Pathogenicity of *Merlinius brevidens* as Related to Host Development

PETE S. MAYOL, Department of Biological Sciences, California State College, Stanislaus, Turlock, CA 95380

ABSTRACT

Mayol, P. S. 1981. Pathogenicity of *Merlinius brevidens* as related to host development. Plant Disease 65:248-250.

Inoculation of wheat (*Triticum aestivum* L. 'Concho') with 400 *Merlinius brevidens* nematodes per 350 cm^3 of soil at planting caused 39 and 41% weight reduction of foliage and roots, respectively. Inoculation with 400 nematodes at the start of vernalization caused 33 and 35% reduction of foliage and roots, respectively. Inoculation with 500 nematodes at planting caused 35 and 43% reduction and at the start of vernalization caused 31 and 38% reduction of foliage and roots, respectively. Inoculation with 400, 500, or 900 nematodes midway through or after vernalization did not significantly reduce foliage or roots.

The association of *Merlinius brevidens* (Allen) Siddiqi, usually in large numbers, with roots of small grains and grasses has been reported (6,8,10). Langdon et al (3) showed that *M. brevidens* was the causal agent of stunt of small grains. They suspected that the ability of the nematode to induce the stunt symptom was closely related to temperature and wheat development. They stated, "Whether environment, particularly temperature, affects the host, the pathogen, or both, needs to be studied."

0191-2917/81/03024803/$03.00/0

Temperature requirements among stunt nematodes have been reported for *Tylenchorhynchus claytoni* (2), *T. clarus* (5), and *T. nudus* (9,11). Population response to temperature of 11 species of stunt nematodes in the subfamily Tylenchorhynchinae has been reported (4). There has been no report of pathogenicity of *Tylenchorhynchus* spp., particularly *M. brevidens,* as related to host development.

The objective of the present study was to determine the stage or stages in wheat development most vulnerable to pathogenic activities of *M. brevidens.*

MATERIALS AND METHODS

Stock cultures of *M. brevidens* were started from handpicked individual nematodes isolated from infested field soil. They were maintained on wheat (*Triticum aestivum* L. 'Concho') that was grown in autoclaved soil in 15-cm diameter clay pots.

In the experiment 1, a 25-ml suspension containing 400 *M. brevidens* was poured into each pot, which then was covered with a small quantity of additional soil, at planting, at the start of vernalization, midway through vernalization, and at the end of vernalization. The control, vernalized, was not inoculated. Each treatment consisted of three pots, with 10 plants per pot. The plants were grown in 350 cm^3 of autoclaved sandy loam soil in 15-cm diameter clay pots. They were placed at random in a controlled environment chamber with an ambient temperature averaging 22 C, a 12-hr photoperiod, and light intensity at 2,400 ft-c at bench level.

After 4-wk growth at 22 C, the plants were vernalized by lowering the temperature to 5 C ± 1 without changing the photoperiod and light intensity. Plants were maintained at this temperature for 4 wk, after which the temperature was again raised to 22 C and maintained for 7 wk, when the experiment was terminated.

At termination, the plants and soil were removed from the pots. The foliage was cut off at ground level, washed carefully, blotted dry, and weighed. The roots were washed carefully, blotted dry, weighed, and examined for damage. Nematodes were extracted from the soil by the Seinhorst inverted flask technique as modified by Chapman (1).

Experiment 2 was conducted in essentially the same manner, except that the number of nematodes was increased to 500 per pot, a 14-hr photoperiod was maintained, and 2 ml of a 20-20-20 analysis fertilizer was applied per pot at planting and after vernalization.

Because the first experiment showed that root damage by the nematodes was likely to occur before or during vernalization, 10 plants in each of three pots were inoculated with 900 nematodes midway through vernalization and at the end of vernalization. This was done to find a damaging level at these later inoculation dates.

RESULTS AND DISCUSSION

The gross fresh weights of foliage and roots were reduced significantly when *M. brevidens* nematodes were inoculated to wheat at the early stages of plant development (Table 1). Among plants inoculated with 400 nematodes at planting, the gross fresh weights of foliage and roots were significantly

Table 1. Effects of *Merlinius brevidens* on wheat inoculated at various stages of plant development[a]

Plants inoculated at	Experiment 1				Experiment 2			
	No. of nematodes		Gross fresh wt (g)[b] with (%) reduction		No. of nematodes		Gross fresh wt (g)[b] with (%) reduction	
	Inoculated	Recovered[c]	Foliage	Root	Inoculated	Recovered[c]	Foliage	Root
Planting	400	683	27.4 (39)	55.2 (41)	500	415	34.1 (35)	50.4 (43)
Start of vernalization	400	760	30.1 (33)	60.5 (35)	500	658	36.2 (31)	55.2 (38)
Midway through vernalization	400	650	43.5 (3)	72.5 (23)	500	447	46.5 (12)	68.3 (24)
					900	421	48.9 (8)	69.8 (22)
End of vernalization	400	755	46.2 (0)	79.7 (15)	500	507	56.5 (0)	85.8 (4)
					900	678	57.0 (0)	79.6 (10)
Uninoculated control, vernalized	0	0	44.7	93.5	0	0	52.7	88.9

[a]Treatment means not enclosed in the same bracket are significantly different at $P = 0.05$, according to Duncan's new multiple range test.
[b]Mean of three replicates.
[c]At end of experiment. Nematodes in 237 cm^3 of soil, mean of three replicates.

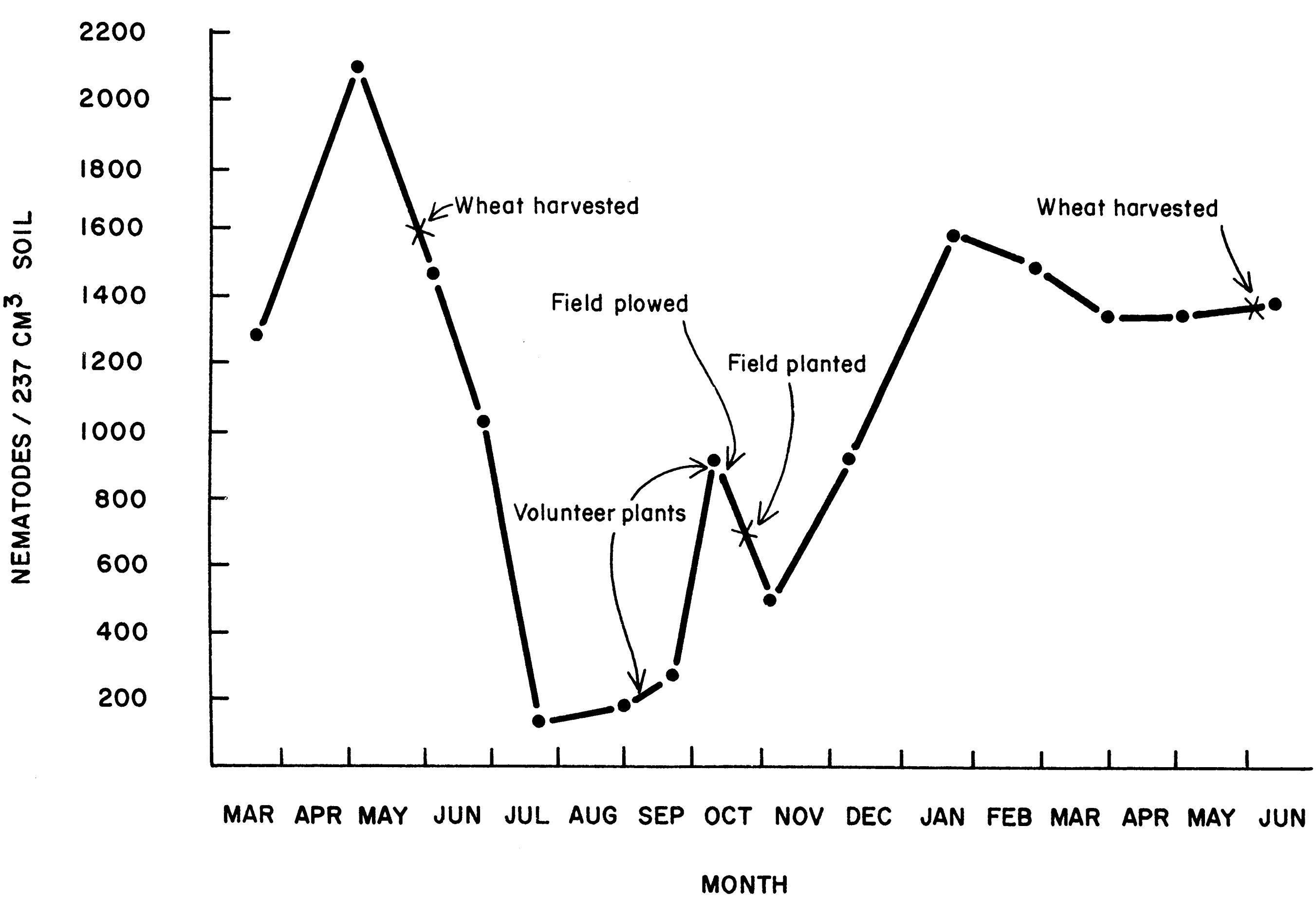

Fig. 1. Effect of the presence or absence of a host on population of *Merlinius brevidens* in the field.

reduced by 39 and 41%, respectively, compared with the uninoculated control. Increasing the nematode inoculum to 500 at planting caused 35 and 43% weight reduction of foliage and roots, respectively. Plants inoculated with 400 nematodes at the start of vernalization caused 33 and 35% foliage and root weight reduction, respectively. Increasing the nematode inoculum to 500 at the start of vernalization caused 31 and 38% foliage and root weight reduction, respectively.

No significant differences in foliage or root weights occurred when plants were inoculated with 400 or 500 nematodes or when inoculated at planting or at the start of vernalization. Inoculation with nematodes, even in numbers up to 900, midway through or after vernalization, did not result in any significant reduction of foliage or roots compared with the uninoculated control.

In addition to the reduced foliage and roots, plants inoculated at planting or at the start of vernalization were generally chlorotic and produced fewer tillers, and many did not produce an inflorescence compared with plants inoculated later or not inoculated. Root systems of plants inoculated at planting or at the start of vernalization generally produced fewer and shorter adventitious roots, and some roots appeared to be slightly shriveled. No distinct lesions nor premature breakdown or decay of the roots were evident compared with the control.

The reduction in the root systems and in the number of tillers, because of the nematode feeding, is important. Winter wheat must undergo a thermoperiod change to complete its normal reproductive cycle, and it is important that plants have adequate root system and tillers to mature and produce normal yields (7). The results of the experiment indicate that winter wheat is most vulnerable to attack by *M. brevidens* in its early stages of plant development. Hence, controlling the nematode population at planting is important to avoid the damaging effects of the nematodes on plant roots.

The nematode population density used in the greenhouse experiment was closely related to the population density observed in the field. Stunting and yellowing of wheat due to the activities of *M. brevidens* have been observed in distinct patches in the field. These areas have been most noticeable when the plants were at boot stage. Fluctuations in the population of the nematodes in the field where these patches of stunted plants occurred during one growing season are shown in Fig. 1.

The population trends of the nematodes closely followed the development of the host. Nematode population declined sharply immediately after crop harvest in summer. In early fall, the nematode population increased when volunteer wheat plants were present and then declined again when volunteer plants were removed. The nematode population again increased sharply a few weeks after wheat germination.

The trends in nematode population may also be related to low temperatures. Severe stunting of wheat in the field occurred especially after winters that have been consistently cold and with adequate moisture (3). *M. brevidens* requires low temperatures. The optimum for population increase on red clover in 90 days was 20 C, with a temperature range of 10–20 C. They could not survive at or above 30 C. Hence, a large number can be obtained in winter, whereas population drops to low levels during the summer when daily soil temperatures frequently rise above 30 C (4).

The number of nematodes recovered from the soil did not differ significantly among the times of inoculation (Table 1).

LITERATURE CITED

1. Chapman, R. A. 1958. An evaluation of methods for determining the number of nematodes in soil. Plant Dis. Rep. 42:1351-1356.
2. Krusberg, L. R. 1959. Investigations on the life cycle, reproduction, feeding habits and host range of *Tylenchorhynchus claytoni* Steiner. Nematologica 4:187-197.
3. Langdon, K. R., Struble, F. B., and Young, H. C., Jr. 1961. Stunt of small grains, a new disease caused by the nematode *Tylenchorhynchus brevidens*. Plant Dis. Rep. 43:248-252.
4. Malek, R. B. 1980. Population response to temperature in the subfamily Tylenchorhynchinae. J. Nematol. 12:1-6.
5. Noel, G. R., and Lownsbery, B. F. 1978. Effects of temperature on the pathogenicity of *Tylenchorhynchus clarus* to alfalfa and observations on feeding. J. Nematol. 10:195-198.
6. Norton, D. C. 1959. Relationship of nematodes to small grains and native grasses in North and Central Texas. Plant Dis. Rep. 43:227-235.
7. Nuttonson, M. Y. 1955. Wheat-Climate Relationships and the Use of Phenology in Ascertaining the Thermal Requirements of Wheat. Am. Inst. Crop Ecol. Wash. DC. 388 pp.
8. Oostenbrink, M., S'Jacob, J. J., and Kuiper, K. 1956. An interpretation of some crop rotation experiences based on nematode surveys and population studies. Nematologica 1:202-215.
9. Smolik, J. D. 1977. Effects of *Trichodorus allius* and *Tylenchorhynchus nudus* on growth of sorghum. Plant Dis. Rep. 61:855-858.
10. Smolik, J. D., and Malek, R. B. 1972. *Tylenchorhynchus nudus* and other nematodes associated with Kentucky bluegrass turf in South Dakota. Plant Dis. Rep. 56:898-900.
11. Smolik, J. D., and Malek, R. B. 1972. Temperature and host susceptibility studies on *Tylenchorhynchus nudus*. Proc. S.D. Acad. Sci. 51:142-145.