Host Range of the Root-Knot Nematode of Western Nebraska[1]

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Introduction

Observations of the reaction of plants to the root-knot nematode of western Nebraska indicated a narrower host range than previously reported in other areas. Neal (8) *, Atkinson (1) and others (2, 10, 14) reported conflicting evidence on the reaction of plants to this pathogen. Tyler (14) recorded an extensive list of plants and their reaction to the nematode. Since then additional hosts have been found, making a total of about 1,800 species.

The root-knot nematode appeared to vary in its pathogenicity in different parts of the United States. Recent workers (4, 5, 6, 10) considered the possibility of races of the nematode. In 1949 Chitwood (3) transferred the root-knot nematode from *Heierodora marioni* to the genus *Meloidogyne* Goeldi, 1887 and set up five species and one variety based mainly on morphological characters.

The purpose of this investigation was to determine the host range of the root-knot nematode especially of economic plants grown in irrigated rotations in western Nebraska. This information would be of interest in considering the feasibility of crop rotations as now practiced and of the advisability of using other crops which may be introduced, such as safflower. This study was conducted in the field from 1918 to 1951 (11)- Included in these tests were 62 species and varieties of plants.

Materials and Methods

During the early part of the studies, a plot in the Great Western Sugar Company Farm, Mitchell, Nebraska, was employed because it was heavily infested with the root-knot organism; later tests were made on heavily infested soil at the Scotts Bluff Substation, Mitchell, Nebraska. Three replications of each variety or species were employed using a randomized block. Each replication was five feet in length. The seed was sown at the time recommended for the crop in the area. Plants were harvested and roots examined when" they reached nearly full size. For example, peas were examined about six weeks and sugar beets 24 weeks after planting.

Species and varieties from 14 families of plants were tested during the period. One species or variety was tested from Liliaceae, Zygophyllaceae, Convolvulaceae, Polemoniaceae, Amaranthaceae; two from Euphorbiaceae; three from Solanaceae; four from Cucurbitaceae, Umbelliferae, Cruciferae; six from Chenopodiaceae; nine from Leguminosae; twelve from Compositae; thirteen from Gramineae. This host range included weeds which were permitted to flourish in the test plots. The susceptible sugar beet was planted in many locations in the test plots as a check or indicator plant to determine the distribution of the nematode.

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Table 1.—Host Range of the Root-knot Nematode of Western Nebraska.

Host Plant	No. plants[1]	
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Amaranthaceae		
Pigweed, *An nthu •etroflexus* L.		slight
Chenopodiaceae, Goosefoot Family		
Lambs quarters, *Chenopodium album* L.	2/16	slight
Fireweed, *Kochia scoparia* (L.) Schrod.	2/17	severe
Sugar beet, *Beta vulgaris* L. var. G.W. 304	124/127	severe
Sugar beet, *Beta vulgaris* L. var. G.W. 526	121/135	severe
Red beet, *Beta xmlgaris* L. var. Detroit Dark Red	37/44	severe
Red beet, *Beta vulgaris* L. var. Early Blood Turnip	9/9	severe
Compositae, Sunflower Family		
Lettuce, *Lactuca sativa* L. var. Grand Rapids	47/47	moderate
Lettuce, *Lactuca sativa* L. var. Black-seeded	60/60	severe
Lettuce, *Lactuca sativa* L. var. Improved Hansen Head	44/44	moderate
Blue Lettuce, *Lactuca puchella* (Purch.) DC.	2/2	severe
Sunflower, *Helianthus annuus* L.	2/8	slight
Safflower, *Carthamus tinctorious* L. var. Nebraska-8	16/20	slight
Safflower, *Carthamus tinctorious* L. var. Nebraska-852	13/37	moderate
Zinnia, *Zinnia elegans* L. var. Little Red Riding Hood	3/9	slight
Cocklebur, *Xanthium commune* Briton	4/15	slight
Bachelor buttons, *Centaurea cyanus* L. var. Jubilee Gem	2/2	slight
Great ragweed, *Ambrosia trifida* L.	0/5	none
Marigold, *Tagetes erecta* var. Chrysanthemum Flowered Hybrids	0/12	none
Convolvulaceae, Morning Glory Family		
Morning glory, *Ipomaea purpurea* (L.) Roth. var. Pearly Gates		
Cruciferae, Mustard Family		
Radish, *Raphanus sativus* L. var. Early Scarlet Turnip	134/236	moder
Rutabaga, *Brassica napobrassica* Mill. var. American Purple Top	35/35	severe
Brussel Sprouts, *Brassica oleracea gemmifera* Zenker var. Long Island	4/4	moder
Turnip, *Brassica rapa* L. var. Purple Top White Globe	52/69	severe
Cucurbitaceae, Gourd Family		
Muskmelon, *Cucumis melo* L. var. Netted Gem	0/8	none
Squash, *Cucurbita maxima* Duch. var. Toble Queen	0/38	none
Pumpkin, *Cucurbita pepo* L. var. New England Pie	0/11	none
Cucumber, *Cucumis sativus* L. var. Improved Long Green	11/38	slight
Euphorbiaceae, Spurge Family		
Spotted spurge, *Chamaesyce maculata* (L.) Small	0/4	none
Castor Bean, *Ricinus communis* L. mixed vars.	1/21	slight
Gramineae, Grass Family		
Sorghum, *Sorghum vulgare* L. var. Black Hull	0/53	none
Sorghum, *Sorghum vulgare* L. var. Leoti Red	0/106	none
Sorghum, *Sorghum vulgare* L. var. Cheyenne	0/32	none
Wheat, *Triticum vulgare* L. var. Cheyenne	0/32	none
Witchgrass, *Panicum capillare,* L.	0/24	none
Field Corn, *Zea mays* L. var. Iowa 4316	0/77	none
Sweet Corn, *Zea mays* L. var. Extra Early Golden Bantam	0/27	none
Smooth brome, *Bromus inertnis* **L.** var. Lincoln	0/18	none
Yellow foxtail, *Setaria lutescens* **L.**	6/27	slight
Sandbur, *Cenchrus pauciflorus* Benth.	0/5	none
Barnyard grass, *Echinocloa crus-galli* (L.) Beauv.	0/6	none
Barley, *Hordeum vulgare* L. var. Velvon 11	0/155	none
Oats, *Avena sativa* L.	0/11	none

Leguminosae, Pea Family		
Pea, *Pisum sativum* L. var. Alaska	3/57	slight
Pea, *Pisum sativum* L. var. Thomas Laxton	5/24	slight
Pea, *Pisum sativum* L. var. Stratagem	1/4	slight
Field bean, *Phaseolus vulgaris* L. var. Great Northern 123	0/45	none
Wax bean, *Phaseolus vulgaris* L. var. Startler	0/21	none
Sweet pea, *Lathyrus odoratus* L. var. Cuthbertsons mixed	0/4	none
Sweet pea, *Lathyrus odoratus* L. var. Spencer Yellow Medal	4/9	slight
Alfalfa, *Medicago sativa media* L. var. Ranger	9/51	slight
Sweet clover, *Alelilotus officinalis* L. (Lamb) var. Griswold Co.	17/87	slight
Liliaceae, Lily Family		
Onion, *Allium cepa* L. var. Sweet Spanish	3/50	moderate
Polemoniaceae, Phlox Family		
Phlox, *Phlox* sp.	2/3	slight
Solanaccae, Nightshade Family		
Potato, *Solarium tuberosum* L. var. Bliss Triumph	1/25	none
Tomato, *JLycopersicum esculentum* L. var. Bonny Best	1/9	slight
Black Nightshade, *Solarium nigrum* **L.**	0/2	none
Umbelliferae, Parsley Family		
Carrot, *Daucus carota* L. var. Danvers One-half Long	73/73	severe
Carrot, *Daucus carota* L. var. Nantes	58/60	severe
Parsley, *Petroselinum hortense* Hoffm. var. Dark Moss Curled	20/22	severe
Parsnip, *Pastinaca sativa* L. var. Improved Hollow Crown	41/45	moderate
Zygophyllaceae, Caltrop Family		
Puncture Vine, *Tribulus terrestris* L.	2/2	slight

vith galls on roots; Denominator, total number of plants

Xhe infection types were grouped into four classes based on the percentage of plants infected and the severity of disease. These classes were as follows: Healthy, *no* sign of infection as evidenced by the absence of galls on the roots; slight infection, by the presence of small and few galls on the secondary roots; moderate infection, the presence of larger and more galls on the secondary roots and the main root; severe infection, numerous large galls on the main and secondary roots with coalescing of galls a common occurrence. This method proved satisfactory in comparative determination of the relative susceptibility of the plants to the pathogen.

Results

The data entered in Table 1 confirm or add to the confusion of the host range which was reviewed by Tyler (14) and who cited conflicting observations and evidence from different parts of the United States. In western Nebraska the white field bean, Great Northern No. 123, appeared to be resistant. Although beans are considered by some workers (2, 15) to be susceptible to the root-knot nematods, others (14) have reported that some varieties such as Alabama No. 1 and No. 2 are resistant. The bean in western Nebraska was grown during the hotter part of the season so temperature should not be a factor (18). It was also found that the potato variety, Bliss Triumph, which is generally considered very susceptible, was free of morphological symptoms in our test. Cunningham (7) on the other hand reported this potato variety to be moderately resistant, using tuber symptoms as the criteria. Contrary to the results of other investigators (2, 15) our findings seem to indicate that certain varieties of safflower, Nebraska-8 and Nebraska-852, are susceptible to the attack of the nematode.

The data confirmed the general consensus of opinion that certain members of the Cruciferae such as turnips, rutabages, radish and Brussel sprouts

are susceptible. Confirmation was also found in regard to susceptibility of carrots, sugar beets, lettuce, onion, phlox and parsnip. Some crops slightly susceptible to root-knot nematode included Zinnia, peas, alfalfa, sweet clover, sweet peas and castor beans.

Resistance was generally found for members of the Gramineae, particularly the economic crops such as corn, wheat, sorghum, smooth brorne, barley and oats. Marigold was also found to be resistant.

The Cucurbitaceae usually considered susceptible were shown to be only slightly infected, using representative species such as muskmelon, cucumber, squash and pumpkin.

Discussion

Data obtained in this study support the observations of others (3, 4, 5, 6, 10) of the variation in reaction of hosts to the root-knot nematode. There may be several reasons to account for these differences.

Many observations and records were made on the reaction of plant species to nematodes without consideration of varieties or strains of the hosts. Just as there are strains of pathogens so there may be strains of host plants. Wherever possible an attempt was made to employ named varieties in the studies reported in Table 1. Weeds, of course, were identified as to species whenever possible. Even different reactions of weeds in various parts of the country may be explained on the basis of variation within weed species.

Another explanation for divergent results may be physiological races of the nematode. One adapted to the latitude and temperatures of western Nebraska may develop at lower temperatures than a race from southern United States. Chitwood (3), Sherbakoff (10) and Christie and associates (4, 5, 6) have shown that *Heterodora marioni* can be considered as several species or races based on morphology or pathogenicity. Recently Tarjan (12) and Sasser (9) attempted to differentiate the five species of the genus *Meloidogyne* as proposed by Chitwood who used host range as a major criterion. Tarjan (12), who indicated that there were decided differences in response of snapdragons to infection by different species of the root-knot nematodes, did not arrive at any definite conclusion in this respect. Sasser (9) believed that it would be possible to differentiate these species; he used 25 plant species to decide the issue involved. He did not consider the possibility of strains within the Meloidogyne species as eventually confounding the issue.

The results obtained indicate that the irrigated rotations in western Nebraska were not in danger from the root-knot disease in so far as infection on two main crops—potatoes and field beans—were concerned. Sugar beets, however, were very susceptible and nematodes could be an important factor in production of this crop in this area, depending upon the length of rotations employed.

Summary

Sixty-two species of plants were tested under field conditions to determine their reaction to the root-knot nematode in western Nebraska. The plants were tested in fields highly infested with the nematode. They were

classified as healthy, slight, moderate, or severely infected on the basis of size and number of galls on the roots.

The field bean and potato, which are two main crops in irrigated rotations in western Nebraska and usually considered as susceptible, did not exhibit root-knot symptoms. The same was true for marigold, ragweed, morning glory and members of the Grass family.

Members of the Mustard family proved to be susceptible. Others included in this category were the carrot, safflower, sugar beet, lettuce, fireweed, onion, phlox, blue lettuce, parsnip and parsley.

Members of the Gourd family usually considered susceptible were at most only slightly susceptible. Similar data were noted for Zinnia, peas, alfalfa, sweet peas, sweet clover, castor beans, pigweed, lambs quarters, sunflower, sandbur, Bachelor buttons, yellow foxtail, tomato and puncture vine.

Crops such as potatoes, beans and corn are not susceptible to root-knot nematode; the use of these crops in sugar beet rotations should make it possible to reduce the damage from this disease. The use of non-susceptible crops will not be effective in controlling the disease if susceptible, weed hosts are allowed to grow in these crops.

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