

## CABBAGE PEST CONTROL INVESTIGATIONS, 1958-1961

Previous investigations established endrin as a satisfactory material for use in cabbage pest control programmes in south-eastern Queensland (Champ 1960). Further trials to consolidate these findings were carried out at Redlands Experiment Station and the Regional Experiment Station at Lawes during 1958-1961.

### Trial 1. Redlands Experiment Station

Trichlorphon (Dipterex), endrin, lindane, methoxychlor and "Telodrin" (octachloro-tetrahydro methanophthalan) were compared as spray formulations using knapsack sprayers in 14-day treatment programmes on two varieties of cabbage, Enkhuisen Glory and Early Jersey Wakefield, at Redlands Experiment Station from September to December 1958. The six treatments were replicated on both varieties of cabbage in a split plot latin square layout. Each plot contained 10 Enkhuisen Glory and 10 Early Jersey Wakefield plants 1 ft 6 in. apart in a single row. Four buffer (untreated) plants separated plots within rows and all data rows alternated with buffer (untreated) rows. All buffer plantings alternated singly both varieties. Rows were spaced 2 ft 6 in. apart.

Cabbage aphids, *Brevicoryne brassicae* (L.), became established immediately after transplanting but after an initial build-up numbers fell to negligible proportions several weeks later. This behaviour appears typical in the Redlands area. Cabbage white butterfly, *Pieris rapae* L., was present throughout the trial and contributed most damage; cabbage moth, *Plutella maculipennis* Curt., appeared in the later stages. Assessments of pest populations and damage are given in Tables 1 and 2. Aphid infestations were recorded as direct counts and later as population ratings using the following six categories—0, no aphids; 1, outer leaves with 1-10 aphids; 2, outer leaves with 10+ aphids (light infestations); 3, inner leaves with few aphids; 4, inner leaves with light infestation; 5, all leaves heavily infested. Total plant damage at harvest was assessed by assigning plant damage to one of six categories 0-5 described previously (Champ 1960).

Endrin and "Telodrin" gave satisfactory pest suppression. Lindane gave good control of aphids only, while methoxychlor, although effective against cabbage white butterfly, did not control cabbage moth. Trichlorphon was unsatisfactory. No general differences due to varieties were apparent.

### Trial 2. Regional Experiment Station, Lawes

This trial was carried out from October 1958 to January 1959, using Succession variety of cabbage. The materials DDD, endrin, methoxychlor and "Telodrin", in 14-day treatment programmes, were compared as spray formulations in a latin square layout using single row plots of 20 plants spaced 1 ft 6 in. apart. Four buffer (untreated) plants separated plots within rows and all data rows alternated with buffer (untreated) rows. Rows were spaced 2 ft 6 in. apart.

TABLE 1

TRIAL 1: REDLANDS EXPERIMENT STATION: SUPPRESSION OF *Brevicoryne brassicae*

		Treatment					Control (No Treatment)	Variety Mean	Necessary Differences for Significance		
		Endrin 0.04*	Trichloro- phon 0.05*	"Telo- drin" 0.1*	Methoxy- chlor 0.1*	Lindane 0.04*			—	0.05	0.01
Pretreatment infestation 10 days after transplanting. (Mature aphids per plant —means)	Enkhuisen Glory . . .	55	50	54	55	60	52	54	—	—	—
	Early Jersey Wakefield	53	57	50	42	48	51	50	—	—	—
Population change 5 days after first treatment. (Percentage of pretreat- ment—means)	Enkhuisen Glory ..	69.0	85.6	63.2	73.4	68.0	101.8	76.8	Treatments x Varieties Varieties .. Treatments	18.3 11.7† 28.5†	25.0
	Early Jersey Wakefield	65.2	75.2	67.2	79.0	61.2	79.6	71.2			
	Treatment .. ..	67.1	80.4	65.2	76.2	64.6	90.7				
Population rating (0-5) 10 days after first treatment. (Means)	Enkhuisen Glory ..	1.10	1.47	1.08	1.18	1.10	1.73	1.28	Treatments x Varieties Varieties .. Treatments	0.16 0.07† 0.17	0.21 0.23
	Early Jersey Wakefield	1.35	1.65	1.15	1.35	1.02	1.53	1.34			
	Treatment .. ..	1.23	1.56	1.12	1.27	1.06	1.63				

\* Materials as emulsifiable concentrates % active w/v.

† No significant differences.

TABLE 2

TRIAL 1: REDLANDS EXPERIMENT STATION: PROGRESSIVE POPULATIONS OF LEPIDOPTEROUS LARVAE AND RATED DAMAGE AT HARVEST

		Treatment					Control (No Treatment)	Variety Mean	Necessary Differences for Significance		
		Endrin 0.04*	Trichloro- phon 0.05*	"Telodrin" 0.1*	Methoxy- chlor 0.1*	Lindane 0.04*			—	0.05	0.01
Pretreatment infestation 10 days after transplanting. (Eggs and newly hatched larvae (10.9%) per plant —means)	Enkhuisen Glory ..	6.3	7.0	7.2	7.8	7.4	6.3	7.0	—	—	—
	Early Jersey Wakefield	6.5	7.1	6.8	7.0	5.9	7.6	6.8	—	—	—
Populations 5 days after first treatment. (Total larvae per plant)	Enkhuisen Glory—								Treatments x Varieties	0.81	0.43
	Mean .. ..	0.66	0.64	0.22	(0)	0.70	1.66	0.78			
	Transformed Mean†	0.78	0.79	0.42		0.79	1.24	0.80			
	Early Jersey Wakefield—								Varieties ..	0.14†	
	Mean .. ..	0.90	0.64	0.56	(0)	0.30	1.72	0.82			
	Transformed Mean†	0.86	0.75	0.73		0.53	1.28	0.83	Treatments	0.22	0.30
	Treatment Mean ..	0.78	0.64	0.39		0.50	1.68				
Transformed Treatment Mean† .. ..	0.82	0.77	0.57		0.66	1.26					
Populations 10 days after first treatment. (Total larvae per plant)	Enkhuisen Glory—								Treatments x Varieties	0.22	0.30
	Mean .. ..	1.21	2.52	1.18	0.33	2.23	2.85	1.72			
	Transformed Mean†	1.09	1.53	1.07	0.57	1.47	1.66	1.23			
	Early Jersey Wakefield—								Varieties ..	—	0.12
	Mean .. ..	2.01	2.67	1.27	0.75	2.05	3.38	2.02			
	Transformed Mean†	1.41	1.61	1.11	0.83	1.40	1.83	1.37	Treatments		
	Treatment Mean ..	1.62	2.59	1.23	0.54	2.13	3.12			0.16	0.22
Transformed Treatment Mean† .. ..	1.25	1.57	1.09	0.70	1.44	1.74					
Populations 7 days after second treatment. (Total larvae per plant)	Enkhuisen Glory—								Treatments x Varieties	0.54	0.76
	Mean .. ..	7.0	12.8	7.6	0.9	14.8	20.3	10.6			
	Transformed Mean†	2.62	3.59	2.68	0.95	3.85	4.50	3.03			
	Early Jersey Wakefield—								Varieties ..	0.22‡	
	Mean .. ..	11.3	13.2	8.5	1.3	12.1	23.8	11.7			
	Transformed Mean†	3.35	3.64	2.91	1.14	3.48	4.86	3.23	Treatments	0.16	0.23
	Treatment Mean ..	9.2	13.0	8.1	1.1	13.5	22.1				
Transformed Treatment Mean† .. ..	2.99	3.61	2.80	1.04	3.66	4.68					

\* Materials as emulsifiable concentrates % active w/v.

‡ No significant differences.

†  $\sqrt{x}$ 

TECHNICAL NOTES

TABLE 2—continued

TRIAL 1: REDLANDS EXPERIMENT STATION: PROGRESSIVE POPULATIONS OF LEPIDOPTEROUS LARVAE AND RATED DAMAGE AT HARVEST—continued

		Treatment					Control (No Treatment)	Variety Mean	Necessary Differences for Significance			
		Endrin 0.04*	Trichloro- phon 0.05	"Telo- drin" 0.1*	Methoxy- chlor 0.1*	Lindane 0.04*			—	0.05	0.01	
Populations of <i>Pieris rapae</i> at harvest. (3rd, 4th, 5th instar larvae per plant)	Enkhuisen Glory—											
	Mean .. ..	1.70	25.40	2.48	1.80	14.50	Plants des- troyed	9.18	Treatments x Varieties	0.32	0.44	
	Transformed Mean‡	1.10	2.36	1.38	1.24	2.15		1.65				
	Early Jersey Wakefield-											
	Mean .. ..	1.48	19.50	1.75	4.45	9.85		7.41	Varieties	0.14††		
	Transformed Mean‡	1.17	2.24	1.20	1.37	2.00		1.60				
Treatment Mean ..	1.59	22.45	2.12	3.13	12.18			Treatments	0.25	0.35		
Transformed Treatment Mean‡ .. ..	1.13	2.30	1.29	1.30	2.07							
Populations of <i>Plutella maculipennis</i> at harvest. (Larvae per plant)	Enkhuisen Glory—											
	Mean .. ..	0.18	3.20	0.23	3.35	0.95	Plants des- troyed	1.58	Treatments x Varieties	0.13	0.18	
	Transformed Mean§	1.05	1.58	1.09	1.61	1.26		1.32				
	Early Jersey Wakefield-											
	Mean .. ..	0.10	2.13	0.20	3.35	0.93		1.34	Varieties	—	0.081	
	Transformed Mean§	1.04	1.48	1.08	1.63	1.28		1.30				
Treatment Mean ..	0.14	2.67	0.22	3.35	0.94			Treatments	0.19	0.27		
Transformed Treatment Mean§ .. ..	1.05	1.53	1.08	1.62	1.27							
Damage ratings at harvest. (0-5)	Enkhuisen Glory—											
	Mean .. ..	1.00	2.87	1.18	2.03	2.37	Plants des- troyed	1.89	Treatments x Varieties	0.09	0.12	
	Transformed Mean†	1.00	1.69	1.09	1.42	1.53		1.35				
	Early Jersey Wakefield-											
	Mean .. ..	1.30	3.00	1.25	1.97	2.50		2.00	Varieties	0.04††		
	Transformed Mean†	1.14	1.73	1.12	1.40	1.57		1.39				
Treatment Mean ..	1.15	2.93	1.22	2.00	2.43			Treatments	0.07	0.09		
Trans. Treatment Mean†	1.07	1.71	1.10	1.41	1.55							

\* Materials as emulsifiable concentrates % active w/v.

†† No significant differences.

†  $\sqrt{x}$ ‡  $\log x + 1$ .§  $\log(x + 1) + 1$ .

Cabbage cluster caterpillar, *Crocidolomia binotalis* Zell., was the major pest species present until three weeks before harvesting, when cabbage moth appeared in considerable numbers. Bulked pest populations and damage ratings at harvest are given in Table 3.

Under the conditions of severe cabbage moth infestation at harvest, DDD, endrin and "Telodrin" gave best control while methoxychlor again failed against this pest.

### **Trial 3. Redlands Experiment Station**

This trial was carried out during June to October 1960, also using Succession variety of cabbage, and comparing spray formulations of azinphos-methyl, DDD, diazinon, thiodan, various levels of endrin and "Telodrin", and a dieldrin dust preparation. The 12 treatments were replicated four times in a randomized block layout using single row plots of 38 plants spaced 1 ft 6 in. apart. Four buffer (untreated) plants separated plots within rows and all data rows alternated with buffer (untreated) rows. Rows were spaced 2 ft 6 in. apart.

Pest populations were low throughout the trial, though approaching harvest some cabbage white butterfly and cabbage moth appeared. At the beginning of harvest a mean of 4.3 larvae per plant were present in untreated plots. No heads were rendered unmarketable by insect damage but separation of treatments on damage was possible (Table 3).

All insecticidal treatments with the exception of endrin at 0.025 per cent. active, thiodan, and dieldrin dust gave satisfactory pest suppression; diazinon-treated plants were unmarked.

### **Trial 4. Redlands Experiment Station**

This trial was carried out from January to March 1961, comparing spray formulations of azinphos-methyl, DDD, diazinon, "Lebaycid" and various levels of endrin and "Telodrin". The 11 treatments were replicated four times in a randomized block layout using single row plots of 38 plants of Ball-head Hybrid cabbage, spaced 1 ft 6 in. apart. Four buffer (untreated) plants separated plots within rows and all datum rows alternated with buffer (untreated) rows. Rows were spaced 2 ft 6 in. apart.

Centre grub, *Hellula undalis* (F.) was prevalent in transplants but soon disappeared. Thrips, *Thrips tabaci* Lind., and cabbage aphids were active during early growth, and cabbage white butterfly and cabbage moth in lesser numbers were present throughout the trial. Bulked pest populations and damage ratings at harvest are given in Table 3.

Endrin at 0.04 per cent., "Telodrin" at 0.075 and 0.1 per cent. active, and diazinon gave satisfactory control. Azinphos-methyl, DDD, endrin at 0.025 per cent. active, "Lebaycid", and "Telodrin" at 0.05 per cent. active did not give adequate control.

TABLE 3

TRIALS 2, 3 AND 4 : INSECTICIDE SELECTION AND CONCENTRATION—LEVEL DETERMINATION

Treatment		Regional Experiment Station, Gatton Trial 2, Oct. 1958—Jan. 1959					Redlands Experiment Station				
Material	Concentration*	Population 13 Days after First Treatment. (Larvae per plant)		Population 13 Days after Second Treatment. (Larvae per plant)		Damage Rating at Harvest (0-5)		Trial 3, June-Oct. 1960	Trial 4, Jan.—Mar. 1961		
		Mean	Mean	Trans- formed Mean†	Mean	Trans- formed Mean†	Mean	Mean	Mean	Mean	Mean
Azinphos-methyl emulsifiable concentrate .. .. .	0.05	..	..	..	..	..	0.04	0.30	8.22	2.54	
DDD emulsion concentrate ..	0.1	4.93	2.1	1.39	2.25	1.49	0.05	0.25	7.67	2.34	
Diazinon emulsifiable concentrate .. .. .	0.1	..	..	..	..	..	0	2.44	6.83	1.44	
Dieldrin dust .. .. .	1.0	..	..	..	..	..	1.21	..	..	..	
Endrin emulsifiable concentrate	0.025	..	..	..	..	..	0.48	1.63	6.66	2.86	
Endrin emulsifiable concentrate	0.04	4.95	7.9	2.72	2.62	1.62	0.02	2.01	7.40	1.80	
"Lebaycid" emulsifiable concentrate .. .. .	0.05	..	..	..	..	..	..	3.84	11.36	(3.56)	
Methoxychlor emulsifiable concentrate .. .. .	0.1	4.48	2.5	1.53	3.80	1.95	..	..	..	..	
"Telodrin" emulsifiable concentrate .. .. .	0.05	5.22	10.7	3.17	2.63	1.62	0.03	1.05	8.12	2.25	
"Telodrin" emulsifiable concentrate .. .. .	0.075	..	..	..	..	..	0.04	1.34	9.93	1.65	
"Telodrin" emulsifiable concentrate .. .. .	0.1	5.42	8.5	2.86	2.63	1.62	0.02	1.94	7.80	1.76	
Thiodan emulsifiable concentrate .. .. .	0.1	..	..	..	..	..	0.41	..	..	..	
No treatment .. .. .	..	4.08	11.7	3.39	(5.00)	..	1.34	3.84	9.22	(4.93)	
Necessary Differences for significance .. .. .	{ 0.05 0.01	1.20 1.64 (N.S.D.)	.. ..	0.35 0.48	0.37 0.50	0.12 0.17	0.30 0.40	Not analysed	Not analysed	0.47 0.64	

\* % active w/v, liquid concentrates; % active w/w, dust

†  $\sqrt{x}$

**Effects of Insecticide Treatment on Yields**

The low infestation and slight plant damage in the trial carried out at Redlands Experiment Station from June to October 1960 enabled assessment of the effect of insecticide treatment on yields in what can be considered the absence of pest infestation. The number of cabbages harvested per plot, their weight, and time taken from transplanting to maturity are given in Table 4.

**TABLE 4**  
EFFECTS OF INSECTICIDE TREATMENT ON YIELDS

Treatment		Harvest Data—Marketable Cabbages (Means)		
Material	Concentration*	Number per Plot of 38 Plants	Weight per Plot (lb)	Av. Days to Harvesting
Azinphos-methyl emulsifiable concentrate	0.05	37.8	265	110.5
DDD emulsion concentrate .. ..	0.1	36.8	258	111.8
Diazinon emulsifiable concentrate .. ..	0.1	37.2	227	112.0
Dieldrin dust .. .. .	1.0	35.2	231	110.5
Endrin emulsifiable concentrate .. ..	0.025	38.0	257	109.8
Endrin emulsifiable concentrate .. ..	0.04	37.5	235	111.8
“Telodrin” emulsifiable concentrate .. ..	0.05	37.5	268	109.8
“Telodrin” emulsifiable concentrate .. ..	0.075	37.0	259	111.5
“Telodrin” emulsifiable concentrate .. ..	0.10	37.5	248	111.5
Thiodan emulsifiable concentrate .. ..	0.10	37.8	242	111.8
Control—no treatment .. .. .		35.8	248	108.8
Necessary differences for significance .. .. .	{ 0.05 0.01	2.3 3.2 (N.S.D.)	54 72 (N.S.D.)	3.2 4.4 (N.S.D.)

\* % active w/v, liquid concentrates; % active w/w, dust.

In this “absence” of infestation, no differences in yield were detected.

**Conclusion**

Diazinon, endrin and “Telodrin” emulsifiable concentrates used as sprays at concentrations of 0.1, 0.04 and 0.1 per cent. active respectively gave consistently satisfactory cabbage pest control. Comparable strengths of azinphos-methyl, thiodan, methoxychlor, “Lebaycid”, lindane and trichlorphon emulsifiable concentrates and DDD emulsion concentrate, lower strengths of endrin and “Telodrin” and a 1 per cent. active dieldrin dust did not give the same levels of control of pest complexes present.

Endrin at 0.025 per cent. active has not given the level of control reported earlier (Champ 1960) and an increase in concentration to 0.04 per cent. active is necessary. “Telodrin”, another cyclodiene, has proved a satisfactory substitute so far as pest kills are concerned, but has not proved superior. Diazinon, an

organic phosphate, has shown promise; this material should be held in abeyance, firstly because organic phosphate exposure among growers is already high from general pest control practices currently used, and secondly as a replacement should acquired cyclodiene resistance develop.

## REFERENCE

CHAMP, B. R. (1960).—Cabbage pest control investigations, 1954. *Qd J. Agric. Sci.* 17:59-65.

B. R. CHAMP

Queensland Department of Agriculture and Stock

(Received for publication January 24, 1962)