TOPDRESSING PRACTICES FOR GRASS-GRUB CONTROL

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Summary

A summary of the Entomology Division's Canterbury Substation's experience with topdressing practices for grass-grub (*Costelytra zealandica*) control from 1945 to 1963 is given. Results are based partly on observations and measurements at the time of application, but mainly on the actual control of grass-grubs. Though not included in the title of this paper, *Oxychanus* spp. must be taken into consideration, as larvae of this group, when present, always complicate assessment of grass-grub control and *Oxychanus* spp. are present in approximately threequarters of all pasture land throughout New Zealand.

INTRODUCTION

IT IS GENERALLY known that insecticides should be applied preferably only to dry, close-grazed pastures in absence of stock. If it is not possible to wait for the close-grazed pasture to dry, stock should be kept off until rain washes insecticides on to the ground; and stipulated stock withholding periods must be adhered to, no matter how much rain falls earlier.

It is also generally recognized how difficult it is to get DDT-superphosphate and sprays on to the ground if winds are over 5 m.p.h., and under high temperature conditions. Some of the reasons for this are as follows:

- (1) If the temperature at 6 in. above the ground is 3° lower than at 5 ft, the dust deposit in trials overseas was as good in a wind of 9 m.p.h. as in a wind of 2 m.p.h. when the 6 in. temperature was 3° higher than at 5 ft.
- (2) Fine particles or droplets when dropped from 10 ft in a breeze of only 3 m.p.h. can drift as follows (G. Lindsay, pers. comm.):
 - 200 micron diameter can drift 18 ft,
 - 100 micron diameter can drift 50 ft,
 - 10 micron diameter can drift nearly 1 mile.
- (3) With sprays there is an additional evaporation factor. Amsden (1962) showed that the lifetime and distance of fall of the liquid phase of some spray droplets through still air was as follows:

Initial diameter of droplets (micron)	Air Condition			
	20° (68°F) at 80% R.H.		30°C (86°F) at 50% R.H.	
200	200 sec	268 ft	56 sec	69 ft
100	50 sec	22 ft	14 sec	6 ft
50	12.5 sec	5 in.	3.5 sec	1¼ in.

In other words, the materials in solution could either volatilize completely or remain in the solid state if temperature and humidity conditions were not right. Because of these factors it is considered that, though the drift from the target area may result in less than the required dosage on the farms concerned, the drift of these "fines" in winds of up to 5 m.p.h. is very unlikely to result in detectable contamination of neighbouring farms.

Materials available in New Zealand to the farmer at present are:

- (1) Insecticide fertilizers, *e.g.*,
 - (a) Dry-mix DDT-superphosphate.
 - (b) Wet-mix DDT-superphosphate.
- (2) Insecticide prills or pellets, *e.g.*,
DDT prills and pellets.
- (3) Sprays, emulsions or wettable powders.
- (4) Dusts.

Methods of application are by:

- (1) Ground equipment:
 - (a) Box topdressers.
 - (b) Spinners.
 - (c) Blowers.
 - (d) Spray booms.
- (2) Aeroplanes using:
 - (a) Vertical hoppers with or without venturis.
 - (b) Spinners.
 - (c) Swathmasters.
 - (d) Spray booms.

Of these, the box topdressers are becoming rapidly replaced by ground spinners and aeroplane application, particularly for DDT-superphosphate application. In so far as DDT-superphosphate is concerned, this tendency is a very regrettable one, as none of the available spinner machines gives as good results in pasture protection as do the star feed and Monro type boxes properly used. To obtain best results with the latter, DDT-superphosphate must be applied in winds of under 5 m.p.h. Most people are quite unable to gauge wind velocities, and it is not realized that most districts in New Zealand have fewer than 15 complete daylight days in which the winds are under 5 m.p.h. from the beginning of September to the end of May—the period when most DDT-superphosphate is applied (see Table 1).

Table 1 indicates that, unless farmers have their own box topdressers, it is very unlikely that their DDT-superphosphate will be applied under recommended conditions, because contract firms can operate successfully only on the basis of use of available daylight days. They cannot guarantee all farmers that they can come back the first day when wind velocities are right. This usually means that the farmer tells the contractor to go ahead, even though wind conditions are wrong.

To lengthen the time during which farmers and contractors can operate box topdressers efficiently, users should hang sacking or rubber sheet "aprons" at the front and back of boxes so that the sacks just brush the pasture and the DDT-superphosphate falls in a "tunnel" made by the sacks. In tests it was found that sacking aprons of this type allowed DDT-superphosphate to be applied when winds were 10 m.p.h. Though they were not tested, it is probable that the more rigid sheet rubber aprons would permit treatment in winds of up to 15 m.p.h. The advantages of this are obvious when it is known that, instead of there being only about

TABLE 1: WIND VELOCITY AND DAYLIGHT DAYS

Location	Spring 91 days		Summer 90 days		Autumn 92 days		Winter 92 days	
	0 to 3 m.p.h.	0 to 15 m.p.h.	0 to 3 m.p.h.	0 to 15 m.p.h.	0 to 3 m.p.h.	0 to 15 m.p.h.	0 to 3 m.p.h.	0 to 15 m.p.h.
Whenuapai (10 yr av.)	0.91	57.3	1.8	65.7	5.5	69.9	5.5	65.3
Rotorua (11 yr av.)	7.3	87.4	9.9	88.2	22.1	90.2	23.9	90.2
New Plymouth (12 yr av.)	0.91	41.9	0.9	46.8	1.8	57.0	5.5	58.9
Napier (12 yr av.)	3.6	73.7	0.9	72.9	11.0	76.4	19.3	78.2
Palmerston North (9 yr av.)	6.4	56.4	5.4	64.8	12.9	68.1	19.3	73.6
Nelson (11 yr av.)	2.7	66.4	1.8	63.0	12.0	76.4	23.9	81.9
Woodbourne (9 yr av.)	3.6	60.1	2.7	54.0	10.1	69.9	23.9	79.1
Christchurch (8 yr av.)	2.7	61.9	0.9	50.4	7.4	70.8	14.7	76.4
Taieri (10 yr av.)	3.6	61.9	2.7	55.8	11.0	72.7	23.0	77.3
Invercargill (8 yr av.)	3.6	50.1	2.7	54.9	8.3	63.5	16.6	72.7
(Based on Meteorological Office records)								

15 complete days available at winds of 5 m.p.h., there are approximately 200 days with winds of up to 15 m.p.h. in the 273-day spring to autumn period when DDT-superphosphate dry- and wet-mix preparations can be applied satisfactorily to get the best results.

Box topdressers are not suitable for applying granulated superphosphates or DDT prills or pellets as there is a crushing effect on these materials and the result is production of "fines" liable to drift.

Ground spinners using DDT-superphosphates give an effective swath width of only about 15 ft, so run centres must not be greater than 20 ft apart. These spinners also result in serious loss of dry- and wet-mix DDT-superphosphates, and these materials should be used only at winds of less than 2 m.p.h. with these machines. At present in New Zealand there is no effective way of improving application by these spinners but at least two firms are interested in an American idea involving a wind and collecting guard that concentrates the fertilizers and deflects them on to the ground in swaths of 24 to 40 ft. Since most districts have only about 5 complete days when winds are under 2 m.p.h., it is considered that ground spinners, in spite of their growing popularity for bulk topdressing, are totally unsuitable for applying dry- and wet-mix DDT-superphosphates.

These spinners, however, give good results with correctly formulated pelleted materials which can be applied in winds of 15 m.p.h. without any significant wind loss.

Ground blower topdressers normally use fine insecticide dusts, but, because they operate on a strong air current principle, the likelihood of wind loss is even greater than with ground spinners and there is no satisfactory way of remedying this loss.

Spray booms employing emulsions and suspensions of insecticides are more suited to control of leaf-eating insects such as *Oxycanus* (porina) caterpillars. These sprays stick firmly to pasture leaves and once dried they are difficult to dislodge and have been known to be present even after 5 in. of continuous rain. For this reason they should be used only on bare ground.

Aeroplane topdressing is gaining in popularity very fast. Here again, it is considered that this is not in the interests of satisfactory control of grass-grubs and *Oxycanus* spp. if dry- and wet-mix DDT-superphosphates are used. Two series of tests involving four aeroplane runs at different wind velocities showed that there was approximately a 10% loss of both dry- and wet-mix DDT-superphosphates for every mile of wind velocity between 2 and 3½ m.p.h. when aeroplanes flew at only 50 ft altitudes. With these DDT-superphosphates the effective swaths were always less than the wing spans of aeroplanes using vertical hoppers or venturis, and the deposit immediately beneath the bodies of aeroplanes was always far too high.

Aeroplanes are the only method of topdressing steep pastureland infested by grass-grubs and *Oxycanus* spp., but the table of days when winds are suitable for applying dry- and wet-mix DDT-superphosphates shows that there must always be a serious loss of these materials.

The solution of this problem of wind loss, of course, is use of granulated DDT-superphosphate or DDT prills or pellets, all of which could be applied by aeroplanes in winds of up to 15 m.p.h. without any real loss of insecticide off the target area. The vertical hopper and venturi type hoppers on aeroplanes are not suitable for pelleted materials because of a very uneven spread. Some aerial firms, however, have apparently developed spinners that throw pelleted materials out beyond wing tips: when these come into general use, it will be a big improvement.

Dry- and wet-mix superphosphate preparations should be restricted to use in box-type ground topdressers with aprons at the front and back of the boxes. These preparations, once granulated insecticide fertilizers are on the market, should not be applied either by ground spinners or aeroplanes.

Granulated insecticide fertilizers, prills or pelleted preparations, however, could be applied either by spinners or aeroplanes.

Entomology Division trials show that, so far as DDT is concerned, there are very large differences in pasture protection between formulations in the year of application in the presence of *Oxycanus* spp., or if grass-grub populations are high, but no differences between formulations against subsequent generations of grass-grub or *Oxycanus*; all gave good results. Since most farmers (more than three-quarters), wait till these insects are present, they should use dry- or wet-mix DDT-superphosphate in these cases as these preparations are at least six weeks earlier in giving pasture response than are the best of the granulated preparations and 12 weeks earlier than pelleted preparations.

REFERENCES

Amsden, R. C. (1962): *Agricultural Aviation* 4(3): 88-93.