DDT RESIDUES ON PASTURE FOLLOWING APPLICATIONS OF OILED WET MIX DDT/SUPERPHOSPHATE

J. H. BAIRD AND W. R. LOBB

Research Division, Department of Agriculture, Ashburton

Summary

Experimental results show a significant correlation between pasture growth and the dilution of DDT residues on pasture. The rate of decay of DDT is similar in different sites even though the absolute residue levels vary. Wide variations of conditions have occurred over the area of the experiment but these should be regarded as normal as they represent the extent of the variations which have to be taken into account in determining any withholding period. An 8-week withholding period between the application of oiled wet mix DDT/superphosphate at the rate of 2 lb active ingredient of DDT per acre was adequate under the conditions of the experiment.

INTRODUCTION

AS A RESULT of the widespread belief that formulations of DDT based on pellets and prills were ineffective for the control of grass grub (*Costelytra zealandica*) and porina (*Wiseana* spp.), oiled wet mix DDT-superphosphate was introduced in the spring of 1967 as a temporary measure until granulated DDT-superphosphate was manufactured in the South Island. The oil was added to reduce the drift of the DDT dust. It has been used previously to reduce drift of 2,4-D-superphosphate and basic slag when applied by aircraft.

The oiled wet mix DDT-superphosphate contained DDT dust mixed with superphosphate at the rate of 2 lb active ingredient of DDT in 1½ cwt of mixture. The material was applied, subject to permits, which specified that an 8-week withholding period be observed between application and grazing of treated pastures. The pastures were required to be short and dry at the time of application of the DDT-superphosphate.

EXPERIMENTAL

In order to obtain information regarding the adequacy of the 8-week withholding period in practice, DDT residues in the pasture were determined at various intervals after oiled wet mix DDT-superphosphate had been applied by farmers at the rate of 1½ cwt per acre on six farms chosen to represent the range of average annual rainfall in mid-Canterbury. The description of the trial sites and details of the weather during the periods of trials are given in Table 1. All the trials were on dryland pasture except site 4 which was on irrigated pasture.

The trials were conducted during the period September-December, 1967. At this time most pastures treated with DDT in Canterbury would be used for seed production or for hay. Under these conditions withholding periods are not a problem in normal circumstances. In general, this time

TABLE 1: DESCRIPTION OF TRIAL SITES

Site and Locality	Av. Annual Rainfall (in.)	Weather over Trial Period			Last DDT Treatment
		Rainfall (in.)	Frost (No.)	Dews (No.)	
1. Seafield	26.1	2.6	1	25	Nil
2. Highbank	36.7	8.47*	3	18	5 yr previously
3. Winchmore	30.4	8.76	13	6	3 and 4 yr previously
4. Winchmore	30.4	8.76	13	6	3 yr previously
5. Eiffelton	26.1	10.33	6	41	Not known
6. Methven	38.4	12.28†	—	—	Nil

* Plus a trace of snow.

† Plus 18 in. of snow.

of application fits in well with management in that the pastures should be hard grazed and short before closing.

At each site duplicate samples of pasture were taken along the diagonal lines of the paddock at each time of sampling. Previously samples of pasture were taken before the DDT-superphosphate was applied and subsequent samples were taken at 4 days, 2, 4, 6, 8 and 10 weeks after the applications. DDT residues were determined in these samples at the Rukura Agricultural Research Centre by the gas-liquid-chromatograph method.

At each sampling time pasture production was determined by cutting a plot 30 ft by 2 ft. A new plot was cut at each sampling time. The pasture was weighed and dry matter determined. Samples were dissected for botanical analyses.

RESULTS

The results of the DDT determination in the pasture, pasture dry matter production, and the rainfall since the previous sampling are given in Table 2. The DDT figures are the averages for the two samples taken.

One pre-treatment sample contained 3.4 ppm DDT and it was thought possible that this contamination was from soil and dung picked up in the samples. This pasture was badly damaged by porina and this re-cycling of the soil to pasture is a likely source of pasture contamination. One sample contained no detectable DDT and the remaining four a trace only.

The preliminary dry matter levels range from 80 lb to 632 lb per acre. In the latter case the site was the last to be treated and it was in the area of highest rainfall. The pasture may have been somewhat long at the time of application.

The application of the fertilizer and insecticide resulted in an immediate contamination by DDT. The four-day samples showed residues 83 to 247 ppm DDT. These residues were not in direct relation to the amount of growth measured just prior to application but could reflect to some degree the density of the pastures. Sample 1 was a young drilled grass paddock with some bare ground, whereas 4 was a dense irrigated pasture with no bare ground. This would indicate, therefore, that the adherence of DDT to

TABLE 2: DDT IN PASTURE, PASTURE PRODUCTION AND RAINFALL AT VARIOUS INTERVALS
AFTER THE APPLICATION OF OILED WET MIX DDT-SUPERPHOSPHATE

Site	Prelim.	4 days	14 days	28 days	42 days	56 days	70 days
SITE 1:							
DDT (ppm)	Nil	83.0	21.8	12.8	1.6	0.4	0.3
DM (lb/acre)	290	312	545	835	2,178	3,256	4,385
Rainfall (points)		5	tr	65	134	56	509
SITE 2:							
DDT (ppm)	tr	114.4	24.4	4.7	0.8	0.8	
DM (lb/acre)	196	269	530	1,285	2,875	4,215	
Rainfall (points)		3	125	—	184	530	
SITE 3:							
DDT (ppm)	3.4	207.0	39.4	6.8	1.7	1.0	
DM (lb/acre)	130	80	283	1,278	2,755	3,796	
Rainfall (points)			21	213	587	55	
SITE 4:							
DDT (ppm)	tr	247.0	45.4	9.1	2.3	2.1	
DM (lb/acre)	218	265	711	2,040	3,215	3,767	
Rainfall (points)			21	213	587	55	
SITE 5:							
DDT (ppm)	tr	144.7	46.6	5.9	2.9	0.4	tr
DM (lb/acre)	80	73	196	929	3,066	3,232	6,055
Rainfall (points)			3	168	824	38	22
SITE 6:							
DDT (ppm)	tr		17.4	tr	tr	tr	
DM (lb/acre)	632		1,651	5,278	8,610	10,810	
Rainfall (points)			1,042	10		176	

a pasture is influenced by what might be termed an opportunity factor as well as by the amount of pasture measured by height or mowing. No accurate account of the moisture status of the pasture can be given but all were stated to be dry in accordance with the regulations at the time of application.

DISCUSSION

On the evidence presented, it would appear that pasture production and time result in an increasing dilution in the concentration of DDT. In this experiment pasture production and time are closely related, there being a steady increase in production with time. This may not always be the case in either the summer or autumn periods in Canterbury.

Substantial concentrations of DDT remained on the pasture for 28 days except for site 6. Significant concentrations were recorded on several sites for 42 days and although the concentrations were of a small order by the eighth week one site still recorded over 2 ppm DDT.

A statistical analysis of the rate of decay of DDT on these pastures was undertaken by G. Arnold of the Biometrics Section of the Department.

TABLE 3: STATISTICAL ANALYSIS OF THE RATE OF DECAY OF DDT ON TRIAL PASTURES

$$\text{Regression: } \log_e (\text{DDT}) = b (\text{time}) + c \\ (\text{DDT} - \text{lb/ac} \times 10^{-6}, \text{ time} - e \text{ days})$$

Site	$b \pm S.E.$	c	s
1	-0.045 ± 0.007	10.2	0.84
2	-0.046 ± 0.011	10.2	0.82
3	-0.028 ± 0.003	9.8	0.20
4	-0.042 ± 0.007	11.0	0.54
5	-0.042 ± 0.011	9.8	1.23

He concluded from this evidence that there was no significant difference between the rate of decay in sites 1, 2, 4 and 5. However, the rate was significantly less on site 3. Overall there was no significant difference between sites 1, 2 and 5. The mean level of DDT was significantly ($P \leq 0.05$) higher in site 4 than site 5.

The significant information, however, is that rates of decay of DDT are much the same over different sites even though the absolute residue level may vary. Any effect of rainfall, other than by affecting growth, must have been small.

The evidence would support an 8-week withholding period under the conditions of this experiment. However, there is some support from the evidence that, if DDT adheres to pasture for any length of time after topdressing, then only exceptional rainfall will remove it and for the most part dilution is an effect of increased pasture production. It could be that this effect would hold good under any condition of growth, so that during droughts or in winter in Canterbury no appreciable drop in DDT, from the original contamination levels could be expected. Harrison (1962) concluded also that insecticides remaining on pasture after a week or two are firmly adherent and, whatever the subsequent rainfall, residue losses would be mainly the result of dilution by fresh pasture growth.

Two points which require some comments are:

- (1) For site 6, residues were reduced just as significantly as for other sites, despite the high initial pasture growth. The removal of the DDT was probably not caused by rain, exceptionally heavy even for this area (10.42 in. and 18 in. snow), because samples after this rain still showed 17.4 ppm DDT. Exceptional pasture growth after this rain and snow (330 lb per day for the next 11 days) reduced the DDT to a trace only.
- (2) The lower rate of decay on site 3 could possibly be explained in an unusual way. This site showed pasture contamination in the pre-sample. This may have resulted from re-cycling of DDT on to the pasture from porina castings. This may have continued to some degree throughout the trial and the rate of decay by pasture dilution would appear less.

Although pasture dissections were made on these sites, there was no evidence to indicate that the different components had any effect on the rate of dilution. Leonard (1963), in discussing a previous Winchmore trial, showed very different residues on different species after 68 days. In this experiment the pasture with the greatest proportion of grass (94%) performed in a similar manner to that with the greatest proportion of clover (11%) both for original contamination after topdressing and for subsequent residues.

ACKNOWLEDGEMENTS

R. Henzill, Ruakura Agricultural Research Centre, for analyses of pasture samples; P. D. Fitzgerald, Winchmore Irrigation Research Station, for statistical assistance; G. Arnold, Biometrics Section of the Department of Agriculture, for statistical presentation of Table 3.

REFERENCES

- Harrison, D. L., 1962: *15th Proc. N.Z. Weed Control Conf.*: 250.
Leonard, W. F., 1963; *16th Proc. N.Z. Weed Control Conf.*: 116.