

CANTERBURY FIELD TRIALS ON GRASS GRUB CONTROL 1966-68

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Summary

To compare residual effects, a trial laid down in 1966 at Carew against DDT-resistant grubs is reported on 15 months after treatment. In grub reduction, heptachlor at both dosage rates, lindane, trichloronate and fensulfothion reached significance. Trichlorfon, diazinon, and fenitrothion were all significantly worse than control. In pasture response trichloronate, lindane, fensulfothion, heptachlor at the high dosage level, trichlorfon and diazinon reached significance.

Another trial in the same paddock was laid down in 1967 and was sampled five months after treatment. All treatments reached significance in both grub reduction and pasture response except DDT which reached significance on pasture cover only.

Although the 1966 Cheviot trial was applied to DDT-susceptible grubs, the two formulations of DDT did not reach significance in counts 1, 2 or 3. The treatments in count 1 to reach significance in larvae reduction were diazinon and the higher dosages of lindane and fensulfothion. Against the second generation, on both larvae reduction and pasture assessment, again fensulfothion and both rates of lindane, together with heptachlor, reached significance. The third count (against the 3rd generation) showed that only the high rate of lindane and heptachlor reached significance in grub reduction.

The 1968 West Melton trial was sampled four months after treatment and trichlorfon, diazinon, parathion B5860, trichloronate, fensulfothion, DDT, lindane and fenitrothion at various dosages and formulations reached significance in larvae reduction. These materials, with the exclusion of the last two, and the addition of malathion, reached significance on pasture response.

With the 1968 subsurface trial located on the same property later, diazinon and lindane, at two rates, reached significance in larvae reduction against the "machine only" and control, 15 weeks after treatment. The pasture assessment showed all materials including the "machine only" gave a significant increase just over 11 weeks after application.

In the 1968 Hororata trial, no significant differences were found in either pasture assessment or grub reduction, five months after treatment.

The 1968 Springston trial, sampled three months after application, showed that only fensulfothion and parathion reached significance in larval reduction; there were no visible pasture responses.

INTRODUCTION

THE AIM of the following trials was to evaluate materials in various formulations, concentrations and dosage levels in comparison with DDT for the control of the common grass grub *Costelytra zealandica*. Materials were all granular except the drymix and oilmix preparations of DDT, and materials in the subsurface trial which were liquids. All rates are expressed in terms of active ingredient per acre.

The subsurface application was by machine to plots of 1/60 acre (4 ft × 80 ft) replicated three times. The dry preparations in the remaining trials were all applied by hand shaker two ways at right-angles to 1/160 acre plots (16 ft 6 in. × 16 ft 6 in.) replicated five times, and all except the DDT-superphosphate preparation plots were topdressed with superphosphate at the rate of 1½ cwt/acre.

Conditions governing the individual trials are given in Table 1.

TABLE 1: CONDITIONS GOVERNING TRIALS

<i>Trials</i>	<i>DDT-resistant Grubs</i>	<i>Pretreatment Count per 7 in. Cube</i>	<i>Wind at Application (mph)</i>	<i>Soil Moisture</i>
1966 Carew	Yes	Average 67 Range 25-86	1-3	Moderate
1967 Carew	Yes	Average 43.6 Range 16-69	2½-3	Moderate
1966 Cheviot	No	Average 6.8	4.75-8.25	High
1968 Hororata	No	Average 4.2	2-8	Low
1968 West Melton	No	Average 8.3	3-5½	High
1968 West Melton Subsurface	No	Range 0-21	Not applicable	High
1968 Springston	No	Average 12.2 Range 6-17	5½-6½	High

1966 CAREW TRIAL

Applied: 14/4/66.

Assessment: Visual: 5-11/7/67 (Rated by 3 officers).

Soil: 5-11/7/67 (Six 7 in. cubes per plot).

Rain 2 weeks after application (in.):

Apr. 18 0.66.

Apr. 26 0.46

Apr. 27 0.33

Total 1.45

Results are given in Table 2.

TABLE 2: RESULTS OF 1966 CAREW TRIAL

Treatments (lb)	A Live Grass Grubs		B % Pasture Cover	
	Stat. Means	Sig. cf. Control	Stat. Means	Sig. cf. Control
trichloronate 2	4.89	*	76.5	***
lindane 2	3.71	***	67.6	***
fensulfothion 2	4.83	*	68.0	***
heptachlor 1	2.57	***	65.2	**
trichlorfon 2	8.03	—*	64.1	*
diazinon 2	8.14	—*	64.2	*
heptachlor 1/2	3.08	***	57.0	N.S.
fenitrothion 2	8.84	—***	56.7	N.S.
DDT pellets 2	6.37	N.S.	49.1	N.S.
Control	6.42	—	54.8	—

Differences for significance				A	B
5%	....	....	....	1.34	7.2
1%	....	....	....	1.81	9.2
0.1%	....	....	....	2.36	12.8
Standard error	....	....	....	0.465	2.52

1967 CAREW TRIAL

Applied: 6/2/67.

Assessment: Visual: 5-11/7/67 (Rated by 3 officers).

Soil: 5-11/7/67 (Six 7 in. cubes per plot).

Results are given in Table 3.

TABLE 3: RESULTS OF 1967 CAREW TRIAL

Treatments (lb)	A Live Grass Grubs		B % Pasture Control	
	Stat. Means	Sig. cf. Control	Stat. Means	Sig. cf. Control
fensulfothion 1	2.30	***	67.3	**
fensulfothion 1/2	3.53	***	67.3	**
diazinon 1	4.66	**	67.7	**
lindane 1	4.31	***	62.4	**
DDT gran. super. 2	6.66	N.S.	60.9	*
Control	6.49	—	52.4	—

Differences for significance				A	B
5%	....	....	....	1.00	7.00
1%	....	....	....	1.36	9.61
0.1%	....	....	....	1.84	
Standard error	....	....	....	0.337	2.39

From Table 2 it can be seen that at Carew after fifteen months the organophosphates trichloronate and fensulfothion, both at 2 lb, reached significance in larval reduction to the 5% level, and at the 0.1% level on pasture cover. Trichlorfon and diazinon at 2 lb were significantly better than control at the 5% level on pasture cover but were significantly worse than control at the 5% level on larval counts, as was 2 lb fenitrothion at the 0.1% level on grub counts only.

All the organochlorine materials gave a significant reduction of grub numbers to the 0.1% level except DDT. With pasture response, lindane reached significance at the 0.1% level, heptachlor 1 lb at the 1% level and heptachlor ½ lb, like DDT, gave no significant response.

In the 1967 Carew trial, sampled five months after treatment (Table 3), both the 1 and ½ lb rates of fensulfothion reached significance at the 0.1% level in grub reduction, as did diazinon at the 1% level. Of the organochlorine materials, lindane reached significance at the 0.1% level but DDT granulated superphosphate did not give any significant reduction.

All materials gave a pasture response at the 1% level except DDT granulated superphosphate which reached significance at the 5% level only.

1966 CHEVIOT TRIAL

Applied 27/7/66.

Assessment: Visual: Rated by 2 officers.

Soil: Six 7 in. cubes per plot for counts 1 and 2 and eight for count 3.

TABLE 4: RESULTS OF 1966 CHEVIOT TRIAL

Treatments (lb)	A		B		C Pasture		D	
	Grass Grubs Count 1 25/10/66		Grass Grubs Count 2		Assessment 18/2/67		Grass Grubs Count 3 5/9/68	
	Stat.	Sig. cf.	Stat.	Sig. cf.	Stat.	Sig. cf.	Stat.	Sig. cf.
	Mean	Control	Mean	Control	Mean	Control	Mean	Control
fensulfothion 2	2.32	***	3.37	***	89.5	***	4.50	N.S.
diazinon 2	2.91	**	5.60	N.S.	61.0	N.S.	—	—
lindane 2	3.34	*	2.07	***	93.0	***	2.50	***
fensulfothion 1	4.02	N.S.	6.05	N.S.	66.0	N.S.	6.08	N.S.
lindane 1	4.11	N.S.	3.56	**	92.0	***	4.60	N.S.
DDT prills 2	4.22	N.S.	8.04	N.S.	46.5	N.S.	5.28	N.S.
heptachlor 1	4.24	N.S.	1.38	***	96.0	***	1.26	***
trichlorfon 2	4.45	N.S.	5.14	N.S.	71.0	N.S.	—	—
DDT gran. super. 2	4.41	N.S.	7.81	N.S.	53.0	N.S.	5.12	N.S.
Control	4.43	—	6.68	—	52.5	—	5.10	—
Differences for significance			A	B	C	D		
5%	....	....	....	0.95	1.87	20.2	1.40	
1%	....	....	....	1.28	2.51	27.0	1.89	
0.1%	....	....	....	1.69	3.31	35.6	2.52	
Standard error	....	....	....	3.32	0.653	7.02	0.485	

The Cheviot trial shows (Table 4) that three months after application fensulfothion, diazinon and lindane all at 2 lb were the only treatments to reach significance at the 0.1%, 1% and 5 % levels, respectively, in grub reduction. No visible pasture responses were detected.

Against the second generation (count 2) the only organophosphate to reach significance was fensulfothion 2 lb at the 0.1% level. The organochlorine materials which also gained significance in grub reduction were lindane at 2 lb and heptachlor at 1 lb, both at the 0.1% level, and lindane 1 lb at the 1% level. A new pasture "pull" technique, which will be described in a later paper, was used to assess the pasture. With this assessment, all the materials which reached significance in larval reduction also gained significance with this pasture assessment at the 0.1% level.

Control of the third generation (count 3) was gained at the 0.1% level by two organochlorines, lindane at 2 lb and heptachlor at 1 lb. No pasture response was detected.

(N.B. Although this was a DDT-susceptible area by topical testing, neither of the two formulations of DDT tested reached significance in any of the three counts.)

1968 HORORATA TRIAL

Applied: 25/3/68.

Assessment: Visual: 2/9/68 (Rated by four officers)

Soil: 28/8-2/9/68 (Eight 7 in. cubes per plot).

Rain seven weeks after treatment (in.)				Treatments (lb)
Apr. 9	....	....	0.24	DDT prills 10% 2
Apr. 10	....	....	1.07	DDT prills 20% 2
Apr. 11	....	....	2.88	DDT drymix (Grubnox) 2
Apr. 12	....	....	1.64	DDT drymix (Pestcheck) 2
Apr. 13	....	....	0.75	DDT super. oilmix 2
Apr. 20	....	....	0.50	DDT gran. super. 2
Apr. 21	....	....	0.08	DDT granules (Ivory's) 2
Apr. 23	....	....	0.15	lindane 10% prill 1
May 7	....	....	0.32	lindane 10% prill 2
May 20	....	....	0.15	lindane 20% prill 2
			Total	7.78
				parathion 10% granule 1
				fensulfothion 5% granule 1
				diazinon 5% granule 1
				B5860 5% granule 1
				trichloronate 2.5% granule 1
				Control

N.B. No rain fell for 15 days after treatment.

No significance was reached between treatments and control, in larval reduction or pasture assessment.

1968 WEST MELTON TRIAL

Applied: 17-18/4/68.

Assessment: Visual: 5/8/68 (Rated by 4 officers).

Soil: 19-27/8/68 (Eight 7 in. cubes per plot).

Rain for one month after application (in.):

Apr. 19	....	....	....	....	....	....	0.17
Apr. 20	....	....	....	....	....	....	0.23
Apr. 21	....	....	....	....	....	....	0.27
Apr. 22	....	....	....	....	....	....	0.04
Apr. 24	....	....	....	....	....	....	0.10
Apr. 25	....	....	....	....	....	....	0.06
Apr. 26	....	....	....	....	....	....	0.10
Apr. 27	....	....	....	....	....	....	0.17
Apr. 28	....	....	....	....	....	....	0.08
May 2	....	....	....	....	....	....	0.01
May 7	....	....	....	....	....	....	0.59
Total	....	....	....	....	....	....	1.82

Results are given in Table 5.

TABLE 5: RESULTS OF 1968 WEST MELTON TRIAL

Treatments (lb)	A Total Larvae for 40 Samples			Sig. cf. Control	B Pasture Cover Rated 0-100		
	Stat. Mean	Stat. Mean	Sig. cf. Control		Stat. Mean	Stat. Mean	Sig. cf. Control
trichlorfon							
5% gran. 2	79	1.83	***	77.5	68.5	**	
diazinon 5% gran. 2	58	1.76	***	77.0	68.1	**	
parathion 20%							
gran. 2	85	2.10	***	76.0	67.6	**	
diazinon 5% gran. 1	134	2.57	**	75.0	66.9	**	
B5860 5% pumice							
gran. 1	188	3.03		74.5	66.5	*	
B5860 5% calcite							
gran. 2	168	2.84	*	74.5	66.4	*	
parathion 20%							
gran. 1	164	2.75	*	73.5	66.2	*	
trichloronate 2.5%							
gran. 2	111	2.28	***	74.0	65.9	*	
DDT gran. super. (Challenge) 2	206	2.98		73.5	65.8	*	
fensulfothion 5%							
gran. 1/2	109	2.31	**	73.5	65.7	*	
parathion 10%							
gran. 2	89	2.10	***	73.5	65.7	*	
trichloronate 2.5%							
gran. 1	205	3.18		73.0	65.4	*	
trichlorfon 5%							
gran. 1	168	2.82	*	72.5	65.0	*	
DDT drymix 2	137	2.60	**	72.0	64.8	*	
malathion 5%							
prills 2	195	3.00		71.5	64.6	*	

TABLE 5 — contd.

Treatments (lb)	A			B		
	Total Larvae for 40 Samples	Stat. Mean	Sig. cf. Control	Pasture Cover Rated 0-100	Stat. Mean	Sig. cf. Control
DDT oil-treated (Hornby) 2	187	3.09		71.5	64.4	
fensulfothion 5% gran. 1	61	1.80	***	71.5	64.2	
lindane 10% prills 2	105	2.26	***	71.0	64.0	
fenitrothion 10% gran. 1	172	2.79	*	69.5	63.3	
parathion 10% gran. 1	110	2.32	**	69.5	62.9	
lindane 20% prills 1	202	3.16		69.5	62.8	
B5860 5% pumice gran. 2	190	2.95		69.0	62.5	
DDT gran. super. (Hornby) 2	249	3.41		68.5	62.4	
DDT 10% prills 2	234	3.46		68.5	62.2	
lindane 20% prills 2	202	3.30		68.0	61.9	
lindane 10% prills 1	218	3.28		67.5	61.5	
B5860 5% gran. (HHY) 2	212	3.26		67.0	61.3	
DDT 25% pellets fine 2	185	2.78	*	67.0	61.2	
fenitrothion 10% gran. 2	198	3.12		66.5	60.9	
B5860 5% gran. (HHY) 1	255	3.56		65.5	60.3	
B5860 5% calcite gran. 1	191	2.98		65.5	60.2	
DDT 25% pellets mixture 2	181	2.78	*	64.5	59.6	
DDT gran. super. (Napier) 2	177	2.78	*	64.5	59.5	
DDT 25% pellets coarse 2	248	3.40		64.5	59.5	
methidathion 5% gran. 2	283	3.67		63.5	58.8	
Control	297	3.84		62.5	58.1	
SD8447 10% gran. 2	323	3.97		62.0	57.8	
DDT 20% prills 2	340	4.04		60.5	56.9	
Differences for significance				A	B	
5%				0.91	6.3	
1%				1.20	8.4	
0.1%				1.55	—	
Standard error				0.324	2.27	

This West Melton trial was soil-sampled four months after application, and the following organophosphate materials gained significance in grub reductions: At the 0.1% level, trichlorfon, diazinon, trichlorate and 10 and 20% granule parathion all at 2 lb and fensulfothion at 1 lb; at the 1% level diazinon and parathion 10% granule both at 1 lb and fensulfothion at ½ lb; at the 5% level the B5860 calcite granule at 2 lb, parathion 20% granule, trichlorfon and fenitrothion reached significance.

The organochlorine materials to reach significance were lindane 10% prills at the 0.1% level, DDT drymix at the 1% level, DDT 25% pellets mixture, fine, and DDT granulated superphosphate (Napier) at the 5% level. All these were at the 2 lb rate.

Regarding pasture assessment at the 1% level, the organophosphates trichlorfon 2 lb, diazinon at 2 and 1 lb and parathion at 2 lb reached significance. At the 5% level the B5860 calcite granule, trichloronate, parathion 10% granule and malathion granule all at 2 lb reached significance along with the B5860 pumice granule, parathion 20% granule, trichloronate and trichlorfon at 1 lb and fensulfothion at ½ lb.

DDT granulated superphosphate (Challenge) and DDT drymix both at 2 lb, were the only organochlorines to reach 5% significance.

SUBSURFACE APPLICATION TRIAL, WEST MELTON

Applied: 6/5/68.

Plot size: 1/60 acre (4 ft × 180 ft).

Replicates: 3.

Assessment: Visual: 31/7/68 (Rated by 3 officers).

Soil: 27-28/8/68 (Twelve 7 in. cubes per plot).

Rain for one month after application (in.):

May 7	....	....	....	....	....	....	....	0.59
May 26	....	....	....	....	....	....	....	0.06
May 30	....	....	....	....	....	....	....	0.79
May 31	....	....	....	....	....	....	....	0.09
June 3	....	....	....	....	....	....	....	1.36
June 7	....	....	....	....	....	....	....	0.65
Total	....	....	....	....	....	....	....	<u>3.54</u>

This trial was carried out using an experimental machine developed by Lincoln College with the aim of placing liquid insecticides under the surface of the pasture. This would enable organochlorine materials to be used as sprays without the problem of residues to stock.

The experimental machine used had two staggered rows totalling five coulters at 10 in. centres followed by rows of tines, immediately followed in turn by a line of water jets designed to give a continuous sheet of insecticides at a depth of 2 in. to 3 in. All these coulters, tines, and jets were spring-mounted to overcome uneven ground. The insecticides were

pumped from a 44 gal tank located on top of the machine and using a pressure of 40 lb/sq. in. The machine was mounted on two rubber-tyred wheels and was pulled by a 38 hp 135 Ferguson tractor.

Because of a certain amount of turf lift caused by the machine, a Cambridge roller was used to cross-roll the trial three days after application. Results of the trial are given in Table 6.

TABLE 6: RESULTS OF 1968 SUBSURFACE TRIAL AT WEST MELTON

Treatments (lb)	A			B Pasture Assessment Rated on a 1-10 Basis ³		
	Total Live Larvae 36 Samples	Stat. Mean	Sig. cf. Control	Sig. cf. Machine	Assessment Av.	Stat. Mean
Diazinon 2	41	3.63	**	**	6.1	18.3
diazinon 1	79	5.10	N.S.	N.S.	6.3	19.0
lindane 2	44	3.83	**	**	7.0	21.0
lindane 1	55	4.20	**	*	6.8	20.3
DDT 1	79	5.07	N.S.	N.S.	6.4	19.3
Machine ¹	108	5.93	N.S.	—	5.7	17.0
Control ²	129	6.47	—	N.S.	4.1	12.3
Differences for significance				A	B	
5%				1.48	4.3	
1%				2.07	—	
Standard error				0.480	1.39	

¹Machine = Same procedure as for treatments but with water only.

²Control = No treatment or machine.

³Significance: All different from control at 5% level but no differences within.

1968 SPRINGSTON TRIAL

Applied: 31/5/68.

Assessment: Soil: 2-4/9/68 (Eight 7in. cubes per plot).

N.B.: Trichloronate was not applied until 6/6/68.

Rain one month after application (in.):

Jun. 4	....	....	....	....	....	....	1.36
Jun. 7	....	....	....	....	....	....	0.65
Jun. 10	....	....	....	....	....	....	1.45
Jun. 17	....	....	....	....	....	....	0.03
Jun. 19	....	....	....	....	....	....	0.06
Jun. 23	....	....	....	....	....	....	0.01
Jun. 25	....	....	....	....	....	....	0.12
Jun. 27	....	....	....	....	....	....	0.03
Total	....	....	....	....	....	....	3.71

Because of rain soon after the start of application, there was an appreciable amount of wheel spin by the tractor, and, as the pump was driven off the power take-off, most of the treatments were applied at rates higher than intended.

Lincoln College, Department of Agriculture, and DSIR are carrying out further work in this sphere.

Table 5 shows that both diazinon and lindane at 2 lb reached significance at the 1% level compared with control and "machine only" in grub reduction. Lindane 1 lb also gained significance at the 1% level compared with control and at the 5% level compared with "machine only".

On pasture assessment, all treatments including "machine only" were better than control at the 5% level.

Results are given in Table 7.

TABLE 7: RESULTS OF 1968 SPRINGSTON TRIAL

<i>Treatments (lb)</i>	<i>Live Larvae per 40 Spade Squares</i>	<i>Stat. Mean</i>	<i>Sig. cf. Control</i>
fensulfothion 5% gran. 2	29	2.38	*
parathion 10% gran. 2	42	2.76	*
diazinon 5% gran. 2	46	2.80	
lindane 10% prill 2	77	3.36	
trichlorate 2.5% gran. 2	64	3.38	
DDT gran. super. (FF East Coast) 2	97	4.14	
B5860 5% calcite gran. 2	117	4.70	
fenitrothion 10% gran. 2	141	4.76	
trichlorfon 5% gran. 2	126	4.80	
Control	153	5.26	
DDT gran. (Ivory's) 2	146	5.34	
DDT prills 2	176	5.72	
DDT gran. super. (Hornby) 2	218	5.94	
DDT drymix 2	269	7.12	

Differences for significance:

5%	....	....	....	....	....	2.46
1%	....	....	....	....	....	3.28
Standard error	....	....	....	....	....	0.866

At Springston two materials only gained significance in larval reduction compared with control in this trial. These were fensulfothion granules and parathion granules, both at the 5% level. No visual responses were detected.

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