

Distribution and Regulation of *Meloidogyne nataliei*

G. BIRD, C. DIAMOND, F. WARNER, AND J. DAVENPORT¹

Abstract: Between 1978 and 1990, eight surveys were conducted in southwest Michigan to document the occurrence of *Meloidogyne nataliei*, the Michigan grape root-knot nematode. The known distribution of *M. nataliei* is limited to a total of six sections in Antwerp and Porter Townships in Van Buren County, Michigan. In 1984, a *M. nataliei* regulatory program was initiated by the Michigan Department of Agriculture, U. S. Department of Agriculture Animal and Plant Health Inspection Service, and Michigan State University. The program was designed to reduce risk of damage associated with this nematode.

Key words: Concord, distribution, grape, *Meloidogyne nataliei*, Michigan, Michigan grape root-knot nematode, nematode, regulation, Van Buren County, *Vitis labruscana*, *Vitis* spp.

Meloidogyne nataliei was originally recovered from a declining grape (*Vitis labruscana* cv. Concord) vineyard in Mattawan, Michigan in 1977 (4). Examination of root tissue revealed a high population density of pearl-white spherical females surrounded by egg masses protruding from the roots. Root galling was not present on infected plants.

Meloidogyne nataliei represented an undetermined threat to the grape industry. By 1984, requests for regulatory actions were initiated by California and Canada through the U.S. Department of Agriculture Animal and Plant Health Inspection Service. To determine the nature of this potential problem and initiate appropriate regulatory strategies, the Michigan Department of Agriculture (MDA) and Michigan State University (MSU) Nematode Diagnostic Laboratory conducted eight surveys. A management program was implemented on the farm at the type location in 1984. The objective of this paper is to describe the known distribution of *M. nataliei* and report on the results of the regulatory program.

MATERIAL AND METHODS

Eight surveys covering the major grape production counties (Berrien, Cass, Kalamazoo, and Van Buren) in southwestern Michigan were conducted between 1978 and 1990 (Fig. 1). Personnel from MSU, MDA, Van Buren County Cooperative Extension Service (CES), and Welsh Grape Cooperative worked cooperatively on these *M. nataliei* initiatives.

1978 Van Buren county survey: The first *M. nataliei* survey was conducted in 50 vineyards. Soil and root samples from 80 vineyard sites in Van Buren County (Fig. 1) were collected late in the fall when females and egg masses were known to be readily visible. A single composite sample of root tissue and ca. 500 cm³ of soil from ca. 24 subsamples was obtained from each site as outlined in the MSU Cooperative Extension Bulletin E-2199 (2). A 100-cm³ subsample of soil from each composite sample was processed by the centrifugal flotation method (5). All roots were examined visually for the presence of egg masses and pearl-white *M. nataliei* females. A 1.0-g fresh weight root sample was incubated in a solution of 10 ppm ethoxyethyl mercuric chloride plus 50 ppm dihydrostreptomycin sulfate on a gyratory shaker for 48 hours to extract migratory forms of *M. nataliei* (1). The samples were processed and assayed at the MSU Nematode Diagnostic Laboratory. Nematode identifications were made at ×40 magnification with a dissecting microscope.

1980 Multicounty survey: The second *M. nataliei* survey was conducted to determine the distribution of *M. nataliei* throughout the grape production regions of Berrien, Cass, Kalamazoo, and Van Buren counties

Received for publication 16 March 1994.

¹ Professor, Graduate Research Assistant, Nematode Diagnostician, and Nematology Research Technician, Department of Entomology, Michigan State University, East Lansing, MI 48824.

We thank Lorraine Graney, Lindy Rose, Murray Hanna, Jim Brozovich, Clare Cargo, John Dreves, Mike Thomas, William Grevelding, and Francis Ryan for assistance.

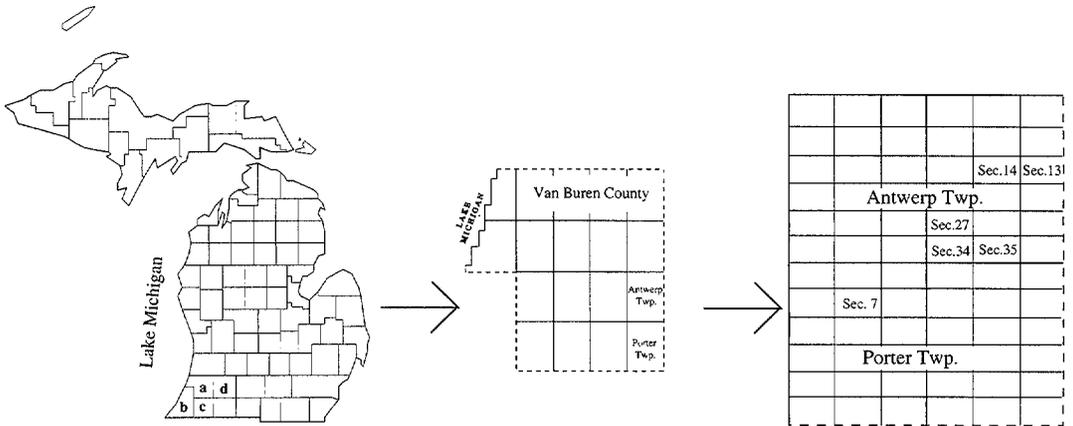


FIG. 1. Southwest Michigan grape production counties (a. Van Buren, b. Berrien, c. Cass, and d. Kalamazoo). Antwerp and Porter Townships in Van Buren County, Michigan, that contain known locations of *Meloidogyne nataliei* infestations (Sections 13, 14, 27, 34, and 35 of Antwerp Township and Section 7 of Porter Township).

(Fig. 1). A total of 127 soil and root samples were collected from vineyards representing 60 growers, and samples were assayed as described for the 1978 survey. Seventeen of the vineyards were located near the type location in Section 13 of Antwerp Township.

1981, 1982, and 1983 Surveys: Surveys of cultivated and noncultivated grapes in woodlots adjacent to the type location were conducted in the fall of 1981 and 1982 to document the distribution of *M. nataliei* in Section 13 (site of the type location) and Section 14 of Antwerp Township (Fig. 1). In 1981, 285 samples were collected and assayed; 221 in 1982. A small survey consisting of 21 samples was conducted in the winter of 1983 to verify the locations of infestations identified previously. The procedures described for the 1978 survey were used in the 1981, 1982, and 1983 surveys.

1988 Survey: In April 1988, the Van Buren County CES identified *M. nataliei* in two vineyards in Antwerp Township that were not previously known to be infested with this nematode. Both vineyards were surveyed in the fall of 1988 to document these new infestations, with 240 samples collected from one of the vineyards and 60 from the other. The assay procedures used were the same as those described for the 1978 survey.

1989 Survey: The seventh *M. nataliei* survey involved fields owned by six vineyard operators potentially associated with the two new sites. Fifty-two samples were collected and assayed in the fall of 1989. The sample collection procedure was the same as described for the 1978 survey; however, the assay involved only visual inspection of grape roots for females and egg masses.

1990 Survey: During January and February 1990, 125 samples were collected from 25 different vineyards and assayed for *M. nataliei* as described for the 1978 survey. In April, 10 samples were collected from noncultivated grape in woodlots near sites known to be infested with *M. nataliei*. An additional 135 samples came from Decatur, Porter, and Antwerp Townships of Van Buren County and Sodus Township of Berrien County. The survey involved only visual inspection of grape roots for females and egg masses.

Regulatory program: The vineyard at the type location was removed in 1983 by pulling and then burning the vines. The property was fumigated in the spring of 1984 with 160 liters/ha of 85% ethylene dibromide applied 20 cm deep and 80 liters/ha applied at 40 cm deep. The treatment was designed to reduce the risk of spread of *M. nataliei* as mandated through the Federal regulatory initiative. Concord cuttings were planted in the fall of 1984 through-

out the fumigated area for use as bioassay indicators for *M. nataliei* infection. Sixteen sites within the fumigated area were delineated, and each was divided into 2 to 4 subplots. Two to four cuttings were planted in each subplot. Soil and root samples were removed from each subplot in the fall of 1985, 1986, and 1987. Forty-nine bioassay vines were destructively sampled in the fall of each year and inspected visually for the presence of *M. nataliei*.

RESULTS

1978 Van Buren County survey: In the 1978 survey of Van Buren County, the only location where *M. nataliei* was detected was on the farm at the type location in Section 13 of Antwerp Township.

1980 Multicounty survey: *Meloidogyne nataliei* was not detected in the 127 samples collected and assayed in 1980 near the type location in Mattawan, Michigan.

1981, 1982, and 1983 Surveys: *Meloidogyne nataliei* was detected in the 1981, 1982, and 1983 surveys of Section 13 and Section 14 of Antwerp Township. The 33 infestations were located within 0.16 km of the type locale (Fig. 1). Noncultivated grapes in wooded areas north of the infested vineyards were found to harbor *M. nataliei*.

1988 Survey: *Meloidogyne nataliei* was found in two of nine root and soil samples collected from two declining vineyards located near the town of Lawton in Antwerp Township of Van Buren County. One sample was taken from Section 27, the other from Section 34 (Fig. 1). *Meloidogyne nataliei* was detected in 83 of 300 additional samples (27.7%) taken from these vineyards, and 58.2% of the samples processed from one of the vineyards were infested.

1989 Survey: *Meloidogyne nataliei* was detected on the roots of 6 of 52 samples collected in Antwerp and Porter Townships in the spring of 1989 (Fig. 1). Four of the samples containing *M. nataliei* were from Section 35 of Antwerp Township

and two from Section 7 of Porter Township (Fig. 1).

1990 Survey: *Meloidogyne nataliei* was detected in an additional site near the town of Lawton in Van Buren County. At this location, *M. nataliei* was recovered from two samples collected from noncultivated grape in a woodlot in Section 7 of Porter Township (Fig. 1).

Management program: *Meloidogyne nataliei* was recovered from one vine in 1985, two vines in 1986, and one vine in 1987 in the fumigated bioassay plot. Each recovery was from a different subplot. All infested subplots were spot-fumigated in the spring of 1988 to eliminate known infestations of *M. nataliei*.

DISCUSSION

Meloidogyne nataliei is considered a pathogen of *V. labruscana* and a risk to Michigan's grape industry. The survey results indicate that the distribution of *M. nataliei* is limited to two townships in Van Buren County (Sections 13, 14, 27, 34, and 35 of Antwerp Township and Section 7 of Porter Township). These locations represent vineyards and woodlots of four grape growers.

Most of the information known about *M. nataliei* relates to its distribution. Three new infestations have been discovered since the spring of 1988. It is believed that *M. nataliei* is being spread by mechanical means, i.e., by equipment shared between vineyards.

Meloidogyne nataliei is tolerant of near-freezing soil temperatures (3). November and December are excellent months to sample for the presence of females with egg masses. Nematodes are abundant on grape roots during these months, and although gelatinous matrices are evident, they are not often filled with eggs. It is possible that the nematode may be restricted to temperate areas. Optimal temperature requirements for egg hatch, nematode development, and reproduction are currently being determined. It has not

been possible to maintain cultures of *M. nataliei* in the greenhouse for prolonged periods of time. We suspect that this is due to the unique temperature requirements of this species.

The establishment of *M. nataliei* on noncultivated grapes adjacent to the type location appears to be related to the nature of the adjacent watershed. Noncultivated grapes in areas adjacent to the other known infested vineyards in Van Buren County should be surveyed for *M. nataliei*.

Future *M. nataliei* management programs should be designed for containment and population density reduction because the distribution of *M. nataliei* is broader than previously reported (4).

LITERATURE CITED

1. Bird, G. W. 1971. Influence of incubation solution on the rate of recovery of *Pratylenchus brachyurus* from cotton roots. *Journal of Nematology* 3:378-385.
2. Bird, G. W., and F. Warner. 1990. Detecting and avoiding nematode problems. Bulletin E-2199, Michigan State University Cooperative Extension Service, East Lansing.
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., L. M. Rose, and G. W. Bird. 1981. Description of *Meloidogyne nataliei* n. sp. (Nematoda: Meloidogynidae) from grape in Michigan, with SEM observations. *Journal of Nematology* 13:393-400.
5. Jenkins, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. *Plant Disease Reporter* 48:692.