Effects of *Paratylenchus projectus* on Growth of Sunflower

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ABSTRACT

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Paratylenchus projectus significantly ($P < 0.05$) reduced sunflower seed yields in a greenhouse study. Yield reductions occurred in both fertilized and unfertilized treatments and ranged from 12 to 33%. Application of fertilizer did not affect *P. projectus* damage to sunflower. Populations of *P. projectus* increased 20- to 126-fold over 14 wk. Population increase of *P. projectus* on sunflower was highest at 20 and 25 C, and populations did not increase above initial inoculum levels at 10, 15, or 35 C.

Sunflower (*Helianthus annuus* L.) is an important crop in the northern Great Plains, where it is indigenous and subject to a variety of insect pests and diseases (4). There is little information concerning effects of nematodes on sunflower in this area. Sunflower is host to a variety of nematodes in the southern United States (1), and nematicide treatment increased yields in Florida (8). Nematicide treatments have also increased sunflower yields 15–24% in South Dakota (9); however, the nematicide used in the South Dakota study (carbofuran) also reduced stem weevil (*Apion occidentale* Fall and *Cylindrocopturus adspersus* LeConte) populations. In a South Dakota survey, the most common plant-parasitic nematodes associated with sunflower were *Paratylenchus projectus* Jenkins, *Quinisulcius acutus* (Allen) Siddiqi, *Tylenchorhynchus nudus* Allen, and *Xiphinema americanum* Cobb (10). The dominant member of this group was *P. projectus*; late-season populations frequently ranged from 1,500 to 4,000 per 100 cm^3 of soil. *P. projectus* is widely distributed in North America (6) and has been associated with reduced forage growth (3,11). It also has been associated with sunflower in Korea (7). The objective of this study was to determine the effects of *P. projectus* on sunflower growth under greenhouse conditions. Because early planting of sunflower in the northern Great Plains will result in cool soil temperatures during early stages of plant growth, the effects of soil

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temperature on development of *P. projectus* populations on sunflower were also investigated.

MATERIALS AND METHODS

P. projectus was obtained from a sunflower field in Spink County, South Dakota, and increased on sunflower in the greenhouse. Ambient greenhouse air temperatures were maintained at 24 ± 3 C, and supplemental lighting was supplied when necessary to extend the photoperiod to 15 hr. The greenhouse experiment was a factorial arrangement of four inoculation and two fertility treatments in a completely randomized design with six replicates. One thousand cubic centimeters of steam-pasteurized soil (55% sand, 24% silt, and 21% clay) was placed in 15-cm-diameter clay pots and lightly moistened. Pots were inoculated with a 20-ml suspension of 5,000, 10,000, or 15,000 *P. projectus* or 20 ml of supernatant water from a settled *P. projectus* suspension (control). Four seeds of sunflower hybrid MF707 were added to each pot and covered with 200 cm^3 of soil. Half of the pots within each inoculation treatment were fertilized at planting and at 4-wk intervals thereafter with 250 ml of 20-20-20 NPK fertilizer (10 g/L). One week after emergence, plants were thinned to one per pot. Fourteen weeks after planting, heads were clipped, oven-dried at 50 C for 72 hr, and hand-threshed, then seed yields were recorded. Soil was washed from roots, the soil suspension was raised to a volume of 8 L, nematodes were extracted from a 2-L aliquot (2), and their numbers were estimated.

The temperature study was conducted in tanks maintained at 10, 15, 20, 25, 30, and 35 C (±1 C). Two hundred cubic centimeters of sterile sand was placed in plastic containers 10 cm in diameter × 21 cm long and covered with 600 cm^3 of steam-pasteurized soil. Soil was lightly moistened, and a 20-ml suspension of 5,000 *P. projectus* was added to each container. Seeding was done as described for the greenhouse study. Ten days after planting, seedlings were thinned to one per container and containers were placed in the temperature tanks. Each treatment was replicated four times. Plants were fertilized at planting and at 4-wk intervals with 100 ml of 20-20-20 NPK fertilizer (10 g/L). Eleven weeks after planting, cylinders were removed, plants were clipped at soil level and dried and weighed, and nematodes were extracted as previously described.

RESULTS AND DISCUSSION

P. projectus significantly ($P < 0.05$) reduced sunflower seed yields (Table 1). The interaction of fertilizer with *P. projectus* was not significant ($P > 0.05$), indicating effects of *P. projectus* on sunflower seed yield were similar with and without fertilizer. Both seed yield and final populations of *P. projectus* were significantly ($P < 0.01$) greater in the fertilized treatments. The reduced growth of sunflower, as evidenced by seed yield, in the unfertilized treatments apparently restricted population development of *P. projectus*.

Population increase (P_f/P_i) of *P. projectus* over the 14 wk of this study ranged from 69 to 126 in the fertilized treatments and from 20 to 52 in the unfertilized treatments (Table 1). Sunflower appears to be an excellent host for *P. projectus*, and it is probable that control of *P. projectus* populations was in part responsible for the yield increases observed in the nematicide studies (9). *P. projectus* is a mild parasite, however, and large populations appear necessary for substantial plant growth reduction.

Populations of *P. projectus* developed best at 20 and 25 C (Table 2), and the highest population occurred at 20 C. Populations did not increase above the initial inoculum level at 10, 15, or 35 C. The large population increase between 15 and 20 C indicates the minimum temperature for population development of *P. projectus* on sunflower lies between these temperatures. Sunflower grew well at all temperatures tested (Table 2); root supply probably was not a limiting factor in nematode reproduction at any temperature. Mean soil temperatures at 10-cm depth in the principal sunflower production area in South Dakota generally do not exceed 15 C until the first week of June (5). Therefore, early planting (mid-April to early May) of sunflower may reduce *P. projectus* damage to this crop.

Table 1. Effects of *Paratylenchus projectus* on growth of sunflower in the greenhouse with and without fertilizer

Fertilizer	*P. projectus*[a]			Seed yield (g)	Percent yield reduction
	P_i	P_f	P_f/P_i		
+	0	0	0	6.43[b]	–
+	5,000	628,330[c]	126	5.21	19[d]
+	10,000	721,670	72	5.65	12
+	15,000	1,040,600	69	4.33	33
–	0	0	0	1.73	–
–	5,000	257,500	52	1.46	16
–	10,000	403,160	40	1.40	19
–	15,000	300,100	20	1.45	16

[a] P_i = initial population and P_f = final population per pot.
[b] Mean of six replicates. Seed yield of fertilized treatments was significantly ($P < 0.01$) greater than that of unfertilized treatments. Reductions in seed yields in *P. projectus*-inoculated treatments were significant ($P < 0.05$).
[c] Populations of *P. projectus* were significantly ($P < 0.01$) higher in fertilized treatments.
[d] Compared with control (P_i = 0) within fertilizer treatment.

Table 2. Population development of *Paratylenchus projectus* on sunflower at six soil temperatures

Soil temperature (C)	*P. projectus*[a]		Plant weight (g)
	P_f	P_f/P_i	
10	1,220 ± 321[b]	0.24	8.69[c]
15	2,535 ± 456	0.51	11.01
20	113,350 ± 10,797	22.67	11.27
25	103,500 ± 17,002	20.70	12.29
30	11,730 ± 4,611	2.35	12.42
35	383 ± 173	0.08	9.66

[a] Initial population (P_i) = 5,000; P_f = final population.
[b] Mean ± standard error (n = 4).
[c] Total aboveground dry weight; mean of four replicates.

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