OREGON VEGETABLE Digest

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Wireworms Present Problem to Agriculture

Your Suggestions Please!

We are beginning our fifteenth year of publication of the Oregon Vegetable Digest. In our first issue, Director F. E. Price stated, "All departments that deal with vegetable problems will contribute to its pages. New and significant findings, here and elsewhere, will be summarized by specialists in the various fields. It is hoped that others interested in the welfare of the industry--growers, fieldmen, processors, county extension agents, and others--will take an active part and interest in the publication. Comments and suggestions may be sent to this office."

We invite your comments and suggestions for improving future issues. Please send them to Horticulture Department, Oregon State University, Corvallis, Oregon 97331.

In This Issue . . .

The "wireworm situation in Oregon" was discussed recently in a talk at the annual meeting of the Oregon Horticulture Society. It was brought out that a "situation" exists for two main reasons: (1) The most effective recommendation had to be withdrawn; and (2) there was growing evidence that our species of wireworms may be developing resistance to the persistent soil insecticides. Regardless of the reasons, wireworms have again been doing economic damage to potatoes, onions, and other row crops in several parts of Oregon during the last year or so. This is noteworthy because, since the recommendation of aldrin and dieldrin as broadcast soil treatments for these insect pests in 1953, wireworms have been only a minor problem of vegetable growing in the Pacific Northwest. Excellent control of these pests was so general during the past decade that it became almost impossible to find enough specimens of these insects for scientific study.

Wireworms, the larvae of "click" beetles, damage vegetable crops by feeding on the roots or other underground portions. Several seedling onions or beans may be killed by a single larva boring through their stems, while crops with edible roots or tubers suffer considerable cullage if wireworm populations are high. Potatoes fall into this latter category and make an excellent "indicator" crop for experiments on wireworm control. One or two wireworm holes in a tuber may throw it into the cull

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Linuron Tested for Weed Control in Carrots

One of the recent registrations for linuron (Lorox) is for a post-emergence application when carrots are 3 to 6 inches tall. With the rather slow rate of germination and slow early development of carrots, some of our more vigorous weed species have become quite large and well established by the time carrots have reached the minimum size. Since this unfavorable size relationship exists, maximum activity from the herbicide is needed in order to obtain satisfactory weed control.

A field trial was conducted at Corvallis in 1965 to determine the effect of rates and kinds of surfactants on the herbicidal activity of post-emergence applications of linuron. Linuron was applied at rates of 1, 2, and 4 pounds active per acre, 6 weeks after planting, when the carrots were at least 3 inches tall. The surfactants used were multi-film X-77 (principally alkylarylpolyoxyethylene glycols), Sur-ten (sodium dioctyl sulfosuccinate), and two experimental materials from Atlas Chemical Industries--Atlox 209 and Atlox 210. These surfactants were applied at rates of 1/10 and 1/2 gallon per acre, alone and with all rates of linuron. Total spray volume was approximately 100 gallons per acre; this was not always adequate to completely wet the weed foliage. The weed cover was predominantly redroot pigweed.

Herbicide effects on the weeds were evaluated 1 and 3 weeks after application. All replications and evaluation dates are averaged in the weed control data summarized in the table.

Increasing the rate of application of linuron resulted in better weed control. At the present time the manufacturer is recommending a maximum rate of 2 pounds active per acre although the registration for this use permits an application rate of 4 pounds per acre. Using some surfactant always increased the activity of linuron, but increased amounts of surfactant did not always result in better weed control. The 1/10 gallon per acre rate is in line with recommended practices. Application rates several times the recommended rate--that needed to get maximum wetting--have been reported to result in increased activity of some herbicides and plant growth regulators. This type of response was not apparent in this trial. There were no major differences between the four surfactants used in this experiment, although certain combinations of surfactant type and rate with a given rate of linuron resulted in greater or lesser activity than the general trend.

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Linuron Tested for Weed Control . . . (Continued from page 2)

Weed Control Ratings of Linuron and Surfactant Combinations

Surfactant (gallons per acre).........	None	X-77 1/10	X-77 1/2	Sur-ten 1/10	Sur-ten 1/2	Atlox 209 1/10	Atlox 209 1/2	Atlox 210 1/10	Atlox 210 1/2
Linuron (pounds per acre)									
1	4.2	6.6	6.3	5.8	6.8	5.1	5.6	5.6	6.7
2	6.2	7.6	7.0	7.1	7.6	6.8	7.4	6.8	7.4
4	7.1	7.8	8.6	8.2	8.1	8.2	8.7	8.1	8.3

Rating scale: 0 = no effect, 10 = complete kill.

The largest variations in crop response to these various treatments was apparently a reflection of the degree of weed control obtained. One series of treatments included surfactant applications without linuron. These plots were not weeded for several days after the herbicide application and in general suffered the greatest reduction in crop growth. There was some marginal necrosis on carrot leaves at the 4 pound per acre rate of linuron. This resulted in a slight growth reduction early in the season but was not evident at harvest time. This apparent injury occurred with all surfactants at the 1/2 gallon per acre rate but was negligible at the 1/10 gallon per acre rate of application.

One can conclude from this study: For post-emergence applications of linuron on carrots, the addition of some surfactant is desirable, if not necessary, to obtain satisfactory weed control; there is probably no need to use more than the recommended rate of surfactant; and any of a number of surfactants will perform satisfactorily.

--Garvin Crabtree
Horticulture Department

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Vegetable Note . . .

Marth of the USDA reported that treatment with growth retardants (B-Nine and Cycocel) resulted in markedly increased cold hardiness in both early- and late-maturing varieties of cabbage. Dosage level was critical because at higher concentrations, cabbage failed to flower, but instead produced heads, after exposure to cold. At the lowest concentration used, there was rapid growth after overwintering and the number of plants that flowered was higher than for check treatments. (Jour. Agr. Food Chem., 13:331-333, 1965.)

Wireworms Present Problem . . . (Continued from page 1)

classification, depending on the depth and size of the holes. Grading potato tubers on a "clean," "single injury," and "multiple injury" basis is relatively simple and gives a good index of the effectiveness of the control treatment under study.

Wireworm biology is different from most soil insects in that more than one year is usually required for development of a complete generation. The several species of irrigated land Limonius in Oregon take anywhere from one to five years in the larval stage, depending on species and, to an even greater extent, on food and water available. Wireworms move up and down in the soil depending on temperatures and moisture. May is the month when the highest percent may be expected in the top six inches of soil. At other times of the year, dryness or excessive temperatures drive the insects down to 18 inches or deeper. Pupation takes place in late summer, but the newly emerged adult beetle does not come out of the ground until the following spring. The males are good fliers and are often seen visiting flowers for pollen or nectar. The females come to the surface to mate and then, after laying most of their eggs in their home soil, they return to the surface and fly to other fields to lay a few more eggs. Because of the tendency of the females to deposit most of their eggs in the soil where they spent their larval life, wireworm populations do not spread rapidly and reinfestation of treated fields may take several years.

The type of crop or plant growth in a field can determine the extent of a wireworm population. Row crops, clover, and grain promote wireworm populations; alfalfa tends to reduce them, mainly from the drying effect of this long-rooted crop on the soil in summer. Sandy soils are favored by most species, and spotty infestations in a field can sometimes be correlated with the locations of sandy areas in an otherwise heavier soil type. The common, spotty infestation pattern of wireworm populations, like that of symphylans, makes field control experimentation difficult.

In 1965, studies were made in the Hermiston-Stanfield area of Umatilla County. Potato growers of this region had experienced losses in 1964, and fields to be planted to potatoes in 1965 were available for experimental work. One rather complex experiment was set up near Stanfield, in which 16 different treatments were compared with an untreated check. A second test was established near Hermiston on land to be planted the first time out of sagebrush. The Stanfield site had a heavy population of the sugar-beet wireworm (Limonius californicus) in corn in 1964; the Hermiston site was known to have the Great Basin wireworm (Ctenicera pruinina), a dryland species which persists in new land for several years after irrigation practices are started. Only those chemicals which were already registered for use in the soil on potato crops were tested in these trials. The purpose was to find a satisfactory chemical control measure which might be recommended for use in 1966 for potatoes or vegetables generally. These tests were conducted in cooperation with the Umatilla County Agent's Office, Geigy Chemical Company, Pacific Supply Cooperative, and Umatilla Experiment Station personnel.

The Stanfield plots were treated and planted to Early Gem potatoes in March, certain sidedressings were made in May after the plants were well up, and the tubers were dug (10 hills from each plot) for examination on July 20.

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Wireworms Present Problem . . . (Continued from page 4)

Based on percents of tubers with multiple wireworm injuries (culls), parathion and Niran (a formulation of parathion designed to be more persistent in the soil) gave the best control, but, because of the great variation between replicates, these results were not significantly different from three or four diazinon treatments which were not considered to be satisfactory (Table 1). In fact, basing the conclusions on percents of tubers without wireworm injuries ("clean"), none of the treatments was really satisfactory for potato production, where 95% or more of the tubers should be free of wireworm injuries.

The Hermiston trial, where parathion, Niran, and diazinon were compared in unreplicated 1/3-acre plots, indicated that these materials could be used successfully against the Great Basin wireworm (Table 2). Diazinon, even at a little higher rate than the parathions, was slightly inferior, although giving satisfactory control under the conditions of the test. After the initial sampling of tubers for the data shown in Table 2, the grower harvested and graded the plots separately as a "double check." The results were essentially the same -- the parathion and Niran treatments showed 99.8% uninjured tubers, diazinon 99.3%, and the untreated check, 88% clean tubers.

A possible side effect of parathion (and Niran) broadcast soil treatments was a high percent of tubers showing severe growth cracks. Cracks were also present in the potatoes from the diazinon and check plots, but in definitely lower proportion to the parathion plots. This possible effect of parathion was not noticed in the Stanfield experiment and may have been brought on by a complex of factors including soil types, fertilizers, irrigation, et cetera.

While soil insecticides were being tested in Umatilla County, soil fumigants were tried in the Ontario area of Malheur County by H. E. Morrison, Department of Entomology, and Glen E. Page, Department of Agricultural Engineering, OSU. These researchers are studying the effectiveness of several fumigants when applied early in the spring of the current planting season as compared to late summer application in anticipation of planting a susceptible crop the following spring. The results of their studies will be published in the Oregon Vegetable Digest when available.

In conclusion, it may be said that Oregon's vegetable growers are facing an ever-increasing threat of wireworm losses without a satisfactory control recommendation. Because of residue problems and increasing evidence of resistance to the persistent chlorinated hydrocarbon soil insecticides, aldrin, dieldrin, and DDT cannot be used in most circumstances, and the position of chlordane is unsure at this writing. Certain fumigants such as ethylene dibromide are effective and registered for use against wireworms, but this type of treatment is generally more complicated and expensive. The use of fumigants early in the spring for current season crops is not practical and probably not as effective as a late summer or early fall treatment.

Of the so-called "nonpersistent" soil insecticides, parathion and diazinon were the only registered materials which showed promise in this past year's tests. Diazinon may require twice the dosage of parathion to give comparable crop protection, but it is less hazardous to handle because of its lower mammalian toxicity. Parathion is relatively cheap, but may contribute

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Wireworms Present Problem . . . (Continued from page 5)

Table 1. Results of Various Soil Treatments for Control of the Sugar-Beet Wireworm Attacking Potatoes (Hermiston, Oregon, 1965)

Material, formulation, and method	Total rate of active ingredient per acre (pounds)	Percent of tubers: Clean (no injury)	Percent of tubers: Multiple injuries (culls)
Parathion, 10G., broadcast	3.8	89.9 *	1.7 *
Parathion (Niran), 10G., broadcast	3.5	90.1	3.6
Diazinon, 14G., sidedress (both sides) at planting time	4.0	82.1	7.1
Diazinon, 14G., broadcast	7.5	71.1	10.1
Diazinon, 14G., broadcast	2.9	55.8	15.6
Diazinon, 5% grits, broadcast	4.1	72.9	20.6
Diazinon, 1% on urea, sidedress (both sides) at planting time	2.0	57.7	22.9
Di-Syston, 10G., broadcast	11.3	62.2	23.8
Phorate, 10G., broadcast	2.1	57.7	27.3
Diazinon, 14G., sidedress (both sides) at planting time	2.0	56.9	27.3
Zinophos, 10G., broadcast	3.2	56.9	28.6
Diazinon, 1% on urea, sidedress 1/2 rate (both sides) at planting time and again at first hilling time	4.0	61.1	29.6
Diazinon, 2G., sidedress (both sides) at first hilling time	2.0	56.8	34.1
Diazinon, 1% on urea, sidedress (both sides) at first hilling time	2.0	48.9	39.2
Diazinon, 14G., broadcast	2.5	32.8	51.1
Di-Syston, 10G., broadcast	2.5	29.9	56.7
Untreated check	--	25.9	61.5

*The values connected by a vertical line are not significantly different from each other at the 5% level of probability.

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Plastic Mulches Increase Melon Yields

Yields of an OSU experimental golden rind melon were increased about 90% from gray plastic mulch and 58% from black plastic mulch, as compared to checks with no mulch, in a test at Corvallis in 1965.

At the OSU Vegetable Research Farm four treatments, replicated five times, were used: (1) Check--no mulch, (2) black paper mulch, (3) black polyethylene plastic mulch--1.5 mil., and (4) smoke-gray polyethylene plastic mulch--1.5 mil. (experimental SGX, Gering Plastics Company). Plastics and paper were 3 feet in width and were placed over the surface of the soil by hand. The experimental melon, OSU 64-371, from Dr. W. A. Frazier, was planted on May 11 in 6 1/2-foot rows in hills 2 feet apart. Seedlings were thinned to four per hill. Approximately 300 pounds 8-24-8 fertilizer per acre was banded by machine prior to seeding by hand. Plots were irrigated as needed by overhead sprinklers. Melons were picked at full-slip, harvests being made at 3- to 4-day intervals from August 30 through September 28. Because of a killing frost on September 17, all green and ripe fruits remaining were harvested on September 28.

Data in the table show that early yields of ripe fruit through the first half of the picking season (September 11) were highest for gray plastic mulch (200% over check), followed by black plastic (103% over check). If both ripe and green fruit are considered, plastic treatments still yielded considerably higher than the check treatment, although differences are not as great as for early yields. Yield increases appeared to be primarily due to a greater number of fruit produced per plant rather than through effects on the average size of fruits.

Early growth and vigor of plants in plastic treatments was evident even until time of harvest, and treatments could be ranked for vigor in the same order as for yields of ripe fruit.

Because the available black paper mulch produced harmful toxic and volatile substances, seedlings were injured during early growth. Black paper for agricultural mulching is available and has been used earlier with beneficial effects.

Weed control was excellent in black plastic and black paper treatments and fair under gray plastic, although hand weeding was required in the latter case.

No soil temperature or moisture measurements were made in this study. Beneficial effects attributed to use of plastic mulches have been shown to be due to an increase in soil and air temperature and a more favorable soil moisture relationship. It has also been speculated that more favorable carbon dioxide levels for plant growth have been created by use of plastic mulches. Other factors may also be involved.

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Plastic Mulches Increase Yield . . . (Continued from page 7)

Effects of Mulch Treatments on Yields of an OSU
Golden Rind Melon (Corvallis, 1965)

Mulch treatments	Yields--tons per acre			Avg. no. ripe fruit per plot	Avg. weight per fruit (pounds)
	Ripe through September 11	Totals through September 28			
		Ripe	Green		
(1) Check--no mulch	3.9	12.7	3.9	45	2.1
(2) Black paper	1.6	11.4	5.4	41	2.0
(3) Black plastic	7.9	20.1	4.4	68	2.1
(4) Gray plastic	11.7	24.1	5.2	81	2.1

--H. J. Mack
J. R. Baggett
Horticulture Department

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Wireworms Present Problem . . . (Continued from page 6)

Table 2. Results of Broadcast Soil Treatments for Control of the Great Basin Wireworm Attacking Potatoes (Hermiston, Oregon, 1965)

Material	Rate of active ingredient per acre (pounds)	Uninjured (clean) potatoes	
		Percent by tubers	Percent by weight
Parathion	5.17	100.0	99.8
Niran	4.54	100.0	99.8
Untreated check	--	72.8	88.3
Diazinon	6.07	98.2	99.3

to undesirable growth activity in potatoes and other crop plants. With either material, treatment would have to be made every year that a susceptible crop was to be planted because of the nonpersistence of these phosphate insecticides. Both materials are registered for use as broadcast soil treatments for most of the vegetable crops grown in Oregon.

--H. H. Crowell
Entomology Department

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Ways Sought to Remove Leaves from Brussels Sprouts

Removal of leaf blades and petioles from Brussels sprouts stalks has become a necessary prelude to cutting off the stalk and mechanically removing the sprouts.

An assortment of manually operated plain rings, rings with cutter blades, and large metal tubes of various kinds have been used commercially. Because these methods are laborious, easier means are sought.

Since 1962, treatments to cause leaf abscission have been applied to Jade Cross hybrid in small plots at the OSU Vegetable Research Farm near Corvallis. These treatments included:

1. Check--no treatment
2. Removal of terminal growing point only
3. Removal of entire terminal rosette of leaves
4. Removal of terminal rosette and about one-half of each young leaf blade remaining at the top of the stalk
5. Acetylene gas released from calcium carbide under plastic row covers enclosing the plants
6. TCBA (trichlorobenzoic acid) 500 ppm solution applied to the intact stem
7. CIPC (isoproply N 3-chlorophenyl carbamate) at 2,000 and 4,000 ppm as overall spray on the intact plant

Each gallon of solution included 10 ml of X-77 wetting agent.

Removal of the terminal rosette and mutilation of the blades of the upper leaves was most effective in causing yellowing of the remaining leaves and hastening their abscission. The treatment at present, however, seems too laborious and drastic; perhaps worthy of further testing, but not recommended. No other treatments were considered sufficiently promising to warrant further testing.

Synthesis and testing in England of Abscissin II, a new growth-regulating compound, may help to bring about easy chemical removal of the leaves. Ready for trial also in England is an F_1 hybrid with brittle petioles that snap off easily, making the preliminary mechanical leaf removal less of an impediment at harvest.

--Andrew A. Duncan
Extension Vegetable Specialist

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Quackgrass Toxin Injures Lettuce

An interesting disorder in lettuce was encountered in 1965 in Wallowa County. Twenty acres of Great Lakes lettuce was planted at three different dates with about 10 days between plantings. Conditions other than the different planting times and the inevitable differences in weather were the same throughout the field. Reasonably good cultural practices were followed, yet growth of the crop in all areas was erratic and the plants appeared to have been injured by misapplied herbicides. The grower stated that no herbicides had been applied.

One unusual condition common to the entire field was a large number of quackgrass (Agropyron repens) rhizomes. This field had been in the soil bank for several years and was thoroughly choked with quackgrass. The grower deep-plowed to a depth of 15 inches to prepare a seedbed and, as a result, the rhizomes were mixed throughout the soil. When the field was observed, large patches were covered with quackgrass and the rest was lightly covered. The poorest growth of lettuce corresponded with the areas of greatest density of quackgrass and was attributed to a toxin released into the soil by this noxious plant.

Kommedahl, in Minnesota, showed that the toxin from quackgrass stunted several agronomic crops, although lettuce was not named. (Kommedahl, Thor. 1957. "Quackgrass can be toxic to crop seedlings." Down to Earth, 13(2): 4-5.) Because of the widespread occurrence of quackgrass in the field and the appearance of the lettuce plants in areas of greatest concentration of the grass rhizomes, it seems reasonable to conclude that quackgrass toxin was responsible for the condition observed in this lettuce field. To prevent this condition, quackgrass infestations should be harrowed or raked out of the field and burned--not plowed into the soil.

--Sidney R. Siemer
Botany and Plant Pathology
Department

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Vegetable Note . . .

Controlling the Garden Symphylan (OSU Extension Bulletin 816, June 1965) by H. E. Morrison, Associate Entomologist, has been published recently.