

Chestnuts: Blight resistant varieties of chestnuts are showing vigor and adaptability in the trial grounds but produce fruit of seemingly low quality.

Persimmons: Persimmons are attractive, of fair quality, and mature when there is a scarcity of fresh fruit in the home orchard. Consequently it is considered of value for home use. Due to disease, persimmon trees are relatively short lived, which will necessitate frequent plantings.

Other Fruits: Cherries, walnuts and quince are poorly adapted. Although some varieties are still surviving they are of little or no value.

Among the fruits that have shown the least evidence of adaptability are: apricots, hazelnuts, prunes and raspberries.

NEMATOTOLOGY

Studies of the plant parasitic nematodes of this section were conducted in cooperation with the Division of Nematology, Bureau of Plant Industry, United States Department of Agriculture.

CONTROL OF ROOT-KNOT BY CHEMICALS

Information derived from experiments indicates that chlorpicrin (or tear-gas) is the most efficient chemical yet found for control of the root-knot nematode (*Heterodera marioni*). Many other chemicals have been tested, but were found to be either ineffective or too dangerous for general use. Chlorpicrin has the disadvantage of being too expensive for field use, but has a very definite place in control of root-knot in small areas such as green-houses and seed beds.

Chlorpicrin is a colorless liquid with a specific gravity of 1.63. It vaporizes easily and the vapor is extremely irritating to the eyes, causing them to water profusely. Larger concentrations taken into the lungs cause violent coughing. However, these effects are produced by concentrations far below the lethal point and are only temporary. It is not inflammable or explosive. If the user transfers it from one vessel to another only in the open air and takes ordinary precautions, it is not particularly dangerous to handle.

Chlorpicrin is used by injecting small amounts into the soil at regular intervals. In the soil, the chlorpicrin vaporizes and permeates the soil mass, killing the nematodes.

Certain precautions must be taken and the soil must be in the proper condition if good results are to be obtained.

The soil must be loose—that is, plowed and leveled. It must be free of lumps, clods and undecayed roots. It should be moist—neither very dry nor very wet—and as warm as possible. Good results cannot be obtained if the soil temperature (at a depth of one foot) is less than 65° F.

Since chlorpicrin is disagreeable to handle, some sort of special applicator is necessary to inject it into the soil. Applicators measure the doses accurately and the larger models also automatically inject the chemical into the soil. Improvised applicators can be made which will measure the doses which can then be placed in prepared holes. Where any considerable area is to be treated, a commercial applicator will be a good investment.

The area to be fumigated is marked with parallel lines 12 inches apart and these lines are crossed at right angles with a second set of parallel lines 14 inches apart. Lines are made with a small row marker and should be accurately located. The soil surface is then sprinkled lightly with water. The applicator is adjusted to deliver the proper amount and the depth gauge set at 6 or 8 inches. The actual application is made by thrusting the point of the applicator into the soil and delivering the measured amount of chemical, or by pouring the measured amount into prepared holes. The holes are filled with soil after the chemical is placed. Applications are carefully located as follows: Working along the 12-inch lines one dose is placed at the intersection of these lines with the 14-inch lines on the first row. On the second row, the doses are placed midway between the intersection of the lines. The operation is repeated, the doses being placed on the intersection of the lines and halfway between the intersections on alternate rows until the full area is treated.

When 200 or 300 square feet have been covered, the soil is raked smooth and again sprinkled with water. Enough water should be used to wet the top inch or so of the soil. This prevents the too rapid diffusion of the fumes into the air and so greatly increases the efficiency of the chemical.

After the whole area has been fumigated it should remain undisturbed for at least one week before planting. Even then it should not be planted if any odor of chlorpicrin remains in the soil, for the chemical is very poisonous to plants and even a trace remaining in the soil will prevent germination of seed or injure seedlings. Chlorpicrin should never be applied to the soil within two feet of the roots of any plant.

Amounts of chlorpicrin to be used and its spacing will vary somewhat under different conditions. Experiments in sandy loam soil have indicated that root-knot can be effectively controlled for one season by the use of 1.5 to 3.0 cubic centimeters per application point with spacing as above. This corresponds to 150 to 300 pounds per acre. Under other conditions larger doses may be needed or the spacing should be varied. It is recommended that users make preliminary trials with varied dosages and spacings before making extensive applications of chlorpicrin. Dosages might be varied between 1.5 and 4 cc., and spacing of 9 by 10.5 inches be tried as well as the above 12- by 14-inch spacing.

In fact, it should be emphasized that soil fumigation may or may not produce worth while results and that the only way the user can be sure is to make a trial under his own conditions. Where nematode infestation is severe and a crop highly susceptible to nematodes is to be planted, good results can be expected if the conditions are right and the application is carefully made, but the user should also be prepared for total failure and should insure against it by making small preliminary applications.

Much the same technique may also be used to fumigate small lots of potting soil. The soil should be placed in a box and a 5 to 10 cc. dose of chlorpicrin placed in the center of each cubic foot.

A variation of the application of chlorpicrin for control of nematodes is being explored. This is the so-called "spot treatment" which can be used in the field on crops which are planted in widely spaced hills. In this case,

the whole area need not be treated, but only the small portion of the soil occupied by the roots of the plants. The hills are carefully located and the injections made on the same spot as will be later used for planting. Preliminary tests have indicated that spots so treated will remain free of root-knot for more than three months in many cases and that severe root-knot can be prevented in nearly all cases. With a crop such as watermelons, large areas can be protected from root-knot at a very low cost.

This Station will be pleased to furnish further information on the subject on request.

SPREAD OF ROOT-KNOT

Experiments have shown that the root-knot nematode spreads very slowly by its own efforts. Even under the best of conditions, the nematodes will spread from an infested area at the rate of little more than one foot per month. This applies both to progress along continuous rows of plants and to migration through bare soil. It is obvious that other agencies are much more important in the distribution of nematodes over large areas than are the efforts of the nematodes themselves.

Over short distances, nematodes are most frequently carried by running water and by cultivating instruments. Plows and cultivators collect infested soil and plants in one portion of a field and drop them in another portion. They may even carry the infestation to other fields. Such spreading of nematodes can be prevented by working infested portions of a field after the clean parts have been worked. Spread from field to field can be prevented by cleaning the tools of all soil after use in an infested field. Tools thoroughly cleaned of adhering soil and exposed to the sun and air to dry for an hour or so can be used in clean soil without fear that they will carry root-knot nematodes to clean soil.

Spread of nematodes by running water can be prevented by diverting surface drainage so that it does not flow over lower fields.

Probably the most common source of infestation of clean soil is nematodes brought in on the roots of plants. Setting out of infected plants not only invites trouble on one crop but also on all subsequent crops.

EFFECT OF ROOT-KNOT ON CUCUMBERS

Average green weight of root-knot infected seedling cucumber plants was found to be 37.5 per cent less than the average green weight of uninfected plants grown under the same conditions. While growth decreases may be somewhat less in other plant species which are less susceptible to root-knot, such results indicate that time and trouble spent on nematode control are well worth while. Infested soil which is to be used for such nematode susceptible plants as truck and garden crops, should be subjected to rotations recommended for tobacco in another section of this bulletin.

ROOT-KNOT RESISTANT CROPS

A root-knot resistant crop might be defined as one which will produce a normal crop on heavily infested soil. Obviously, such crops can be more

