SOIL INSECTICIDES FOR CONTROL OF THE TUBER FLEA BEETLE, *EPITRIX TUBERIS* GENT., IN THE LOWER FRASER VALLEY OF BRITISH COLUMBIA[1]

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The tuber flea beetle, *Epitrix tuberis* Gent., was first reported from the southwestern coastal area of British Columbia in 1940. The losses resulting from the larval feeding in tubers were severe, so that it was necessary to develop control measures. This is a summary report on experiments to destroy larvae conducted mainly from 1947 to 1955 on clay loam, sandy to gravelly loam, and silt soils in the Agassiz and Chilliwack areas. The work was carried on under the direction of Mr. R. Glendenning, Officer-in-Charge, Entomology Laboratory, Agassiz, until his retirement in 1953, and was continued by the writer after that time.

Early experiments showed that a thorough application to potato foliage of DDT and calcium arsenate, or DDT alone, reduced damage to the tubers by destroying the beetles. However, this method of control sometimes failed when materials were not applied early, often, or thoroughly enough or when weather conditions were unfavorable. The economic advantage of foliar application is that insecticides may readily be combined with sprays which are routinely applied to control late blight.

An experiment in 1944 on the value of five materials applied to the foliage showed that tuber damage was by no means proportional to the numbers of adults. With the advent of stable organic insecticides effective against soil insects, experiments were conducted on ways of killing the larvae.

Preliminary tests in 1945 and 1946 with both field- and pot-grown potatoes showed that neither calcium arsenate nor cryolite was effective as a larvacide in the soil. The best control was obtained with dust containing DDT and calcium arsenate applied to the foliage.

Experiments in 1947 showed that BHC from different sources applied to the surface and worked into the soil by various methods gave excellent control, but caused phytotoxicity at certain rates. Stored tubers from all the BHC plots developed the characteristic taint and were very distasteful by spring.

In 1948 similar experiments with BHC confirmed the previous year's results. DDT in the soil did not give any control. The standard control remained a dust of DDT and calcium arsenate on the foliage.

Tests in 1949 showed that soil pH had little or no effect on the control achieved with either crude or refined BHC, nor did acidity or alkalinity prevent tainting. Good control was achieved with chlordane worked into the soil. Four applications of the standard control proved insufficient, possibly because the first application was not made soon enough.

In 1950, single applications of chlordane, aldrin, and lindane broadcast and incorporated into the soil at various rates were compared with DDT and methoxychlor applied to the foliage. The soil treatments gave excellent control, but four foliage treatments with DDT or methoxychlor were not effective. Tubers from the plots treated with lindane were condemned because they were off-flavored.

In 1951, one of the two experiments intended to check the data on single soil applications of aldrin and chlordane was a failure because of poor

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tillage. The area occupied by the experimental plots had been the site of permanent hedgerows of evergreens for many years. These had only recently been removed and it was impossible to put the soil in a condition of good tilth. The other experiment demonstrated 97 per cent control with aldrin at 2½ pounds per acre.

No experiments were set up in 1952 because the question of residue hazards had not been settled.

In 1953, replicated experiments were conducted with aldrin, dieldrin, and heptachlor dusts and granular heptachlor, each at 3.6 pounds of toxicant per acre and incorporated into the soil in a 12- to 14-inch band along the row. The best control was 77 per cent with aldrin, which indicated that the insecticides should be distributed in a wide band, as better control had been obtained with aldrin broadcast at lower rates. Granular heptachlor gave only 47 per cent control; the carrier used was later found to have contributed to a rapid loss of toxicity. Chlordane was not tested in 1953 because of limitations of space and labor.

TABLE I.—Percentages of control of the tuber flea beetle after single soil applications of various insecticides by three methods, Sardis, B.C., 1954.

Material	Toxicant per Acre, pounds	Method of application	Infestation index	Control %
Aldrin, 2.5% dust	4	Broadcast, deep working	6.87	95.0
	4	Broadcast, shallow working	5.62	95.8
	2	6-inch band, shallow working	33.75	75.4
Aldrin, 5.0% granular	4	Broadcast, deep working	9.25	93.1
Heptachlor, 2.5% dust	4	Broadcast, deep working	4.50	96.6
	4	Broadcast, shallow working	12.50	90.6
	2	6-inch band, shallow working	20.75	84.4
Check		No treatment	133.25	0
Difference necessary for significance at 5% level				16.5

[1]Average for 100 tubers taken at random from each of 4 replicate plots, washed, and weighted as follows according to 4 categories of damage: clean, up to 3 light injuries, 0; light, 4 to 15 feeding marks, 1; medium, 16 to 30 feeding marks, 2; heavy, over 30 feeding marks, 4. Clean and light categories marketable. Maximum infestation index: 400.

In 1954, tests were conducted on shallow and deep incorporation of aldrin and heptachlor dusts and granular aldrin after broadcasting, and on a narrow, 6-inch band treatment with the two dusts. Table I shows that the broadcast treatments gave excellent control. There was no significant difference between materials worked into the soil deeply with a rotary cultivator and those worked in shallowly with a hand rake. The band treatment was more economical but significantly less effective.

In 1955, dusts of aldrin, dieldrin, heptachlor, and chlordane were each tested at three rates to establish minimum dosages. Before planting, the dusts were broadcast on the surface and worked into the soil by light hand raking. The rates in pounds per acre were: aldrin and heptachlor, 4, 3, and 2; dieldrin, 2, 1½, and 1; chlordane, 10, 7½, and 5. An unusually light infestation helped to reduce to insignificance the differences between the treatments, which were all at or close to 100 per cent effectiveness. No experiments were conducted in 1956.

Summary

Experiments from 1940 to 1955 on clay loam, sandy to gravelly loam, and silt soils showed that satisfactory protection of potatoes from larvae of the tuber flea beetle can be obtained by broadcasting and incorporating a single application of one of several chlorinated hydrocarbons into the soil before planting. Effective materials were: aldrin, dieldrin, heptachlor, and chlordane. Incorporating the insecticide into the soil over the entire area was superior to either narrow or wide band application. No apparent differences in control were noted with deep or shallow incorporation. BHC and lindane caused off flavors in the tubers during storage. Given soil in good tilth, soil treatment is simpler and more reliable than foliar applications, although the latter are still popular because the insecticides can be applied in the spray necessary to control late blight.

ANNOTATED LIST OF FOREST INSECTS OF BRITISH COLUMBIA PART VII — *APATELA* SPP. (NOCTUIDAE)[1]

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More than 20 species of *Apatela* (*Acronycta*) are known to occur in British Columbia. The larvae feed on deciduous-leaved trees, shrubs, and herbs, and, although occasionally numerous, are of little or no economic importance. No severe tree defoliation by species of *Apatela* has been reported in British Columbia. The larvae have the typical body structure of garden cutworms; unlike the common cutworms, a number of species are clothed with medium to very long, sparse to dense hairs. Body colours are: green and brown, yellowish, brown, or black. The *Apatela* larval head is slightly bilobed; it bears primary setae only.

Most, if not all, local species overwinter in the pupal stage within cocoons in the bark or on the ground.

A. dactylina Grote. *Salix* spp.; Southern Interior, notably along the Big Bend Highway, between Revelstoke and Mile 80; found also on *Alnus tenuifolia* at Aleza Lake and Yard Creek. **Larva:** 2½ inches long; head glossy black; body blackish, with dorsal transverse bands of short brush-like orange hairs; hairs on sides yellowish; dorsal, closely-paired pencils of long black hairs on A_1, A_3 and A_8.

A. lepusculina Gn. *Populus tremuloides, Salix* spp.; Central and Southern Interior and Vancouver Island. **Larva:** 1¼ inches; head black with some whitish markings on frons and sides; body yellowish or greenish excepting blackish venter and dorsal stripe; clothed with soft, long yellow hairs; black pencil tuft on abdominal segments 1, 3, 4, 5, and 8.

A. leporina L. *Populus tremuloides, P. trichocarpa, Salix* spp.; Cuisson Creek Quesnel, Castle Rock, and Cluculz Lake. **Larva:** 1¼ inches; head and body greenish-white; clothed with very long, curved white or yellowish hairs (curved forward on one side, backward on the other) and a few black ones at the end of the abdomen; there may be 3 to 5 black dorsal spots on the dorsum of the abdomen, vestiges of black pencil tufts that occur in early instars.

A. innotata Gn. *Betula papyrifera;* Central and Southern Interior. **Larva:** 1½ inches; top of head reddish-brown, front flesh-coloured, remainder blotched with black; body brown, tinged with blue and purple; small "warts"

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