

INTEGRATED PEST MANAGEMENT OF *PRATYLENCHUS BRACHYURUS* ON SOYBEAN¹

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ABSTRACT

Koenning, S. R., and D. P. Schmitt. 1986. Integrated pest management of *Pratylenchus brachyurus* on soybean. *Nematropica* 16:237-244.

The biology, pathogenicity, and management of *Pratylenchus* species have been discussed. This paper evaluates current research in order to propose tactics for managing *Pratylenchus brachyurus* (Godfrey) Filipjev and Schuurmans Stekhoven on soybean, *Glycine max* (L.) Merr.

Additional key words: lesion nematode, ecology, rotations, cropping systems.

RESUMEN

Koenning, S. R., y D. P. Schmitt. 1986. Manejo integrado de *Pratylenchus brachyurus* in soya. *Nematropica* 16:237-244.

La biología, patogenicidad y manejo de las especies de *Pratylenchus* han sido discutidas. El presente trabajo evalúa la investigación actual con el objetivo de proponer tácticas para el control de *Pratylenchus brachyurus* (Godfrey) Filipjev y Schuurman Stekhoven en soya, *Glycine max* (L.) Merr.

Palabras claves adicionales: nematodo lesionador, ecología, rotaciones, sistemas de cultivo.

INTRODUCTION

Pratylenchus brachyurus (Godfrey) Filipjev & Schuurmans Stekhoven is found throughout subtemperate to tropical regions (8). This migratory endoparasite reproduces on numerous plant species (9,26) including numerous weed species (15). Its pathogenicity has been established on cotton (6), peanuts (3,10,12), soybean (18,19,22,25,26,27), and tobacco (3,13,28).

This nematode is capable of suppressing soybean yield in the absence of other pathogenic organisms (18,19,22,26,27). Previous research showed that *P. brachyurus* increased damping-off of cotton caused by *Rhizoctonia solani* (6). Species of this genus are frequently important components in other disease complexes of many plants (6,24,29).

Moderately high soil temperatures (15-30C) are required for population increase of *P. brachyurus* (1,24). However, the role of high soil temperatures in disease development on soybean has been questioned

(18,19). Early work with *P. brachyurus* and soybean demonstrated that damage in response to the nematode was greater in some soybean cultivars at lower soil temperatures than at higher soil temperatures, even though nematode reproduction was reduced at low soil temperatures (22). Microplot studies with this pest and soybean cv. Forrest showed that yield suppression and stunting were associated with cool, wet conditions (18,19). These results suggest that soybean may compensate for root damage better at higher soil temperatures.

Effects of soil pH on *P. brachyurus* are minimal (17) unless it is so extreme as to influence root distribution (7). Sandy soils generally favor movement and population increase of this parasite (9), and may also enhance the damage potential of this nematode on soybean (27). Increased host damage results in a population density decrease after mid-season (18).

Little is known about the effects of soil moisture on this nematode. However, irrigation regimes which maintained soil moisture near field capacity increased pod infection of peanut by *P. brachyurus* (12). Damage to soybean was enhanced when rainfall was excessive (18). The pest is resistant to desiccation because it can enter an anhydrobiotic state (20) to survive dry periods and may be spread in peanut hulls used as fertilizer carrier (11).

Soybean yield loss in response to this nematode, however, may be underestimated. Generally, plant growth is suppressed and roots are decayed. Because there are no symptoms specific to this disease, growers are likely to ascribe the poor growth to fertility problems, poor soil, or inadequate weed control.

Surveys conducted by Barker and Schmitt in 1975 and 1982 (personal communication) identified numerous soybean fields in which *P. brachyurus* was implicated as the causal agent for poor growth. Yet, few plant samples which come to the Plant Disease and Insect Clinic at North Carolina State University are found to contain numbers of this nematode deemed adequate to cause disease (27). The detection and/or recognition of *P. brachyurus* as a problem is further compounded because many nematode advisory services do not extract nematodes from roots, a necessity when one is concerned with an endoparasite (4).

POPULATION DYNAMICS AND PLANT DISEASE

Sufficient ecological information (7,17,18,19,23) is available about *P. brachyurus* to aid in the development of tactics to limit its damage to soybean. In the absence of damaging levels of plant-pathogenic nematodes, key factors which influence soybean yield are soil type, texture and fertility, cultivar, planting date, environmental conditions during the growing season, and other pests (Fig. 1). The population

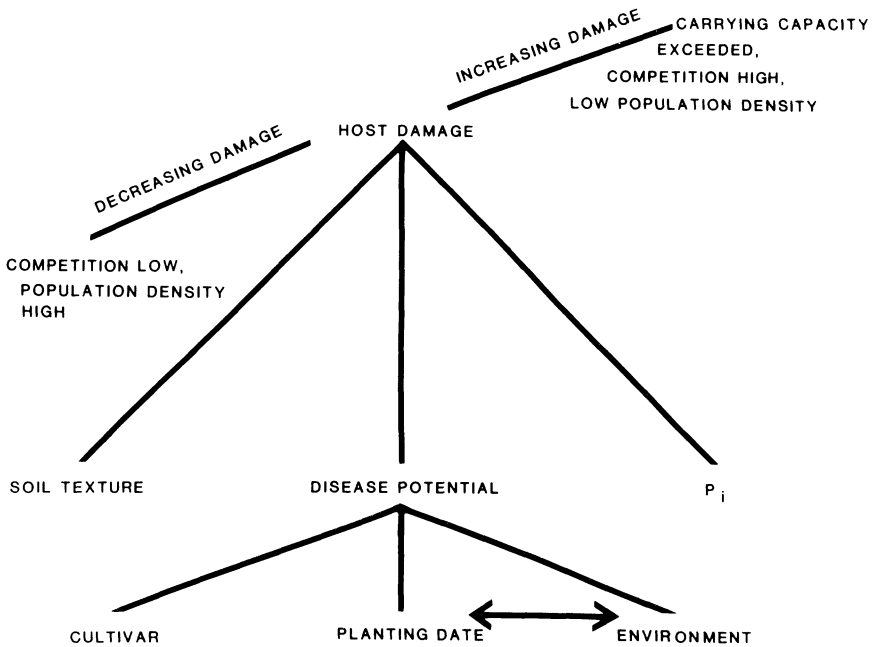


Fig. 1. Simplified schematic diagram of variables which influence the damage potential and population dynamics of *Pratylenchus brachyurus* on soybean. Planting date and environment are viewed as interacting variables. Cultivar, planting date, and environment determine the potential for plant disease. Soil texture, P_i , and disease potential will determine the extent to which soybeans will be damaged. Greater host damage results in intraspecific competition which suppresses nematode population density, and low damage allows the nematode to build a high population density.

dynamics of *P. brachyurus* are also influenced by the aforementioned factors either directly or through effects on the host. Additionally, this nematode, a relatively immobile soil inhabitant, must survive between crops and thus will be influenced by winter environmental conditions and the presence or absence of winter cover crops.

The previous year's planting date of soybean will influence the number of *P. brachyurus* present in the subsequent year (18), with early plantings producing high numbers of this pest. This effect may be modified by the extent to which the previous crop was damaged by the nematode (18,19). Severe damage will result in low population densities on soybean (Fig. 1). The current year's planting date will influence the damage potential in two distinct ways: (i) the damage decreases as plan-

ting date is delayed (18), and (ii) the inoculum density (P_i) continues to decrease as the planting date is delayed (19).

Cropping systems have a major influence on the damage potential through their effects on the population dynamics of *P. brachyurus*. In North Carolina, a maize-soybean rotation reduces the potential for damage to soybean, although maize is reported to be an excellent host (9). Maize favors the increase of a related species, *Pratylenchus zaeae* Graham, a common cohabitant with *P. brachyurus* in North Carolina (2) which probably competes with *P. brachyurus* (13,14). Early research from South Carolina indicated that numbers of *P. zaeae* were greater than numbers of *P. brachyurus* on maize (13). Olowe and Corbett (23) found that *P. zaeae* penetrates maize roots and reproduces more rapidly with shorter generation time on this host than does *P. brachyurus*. They suggested that *P. zaeae* should displace *P. brachyurus* where maize is grown because of these competitive advantages (23). In several maize-soybean rotation studies in the North Carolina coastal plain, *P. zaeae* displaced *P. brachyurus* as the dominant species of lesion nematode when maize was grown, and the reverse occurred when soybean was grown (unpublished observations). A double cropping system of wheat and soybean can minimize damage by this pest, since a winter wheat cover crop reduces the numbers of *P. brachyurus* more than winter fallow (19). Additionally, the associated delay in planting of soybean provides more time for nematode mortality resulting in a lower P_i . Fallow periods are probably not viable management tactics unless clean fallow can be maintained, since numerous weeds are hosts to *P. brachyurus* (15).

RECOMMENDATIONS

In North Carolina, growers have a number of options to manage *P. brachyurus*. North Carolina is divided geographically into the mountains, piedmont, and coastal plain. These areas contain distinct soil types, with clay and loam soils dominating the mountain and piedmont areas and sandier soils dominating the coastal plains. *Pratylenchus brachyurus* is unlikely to be an important pest in the piedmont or mountains since it will rarely maintain the higher population densities required for suppression of soybean yield in these soils (18,27).

This nematode is near its northern limit in distribution in North Carolina. Its inability to survive colder winters further north results in population levels below the damage threshold (19). Thus, available weather data can be used to further subdivide the coastal plain by the average frost-free period (14). The weather data and soil type distribution allows us to predict that damage by *P. brachyurus* will be restricted to the coastal plain in the southeastern portion of the state.

The first choice of the available management options is a soybean-maize rotation. Other rotations with monocots such as millet or sorghum may also be beneficial but have not been evaluated. Peanuts, tobacco, and cotton are hosts for this nematode (9) and should be avoided as rotation crops if this nematode is present. Peanuts, although generally considered a poor host, should be avoided since it is a legume and may favor the increase of other soilborne soybean diseases. Where a grower wishes to crop soybeans continuously, tolerance to this pest has been identified in the cultivar Essex (21,26,27). Susceptible cultivars may be used in a wheat/soybean double-cropping system because of the negative impact of this system on *P. brachyurus*. Finally, certain nonfumigant nematicides are effective in reducing population densities and limiting subsequent yield suppression in early plantings (18,21).

The aforementioned recommendations are fairly specific to North Carolina. A similar approach may be useful in other regions of the world provided there is adequate information on population dynamics, climate, and host status of various crops. A report from Florida indicated that maize increases the population density of *P. brachyurus* compared to soybean (16). The discrepancy between North Carolina and Florida data may be a result of different climates, nematode biotypes, other nematode cohabitants, or cultural practices. Such discrepancies illustrate the need for regionalized research on pest populations. Climatic, biotic, and/or cultural conditions may affect the viability of a rotation system.

NEED FOR FURTHER RESEARCH

The synthesis of research presented in this paper provides a basis for predicting where and when damage to soybean caused by *Pratylenchus brachyurus* is likely to occur in North Carolina. More research is required to refine our predictions and expand them to other areas. For instance, little information is available about the abilities of this pest to survive hot fallow periods in the tropics. Similarly, the pest status of *P. brachyurus* in many tropical areas is poorly defined.

Research is needed to develop additional control tactics, and to identify tolerance in soybean cultivars currently available. Improved techniques for extraction of endoparasitic nematodes are needed to increase the efficiency of a diagnostic service. Most current procedures (mist extraction or Baermann funnel) require excessive amounts of lab space and time. Mechanical maceration of roots or the use of a shaker and various incubation solutions (5) can be used to improve extraction of *P. brachyurus* but require a greater expenditure for equipment. Extension programs need to emphasize the inclusion of roots in soil samples taken by growers.

Tolerance to *P. brachyurus* is available in tobacco, peanuts, and soybean (21,26,27,28,29), and is known to be genetically controlled in tobacco (28). However, the current emphasis in soybean breeding for resistance to *Heterodera glycines* Ichinohe and *Meloidogyne* spp. results in resistance screening being done in fields heavily infested with these nematodes. *Pratylenchus brachyurus* is a poor competitor in these situations (16) and is likely to be absent or in low numbers. Thus, soybean cultivars resistant to the more serious nematode pests may lack tolerance to *P. brachyurus*. The current proliferation of soybean cultivars dictates that these cultivars be screened for tolerance to nematode pests other than cyst and root-knot nematodes.

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