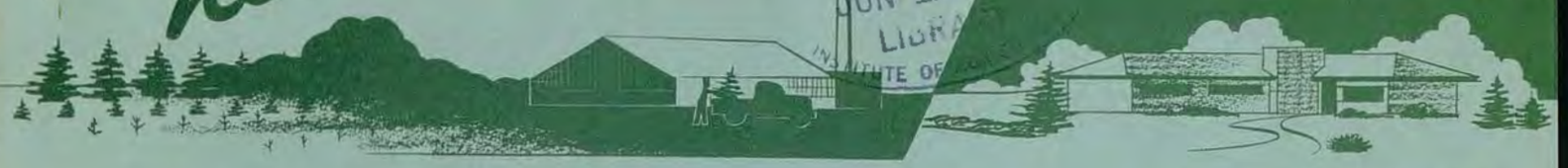
Minnesota Nurserymen's newsletter

Prepared by
UNIVERSITY OF MINNESOTA
Institute of Agriculture
- Agricultural Extension Service
- Horticulture Department

In Cooperation with
- Minnesota Nurserymen's Association
- Minnesota State Horticultural Society



Vol. 6 No. 5 and 6 May - June 1958

NEMATODES AND NURSERY CROPS 1/

Donald P. Taylor 2/

Introduction

During the last 20 years we have become increasingly aware of the fact that nematodes constitute a serious menace to a multitude of different crops grown in the United States. They not only cripple and kill plants by themselves, and thus reduce yields, but also open the way for infection by other organisms that cause disease. There are hundreds of different kinds or species of nematodes, and practically all of our crop plants are subject to attack by one or more kinds.

These nematodes are small, slender, wormlike animals, usually no more than 1/25 of an inch long, most invisible to the naked eye. Most of them live in the soil and attack roots or other underground structures of the plant, and the farmer or nurseryman may not suspect their presence even though his crops are being severely injured by them.

Some of the nematodes that injure plants attack the roots from the outside, inserting a hollow, needlelike stylet into the cells; others invade the root tissues and develop inside. Once inside certain species may travel considerable distances through the root tissues. Although these nematodes are small, in soil heavily infested with them there may be thousands of them feeding on or within each small root, and an acre of cultivated soil may contain several to many billions of them.

Nematode Damage and Symptoms

When nematodes attack a cell, its liquids are withdrawn causing death of the cell. This is the most common type of nematode damage. Death of only one cell does not affect the welfare of a plant, but a single nematode can kill hundreds of cells in this manner during its lifetime. Extensive root damage can be caused when tens of thousands of nematodes attack a single plant. Nematode damage ranges from a few small wounds to death of whole roots depending on the number of nematodes feeding on a root system.

A few nematodes secrete a digestive fluid into root cells while they feed. Interaction of this material and host tissues results in the production of large galls or "knots" on the roots. These galls, although easily seen and recognized, are less common than other types of nematode damage.

Since nematode damage is usually restricted to roots, symptoms of nematode attack are not as easily recognized as are those of diseases affecting aboveground parts. Nematode damage is often unrecognized and often explained as poor growth caused by any one of many factors known to affect plant growth. Symptoms of nematode attack are: (1) stunted plants, (2) gradual reduction in vigor or yield, (3) yellow leaves, (4) temporary or permanent wilts, and (5) small or twisted roots that may also be "bushy" or galled.

Thus, recognition of nematode damage is very difficult when only sumptoms are considered. The only positive means of diagnosing nematode problems is to isolate and identify nematodes from diseased plants and surrounding soil. Only trained personnel using special equipment can do this - it is not a job for the grower.

Nematodes in Minnesota

For many years it was believed that nematodes were not a problem in Miunesota. It was thought that these small animals could not survive the cold winter temperatures. However, research at the University of Minnesota, supported by findings in Wisconsin and New York, has demonstrated that nematodes are just as common in the North as they are in the South. Some species are found in both areas, while others are found in only one. The species we have in Miunesota are well adapted to our climate and can cause great damage to crops despite the low winter temperatures.

Over 400 soil samples have been collected from Minnesota fields during the last two years. When the results of this survey are compared with those of a similar nematode survey in Maryland, it is discovered that many of the most important genera of plant parasitic nematodes are more abundant in Minnesota. Since many of these are known to cause heavy losses, it must mean that nematodes are causing considerable damage to Minnesota crops. Therefore, nematodes must not be considered a southern problem. We must also consider them here.

Importance of Nematodes to Nursery Crops

Nursery crops are as severely attacked by nematodes as are any other group of crops, but because of

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1/ Paper No. 973, Miscellaneous Journal Series, Minnesota Agricultural Experiment Station

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certain practices in their production and handling, nursery crops often have nematode problems not occurring on other crops.

In the first place, nursery crops are perennials. In the production of annuals, crop rotation is generally practiced. If nematodes in the field have a preference for certain hosts, introduction of an unfavorable host plant in a rotation would retard the development of a large nematode population. If only favorable hosts were used, a large nematode population build-up would occur. Thus, even though the grower is not aware that nematodes are affecting his crop, he may be practicing nematode control in the form of crop rotation. In nurseries, the same crop may be grown on the same land year after year and, perhaps more important, the same plant may remain in the same position for several years before it is sold. If nematodes that can attack such a plant were present in the nursery, these conditions would be favorable to a rapid population increase. Thus, even though the number of nematodes originally present in the nursery soil may have been too small to cause damage, with the passing of time the nematode problem would become more and more serious.

Another problem facing the nurseryman is that much of his nursery stock is introduced from other areas. Since nematodes can be introduced with stock, a nursery that had been nematode-free can easily become heavily nematode-infested. Some species are introduced in soil around roots, whereas others can be introduced in the roots. Thus, even bare-rooted cuttings can harbor parasitic nematodes. When it is remembered that nurseries themselves ship stock to new areas, locally or for long distances, their importance as centers of introduction and spread of nematode diseases is realized. Thus, an understanding of nematodes, the damage they cause, and their control should be vital to nurserymen.

Every year nematodes are causing substantial losses to the nurseryman. One grower in Michigan with a nematode problem stated that nematode control saves him $2000 an acre every year. He has learned just how bad nematodes can be! This emphasizes another fact about nursery crops. Plants in a nursery are high value crops. Each plant is the result of several years of hard work and a large investment. Death or damage to such a plant represents a much greater loss to a grower than the same amount of damage to a field grown plant. Can nurserymen ignore these losses?

Nematode Control

The basic principle of nematode control is to place nematode-free plants in nematode-free soil. For control, both and not just one of these requirements must be fulfilled. It is useless to obtain nematode-free nursery stock and then plant it in nematode-infested fields. It would be equally foolish to control nematodes in the field and introduce infested planting stock. Nematode control must be approached from both sides.

Only a few wholesale nurseries attempt to maintain nematode-free stock. However, as consumers, either home-owners or other nurserymen, become more aware of the damages caused to plants by nematodes, more pressure will be exerted on the wholesaler to supply clean stock. It is probable that nematode-free nursery stock will be commonly available throughout the country within the next five years.

Hot water treatment of infected planting stock. Under certain conditions nursery stock can be treated with hot water to control nematodes without injuring plants. In all successful cases, only dormant plants have been used. The time interval and the temperature must be carefully controlled because there is little difference between a treatment which will control nematodes and one which will kill the plants. Some successful treatment that have been used in the past are: peonies - root-knot nematodes, 120°F for 30 minutes; roses - dagger nematodes, 121°F for 3½ minutes; black locust - root-knot nematodes, 118°F for 30 minutes.

Chemical treatment of infected planting stock. A new material, 1, 2-dibromo-3-chloropropane ("Nemagon", "Fumazone"), shows considerable promise in the treatment of infected nursery stock. This material is non-toxic to many plants and can control nematodes when injected into the soil around the bases of infected plants. In one case it has given good control of root-knot on peaches when used at the rate of 5 gallons per acre. Caution should be used in treating any living plants with chemicals.

Cuttings. Since the nematodes that attack roots do not attack stems or leaves, infected stock can be made nematode-free by taking top cuttings and rooting these in nematode-free soil. In some cases this is the only way to obtain stock free of these parasites.

Pre-plant treatment of soil. Pre-plant soil treatment is called soil fumigation, and the chemicals used are called nematocides. Whenever soil fumigation is used, manufacturers' recommendations shoud be followed, particularly those regarding physical condition of the soil, soil temperature and moisture, rate of application, and length of aeration period (if needed). Some of the better nematocides will be mentioned.

Methyl Bromide. This material is a gas which diffuses rapidly through the soil killing nematodes by contact. Because of its rapid movement, it escapes from the soil too soon unless the soil is covered with a gas-tight material. Because of the expense of such materials, (gas-proof plastic tarps, etc.), methyl bromide is usually used to treat only seedbeds and other small areas. One of its disadvantages is its high toxicity to plants and animals. Its biggest advantage is that in addition to nematode control, methyl bromide also controls weeds, soil insects, bacteria, and fungi.

1, 3-dichloropropene. This material is known as "D-D", "Telone," and "Dorlone" (in part). This chemical is injected into soil at a depth of 6-8 inches and at a rate of 15-40 gallons per acre. Because this material does not diffuse as rapidly as methyl bromide, no cover is required after treatment. Thus, it can be used in field-scale applications. Since this material is toxic to plants a two week aeration period is required before planting. Fall may be the best time for treatment. Applied broadcast, 1, 3-dichloropropene costs about $30 an acre. Row treatment is much less expensive.

Ethylene dibromide. Ethylene dibromide or EDB (Dowfume W-85) is a liquid nematocide that has about the same advantages and disadvantages as 1,3-dichloropropene. The dosage for EDB is lower, but the cost per gallon is higher. The cost per acre of the two materials is about the same.

1,2-dibrome-3-chloropropane (Nemagon, Fumazone) is a good nematocide and has the advantage, already mentioned, of being non-toxic to many crops. Thus, this material can be of more general use in perennial crops. In application, this material is handled in about the same way as D-D and EDB; however, it is also available in a granular formulation.

Additional materials are now on the market in some parts of the country. Two of these that show considerable promise, but which have not been tested under Minnesota conditions, are "Mylone" and "Vapam."

Nematode control is neither cheap nor easy, however, when nematodes are attacking nursery crops and costing the nurseryman a large portion of his profit, nematode control programs should be undertaken.

(To be Concluded in the July-August Newsletter)

NOTES FOR NURSERYMEN

Walter P. Trampe
Supervisor-Section of Nursery Inspection
Minnesota Department of Agriculture

Winter Injury Survey

The Departments of Horticulture and Plant Pathology, University of Minnesota and the Section of Nursery Inspection, are again co-operating with various nurserymen in making another winter injury survey. We are pleased to report that 26 nurserymen have answered their questionnaires at the time this is written.

Will you please return yours if you have not already done so?

Barberry Shipping Permits

"Nurseries and dealers desiring to ship species of Berberis mahoberberis, or Mahonia interstate under the provisions of Federal Quarantine No. 38 during the shipping season beginning October 1, 1958, should make application for inspection. Department officials report that application blanks have been mailed to all nurserymen, dealers, and seed growers who were on the approved list in 1957 and to those who have requested inspection of their stock for the first time this year. If you have not received an application blank, please write to R. O. Bulger, Central Plant Pest Control Region, 35 South 5th Street, Minneapolis 2, Minnesota."

Shipping Dealer Inspections

Approximately two-thirds of our dealers in nursery stock have received one or more inspections at the time that this is being written. Condemnations of roses are running fifty percent fewer than last year. The main reason for this is that many rose bushes were condemned last year, consequently, rose growers found it unprofitable to ship diseased stock into the state. The inspection schedule is also ahead of last year and for that reason, the bushes are often in fresher condition when the inspections are made.

Spruce Needle Miner

Spruce trees showing evidence of needle miner injury should be sprayed as soon as possible. Use 2 pints of 50% Malathion per 100 gallons of water.

Pine and Spruce Needle Scale

Pines and spruces which are infected with pine needle scale (small white spots on the needles)should be sprayed at the time that the lilacs are in full bloom. Use the same spray formulation recommended for the needle miner.

Minnesota Insect Reporting Service

The Minnesota Department of Agriculture is again publishing its weekly insect report. It is available to anyone who wishes to be put on the mailing list.

CALIBRATING WEED SPRAYER 1/

The importance of applying just the right amount of spray per acre was never so important as with some of the newer selective herbicides--particularly where they are used for pre-emergence weed control.

Proper calibration of a sprayer to apply specified amounts can be a confusing and time-consuming job, unless a simple set of rules are followed. The instructions given below came from a recent bulletin from the University of Massachusetts and are one of the most explicit sets of directions yet seen for this operation:

"To be certain of applying the correct amount of herbicide, you must know the volume of spray delivered per acre. This may be checked by a test-run over some measured distance.

"1. Set marker at some measured distance -- the greater the distance the more accurate the calibration.

"2. Fill the tank with water and have pump in motion back of the starting line, with boom valve closed.

"3. Open valve as starting line is crossed and drive at rate to be used in spraying operations, with throttle in marked position.

"4. Shut valve as finish line is passed.

"5. Measure exact amount of water needed to refill the tank.

"6. To figure acre rate of dischage use the following formula:

$$\frac{43,560 \times \text{gallons used}}{\text{Distance (ft.)} \times \text{Length of boom (ft.)}} = \text{gallons per acre}$$"

Example: Assuming 14 gallons used, 660 ft. distance traveled, and 20 ft. length of boom, we have

$\frac{43,560 \times 14}{660 \times 20}$ = 46.2 gallons per acre

You then decide either (1) to apply the recommended amount of herbicide to each 46 gallons of water or (2) a new gallonage rate by altering the speed, pressure, or nozzle opening.

1/ From Agricultural News Letter
Vol. 24(3): 59 May - June, 1956.

Editors Comments
R. J. Stadtherr

INSECT CONTROL PROGRAM

With your Newsletter, we are sending copies of "Chemical Control of Insects" which was prepared by Dr. L. K. Cutkomp. This is a summary of a talk presented at the Shade Tree Short Course, March 5 and 6, 1957.

Save this copy. I'm sure it will help you control insects in the nursery.

NEW PUBLICATIONS FOR NURSERYMEN

In reviewing the many publications that come in, we found the following very informative and useful.

1. The U. C. System for Producing Healthy Container-Grown Plants.
Edited by K. F. Baker.
California Agricultural Experiment Station
Manual 23.

This is the most complete reference manual available today on the commercial production of nursery stock in cans. Topics covered exceedingly well include: soil mixtures, sterilization, diseases and fertilization. Copies of the manual can be obtained for $1.00 by writing to: Agricultural Publications, 22 Giannini Hall, University of California, Berkeley 4, California.

2. Forest Nursery Practice in the Lake States Agriculture Handbook No. 110.
J. H. Stoeckler and G. W. Jones.

From the selection of the nursery site to the development of the nursery, this publication covers all phases of nursery management. Although this publication is primarily for trees for reforestration nevertheless it is an excellent reference for the commercial nurseryman.

Copies can be obtained for $2.00 from the: Forest Serivce, U.S.D.A., Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

3. Forest Fertilization.
World Forestry Series, Bulletin #2 State University, Syracuse, N. Y.

The use of fertilizers and soil amendments for forest tree production with an excellent bibliography with abstracts of important papers are given in this informative educational bulletin. Fertilization for shade trees is included.

4. Pesticide Handbook, Ninth Edition. Donald E. H. Frear.

This is one of the most complete, best organized handbooks for nurserymen on the types and uses of pesticides. This easily-used book contains active ingredients, antidotes, compatabilities and tolerances for all pesticides commonly used today. Trade names and the manufacturers are included also.

Copies of this handbook can be obtained for $1.50 from the College Science Publishers, State College, Pa.

5. Entoma, 12th Edition 1957-58 published by: Entomological Society of America.

Formulations, kinds and uses of fungicides, herbicides, insecticides and rodenticides are covered. Trade names and manufacturers are given.

Copies may be purchased for $2.00 by writing to Entomological Society of America, Dept. of Entomology, University of Wisconsin, Madison 6, Wisconsin.

6. Tree Care by John Haller.

This book is written for the homeowner, however it discusses and illustrates very clearly the various problems of tree maintenance. A practical guide which covers every aspect of ornamental tree care including selecting, planting, fertilizing, watering, pruning, bracing, and spraying. Published and sold for $5.95 by: The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y.

7. The Nickerson Color Fan.

A standard color chart for nursery and other horticultural industries is now available from the American Horticultural Council. A uniform color system for descriptions of plant parts is an important tool of the industry.

The Nickerson Color Fan was developed by Miss Dorothy Nickerson, color technologist of the U. S. Department of Agriculture and the Munsell Color Foundation. Included with the color chart is a booklet explaining the use of the fan in detail.

Copies can be obtained for $5.00 from Dr. Donald Wyman, Secretary of the American Horticultural Council, Jamaica Plain 30, Mass.

IN THIS ISSUE

CHEMICAL CONTROL OF INSECTS

L. K. Cutkomp, Associate Professor
Department of Entomology

A summary of chemical control measures for shade tree pests can best be presented by tabulating the chief insects pests (Table 1) and referring to the recommended chemical and its proper concentration in Table 2. Since the proper timing of the sprays is all important, this is listed with the injurious insect. Common names of insects are used.

Table 1

Defoliators or Chewing Insects

Insect	Host	Time for Effective Chemical Control	Chemical (see Table 2)
Cankerworm, Spring and Fall	Elms, apples, others	First sign of laciness in leaves in tree tops (early May)	DDT
Eastern tent caterpillar	Wild cherries, apples, mountain ash, others	Early to mid-May	DDT
Tussock moth, white-marked	Elm, basswood, poplars, apples, others	Early leaf skeletonized (about mid to late May) Occassional August treatment	DDT
Webworm, fall	Many deciduous trees	July and early August, with first webbing	DDT
Spiny elm caterpillar	Elm	First sign of Feeding, usually late May	DDT
Sawfly, brown-headed ash	Ash	Leaf-feeding late May, early June	DDT
Sawfly, red-headed	Jack pine	Late June, early July	DDT
Sawfly, Jack pine	Jack pine	June-July	DDT
Sawfly, Introduced pine	White pine	Early feeding in June	DDT
Budworm, spruce	**Fir-Spruce**	As buds break and again 10 days later	DDT

Insect	Host	Time for Effective Chemical Control	Chemical (see Table 2)
		Sucking Insects	
		Aphids	
Elm cockscomb gall	Elm - grasses	Spring dormant	Dormants
Elm leaf aphid	Elm	Spring dormant	Dormants
Woolly apple	Elm-apple	Spring dormant	Dormants
Woolly elm	Elm-service berries	Spring dormant	Dormants
Woolly elm bark	Elm	Dormant or as leaves are breaking	Dormant or DDT-malathion
Pine bark	White pine, Scotch, Austrian	Early spring	Malathion
Spruce gall	Spruce	Late April, May	Malathion
White pine	White pine and others	Late May	Malathion
		Scale Insects	
European fruit Lecanium	Elm, fruits	Dormant or Late June, July	Dormant or Malthion
Oystershell scale	Ornamental deciduous shrubs, fruit	Dormant or crawler stage (time of apple tree bloom)	Dormant, DDT or Malathion
Cottony maple	Various deciduous trees	Dormant or late June, July for crawlers	Dormant or Malathion
Elm scurfy scale	Elm, Maple, hackberry	Dormant or June-July for crawlers	Dormant or Malathion
Pine needle	Pines, esp. ornamentals	Dormant or crawler hatch about lilac bloom.	Dormant or Malathion

Insect	Host	Time for Effective Chemical Control	Chemical (see Table 2)
		Mites	
Maple bladder-gall mite	Soft maples	When leaf buds are breaking	Malathion plus ovex
Spruce mite	Spruce	As early in season as detected	Kelthane or ovex
Red spider mites	Many ornamentals	As soon as detected	Ovex, aramite, Kelthane, Chlorohenzilate
		Borers	
Bronze birch borer	Birch	Increase vigor by fertilizing and cut and burn infested branches before adults emerge in May. Spray in May or June.	DDT
Poplar borer	Lombardy, Bolleana, Carolina, aspens, willows	At signs of activity in tunnels.	Inject carbon bisulfide
		Soil Infesting Insects	
White grubs	Especially evergreens	Treat any grassy or weedy areas when ground is not frozen. Work into soil as well as possible.	Aldrin, Chlordane, Heptacblor, Dieldrin

Table 2

Summary of insecticides and desirable concentrations for use against pests given in Table 1. Rates refer to those which would be used in hydraulic sprayers.

Insecticide	Formulation	Quantity per 100 gal. water
DDT	50% Wettable powder	2 lbs.
	25% Emulsion Concentrate	2 qts.
Malathion	5 lb. emulsifiable concentrate	1 1/2 - 2 pts.

Insecticide	Formulation	Quantity per 100 gal. water
Aramite	15% Wettable Powder	1 1/2 lb.
Ovex	50% Wettable Powder	1 - 1 1/2 lbs.
Chlorobenzilate	25% Emulsion Concentrate	1 qt.
Kelthane	18 1/2% Emulsion Concentrate 18 1/2% Wettable Powder	1 qt. 1 1/2 - 2 lbs.

Dormant Sprays: (applied in spring when temperatures are above freezing, but plant growth is not evident)

DN - 289 or Elgetol	Miscible with water	1 gal.
Dormant Oils	Miscible with water	2 - 3 gal.

Soil treatment:

Aldrin	25% emulsifiable	2 gal. in water per acre
Chlordane	40% emulsifiable	2 1/2 gal. in water per acre
Heptachlor	25% emulsifiable	2 gal. in water per acre
Dieldrin	19 1/2% emulsifiable	1 1/2 gal. in water per acre

Presented at the Shade Tree Short Course, March 5 and 6, 1957.