Observations on the Host Range of *Meloidogyne nataliei*

C. J. DIAMOND, Former Graduate Research Assistant, and G. W. BIRD, Professor, Department of Entomology, Michigan State University, East Lansing 48824

ABSTRACT

Diamond, C. J., and Bird, G. W. 1994. Observations on the host range of *Meloidogyne nataliei*. Plant Dis. 78:1050-1051.

Meloidogyne nataliei is a root parasite of *Vitis labruscana* cv. Concord. Evaluation of 20, 7, and 9 plant species as potential hosts for this nematode under greenhouse, field, and growth chamber conditions, respectively, indicated that *M. nataliei* has a narrow host range. Nematode development and reproduction were not observed on 30 of the species. Five new hosts of *M. nataliei* were identified: three *Vitis* rootstocks (5BB, St. George, and Gloire), *Parthenocissus quinquefolia,* and *P. tricuspidata.*

Meloidogyne nataliei Golden, Rose & Bird was first observed in 1977 and described in 1981 (4). This nematode was originally found parasitizing roots of grape (*Vitis labruscana* L.H. Bailey cv. Concord) in a commercial vineyard in Mattawan, Michigan (4). *M. nataliei* was also discovered on the roots of a row of *V. labruscana* cv. Niagara planted in the grower's garden adjacent to the type vineyard. A series of host-range trials was initiated in 1979 to determine whether plant species other than *V. labruscana* are hosts for *M. nataliei.*

MATERIALS AND METHODS

Greenhouse test. Twenty plant species were evaluated as potential hosts for *M. nataliei:* Asteridae, pepper (California Wonder), tomato (Rutgers), and potato (Superior); Caryophyllidae, pigweed and sugar beet; Commelinidae, oat (Ausauble), barnyard grass, and corn (Pioneer 3901); Dilleniidae, watermelon (Charleston Gray), cucumber (Northrup King), and cotton (Delphine 16); Liliidae, asparagus; and Rosidae, strawberry (Red Chief), soybean (Hark), carrot (Gold Pak Elite), cherry scion cultivar Montmorency initially budded onto rootstock cultivar Mahaleb (Montmorency/Mahaleb), peach (Cresthaven/Halford), apple (Empire), red clover, and peanut (Florunner). *V. labruscana* was used as a control.

Egg masses of *M. nataliei* were obtained from grape roots collected in 1977 at type location in Mattawan, Michigan, and maintained under refrigeration until eggs were removed from the gelatinous matrix with sodium hypochlorite (5). Seedlings of each species were planted in steam-sterilized soil in 30.8-cm clay pots, with one seedling per pot and six replicates of each plant species. Each seedling was inoculated by adding 3,000 eggs to holes in the soil next to the seedling. Pots were placed in a greenhouse at 24 ± 3 C and arranged in a randomized complete block design. Supplemental light for a 19-hr photoperiod was provided by fluorescent lamps.

Nematodes within 1.0 g of root tissue were stained with acid fuchsin (2) and enumerated with the aid of a dissecting microscope. Total numbers of *M. nataliei* in root tissue were recorded, and individuals were assigned to one of three growth stages: nonswollen second-stage juveniles; adult males; and swollen, sedentary forms. Soil was assayed for *M. nataliei* by the centrifugation-flotation technique (6).

Field trial. Six woody perennials and one herbaceous perennial were evaluated as hosts of *M. nataliei* under field conditions: Rosidae, cherry (Montmorency/Mahaleb), peach (Halford and Reliance/Siberian), apple (Rodger's Red Mac/MVIIa and Smoothee Golden/MMIII), strawberry (Sparkle), raspberry (Allen and Brandywine), and grape (Niagara); and Dilleniidae, blueberry. Two rooted plants of each species were planted in March 1982 in the type vineyard adjacent to an established *V. labruscana* cv. Concord plant known to be infected with *M. nataliei* and destructively sampled in July 1983. Nematodes were extracted from 100 cm^3 of soil and enumerated in root samples from each experimental unit as described above.

Growth chamber test. Cuttings of *V. berlandieri* Planch. × *V. riparia* Michx. cv. 5BB Teleki, *V. riparia* cv. Gloire de Montpellier, and *V. rupestris* Scheele cv. du Lot (St. George), all *Vitis* rootstocks, and wild *Parthenocissus quinquefolia* Planch. (Virginia creeper), *Tetrastigma voinierianum* (Baltet) Pierre ex Gagnep. (chestnut vine), *Cissus rhombifolia* Vahl (grape ivy), and *P. tricuspidata* (Siebold & Zucc.) Planch. were rooted in a greenhouse. Stock plants of domestic *P. quinquefolia, Ceanothus sanguineus* Pursh (wild lilac), and *Citrus sinensis* (L.) Osbeck (common orange) were obtained commercially. *C. sanguineus* and *C. sinensis* were obtained as rooted plants.

Plant species were transplanted to soil in pots of varying size, depending on plant size. Mechanical analysis of the soil showed it contained 83.9% sand, 9.0% silt, and 7.1% clay; it classified as a loamy-sand. Plants were maintained with Hoagland's No. 2 Basal Salts and Peter's fertilizer 20-20-20 (100 g/18.92 L) and watered as required.

M. nataliei inoculum was collected from infected grape roots from a vineyard in Mattawan, Michigan. The roots were chopped and placed into 250-ml Erlenmeyer flasks with approximately 100 ml of tap water on a gyratory shaker for 4 days (1). Plants were inoculated by adding second-stage juveniles to holes made in the soil in the root zone near the plant stems.

The *Vitis* rootstock 5BB had four inoculum treatments and five replicates (Table 1). The rootstocks Gloire and St. George had one inoculum treatment and three replicates. Two trials with *P.*

Table 1. Reproduction of *Meloidogyne nataliei* on *Parthenocissus tricuspidata*, *Vitis* cultivars, and *P. quinquefolia*

Plant species	Trial days (no.)	Initial nematode density[a]	Final nematode density[b]
P. tricuspidata	182	1,800	1
	182	750	26
Vitis			
5BB	157	500, 1,000, 1,500, and 2,000	1,554, 1,108, 136, and 82
Gloire	146	750	23
St. George	181	750	38
P. quinquefolia			
Wild	181	500, 1,000, 1,500, and 2,000	9, 5, 10, and 23
	101	580 and 1,160	2 and 22
Domestic	89	18 and 324	1 and 2

[a] Inoculated with second-stage juveniles.
[b] Based on 0.5 g of root tissue and 100 cm^3 of soil combined.

Accepted for publication 27 July 1994.

tricuspidata had one inoculum treatment and four or six replicates. The first *P. quinquefolia* test had four inoculum treatments and five replicates. The second and third *P. quinquefolia* tests had two inoculum treatments and six or seven replicates.

Plants were watered just to leaching after inoculation and placed in the growth chamber at approximately 18 C with a 16-hr photoperiod, 8.7 calories cm^{-2} hr^{-1}, for the duration of the trial, with one exception. After 2 mo, *P. tricuspidata* (Table 1) plants in the first trial were placed in a greenhouse for 1 mo in an attempt to stimulate new shoot and leaf growth. Greenhouse temperatures ranged from 18.3 C at night to 32.2 C during the day. Nematodes were assayed as described above.

RESULTS

In greenhouse tests, *M. nataliei* was observed only in the roots of grape, cotton, cherry, peach, and peanut. These species are in the subclass Rosidae, except cotton, which is in the Dilleniidae. Mature females were not observed, except on *Vitis*. Males of *M. nataliei*, however, were observed in roots of peach. Second-stage juveniles and males were recovered from soil only from grape.

Roots of established Concord vines used in the vineyard trial contained second-stage juveniles, males, and females with egg masses. *V. labruscana* cv. Niagara was the only other species identified as a host for *M. nataliei* in this experiment. Stained roots, however, showed one to two males present in peach cultivars Reliance/Siberia C and Halford and in blueberry and cherry.

The three *Vitis* spp. evaluated in the growth chamber test were hosts of *M. nataliei*. Root tissues of *Vitis* cultivars Gloire and St. George contained second-stage juveniles, males, and females with egg masses (Table 1). *P. quinquefolia* and *P. tricuspidata* also were hosts for *M. nataliei*. Fecund females were observed on roots of *P. tricuspidata*. Second-stage juveniles, males, and eggs were recovered from soil and roots but only from the second *P. tricuspidata* trial (Table 1). Nematode development was not observed during the first trial on *P. tricuspidata* plants, which were subsequently placed in the greenhouse. Limited development and no reproduction occurred on *P. quinquefolia* during the first trial. Second-stage juveniles, males, females, and eggs were recovered from soil and roots of *P. quinquefolia* during the second and third trials. *M. nataliei* did not develop within root tissues of *C. rhombifolia, T. voinierianum, C. sanguineus,* or *C. sinensis*.

DISCUSSION

Many *Meloidogyne* spp. have extensive host ranges and parasitize monocotyledons, dicotyledons, and woody and herbaceous plants (7). Our greenhouse, field, and growth chamber data show that *M. nataliei* has a narrow host range. Of the plant species used in this study, only those in the subclass Rosidae were hosts for *M. nataliei*.

In previous field observations, *M. nataliei* began egg laying as soil and air temperatures began to decline during October and November (J. F. Davenport, *personal communication*). Triantaphyllou (8) noted that when Concord grape seedlings were inoculated with *M. nataliei* and grown in a greenhouse at 22–28 C, no juvenile stages and only adult females with a few eggs were found in root tissues after 5 mo. It was suspected that greenhouse temperatures were too high for reproduction to commence; therefore, 18 ± 2 C was selected for the growth chamber trial. Recent studies have shown that the optimal temperature for embryogenesis is 9 C, with 33 and 2.5 C as the maximum and minimum, respectively (3). *M. nataliei* females attached to root pieces in water in a petri dish continue to lay eggs at 4 C (3).

The second-stage juvenile is the infective stage of *M. nataliei*. Sedentary females were always located on mature roots with a fully developed periderm in these trials. *M. nataliei* may be attracted to older, woody roots on their hosts.

In conclusion, the known host range of *M. nataliei* was expanded to include two cultivars of *V. labruscana* (Concord and Niagara), three *Vitis* rootstocks (5BB, St. George, and Gloire), and two species of *Parthenocissus* (*P. quinquefolia* and *P. tricuspidata*), all taxa of the subclass Rosidae.

ACKNOWLEDGMENT

We thank J. F. Davenport, Field Research Technician, Department of Entomology, Michigan State University, East Lansing, for technical assistance.

LITERATURE CITED

1. Bird, G. W. 1971. Influence of incubation solution on the rate of recovery of *Pratylenchus brachyurus* from cotton roots. J. Nematol. 3:378-385.
2. Byrd, D. W., Jr., Kirkpatrick, T., and Barker, K. R. 1983. An improved technique for clearing and staining plant tissue for detection of nematodes. J. Nematol. 15:142-143.
3. Diamond, C. J. 1994. Observations on the biology of *Meloidogyne nataliei:* With special references to host parasite relationships. M.S. thesis. Michigan State University, East Lansing.
4. Golden, A. M., Rose, L. M., and Bird, G. W. 1981. Description of *Meloidogyne nataliei* n. sp. (Nematoda: Meloidogynidae) from grape (*Vitis labrusca*) in Michigan, with SEM observations. J. Nematol. 13:393-400.
5. Hussey, R. S., and Barker, K. R. 1973. A comparison of methods of collecting inocula for *Meloidogyne* spp., including a new technique. Plant Dis. Rep. 57:1025-1028.
6. Jenkins, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Dis. Rep. 48:692.
7. Sasser, J. N., and Carter, C. C. 1985. An Advanced Treatise on Meloidogyne. Vol. 1, Biology and Control. North Carolina State University Graphics, Raleigh.
8. Triantaphyllou, A. C. 1985. Gametogenesis and the chromosomes of *Meloidogyne nataliei:* Not typical of other root-knot nematodes. J. Nematol. 17:1-5.