TECHNICAL NOTES

CABBAGE PEST CONTROL INVESTIGATIONS, 1954

Cabbage (*Brassica oleracea* var. *capitata* L.), cauliflower (*B. oleracea* var. *botrytis* L.) and related crops form a large part of vegetable plantings in south-eastern Queensland during autumn, winter and spring. There have been few instances where marketable crops have been harvested without some form of insect control, and attention to pests has become routine.

Important insect pests are cabbage white butterfly, *Pieris rapae* L., cabbage moth, *Plutella maculipennis* Curt., and cabbage centre-grub, *Hellula undalis* (F.); pests of minor importance are cabbage aphid, *Brevicoryne brassicae* (L.), and cabbage leaf-miner, *Liriomyza cruciferarum* Her.

Comparison of 1954 Control Programmes

A comparison was made of control programmes in common use at March 1954. Early Allhead variety of cabbage, planted 1 ft 6 in. apart in rows spaced 2 ft 6 in. apart at Redlands Experiment Station, Ormiston, was used as test material. Two 6 x 6 latin squares were laid out, using plots of 24 plants in two adjacent rows of 12 plants. No guard rows were used. Treatments were applied six times at fortnightly intervals to an infestation of cabbage centre-grub, cabbage white butterfly and cabbage moth. Data obtained were bulked for analysis (Table 1).

In this trial, cabbage centre-grub, which is usually less important than cabbage white butterfly and cabbage moth, was the most important species present. Dieldrin (0·1 per cent. active ingredient) and DDT (0·1 per cent. active ingredient) sprays, and the BHC/DDT dust, gave satisfactory control of this pest and also of light infestations of cabbage white butterfly and cabbage moth. Rotenone and BHC (0·03 per cent. active ingredient) gave unsatisfactory control.

Screening of Newer Insecticides

A screening trial was carried out later in 1954 to give information on efficacies of newer insecticides for general cabbage pest control, using an established infestation of cabbage white butterfly and cabbage moth on cabbage plants six weeks after transplanting. The cabbages were Succession variety and were planted in late September 1 ft 6 in. apart in rows spaced 2 ft apart at the Queensland Agricultural High School and College, Lawes. Nine treatments replicated six times were applied, using single-row plots of 20 plants arranged in a randomized block layout. On completion of the screening test 14 days after treatment, a fortnightly treatment programme was maintained to determine whether economic control was possible in such circumstances. Total plant damage at harvest was assessed by assigning plant damage to one of six categories, 0–5, as shown in Figure 1.

Table 1

COMPARISON OF CONTROL PROGRAMMES IN USE AT MARCH, 1954

Treatment		Larvae per Plant 4 Weeks from Planting (Immediately prior to 3rd treatment)				Harvest Data—Marketable Heads		
		H. undalis		*P. rapae*	*P. maculipennis*			
Material	Concentration†	Transformed Mean*	Mean	Mean	Mean	Number per Treatment (288)	Weight per Treatment	Average Days to Harvesting
DDT plus BHC dust	2·00 DDT 0·26 BHC	0·86	0·014	0·012	0	274·8	1,135·2	70·9
Rotenone dust	0·45	5·78	1·410	0·033	0·175	153·6	616·8	77·8
BHC emulsifiable concentrate ..	0·03	4·43	0·819	0·054	0·012	184·8	770·4	74·2
DDT emulsion concentrate ..	0·1	0·90	0·020	0·092	0·008	264·0	1,046·4	72·2
Dieldrin emulsifiable concentrate	0·1	0·99	0·028	0·049	0·008	273·6	1,123·2	71·4
No treatment		6·15	1·583	0·833	1·075	34·8	129·6	78·3
Differences necessary for significance	·05	·86	..	Not analysed		26·4	108·0	2·7
	·01	..	..			36·0	144·0	3·7

* $\sqrt{24x + \frac{1}{2}}$.

† % active w/v (dusts); % active w/w (concentrates).

Data from the screening trial are presented in Table 2.

Table 2

SCREENING OF MATERIALS FOR CABBAGE PEST CONTROL

Treatment		Screening Data						Harvest Data			
		P. rapae			*P. maculipennis*			Average Number of Larvae per Plant		Average Damage Rating (0–5)	Percentage of Marketable Cabbages
Material	Concentration*	Pre-treatment	Post-treatment		Pre-treatment	Post-treatment					
		Average Number of Larvae per Plant†	Percentage of Pre-treatment§		Average Number of Larvae per Plant	Percentage of Pre-treatment§		*P. rapae*	*P. maculi-pennis*		
			3–4 days‡	13–14 days		3–4 days	13–14 days				
DDT emulsion concentrate	0·1%	1·68	1·6	6·2	1·33	0	12·0	5·03	0·62	2·78	87·5
BHC emulsifiable concentrate	0·03%	1·15	0	1·5	1·33	0	6·5	2·16	0·33	1·75	96·7
DDT plus BHC dust ..	2·0% DDT 0·26% BHC	1·48	20·4	43·5	1·13	9·7	20·5	3·11	0·45	2·22	91·5
Lead arsenate dispersible dust	1¼ lb to 50 gal	1·58	22·6	44·0	0·93	11·8	107·5	1·99	16·33	3·25	15·8
DDT dispersible dust ..	0·1%	1.62	16·2	28·0	0·97	24·4	52·6	1·81	0·43	1·77	93·2
Dieldrin emulsifiable concentrate	0·05%	1·78	2·3	6·8	1·32	1·2	15·4	4·50	0·24	1·83	91·2
Endrin emulsifiable concentrate	0·025%	1·57	0	1·1	0·98	3·2	1·5	0·97	0·36	0·85	97·5
No treatment		1·97	121·3	95·7	1·28	106·0	114·6	1·65	> 19·50	(4·58)	(4·2)
Differences necessary for significance	0·05 0·01	Not analysed			Not analysed			Not analysed		·65 ·85	No sig. diff.

* Percentages are w/v active ingredient (dusts) and w/w active ingredient (concentrates).

† 1 in. rain and 1 in. irrigation from 1st to 3rd days.

‡ 0·30 in. rain plus hail on 4th day; 3·50 in. rain on 8th day.

§ Treatment percentages adjusted for variations in populations receiving no treatment.

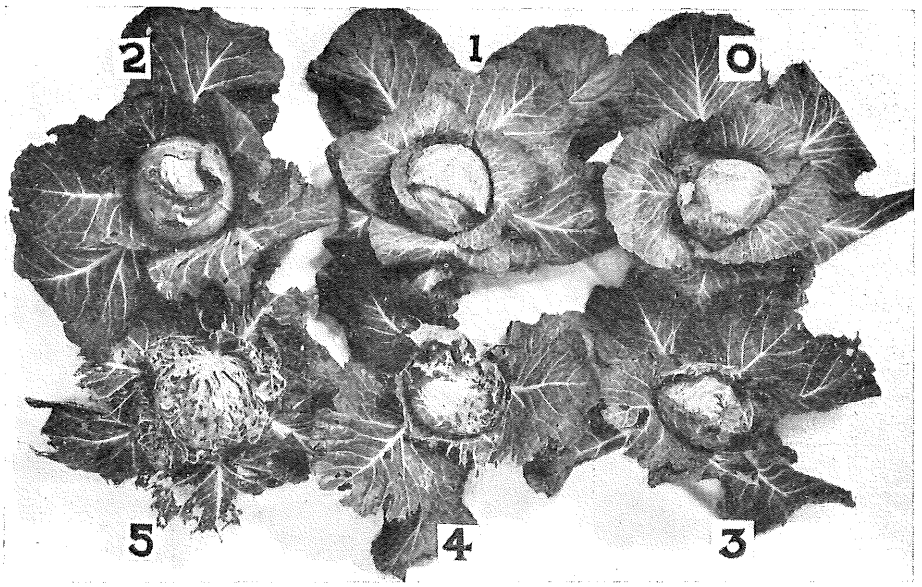

Fig. 1.—Damage ratings of cabbage at harvest.

Sprays containing endrin emulsifiable concentrate at 0·025 per cent. active ingredient, dieldrin emulsifiable concentrate at 0·05 per cent. active ingredient, BHC emulsifiable concentrate at 0·03 per cent. g.i., and DDT dispersible powder at 0·1 per cent. active ingredient proved the superior treatments, and endrin was the most efficacious in all factors considered.

Concentration-level Trials

To determine optimum concentrations of endrin and dieldrin as an alternative to established treatments, a concentration-level trial was laid down in the spring of 1954 at Redlands Experiment Station on a block of Early Allhead cabbage planted 1 ft 3 in. apart in rows spaced 2 ft apart. Eleven treatments replicated five times were arranged on 8-plant single-row plots in a randomized block layout; each datum row alternated with an untreated row. Pest species prevalent were cabbage white butterfly, cabbage moth and cabbage leaf miner. To assess leaf-miner infestation, six categories of mine prevalence were raised. Of these, the first three only were used. They were 0 = no damage; 1 = few mines on older leaves; and 2 = older leaves mined and few mines on new leaves.

Data obtained are presented in Table 3.

To confirm the efficacy of endrin in cabbage pest control, a concentration-level trial was carried out comparing endrin treatment with the then standard BHC/DDT dust treatment on a yield basis. Enkhuisen Glory variety of cabbage, planted 1 ft 6 in. apart in rows spaced 2 ft 6 in. apart at Redlands Experiment

Table 3

CONCENTRATION-LEVEL DETERMINATION FOR DIELDRIN AND ENDRIN

Treatment		Larvae per Plant—Post-treatment†						Mean Damage Rating per Plant—Post-treatment		Overall Mean Damage Rating per Plant
		P. rapae			*P. maculipennis*			*L. cruciferarum*		
		14 days		21 days						
Material	Concentration‡	Transformed Mean*	Mean	Mean	14 days Transformed Mean*	Mean	21 days Mean	14 days	21 days	
DDT plus BHC emulsifiable concentrate	0·1 DDT 0·03 BHC	1·81	0·375	0·2	1·17	0·15	0·2	1·6	1·8	1·275
DDT plus BHC dust	2·0 DDT 0·26 BHC	1·81	0·375	0·2	1·17	0·15	0·2	1·6	1·8	1·275
Dieldrin emulsifiable concentrate	0·1	1·61	0·275	0·4	1·43	0·25	0·2	1·6	1·8	2·65
Dieldrin emulsifiable concentrate	0·075	2·23	0·625	0·2	0·81	0·025	0·2	0·6	0·8	0·45
Dieldrin emulsifiable concentrate	0·05	1·78	0·375	0·2	1·09	0·10	0·4	0·4	0·2	0·575
Dieldrin emulsifiable concentrate	0·025	1·55	0·25	0·2	1·09	0·075	0·4	0·6	1·0	0·975
Endrin emulsifiable concentrate	0·05	2·11	0·55	0·4	1·04	0·075	1·0	0·8	1·8	2·05
Endrin emulsifiable concentrate	0·0375	1·81	0·375	0·2	1·22	0·20	0·4	0	0·2	(0)
Endrin emulsifiable concentrate	0·025	1·49	0·275	0	1·04	0·0125	0·2	0·2	0	(0)
Endrin emulsifiable concentrate	0·0125	1·96	0·55	0	1·35	0·275	0	0·2	0·6	(0·075)
No treatment		1·86	0·45	0·2	1·04	0·075	0·2	1·0	1·0	0·525
			(4·70)	5·6			2·71	2·0	2·0	5·00
Differences necessary for significance	0·05	0·85		Not analysed	0·67			Not analysed		0·59
	·01				0·90					0·80

* $\sqrt{8x + \frac{1}{2}}$.

† No pre-treatment infestation.

‡ % active w/v (dusts); % active w/w (concentrates).

Table 4

ASSESSMENT OF ENDRIN CONTROL PROGRAMMES

Treatment		Larvae per Plant												Mean Value of Infestation Rating		
		P. rapae						*L. maculipennis*						*L. cruciferum*		
Material	Concentration‡	5 days		22 days		29 days		5 days		22 days		29 days				
		Transformed Mean*	Mean	Transformed Mean†	Mean	Transformed Mean*	Mean	Transformed Mean*	Mean	Transformed Mean*	Mean	Transformed Mean*	Mean	5 days	22 days	29 days
Endrin emulsifiable concentrate ..	0·05	6·06	1·85	29·4	0·46	3·40	0·59	5·85	1·73	5·15	1·39	3·64	0·66	2·0	1·2	0·1
Endrin emulsifiable concentrate ..	0·025	6·06	1·85	40·9	0·85	5·82	1·78	5·78	1·70	5·58	1·60	4·30	0·94	2·0	1·0	1·0
Endrin emulsifiable concentrate ..	0·0125	6·19	1·94	40·1	1·18	6·04	1·89	6·12	1·90	6·22	2·10	4·28	0·925	2·0	1·2	1·0
DDT plus BHC dust	2·0 DDT 0·26 BHC	6·21	1·94	46·6	1·43	7·04	2·63	5·93	1·76	5·68	1·68	4·06	0·84	2·0	1·2	1·0
No treatment ..		6·46	2·10	46·1	1·06	9·59	4·60	6·06	1·85	13·35	8·94	6·85	2·35	2·0	1·6	2·0
Differences necessary for significance	0·05	·72		20·4		2·11		1·09		1·16		·54		Not analysed		
	0·01	1·0		29·0		2·95		1·53		1·62		·75				

Larvae counts and infestation ratings given at various days after transplanting.

First treatment on 6th day, second on 23rd day after transplanting.

* $\sqrt{20x}$

† $\sqrt{\frac{1}{\sin e\ 20x}}$

‡ % active w/v (dusts); % active w/w (concentrates).

Station in mid-October, was used. Five treatments replicated four times were applied at fortnightly intervals against a pest complex of all major species. Each plot contained 20 plants in two adjacent rows of 10 plants.

Relevant data are presented in Tables 4 and 5.

Table 5

HARVEST DATA FOR ENDRIN CONCENTRATION-LEVEL TRIAL

	Endrin Emulsifiable Concentrate			DDT/BHC Dust	No Treatment	Differences Necessary for Significance	
	0·05%	0·025%	0·0125%			0·05	0·01
Mean damage rating per plant	0·20	0·63	0·59	1·10	(5·00)	·35	·51
Number of marketable heads per treatment (max. 80)	80	77	77	76	0	Not analysed	
Weight of marketable heads per treatment (lb)	436·0	392·0	377·6	361·2	(0)	84·8	122·0
Average weight of marketable heads (lb)	5·45	5·09	4·90	4·70	0	Not analysed	
Weight of unmarketable cabbages per treatment (lb)	0	4·8	5·2	11·2	141·6	Not analysed	
Endrin residues 7 days after last treatment (p.p.m.)—							
External leaves	4·3	3·5			6·0		
Internal leaves	3·0	2·0			5·5		

The minimum satisfactory concentration of endrin was determined in the first concentration-level trial as 0·025 per cent. active ingredient (Table 3), and this was confirmed in the final yield trial (Table 4). Dieldrin did not prove a satisfactory alternative material.

Conclusion

From the data obtained in these trials, endrin emulsifiable concentrate as a spray at a concentration of 0·025 per cent. active ingredient applied at fortnightly intervals from transplanting was deemed to be the best replacement for the BHC/DDT dust included in control programmes. Recommendation of this treatment recognized prevention of infestation as the basic requirement for this type of pest control.

Further work has been undertaken to determine the status of endrin in aphid control and the suitability of more recently developed materials as substitutes or replacements for endrin.

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