CARROT RUST FLY CONTROL WITH DIAZINON

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Summary

Use of diazinon for carrot rust fly (*Psila rosae*) control was investigated on silt loam soil in autumn, spring and summer carrot sowings. In autumn and early spring sowings, diazinon granules at 2 lb a.i. per acre banded 1½ in. beneath the seed rows gave good protection, as did lindane seed dusting coupled with one subsequent surface banding of diazinon granules (2 lb) along the rows. By itself, lindane seed dusting protected carrots until the pencil stage only. For a summer sowing into warm soil, diazinon was not sufficiently persistent to control late infestations.

INTRODUCTION

CARROT rust fly (*Psila rosae*) is present in most North Island carrot growing areas and in untreated crops damage caused by larvae to the roots can cause severe economic loss.

Aldrin or dieldrin soil-incorporated before sowing, or lindane seed treatment coupled with foliar sprays of dieldrin, gives effective control, but the uses of aldrin and dieldrin are being continually restricted and alternatives are required. Seed treatment with lindane does not pose residue problems and remains an effective means of protecting the seedlings, but additional protection other than by dieldrin from 10 weeks until harvest at four to five months is required. An alternative to aldrin applied at sowing time to control this pest is also required.

Evaluation of non-residual insecticides against carrot rust fly has been carried out overseas and, in general, diazinon, an organophosphate with low human toxicity, has given good results (Howitt and Cole, 1959; Wright, 1960, 1961, 1962; Houten, 1963; Hartley and Geering, 1965).

Laboratory studies have indicated its behaviour in soil. Diazinon has some volatility in soil and is strongly inactivated in both organic and dry mineral soil (Harris and Mazurek, 1966) through absorption by the organic and mineral fractions, respectively (Harris, 1967). Adequate soil moisture is essential for activity in mineral soils (Harris, 1967). In silt loam, a half life of five to six weeks has been measured (Getzin, 1968).

Decomposition is accelerated by increasing soil temperature, moisture level or acidity (Getzin, 1968). Persistence and toxicity of liquid preparations is increased by the addition of detergents (Lichtenstein, 1966).

Field studies have revealed the best ways of using diazinon for larvae control and have also shed some light on its action. Diazinon soil-incorporated has been less effective than in-furrow application (Howitt and Cole, 1959) or below-seed placement (Wright, 1962, 1965), and placement 2 in. or deeper in the soil has given better results than at shallower depths (Wheatley and Hardman, 1966). Seed treatment and in-furrow placement may result in reduced seedling emergence through phytotoxic

effect (Wright, 1960) and granule applications have been more persistent than liquid applications (Wright, 1965). The action of diazinon against rust fly larvae appears to be not a direct contact action, but a result of uptake by the roots in sufficient concentration to kill larvae at their feeding sites (Wheatley and Hardman, 1966).

In the three field trials reported here, diazinon was evaluated in autumn-, spring-, and summer-sown carrots.

EXPERIMENTAL

All trials were carried out on Levin silt loam soil with treatments replicated six times in randomized blocks. Plots were 11 ft long containing six rows of carrots (cv. Manchester Table) at 12 in. row spacing with guard strips between plots. Other details pertinent to each trial are as follows:

<i>Trial No.</i>	<i>Sown</i>	<i>Harvested</i>	<i>Duration</i>	<i>Soil Temperatures Predominantly</i>
1.	9/5/68	26/11/68	28 wk	below 60° F
2.	2/9/68	19/1/69	19 wk	below 60° F
3.	7/2/69	3/6/69	16½ wk	above 60° F

Seed was dusted by adding 1% by weight of lindane 50% WP in a tin and shaking well. Sprays at approximately 100 gal per acre were banded over the rows using a small pneumatic sprayer. Granules were accurately banded either in-furrow, 1½ in. below the seed, or along the rows at later stages of growth with an experimental granule applicator attached to a Planet Junior seeder.

Treatment effectiveness was assessed at harvest by determining the percentage of larvae-damaged roots in each plot. Roots were classed as "clean" or "mined" with no intermediate grades. Regular checks on fly and maggot incidence showed that in all trials larvae attacks continued until late in growth, which provided a good test of the treatments.

RESULTS

All rates of insecticide quoted are in terms of active ingredient per acre.

TRIAL 1

TRIAL 1: EXTENT OF MINING IN HARVESTED CARROTS

<i>Treatments At Sowing Time</i>	<i>Subsequently</i>	<i>Mean %*</i>	<i>% Reduction</i>
1. Untreated	—	17.1 aA	—
2. Seed lindane-dusted	—	8.4 bAB	50
3. Seed lindane-dusted	Fortnightly diazinon band sprays from Sep. 13 (1 lb)	1.7 cdBC	87
4. Seed lindane-dusted	Diazinon gran. banded above rows Sep. 5 (2 lb)	0.7 cdC	93
5. diazinon gran. in furrow (2 lb)	—	2.4 cBC	86
6. diazinon gran. in furrow (2 lb)	Fortnightly diazinon band sprays from Sep. 13 (1 lb)	0.1 dC	99
7. diazinon gran. in furrow (2 lb)	Diazinon gran. banded above rows Aug. 6 (2 lb)	2.0 cdBC	89

*Square root transformation

The effect of the seed dusting treatment persisted into spring, since seedling damage up to this stage is not detectable at harvest, and detectable damage was reduced by 50%. All subsequent treatments tested gave good protection until harvest. In-furrow application of diazinon appeared to be phytotoxic, since an obvious reduction in seedling emergence was observed at four weeks on these plots. Protection from in-furrow placement was improved by fortnightly band sprays of diazinon from early spring, showing that control did not persist for the full duration of the crop. Surface banding diazinon granules at 2 lb in August did not improve this control.

TRIAL 2

TRIAL 2: EXTENT OF MINING IN HARVESTED CARROTS

<i>Treatments At Sowing Time</i>	<i>Subsequently</i>	<i>Mean %</i>	<i>% Reduction</i>
1. Untreated	—	23.0 aA	—
2. Seed lindane-dusted	Diazinon gran. banded above rows at 6 wk (2 lb)	1.3 cdC	95
3. Seed lindane-dusted	Diazinon gran. banded above rows at 8 wk (2 lb)	0.7 dC	94
4. Seed lindane-dusted	Diazinon gran. banded above rows at 10 wk (2 lb)	0.6 dC	99
5. Seed lindane-dusted	Dieldrin band sprays at 6 and 10 wk (6 oz)	1.9 cdC	88
6. Seed lindane-dusted	—	5.5 bB	76
7. Untreated	Diazinon gran. banded above rows at 6 wk (2 lb)	2.6 cBC	93
8. diazinon gran. below-seed banded (2 lb)	Fortnightly diazinon band sprays from 10 wk (12 oz)	1.2 cdC	96
9. diazinon gran. below-seed banded (2 lb)	—	0.6 aC	98

Lindane dusting of seed followed by diazinon granules (2 lb) surface-banded at eight to ten weeks was very effective, as was a single application of diazinon granules (2 lb) banded beneath the seed. Subsequent treatment did not improve this protection. Dieldrin band sprays at 6 oz were also effective. Lindane seed dusting by itself did not have sufficient persistence.

TRIAL 3 (see overleaf for results)

Warm soil conditions persisted for the greater part of Trial 3 and irrigation was required to establish the crop. The seven week diazinon granule application was watered in to prevent inactivation on the dry soil surface.

At 2 lb, below-seed banding was superior to surface banding at sowing time and diazinon at 2 lb was not significantly better than 1 lb when banded below the seed. There was no difference between granule and liquid application at seven weeks' growth. Surface banding at seven weeks was no better than below-seed banding at sowing time, indicating a rapid loss of effectiveness when applied to the soil surface during summer. No one treatment was really satisfactory.

TRIAL 3: EXTENT OF MINING IN HARVESTED CARROTS

<i>Treatments At Sowing Time</i>	<i>Subsequently</i>	<i>Mean %</i>	<i>% Reduction</i>
1. Untreated	—	35.8 aA	—
2. diazinon gran. surface-banded (2 lb)	—	24.0 bB	37
3. diazinon gran. below-seed banded (2 lb)	—	9.8 cC	70
4. diazinon gran. below-seed banded (1 lb)	—	15.8 bcBC	56
5. Seed lindane-dusted	Diazinon gran. banded above rows at 7 wk (2 lb)	12.0 cBC	67
6. Seed lindane-dusted	Diazinon e.c. (plus surfac- tant*) band-sprayed at 7 wk (2 lb)	13.9 cBC	62

*Citowett at 1 pint per acre

DISCUSSION AND CONCLUSIONS

Diazinon placement with or below autumn- or spring-sown seed performed well over long periods but was less satisfactory in a summer sowing. Difference in performance is attributed to soil temperature since moisture would not have been limiting at below-seed depth. The risk of reduced seedling emergence resulting from in-furrow placement of diazinon (Wright, 1965) was confirmed in Trial 1.

Diazinon banded on the soil surface at mid-growth performed well under cool, moist soil conditions but not under hot, dry conditions. Correct timing of application in relation to the subsequent persistence required is important, and in these trials most of the surface treatments tested could have been delayed with advantage. Surface placement at sowing time cannot be considered a useful treatment owing to reduced persistence compared with soil placement.

The following recommendations can be made for autumn, winter or spring sowings in rows on silt loam soils (soil temperatures at 4 in. depth predominantly below 60° F).

- (1) Lindane-dusted seed. Diazinon granules (2 lb) applied as a narrow band along the rows in early spring or at eight to ten weeks' growth, respectively.
- (2) Diazinon granules (2 lb) banded 1½ in. below the seed at sowing time. Trial 3 suggests that 1 lb is as effective as 2 lb. This needs further investigation. In England, the present recommendation for diazinon granules in mineral soil is 1½ lb when banded beneath the seed (Anon., 1968).

For sowings into warm soil (predominantly above 60° F) diazinon does not appear to have sufficient persistence and late spray applications would be required to supplement a band application below the seed. A higher rate than 2 lb or the use of a "slow release" formulation might obviate the need for this. Mid-growth application would be unwise in the

absence of rain or irrigation, and dense foliage would favour granule rather than liquid application since the aim is not to treat the foliage but the soil in the vicinity of the crowns. A recent overseas development is the side placement of granules 4 in. below the surface at mid-growth (Wheatley, 1969).

Growers are likely to accept a single pre-sowing treatment in preference to multiple applications provided suitable equipment for granule placement is available. Equipment is available for surface-banding granules but below-seed banding requires either double drilling or an extra coulter placed ahead of the seeder to drill the granules separately.

ACKNOWLEDGEMENT

Thanks are due to Geigy (N.Z.) Ltd. for supply of materials, Biometrics Section, NZDA, for statistical analyses, and B. Forster for assistance in the field.

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