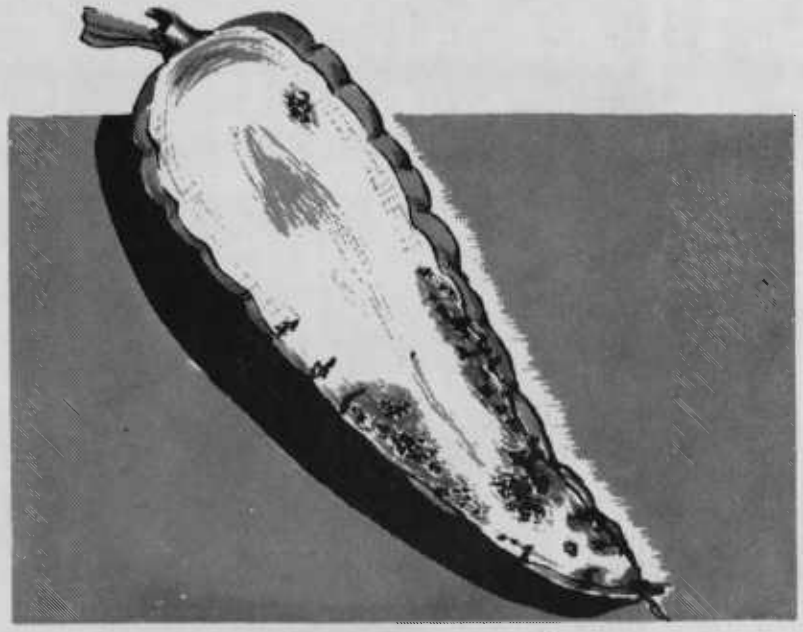
Control

The Carrot Rust Fly

H. E. Morrison



Dark areas show typical carrot rust fly damage.

Agricultural Experiment Station
Oregon State College
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Summary

The carrot rust fly in commercial plantings or home gardens can be controlled by the use of soil insecticides.

Aldrin, heptachlor or dieldrin (2 pounds) or chlordane (5 pounds) actual material per acre is recommended. This corresponds to about 3/4 or 1-3/4 oz. actual material per 1,000 square feet.

The soil insecticides are available as dilute dusts, wettable powders, emulsifiable concentrates, pellets, or in fertilizer mixtures.

Methods are discussed for applying the formulations evenly on the soil.

Thorough mixing of the insecticides into the soil is important. Directions for soil mixing are given.

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The carrot rust fly is widely distributed in Western Oregon, extending from Clatsop to Coos county along the coast and from Multnomah to Lane County in the Willamette Valley. The larvae of this fly attack carrots, celery, and parsnips and is often a serious threat to commercial plantings and home gardens. The extent of damage varies tremendously and there is no way to predict how severe the infestations will be from one year to the next.

Description and Seasonal History

There are either three complete broods or two and a partial third brood each season. The overwintering stages of the maggot (dusky straw colored, wiry, 1/2 to 3/4 inch long) can be found in carrots in the field from October to late January. Yellowish brown pupae (1/4 inch long) can be found close to the host plant during the late winter months.

The adult flies (1/4 inch long; body metallic green to blue; eyes, legs, and antennae reddish-yellow; wings irridescent) begin to emerge about the middle of April. This emergence continues till mid-June. Eggs (small, pearly-white) are deposited on the soil surface or slightly beneath the surface at the base of the host plant.

Spring maggots may be found in the carrot roots from the beginning of June to mid-July and about thirty days are required to complete the larval development. Approximately thirty to thirty-five days are needed to complete the pupal period.

The summer brood of flies may be expected about the middle of July and larvae will be found in the plants during August. Pupae from this brood can be found from mid-August to late September.

The fall brood of flies emerge from late September to mid-October. Larvae from this brood enter carrots from early October to early November. Heavy damage by this brood may be expected after the middle of October. Larvae from this brood overwinter in roots which are left in the field.

Habits

The adult flies seek shelter in brushy areas during the day and move into carrot and parsnip plantings about dusk. Areas which receive early afternoon shade frequently are more heavily infested than the unshaded portions of the field. Adults have been observed depositing eggs about sundown and seem to prefer young seedlings to older plantings. Certain chemicals such as naphthalene have on occasion repelled the adult flies from treated to untreated rows. However, when an entire planting was treated with the chemical, the repellency was not sufficient to protect the crop from injury.

Control

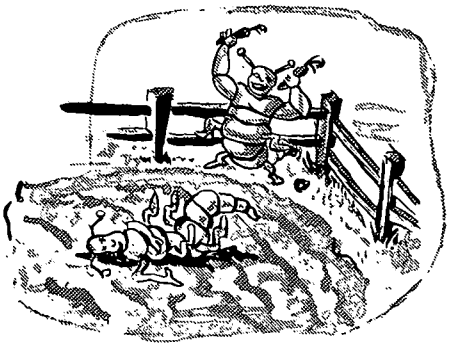
Materials and rates of application *

Aldrin, dieldrin, or heptachlor at the rate of two pounds, or chlordane at five pounds, actual material per acre thoroughly mixed in six inches of soil has given excellent control of the carrot rust fly. The effectiveness of these materials against the same pest on parsnips and celery has not been determined.

Two steps are required for adequate pest control. They involve the application of materials to the soil surface and the proper mixing of these materials into the soil. These steps are discussed as follows:

Methods of application

It is very important to cover the entire surface of the field with the insecticide. Carrot rust fly maggots will damage the carrots in the areas which are missed when the material is applied. The insecticides can be applied to the soil by airplane or ground equipment and can be purchased in several different forms. These forms or formulations are adaptable to various types of equipment, such as sprayers, dusters, and fertilizer applicators.



* Toxaphene at the rate of 10 pounds actual material per 6-inch acre has also given excellent control of the carrot rust fly, but flavor evaluations and residue tests have not been made. DDT has been ineffective as a soil treatment against this pest.

Formulations

Dusts. Dilute dusts of various concentrations (1 to 10%) may be purchased. They are composed of very fine particles and are designed for use in dusting equipment. This type of application is not favored on large fields because air currents often carry the insecticide away from the desired area of treatment. Dusts will not flow readily from small lawn fertilizer applicators. The efficiency of flow through this kind of equipment can be improved by thoroughly mixing the desired amount of dust in dry sand. If dusts are used, the following table will aid in determining the amount of material needed.

Per cent of insecticide in dust	Amount of dust to use			
	Per acre		Per 1,000 square feet	
	2-pound rate	5-pound rate	2-pound rate	5-pound rate
	Pounds	Pounds	Pounds	Pounds
1	200	500	4 1/2	11 1/2
1 1/2	133	333	3	7 3/4
2	100	250	2 1/3	5 3/4
2 1/2	80	200	1 3/4	4 1/2
5	40	100	1	2 3/4
10	20	50	1/2	1 1/2

Wettable powders can be purchased in concentrations of 20, 25, 40 and 50%. They contain wetting agents and are intended for use as sprays in machinery with mechanical agitation (orchard-type sprayers). If the sprayer is equipped with a horizontal boom, these formulations can be readily applied to the soil. They should not be used in weed sprayers because suspended materials will clog the nozzles. The wettable powders can be used in small garden sprayers if care is taken to keep the material agitated. These materials, like dusts, can be used in lawn fertilizer applicators, but dilution with dry sand will improve the efficiency of application. If orchard type sprayers are used, the delivery rate should be from 50 to 100 gallons per acre (2 1/2 gallons per 1,000 square feet). If wettable powders are used, the following table will aid in determining the amount needed.

Per cent of insecticide in wettable powder	Amount of wettable powder to use			
	Per acre		Per 1,000 square feet	
	2-pound rate	5-pound rate	2-pound rate	5-pound rate
	Pounds	Pounds	Ounces	Ounces
20	10	25	3 3/4	9
25	8	20	3	7 1/3
40	5	12 1/2	1 3/4	4 1/3
50	4	10	1 1/2	3 3/4

Emulsifiable concentrates* are liquids which contain 1 1/2 to 8 pounds actual material per gallon. When mixed with water they form emulsions which require only occasional agitation. These emulsions can be used in orchard-type sprayers, weed sprayers, or small garden sprayers. In weed sprayers a rate of application of 10 to 20 gallons per acre of the emulsion is suggested (2 1/2 gallons per 1,000 square feet for small garden plots). These emulsions have been successfully applied by airplane at the rate of 5.7 gallons per acre. If emulsifiable concentrates are used, the following table should be useful in determining the amount needed.

Amount of active ingredient per gallon	Amount of concentrate to use			
	Per acre		Per 1,000 square feet	
	2-pound rate	5-pound rate	2-pound rate	5-pound rate
	Gallon	Quarts	Fluid ounces	Fluid ounces
1 1/2	1 1/3	13 1/3	4	10
2	1	10	3	7 1/2
4	1/2	5	1 1/2	3 3/4
8	1/4	2 1/2	3/4	1 7/8

Insecticide-fertilizer mixtures

Dusts and wettable powders have been mixed with various fertilizer combinations and applied by means of a fertilizer applicator. The insecticide formulations are generally much finer than the fertilizer and tend to separate in the applicator. This results in unequal distribution of the material. Blending finely ground landplaster with the insecticide tends to eliminate this undesirable feature. Chlordane and aldrin are compatible with practically all of the common fertilizers.

If it is desired to combine the insecticide with commercial fertilizers or soil conditioners, it is suggested that they should be blended by a custom mixer. The information needed by the custom mixer will include (1) the amount and kind of fertilizer or soil conditioner desired per acre, (2) the acreage to be treated, and (3) the recommended rate of the insecticide. The application of dilute materials (1 or 2%) will minimize inequalities in application.

Granular and pelletized insecticides are new developments on the market. They are composed of insecticides on coarse particles of clays, ground tobacco stems, vermiculite, or other carriers. They may be used as purchased in fertilizer applicators or blended with fertilizers and applied in the same manner. In lawn fertilizer applicators they are very free flowing and care in calibration is necessary.

They can be purchased in concentrations of 1, 1 1/2, 2, and 5% and the table used for dusts can be used to determine the amount of material needed. It is generally advisable to use very dilute materials in order to compensate for unevenness or irregularities in coverage. With proper calibration and flying techniques, it is likely that pelletized materials can be applied by airplane.

* Emulsions recommended here are for application to the soil. Serious foliage burning may result if they are applied to plants.

Mixing insecticides with the soil

Immediately after application, the material should be mixed with the soil. The insecticides are volatile and may be lost if several days pass before mixing is accomplished. Thorough mixing of the material with the soil to a depth of six inches is very important. Rotary tillers are quite satisfactory for this purpose. Discs do not mix materials thoroughly to the desired depth. If rotary tillers are not available, good mixing can be accomplished with a split application of the insecticide. (1) Plow under one half of the material; (2) disc to seedbed condition; (3) apply remainder of insecticide, and (4) disc. The following suggestions are made to growers who contemplate using soil insecticides for carrot rust fly control.

1. Wait until the soil is in a good friable condition (will crumble readily) for tillage.

	For large fields	For garden plots
2.	Use rotobeater or disc to shred cover crop or plant debris.	Use spade or shovel to break up cover crop or plant debris.
	EITHER	
3.	Apply insecticide evenly to soil surface. Rotary till material gets into soil to a depth of 6 inches. Two times over may be necessary.	Apply insecticide evenly to soil surface. Rotary till material gets into soil to depth of 6 inches. Twice over may be necessary.
	OR	
	Apply 1/2 insecticide evenly to soil surface. Plow under and disc to good seedbed condition. Apply remainder of material and disc thoroughly.	Apply 1/2 insecticide evenly to soil surface. Spade under and rake to good seedbed condition. Apply remainder of material. Rake deeply.

Timing of application

Timing of application is of little importance as long as the insecticide is mixed into the soil before planting. The material is generally applied in the spring, but fall applications can be made if soil erosion is not a problem. If fall applications are made, the soil should be dry at the time of mixing and should not be plowed the following spring. Deep plowing may bury the insecticide too deeply for it to be effective against the larvae of the carrot rust fly.

When to re-treat the soil

At the recommended rates these materials will probably remain effective against the carrot rust fly for several seasons. However, if carrots are planted in the same field a second year and plowing is practiced, it is advisable to apply these materials each season.

Most of the newer insecticides, if present in the soil in excessive amounts, may cause plant injury. The critical concentration will, of course, vary with the insecticide, the soil type, and the crop. The rate of decline of the materials from the soil is not yet known. Repeated applications in the same field could easily increase the insecticide concentration faster than it declines naturally. Growers are advised to use caution in this respect until more information can be collected.

Studies on soil bacteria

Field applications of aldrin, dieldrin, heptachlor, and chlordane at the recommended rates have no significant effect on micro-organisms in different soil types. In order to obtain measurable effects, amounts as high as one ton actual material per acre were necessary. Such amounts are far beyond practical dosages and probably would be directly injurious to crops. The micro-organisms studied have included nodule bacteria, and others involved in the nitrogen cycle.

Residue studies

Residue studies carried on for several seasons on carrots grown in aldrin-, heptachlor-, and dieldrin-treated soil indicate that extremely small amounts of insecticide may be present in the carrots. The tests on carrots grown in chlordane-treated soil in Oregon have not been completed. Similar tests have been made in other states (California, Wisconsin, New York, New Jersey, and Ohio). The residues found have been less than one tenth of a part per million (0.1 ppm). This amount of residue is less than one ounce of insecticide in 312-1/2 tons of carrots and is not considered hazardous to the consumer.

Flavor studies

Carrots grown in soil treated with aldrin, dieldrin, heptachlor, and chlordane, both at recommended rates and at rates in excess of the recommended dosage, have been subjected to extensive flavor evaluations. No flavor changes were detected in fresh carrots or in carrots canned and stored for eight months.

Effects on earthworms

Most insecticides are poisonous to earthworms if applied to the surface litter on which they feed. However, soil treatments with these recommended materials at the rate of ten pounds per 6-inch acre have produced no measurable changes in earthworm populations.

Precautions

Aldrin, heptachlor, chlordane, and dieldrin should be considered as poisonous materials. Directions for their use are always printed on the label. Growers are advised to always follow these detailed instructions.

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