Vertical Distribution of *Pratylenchus Alleni* and *P. Scribneri* in Soybean Roots.[1, 2]

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ABSTRACT

In a study of the distribution of *Pratylenchus alleni* and *P. scribneri* within Clark 63 soybean roots from nematode-infested soil, populations of both nematode species were most abundant in the first 10–15 cm of the root zone, 30 days after planting. There was a distinct decrease in nematode population density in both species with depth of the taproot. Fifty percent of the total *P. alleni* population in lateral roots was located in the first 5 cm from the taproot, whereas only 26% of *P. scribneri* population occurred in this region.

INTRODUCTION

Vertical distribution and movement of nematodes in the soil is irregular and highly variable. In cultivated soils, it is generally closely related to the distribution of the plant roots or to the rhizosphere (1). The distribution is greatly affected by abiotic or biotic factors such as temperature, rainfall and depth of subsoil (1,2,4,5,7). Nematodes are concentrated mainly in the top 30 cm of soil. The distribution and number of individuals within the area of a given species are determined by the environmental components (4,7). Since the rate of oxgen received by a nematode would increase with a decrease in moisture content in the soil, oxygen concentration in the soil therefore, will probably affect penetration of roots and further distribution of nematodes within the roots. Soil moisture is among the most important factors influencing nematode populations. Studies conducted to determine the distribution of *Pratylenchus alleni* Ferris, in wet and dry regimes, indicated that there were more *P. alleni* per unit length of taproot in the dry than in the wet regime in the top 5-cm (5).

MATERIALS AND METHODS

The distribution of lesion nematodes in Clark 63 soybean roots from plants grown in the greenhouse was studied in two experiments. Black polyvinyl chloride (PVC) piping was cut into sections 30 cm long forming cylinders 9.5 diam, and then filled with Sparta loamy-sand (84.9% sand, 10.2% silt and 4.9% clay with 0.4% organic content and pH 4.3) infested

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with nematodes. The soil was infested by mixing appopriate amounts of autoclaved soil with soil from culture pots containing *Pratylenchus alleni* Ferris or *P. scribneri* Steiner in a Twin Shell dry blender (Patterson-Kelly Company, Inc., East Stroudsburg, Pa.)[4]. Each cylinder was inserted vertically in a 12 cm diam plastic container to prevent soil loss from the bottom, planted with a 3-day-old seedling and placed on a greenhouse bench for 45 days.

In the first test were used sixteen 57 × 9.5 cm black PVC cylinders each containing 2,500 cm^3 of soil infested with 2,000 *P. scribneri*. Forty-five days after planting, shoots were cut at the cotyledonary node, and the soil was gently washed from the roots. The roots were divided into three parts: the primary root, averaging 27 cm and the top and bottom halves of the lateral root system, each averaging 20 cm long. Roots in each portion were cut into small pieces (0.75 cm) and placed in funnels inside the mist chamber. Numbers of nematodes recovered were determined after a 10-day extraction period.

TABLE 1.—*Numbers (1,000's) of* **Pratylenchus scribneri** *and percent of the total population in different parts of the root system of soybean roots 45 days after planting in soil infested with 2,000 nematodes/container (Experiment 1)*

Taproot		Lateral roots[1]			
		Upper half		Lower half	
Number	%	*Number*	%	*Number*	%
0.8a	14	4.2b	79	0.4a	7

[1] Each value is the mean of 16 replications; nematode number means followed by unlike letters differ (P = 0.05) according to Duncan's New Multiple Range Test *t* test.

In the second test, were included twelve 37.5 × 9.5 cm white PVC cylinders, each containing 2,300 cm^3 of soil. Five cylinders were filled with soil containing approximately 2,500 *P. alleni* per cylinder, and seven containing 2,000 *P. scribneri* per cylinder. Thirty days after planting, shoots were removed and soil washed from the cylinder and roots. The root system was divided into two parts, taproot and lateral roots, each approximately 25 cm long. Each part was subdivided into sections, each averaging 5 cm long. Nematodes were mist-extracted from the individual sections for 10 days, after which time populations were estimated.

RESULTS AND DISCUSSION

Results in the first test demonstrated that most of the *Pratylenchus scribneri* population in the roots was recovered from the top half of the

[4] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

lateral root system 45 days after planting (table 1). Seventy-nine percent of the population was located in this area, while only 14 and 7% was present in the taproot and lower half of the lateral roots, respectively. The total nematode population increased less than 3-fold during this period.

In the second test, over 82% of the total *P. alleni* and *P. scribneri* populations was recovered from the lateral roots system, 30 days after planting (table 2). There was a distinct decrease in population density of both nematode species with depth of the taproot and distance of the

TABLE 2.—*Numbers (1,000's) of* **Pratylenchus alleni** *and* **P. scribneri** *and percent of the subtotal and total populations in different sections of the taproot and lateral roots of soybean 30 days after planting in infested soil (Experiment 2)*

Root section	Taproot		Lateral roots		Total	
	Number	%	*Number*	%	*Number*	%
			P. alleni[1,2]			
0–5	2.4a	27	20.7a	50	23.1	46
5–10	2.8a	32	6.7b	16	9.5	19
10–15	1.3b	15	5.4b	13	6.7	13
15–20	1.6b	18	4.2b	9	5.3	11
20–25	0.6b	7	4.5b	11	5.2	10
Total	8.7	–	41.5	–	50.3	–
			P. scribneri[1,3]			
0–5	1.4a	35	5.1a	26	6.4	28
5–10	1.0a	26	5.2a	27	6.3	27
10–15	0.8b	20	3.6b	19	4.4	19
15–20	0.5b	12	3.3b	17	3.8	16
20–25	0.2b	6	2.0b	10	2.3	10
Total	3.9	–	19.2	–	23.2	–

[1] Means in column followed by unlike letters differ (P = 0.05) according to Duncan's New Multiple Range Test

[2] Each value is the mean of five replications; inoculum level was 2,000 nematodes/container.

[3] Each value is the mean of seven replications, inoculum level was 2,000 nematodes/container.

laterals from the taproot. In the taproot, both species were more numercous in the top 10 cm, where approximately 60% of the population occurred, than at lower depth, but there were no significant differences in numbers within the top 10 cm. Fifty percent of the *P. alleni* population in the lateral roots was located in the first 5 cm from the taproot with approximately equal numbers recovered from more distal sections. The *P. scribneri* population was more dispersed throughout the lateral roots, only 26% occurring within the first 5 cm. The trend in total distribution

of both species away from the plant crown closely paralleled that in the the lateral root system.

The total population of *P. scribneri* had increased almost 12-fold during the 1-month period, this was considerably faster than in the first test. High soil temperatures, because of absorption of heat by the black containers used in the first test, probably suppressed population development. The total population of *P. alleni* in the second test increased 16-fold, and roots were distinctly more necrotic than those infected by *P. scribneri*.

The results of these tests in uniformly infested soil contrast with observations by Norton and Burns (5), who found the highest number of *P. alleni* in the top 5 cm of taproot of soybeans 14 days after seeding, with little colonization of the lateral roots. Dave (3) noted that the *P. scribneri* population became concentrated in the taproot of soybeans when the nematodes were added to the soil just below the seed. These workers, however, used relatively small growth containers, which concentrated the nematode population and restricted vertical and lateral growth of roots. The findings are comparable, however, with those of Tobar-Jiménez et al. (6), who found that populations of *Pratylenchus* spp. were most abundant in the first 10–15 cm of roots of different plant species in a natural meadow in Spain. The concentration closer to the crown in the soybean plants was probably due to less moisture stress near the soil surface under greenhouse conditions than in the field.

The high density of root population in the upper portions of the column, even when the soil was uniformly infested initially, could be due to several factors. Population expansion would be expected to begin earliest in the young seedling in its first roots. Greatest densities, therefore, would be encountered in this area of the root systems at any point early in the plant growth cycle, before intraspecific competition and severe root deterioration commences. Moreover, penetration at these depths may be facilitated by the relatively large openings in the epidermis created by the emergence of secondary and tertiary roots in this area of the developing root system. Wallace (7) and Jones (4) stated that the environmental components that determine the limits of distribution of a species are the same as those that determine the number of individuals within the area of its distribution. Wallace notes that a nematode will receive oxygen at a greater rate, not only as the soil moisture content decreases, but also the closer it is to the soil surface. Oxygen concentration in the soil, therefore, may also affect nematode penetration of roots and subsequent distribution within the root system through its influence on nematode activity. Little is known about the rate of movement of lesion nematodes in soil, but upward movement toward the developing root

system probably contributed little to the greater concentration of these nematodes in soybean roots at upper levels of the soil column.

RESUMEN

En un estudio de la distribución de *Pratylenchus alleni* y *P. scribneri* en raíces de la variedad de soya Clark 63, procedente de un suelo infestado, las poblaciones de ambas especies de nematodos fueron más abundantes en los primeros 10–15 cm de la zona radical, 30 días después de la siembra. Hubo una marcada reducción gradual de la densidad poblacional de ambas especies a medida que aumentaba la profundidad de la raíz primaria. Un cincuenta por ciento del total de la población de *P. alleni* en raíces laterales estaba localizada en los primeros 5 cm de la raíz primaria, mientras que sólo un 26% de la población de *P. scribneri* se encontró en esa región.

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