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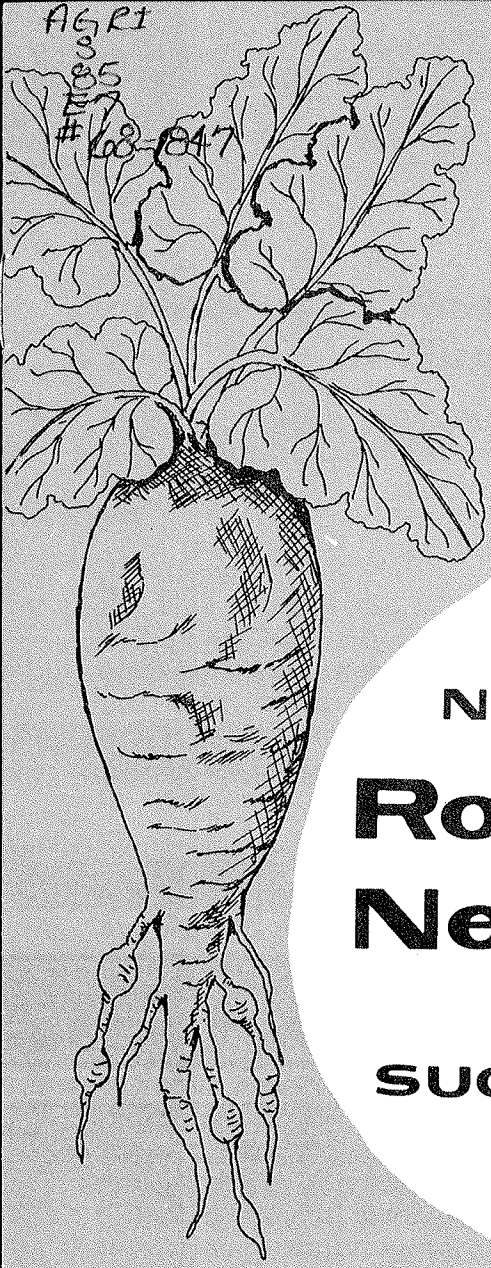

NEBRASKA Root-Gall Nematode of SUGAR BEETS

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Nebraska Root-Gall Nematode of Sugar Beets

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Introduction

There is a world of living organisms in the soil. We can easily see only the larger forms of life within the soil such as insect grubs or worms. By magnifying our view of soil life, we see innumerable forms of life--bacteria, fungi, protozoans. Unfortunately, we don't see this world unless we have a microscope. Thus, it is left to scientists to study and to tell us about it.

A part of the microscopic life in the soil is made up of a group of organisms known as nematodes. Most nematode species do not damage plants. However, there are some which have the capacity to enter and obtain nourishment from roots of living plants. In these instances the plants are usually stunted or even killed.

Most nematodes of the soil are too small to be seen with the unaided eye. When magnified, they are eel-shaped, long, cylindrical, and rounded or pointed at the ends. They move through the soil by swimming in the water film surrounding the soil particles. They reproduce by the female laying eggs which hatch into a form similar to that of the adult but which must pass through four moults before reaching adulthood.

1/ The information in this circular was obtained from research conducted by Max L. Schuster, Professor, Nematode Diseases, Dept. of Plant Pathology, Nebraska Agricultural Experiment Station.

Symptoms

The Nebraska root-gall nematode 2/ may infest a whole field or just an area of a field. Beets in heavily infested fields or areas are stunted and wilt prematurely. This is because normal physiological functions and growth of the roots have been disrupted by the nematodes.

The most striking symptoms occur on the roots. Numerous galls are formed, particularly on the lateral roots (Figure 1). These galls range in size from those just barely visible to those 3/8 of an inch in diameter. Another characteristic feature is the production of many small rootlets from the gall causing a hair-like, or whiskery, appearance.

An added characteristic is the presence of high quantities of starch in the gall. No other known nematode species induces starch production in root tissues.

2/ Nacobbus batatiformis

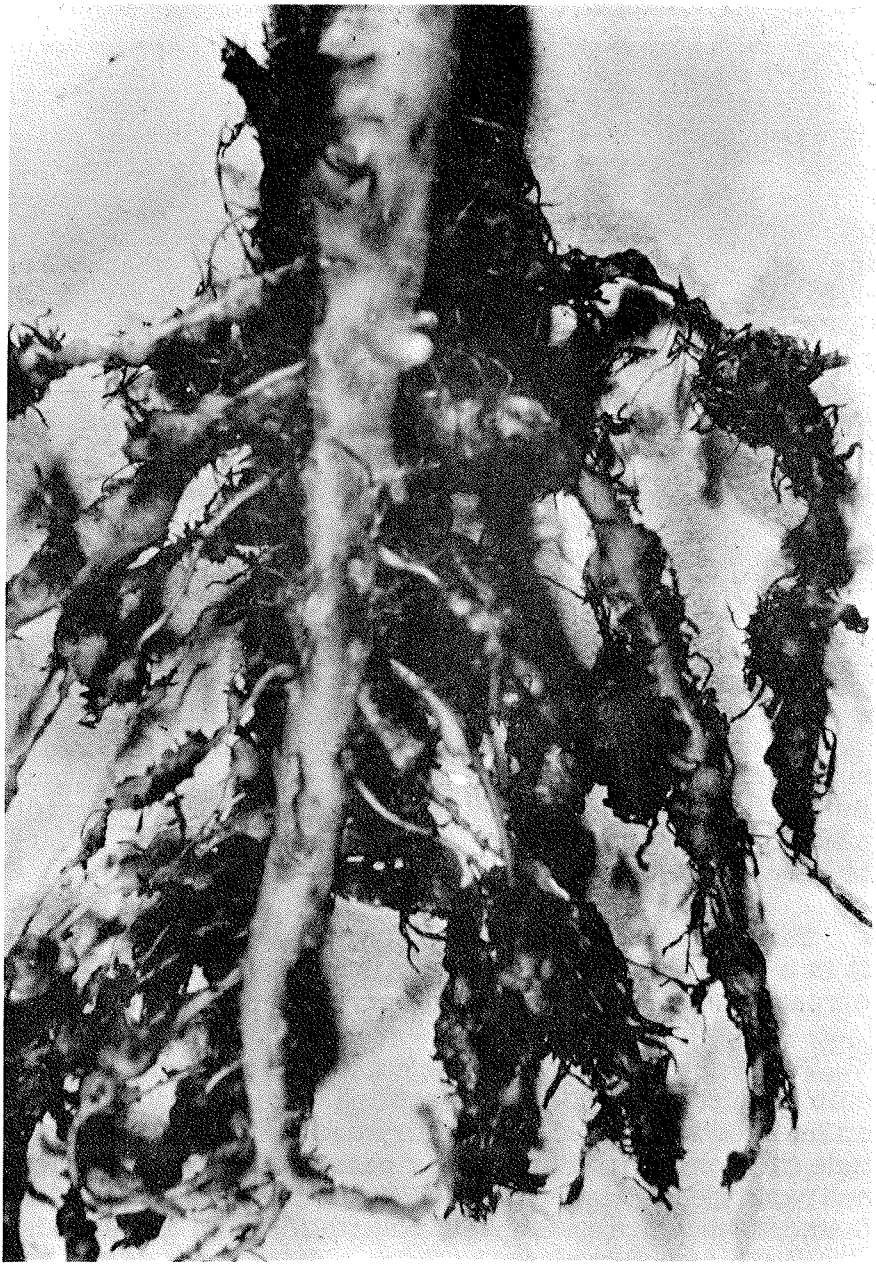

Figure 1. A sugar beet root showing swellings on the lateral roots and rootlets caused by the Nebraska root-gall nematode.

Cause

Swelling of the roots is caused by entry of the female Nebraska root-gall nematode. (See Figure 2 for life cycle). This nematode has a spear-like organ within its mouth parts. Upon contact with a root, it can pierce the root surface until a sufficiently large opening is produced to allow the female larva to force all of its body, except the very tail end, into the outer tissues (the cortex). Here she releases substances into the cellular tissue of the root causing the surrounding cells to multiply and enlarge into a gall.

The female obtains nourishment for growth and reproduction within the gall. She literally turns into an egg factory. Her body swells so that she becomes sweet potato shaped. Five hundred to a thousand eggs are laid within a gelatinous matrix (egg sac) that is extruded by the female on the surface of the gall.

Temperature has a marked influence on the development of the nematode. In soil temperatures from 75° to 95°F, it will complete a cycle in 30 to 36 days. Therefore, the nematode can easily complete two cycles in a growing season and probably three in unusually long, warm seasons. Below 75°F, its growth and activity begin to drop rapidly and there is essentially no reproduction or infection at 50°F or below.

This nematode cannot move very far on its own although it is a very active swimmer. It is just too small. It may spread as much as a foot in a very favorable year.

The real spreader of the nematode is man during certain crop production practices. Irrigation water passing through an infested zone of soil will carry and distribute the nematode through the field. This is perhaps the most efficient and rapid means of spreading the organism. Depositing infested dump soil from the weighing station onto a nematode-free field is another means.

Hosts

The Nebraska root-gall nematode attacks roots of many

Figure 3.

Nematode eggs in which developing nematodes can be seen.

Freshly hatched nematode (left) and two nematodes beginning to swell for egg production.

plant species (Table 1). However, the sugar beet is the only cultivated crop in western Nebraska on which it presently is a problem.

The nematode does infect certain weeds, particularly kochia and lambsquarters. This is very important in relation to the perpetuation and field build-up of this nematode. Soils of the western beet growing region are generally infested with the seeds of these two weeds. If these weeds are allowed in a field, it will become heavily populated with the nematode. Sugar beets planted in such fields will inevitably become infected.

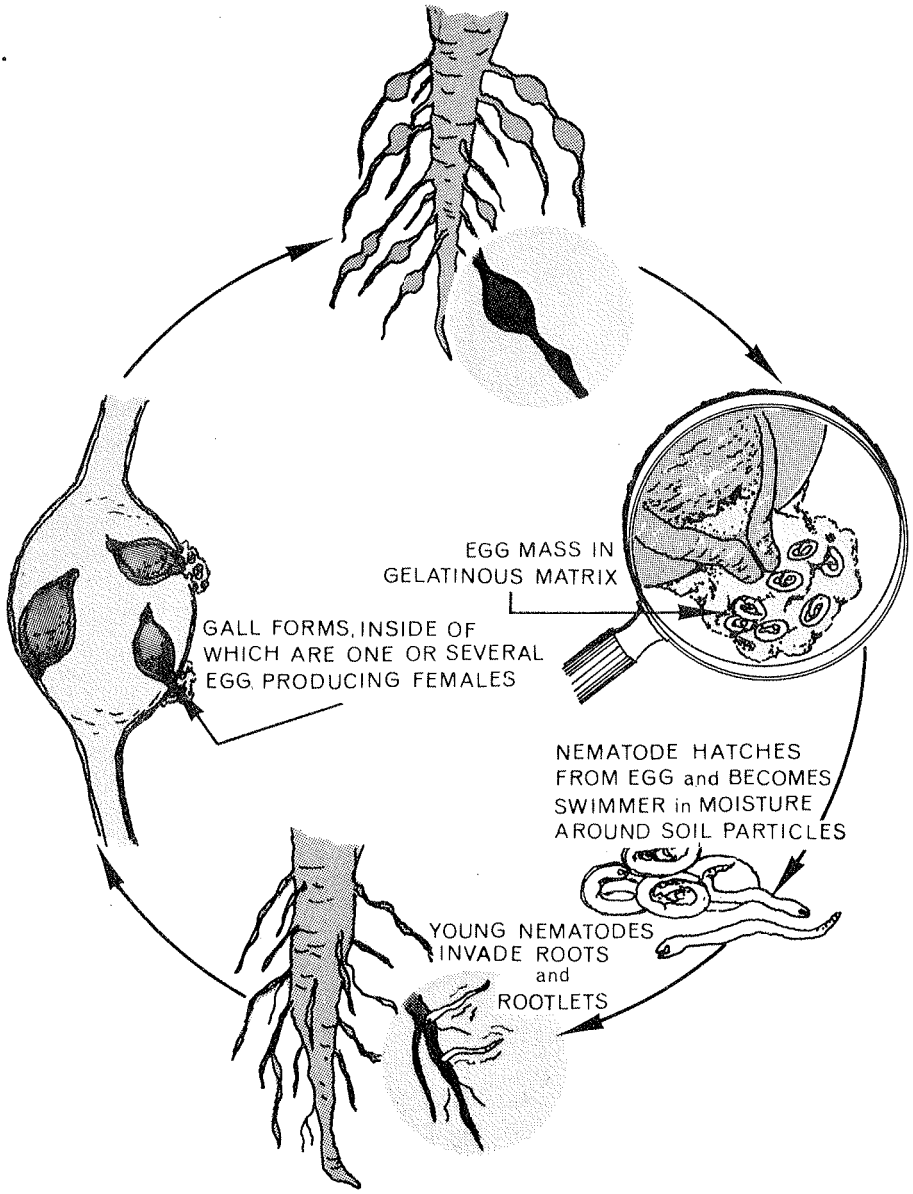

Figure 2. Life cycle of the Nebraska root-gall nematode.

Control

Rotation: It is necessary to rotate sugar beets with non-susceptible crops. It is best to have at least a four-year rotation, preferably longer. Field surveys have shown there is a large nematode population in the soil the year following a sugar beet crop and still a dangerously high level the second year and perhaps even the third year after sugar beets.

Early planting: Early planting should lessen the intensity of the disease because of the inactivity of the nematode in cool soil conditions. After the soil has warmed up, the plants would become infected but because of their large size would be less affected than smaller plants. Seedling infection often results in a stand reduction as well as in severe reduction in plant vigor.

Weed control: Weeds, particularly kochia and lambsquarters, play an important role in the harboring of the nematode in fields growing along fences and irrigation ditch banks. Elimination of these natural hosts will do much to reduce the population of the nematode. Rotation of crops will be of no value if weeds are permitted in the field.

Soil fumigation: Where highly valuable fields are badly infested and cultural practices have not been particularly effective in reducing the nematode population, the cost of fumigation may be warranted.

Certain chlorinated hydrocarbons 3/ are good nematicides. Application is made by mechanical injection of the fumigant 8 to 10 inches into the soil. These chemicals are poisonous to plants. Therefore, it is necessary to wait until they have time to diffuse and evaporate from the soil before planting. This requires 7-14 days. The higher the temperature the more rapid the escape.

Nematicides are more effective when applied within a soil temperature range of 40 to 85°F and with soil moisture equivalent to that in a good seedbed. The soil should be

3/ Sold under trade names such as D-D, Telone and Vorlex.

plowed before fumigation and worked into a good seedbed with little straw, roots and other debris present. Immediately after fumigation the soil surface should be firmed to prevent escape of the gas.

Other Nematodes

The root-knot nematode (Meloidogyne spp.) and the sugar beet nematode (Heterodera schachtii) are also common injurious parasites of sugar beets in western Nebraska. They are similar to the Nebraska root-galling nematode in that bodies of egg-laying females are swollen. The adult females of the root-knot nematodes are pear-shaped and those of the sugar beet nematode are lemon-shaped. Symptoms are also similar. The root-knot nematodes cause galls on sugar beet roots and the sugar beet nematode causes root proliferation.

Both species infect several kinds of common field weeds. Thus, the same control practices must be used as for the Nebraska root-galling nematode. Wheat, barley, corn, oats and grasses are not good host plants for either species and can be used safely between crops of sugar beets.

Table 1. The reaction of plant species to the Nebraska root-gall nematode.

Family	Common Name	Scientific Name
	Susceptible Species	
Cactaceae	Barrel Cactus	Mamillaria vivipara
	Brittle Cactus	Opuntia fragilis
	Prickly Pear	Opuntia tortispina
Chenopodiaceae	Red Garden Beet	Beta vulgaris
	Sugar beet	Beta vulgaris
	Swiss Chard	Beta vulgaris cicla
	Mangel	Beta vulgaris macrorhiza
	Lambsquarters	Chenopodium album
	Kochia	Kochia scoparia
	Russian thistle	Salsola kali var tenuifolia
	Spinach	Spinacia oleracea
Zygophyllaceae	Puncture vine	Tribulus terrestis
Compositae	Gaillardia	Gaillardia pulchella
	Lettuce	Lactuca sativa
	Salsify	Tragopogon porrifolius

Family	Common Name	Scientific Name
Cruciferae	Rutabaga	Brassica napbrassica
	Mustard	Brassica nigra
	Kale	Brassica oleracea viridis
	Broccoli	Brassica oleracea botrytis
	Cabbage	Brassica oleracea gongylodes
	Brussel sprouts	Brassica oleracea gemmifera
	Chinese cabbage	Brassica pekinesis
	Turnip	Beta rapa
	Stock	Matthiola sp.
	Radish	Raphanus sativus
Cucurbitaceae	Pumpkin	Cucurbita pepo
	Cucumber	Cucumis sativus
Solanaceae	Tomato	Lycopersicon esculentum
	Eggplant	Solanum melongena
Leguminosae	Pea	Pisum sativum
Umbelliferae	Carrot	Daucus carota
	Non-Susceptible Species	
Compositae	Safflower	Carthamus tinctorius
	Endive	Cichorium endivia
	Cosmos	Cosmos sp.
	Sunflower	Helianthus annuus
	Marigold	Tagetes erecta
	Zinnia	Zinnia elegans
Cucurbitaceae	Squash	Cucurbita maxima
	Cantaloupe	Cucumis melo
	Watermelon	Citrullus vulgaris
Solanaceae	Pepper	Capsicum sp.
	Potato	Solanum tuberosum
Leguminosae	Peanut	Arachis hypogaea
	Soybean	Glycine max
	Sweet peas	Lathyrus odoratus
	Alfalfa	Medicago sativa
	Sweetclover	Melilotus officinalis
	Tepary bean	Phaseolus acutifolius latifolius
	Bush lima bean	Phaseolus limensis
	Bean	Phaseolus vulgaris
Umbelliferae	Dill	Anethum graveolens
Amaranthaceae	Pigweed	Amaranthus retroflexus
Convolvulaceae	Morning-glory	Ipomoea tricolor
Gramineae	Oats	Avena sativa
	Brome	Bromus inermis
	Barley	Hordeum vulgare
	Rye	Secale cereale
	Sorghum	Sorghum vulgare
	Wheat	Triticum vulgare
	Popcorn	Zea mays
	Sweet Corn	Zea mays
Iridaceae	Gladiolus	Gladiolus sp.
Liliaceae	Onion	Allium cepa
	Asparagus	Asparagus officinalis
Malvaceae	Okra	Hibiscus esculentus
	Cotton	Gossypium hirsutum