no significant differences amongst pre-treatment counts for treatments and checks. The population levels, where no yield increases resulted, ranged from 2·2 to 20·1 thrips per plant; with yield increases the range was 4·7 to 23·2. The yield increases therefore, as mentioned earlier (page 65), were not related to thrips control. To clarify the position further, a series of trials would be necessary, using weekly and fortnightly insecticide applications and correlating the results from these treatments with a wide range of thrips populations.

The economic status of the problem at present, and the results which could be expected, do not warrant the large amount of work involved.

III. SEED CROP TRIALS.

A screening trial was conducted in 1951 and a field trial in 1952. Both trials were irrigated.

In both trials, thorough plant cover was obtained using small continuous hand atomisers and hand dusters. All insecticide applications were made in the pre-flowering period in the screening trial. In the field trial, six applications were within this period and all treatments except one DDT treatment were continued for three applications during the flowering stage. The details of treatments and relevant comments are given with the results of the trials.

Downy mildew (*Peronospora destructor*) was severe in the field trial, and for entomological trial purposes six applications of copper oxychloride-detergent were not efficacious.

(1) Materials.

The materials used are included in the list on pages 55–56.

(2) Design of Trials.

Randomised blocks were used in both trials. Plot size in the screening trial was five sets and in the field trial 10 sets.

(3) Assessing Results.

(a) Pest Populations.

Counts of mature thrips visible on the five inner leaves were made on the number of shoots necessary to give a datum number of thrips, at least 150, in the check plots. A similar number was examined in the treated plots. A new shoot number was determined when the interval between counts exceeded two days.

Table 10.

REDUCTION IN PEST NUMBERS.

(1951, Forest Hill.)

Treatment.	First Application.							Second Application.		
	Pre-treatment Mean*. July 12.	7 Days After Treatment.		14 Days After Treatment.		21 Days After Treatment.		Pre-treatment Mean†. Aug. 2.	7 Days After Treatment.	
		Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.	Transformed Mean.	Equiv. % Reduction.		Transformed Mean.	Equiv. % Reduction.
(1) DDT emulsion 0·1%	146·3	79·8	96·9	59·6	74·4	51·5	61·2	77·7	83·4	98·7
(2) DDT dust 2·0% ..	188·0	65·9	83·3	47·1	53·7	47·9	55·0	117·0	80·8	97·4
(3) BHC 0·1%	178·9	74·0	92·4	47·7	54·8	47·5	54·3	108·3	78·1	95·8
(4) Chlordane dust 2·0%	162·0	73·6	92·0	45·3	50·5	55·6	68·1	69·0	68·5	86·6
(5) Toxaphene dust 2·0%	164·3	65·2	82·4	38·9	39·4	49·1	57·1	93·7	71·6	90·1
(6) Parathion dust 1·5%	184·7	77·3	95·1	48·3	55·8	58·5	72·8	67·0	72·2	90·7
(7) Aldrin 0·1%	172·0	78·4	96·0	60·2	75·3	58·6	72·8	64·3	73·7	92·1
(8) Dieldrin 0·1% ..	161·3	58·6	72·8	39·7	40·9	55·0	67·0	71·0	79·5	96·7
(9) Toxaphene spray 0·1%	181·7	62·5	78·7	40·8	42·7	54·4	66·1	82·0	76·9	94·9
(10) Chlordane spray 0·1%	192·7	65·4	82·7	39·9	41·2	50·0	58·7	105·3	78·5	96·0
(11) Pyrethrum	204·7	44·3	48·8	36·4	35·2	44·8	49·6	136·3	50·0	58·7
(12) Systox 0·05% at 1 gal. per sq. yd.	166·3	74·9	93·2	54·4	66·2	61·4	77·0	51·0	76·6	94·6
(13) Check	153·0	4·8	0·7	3·2	0·3	39·7	40·9	126·3	34·8	32·6
Necessary differences for significance 5%	..	15·9	..	18·2	..	10·1	..	..	14·7	..
Necessary differences for significance 1%	..	21·6	..	24·6	..	13·7	..	..	19·9	..

* Based on counts from 21 shoots per plot.

† Based on counts from 28 shoots per plot.

Results are given as the pre-treatment mean number of thrips per plot, the post-treatment transformed means per plot, and the equivalent percentage reductions in the screening trial. Thrips numbers were transformed by means of the inverse sine transformation: negative values indicate a population increase between counts. In the field trial only pre-treatment population assessments were made and these are expressed as thrips per plant.

(b) Yields.

All seedheads in the field trial were collected at maturity and divided into seed-bearing, sterile "white heads" and those sterile as a result of mildew. After thorough drying, the seed-bearing heads were threshed and winnowed. Results were assessed on weight of clean seed and number of seed-bearing heads. Germination tests were made by the Standards Branch of this Department.

(4) Results of Screening Trial.

(a) 1951, Forest Hill, 13 x 3 Randomised Block.

Three applications, commencing on July 12, were made at intervals of three and four weeks. Population assessments were made in association with the first two applications. The results are given in Table 10. On the basis of these results and those from earlier work on bulb crops, DDT, aldrin, dieldrin and parathion were used in the field trial.

(5) Results of Field Trial.

(a) 1952, Gatton, 6 x 4 Randomised Block.

Nine applications of all treatments except one DDT treatment were made at intervals of a fortnight commencing on July 1. Pre-treatment assessments of populations were made prior to the first five applications. Harvesting was from Dec. 8 to Dec. 17. The results are given in Table 11.

There were no significant differences in germination amongst treatments.

(6) Discussion.

All insecticides applied in the screening trial reduced *T. tabaci* population levels, with systox having the most prolonged efficacy.

In the field trial, populations varied from 3·8 to 13·8 mature thrips per plant in check plots. With the appreciable complication of losses from downy mildew, yield differences due to thrips attack were not obtained. Fortnightly spray applications did not affect pollination, and germination was not impaired by sprays applied during flowering.

Table 11.

THRIPS NUMBERS, AND YIELDS.

(1952, Gatton.)

Treatment.	Pre-treatment Counts.					Yields.			
	Mean Number of Thrips Per Plant*.					Number of Heads.			Weight of Seed. (g./Plot.)
	First.	Second.	Third.	Fourth.	Fifth.	Sterile (Mildew Damage).	Sterile ("White Heads.").	Seed-bearing.	
(1) DDT emulsion 0·1%, preflowering sprays only	12·5	11·5	8·1	2·2	8·9	24·0	4·5	45·0	69·8
(2) DDT emulsion 0·1%, preflowering and flowering sprays	10·2	6·2	7·8	2·5	9·5	17·8	7·5	49·0	71·4
(3) Parathion spray 0·125% applied as (2)	10·8	6·5	7·8	2·5	5·3	22·0	10·3	38·0	66·9
(4) Dieldrin 0·1% applied as (2) ..	13·1	2·2	5·2	0·9	1·8	27·0	7·3	37·5	62·9
(5) Aldrin 0·1% applied as (2) ..	9·1	6·8	4·1	2·3	2·8	25·3	7·0	55·3	99·4
(6) Check	10·4	13·8	11·5	3·8	11·9	28·0	1·7	33·5	53·6
Necessary differences for significance 5%	..	..	..	..	..	..	..	18·2	31·2
Necessary differences for significance 1%	..	..	..	..	..	..	..	25·2	43·2

* Based on counts from 20 plants per plot.

IV. GENERAL DISCUSSION AND CONCLUSIONS.

Field observations in irrigated plantings invariably indicate that unthrifty onion plants, rather than vigorous ones, carry large thrips populations, and are also more susceptible to thrips damage. This was demonstrated by the obvious thrips injury in the 1951 Forest Hill field trials, when over the final month irrigation was not used.

After consideration of data from the earlier trials and general field observations, the author (Passlow 1953) stated: "With adequate irrigation and sound farming methods to ensure continuous rapid growth, onions can be produced profitably despite the presence of thrips. Under these conditions the application of suitable insecticides will not appreciably increase yields in either bulb or seed crops." This is supported by results from the later trials, and by further observation in commercial crops.

Irrigation of onion crops in the Lockyer Valley, as carried out over the past decade, has in effect reduced the status of thrips as a pest, and has forestalled the benefits which might have been derived from the use of modern insecticides under the older dry-farming conditions.

V. ACKNOWLEDGEMENTS.

All statistical analyses were carried out by Mr. P. B. McGovern (Biometrician, Division of Plant Industry). Downy mildew was discussed with Mr. T. McKnight (Senior Pathologist, Division of Plant Industry) on several occasions. Mr. G. Hooper (Assistant Entomologist) and Mr. N. Heather (Assistant Experimentalist) conducted the 1955 trials. The Standards Branch of the Department of Agriculture and Stock, carried out the germination tests. Facilities for conducting the trials were provided by several farmers and the Gatton Irrigation Research Station, where threshing machinery was also made available for the seed crop trial.

All this assistance is gratefully acknowledged.

REFERENCES.

HARRISON, R. A., and JACKS, H. 1952. Control of onion thrips. I. Preliminary selection of insecticides. N.Z. J. Sci. Tech. A. 34: 335-338.

HELY, P. C. 1946. Control of *Thrips tabaci* on onions. Experiments with DDT and tartar emetic. Agric. Gaz. N.S.W. 57: 467-471.

JACKS, H., and HARRISON, R. A. 1953. Control of onion thrips. II. Final selection of insecticides. N.Z. J. Sci. Tech. A. 35: 164-167.

OFFICERS OF THE DEPARTMENT OF AGRICULTURE AND STOCK. 1951. The Queensland Agricultural and Pastoral Handbook, Vol. III. 2nd Ed. Government Printer, Brisbane.

PASSLOW, T. 1953. Onion thrips control in the Lockyer Valley. Qd Agric. J. 77: 149-150.

PEAY, W., and SORENSON, C. J. 1946. Onion seed yield increased by thrips control. Fm. Home Sci. 7: 12.

SLEESMAN, J. P. 1946. DDT for the control of onion thrips. Bi-monthly Bull. Ohio Agric. Exp. Sta. 31: 39-40.

SUMMERVILLE, W. A. T. 1933. Notes on onion thrips. Qd Agric. J. 39: 41-46.

VEITCH, R. 1938. The Queensland Agricultural and Pastoral Handbook, Vol. III. Government Printer, Brisbane.

WILCOX, J., and HOWLAND, A. F. 1948. DDT dust for control of onion thrips. J. Econ. Entom. 41: 694-700.

WILCOX, J., HOWLAND, A. F., and CAMPBELL, R. E. 1949. Insecticides for the control of thrips on onions grown for seed. J. Econ. Entom. 42: 920-927.