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Host Status of Seven Weed Species and Their Effects on *Ditylenchus destructor* Infestation of Peanut

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Abstract: The host suitability to *Ditylenchus destructor* of seven common weed species in peanut (*Arachis hypogaea*) fields in South Africa was determined. Based on the number of nematodes per root unit, white goosefoot (*Chenopodium album*), feathertop chloris (*Chloris virgata*), purple nutsedge (*Cyperus rotundus*), jimson weed (*Datura stramonium*), goose grass (*Eleusine indica*), khaki weed (*Tagetes minuta*), and cocklebur (*Xanthium strumarium*) were poor hosts. *Ditylenchus destructor* survived on all weed species; population densities increased in peanut hulls and caused severe damage to seeds of peanut grown after weeds. Roots of purple nutsedge left in the soil suppressed populations of *D. destructor* and root and pod development in peanut grown after the weed. However, nematode populations in peanut hulls and seeds were not suppressed. Some weed species, especially purple nutsedge which is common in peanut fields, can be used to indicate the presence of *D. destructor* in the absence of peanut.

Key words: Arachis hypogaea, Chenopodium album, Chloris virgata, cocklebur, *Cyperus rotundus, Datura stramonium, Ditylenchus destructor, Eleusine indica,* feathertop chloris, goose grass, host status, jimson weed, khaki weed, peanut, purple nutsedge, South Africa, *Tagetes minuta, Xanthium strumarium.*

The potato rot nematode, *Ditylenchus destructor* Thorne, is an important pest of peanut only in South Africa (4,15). It has been isolated in large numbers from peanut pegs, hulls, and seeds and has caused severe damage to the appearance and yield of seeds (4). Seventy-three percent of 877 seed samples graded "damaged" from all major peanut producing areas were infected (4). *Ditylenchus destructor* is a migratory endoparasite, mainly on the underground parts of plants, and is most important in the northern hemisphere as a pest of potato tubers and tubers of bulbous flowers (12). More than 70 crops and weeds are hosts of *D. destructor* (12).

White goosefoot (*Chenopodium album* L.), goose grass (*Eleusine indica* (L.) Gaertn.), purple nutsedge (*Cyperus rotundus* L.), jimson weed (*Datura stramonium* L.), and khaki weed (*Tagetes minuta* L.) are among the most common weed species in peanut fields in South Africa. Purple nutsedge, jimson weed, and khaki weed are sometimes difficult to control by normal practices. Feathertop chloris (*Chloris virgata* Sw.) and cocklebur (*Xanthium strumarium* L.) are also found in peanut fields in South Africa.

Weeds may be good or poor hosts of plant-parasitic nematodes (7,10,11). If weeds are good hosts, they may maintain nematode populations between susceptible crop seasons (5,11), and they may serve as indicator hosts for the presence of plant-parasitic nematodes before the planting of susceptible crops (11).

The objectives of our study were 1) to establish the host suitability of seven common weed species to *D. destructor* and 2) to determine the effects of weed species on maintenance of *D. destructor* populations in the absence of peanut on subsequent *D. destructor* infestation of peanut.

Materials and Methods

Three greenhouse experiments were conducted. The following procedures were used in all experiments: seeds of white goosefoot, feathertop chloris, purple nutsedge, jimson weed, goose grass, khaki weed, cocklebur, and peanut (*Arachis hypogaea* L. cv. Sellie) were planted in 3-liter plastic pots filled with steamed sandy soil (93% sand, 4% silt, 3% clay). *Rhizobium* nitrogen-fixing bacteria were added to the soil containing peanut seeds. In experiments 1 and 3, the weed and peanut seeds were planted in eight pots each while in

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experiment 2 the seeds were planted in 16 pots. Seedlings were thinned to 10 weeds and 1 peanut plant per pot. Plants were fertilized by irrigation with tap water containing a hydroponic nutrient powder (6.5% N, 2.7% P, 18% K) and maintained at 20–25 C with a 13-hour photoperiod. *Ditylenchus destructor* obtained from an infested peanut field was increased in monoxenic cultures on callus tissues initiated from peanut leaves (20). Inoculum consisted of nematodes of different life stages. Four weeks after planting, nematodes (5,000, 7,000, and 13,000 per pot in experiments 1, 2, and 3, respectively) were pipetted in 10-ml aqueous suspensions into holes in the soil around the roots. Ten weeks after planting, all plants in experiments 1 and 3 and half of the plants in experiment 2 were harvested and fresh root weights were determined. Nematodes were extracted from 200-cm^3 soil subsamples by a modified decanting and sieving method (6) using 710-μm-pore and 45-μm-pore sieves, followed by the centrifugal-flotation method (14); nematodes also were extracted from 5 g fresh roots (2).

In experiment 2, stems were cut at the base of the remaining plants and the roots remained undisturbed in the soil. In experiment 3, all roots were removed from the soil and soil in which each weed species or peanut had been grown was combined, thoroughly mixed, and again divided into eight pots. In both experiments, peanut seeds were planted in the soils previously planted to weeds and peanut. Plants were harvested 20 weeks after planting. Fresh root, peg, hull, and seed weights were determined, and nematodes were extracted from soil and roots as described in the previous paragraph. Nematodes were extracted from the pegs (2) and from fresh hulls and seeds by soaking the tissues in shallow water in petri dishes for 24 hours at room temperature (1).

In experiment 3, mature pods were rated for severity of symptoms on a 0–10 scale: 0 = clean pod; 2 = black discoloration at either peg or beak end of pod; 4 = black discoloration at both ends of pod; 6 = black discoloration extending along one longitudinal vein joining peg and beak ends of pod; 8 = black discoloration extending along both longitudinal veins joining peg and beak ends of pod; and 10 = black discoloration extending over more than 80% of pod surface. Mature pods were opened and the seeds were rated for disease severity (number of discolored or sprouted seeds per total number of seeds) $\times 10$.

The experimental design was a randomized complete block for all experiments. Treatments were replicated eight times in experiments 1 and 3, and 16 times in experiment 2. Population data were transformed to $\log_e$ before analyses of variance were calculated.

Results

Very few *D. destructor* ($< 7/200$ cm^3 soil) were extracted from soil subsamples and were not included in the calculations of the final nematode population densities.

The final population densities per 5 g roots were lower ($P = 0.05$) in all weed species, except purple nutsedge (experiment 2), than in peanut (Table 1). The highest ($P = 0.05$) numbers of nematodes per root unit among the weed species were supported by feathertop chloris and jimson weed in experiment 1, purple nutsedge in experiment 2, and khaki weed in experiment 3. Cocklebur supported the lowest ($P = 0.05$) number of nematodes per root unit in experiment 1; jimson weed and goose grass supported the lowest number in experiment 2; and cocklebur, goose grass, and feathertop chloris supported the lowest number in experiment 3.

In experiment 2, initial nematode populations in soil per pot averaged 64 in pots previously planted to weeds and 273 in pots previously planted to peanut. Final population density in soil and per root unit was lower ($P = 0.05$) in peanut grown after purple nutsedge than in peanut grown after the other weed species and peanut (Table 2). Population densities of *D. destructor* in hulls and seeds were not different in peanut grown after the weed species and peanut. The highest number of *D. destruc-*

TABLE 1. Root population densities of *Ditylenchus destructor* on seven weed species and peanut, 10 weeks after planting.

Host	Experiment 1		Experiment 2		Experiment 3	
	Nematodes/5 g roots	Fresh root weight (g)	Nematodes/5 g roots	Fresh root weight (g)	Nematodes/5 g roots	Fresh root weight (g)
Cocklebur	1 a	53.9	8 bc	5.8	3 a	6.1
Khaki weed	6 b	29.1	8 bc	4.7	45 c	5.1
Goose grass	10 bc	52.4	1 a	18.7	5 a	16.2
Jimson weed	17 c	9.9	2 ab	3.8	21 b	4.3
Purple nutsedge	9 bc	61.0	43 e	24.3	12 b	13.8
White goosefoot	8 bc	9.6				
Feathertop chloris	19 c	16.4			5 a	6.4
Peanut	125 d	11.3	19 d	11.7	144 d	3.1

Numbers are the means of eight replicates. Column means followed by the same letter do not differ ($P = 0.05$) according to the Student-Newman-Keuls range test.

tor extracted from 2 g fresh hulls was 45,276 (from peanut grown after goose grass). The highest number from 5 g fresh seeds was 57,288 (also from peanut grown after goose grass). The total number of *D. destructor* extracted from soil, roots, pegs, hulls, and seeds varied from 14,005 per plant (from peanut grown after purple nutsedge) to 62,629 per plant (from peanut grown after peanut). Fresh root, hull, and seed weights of peanut grown after purple nutsedge were lower ($P = 0.05$) than those of peanut grown after the other weed species and peanut.

In experiment 3, before planting peanut, no nematodes were recovered from pots in which khaki weed, jimson weed, and purple nutsedge had grown. Following the remaining weeds and peanut, initial nematode population densities in soil were fewer than 5/pot. Final population densities in hulls of peanut grown after feathertop chloris, cocklebur, and purple nutsedge were suppressed ($P = 0.05$) compared with peanut grown after peanut (Table 3). Seeds of peanut grown after peanut supported the highest ($P = 0.05$) number of *D. destructor*. Population densities in seeds of peanut grown after purple nutsedge and feathertop chloris were lower ($P = 0.05$) than in peanut grown after the other weed species. The highest number of *D. destructor* extracted from 2 g fresh hulls was 50,312 (from peanut grown after purple nutsedge). The highest number from 5 g fresh seeds was 21,437 (from peanut grown after khaki weed). The total number of *D. destructor* recovered from soil, roots, pegs, hulls, and seeds varied from 6,101 per plant (from peanut grown after feathertop chloris) to 77,860 per plant (from peanut grown after peanut). Pod and seed ratings were highest in peanut grown after peanut and lowest in peanut grown after feathertop chloris (Table 4).

TABLE 2. Numbers of *Ditylenchus destructor* in soil, roots, pegs, hulls, and seeds and fresh weights of roots, pegs, hulls, and seeds of peanut grown after weeds or peanut, 20 weeks after planting (experiment 2).

Previous host	Number nematodes					Fresh weight (g)			
	Soil	5 g roots	1 g pegs	2 g hulls	5 g seeds	Root	Peg	Hull	Seed
Cocklebur	1,573 c	31 b	174 ab	7,833 a	4,932 a	7.2 bc	1.5 a	5.5 b	5.4 b
Khaki weed	659 bc	55 b	97 a	8,629 a	3,814 a	7.7 cd	1.5 a	7.0 b	6.3 b
Goose grass	230 b	24 b	238 b	10,746 a	16,112 a	5.8 b	2.1 a	6.0 b	5.1 b
Jimson weed	492 b	20 b	385 b	13,447 a	6,944 a	6.6 bc	1.4 a	7.0 b	5.4 b
Purple nutsedge	9 a	4 a	169 ab	3,729 a	8,823 a	3.2 a	1.2 a	3.8 a	3.8 a
Peanut	1,494 c	69 b	454 b	13,581 a	12,368 a	9.7 d	1.6 a	6.8 b	5.7 b

Numbers are the means of eight replicates. Column means followed by the same letter do not differ ($P = 0.05$) according to the Student-Newman-Keuls range test.

TABLE 3. Numbers of *Ditylenchus destructor* in soil, roots, pegs, hulls, and seeds and fresh weights of roots, pegs, hulls, and seeds of peanut grown after weeds or peanut, 20 weeks after planting (experiment 3).

Previous host	Number nematodes					Fresh weight (g)			
	Soil	5 g roots	1 g pegs	2 g hulls	5 g seeds	Root	Peg	Hull	Seed
Cocklebur	272 a	149 a	883 a	7,845 ab	2,609 b	3.7 a	1.3 a	3.9 a	7.4 a
Khaki weed	128 a	172 a	349 a	13,846 bc	5,674 b	3.4 a	1.3 a	3.4 a	7.6 a
Goose grass	173 a	199 a	882 a	18,955 c	3,395 b	5.2 a	1.3 a	3.0 a	6.7 a
Jimson weed	144 a	157 a	494 a	13,376 bc	4,093 b	4.7 a	1.5 a	3.2 a	6.9 a
Purple nutsedge	50 a	92 a	355 a	8,250 ab	147 a	2.7 a	1.2 a	2.8 a	6.0 a
Feathertop chloris	163 a	43 a	104 a	2,194 a	844 a	3.0 a	1.3 a	3.8 a	9.5 a
Peanut	500 a	314 a	2,058 a	41,039 c	9,991 c	3.6 a	1.2 a	3.0 a	6.6 a

Numbers are the means of eight replicates. Column means followed by the same letter do not differ ($P = 0.05$) according to the Student-Newman-Keuls range test.

DISCUSSION

The seven weed species varied in host suitability for *D. destructor* under greenhouse conditions. Ranking of the weed species, based on the number of *D. destructor* per root unit, varied among the experiments: khaki weed supported about the same number of nematodes per root unit as purple nutsedge in experiments 1 and 3, but in experiment 2 purple nutsedge supported more nematodes than khaki weed. The cause of these differences is not known. Since the root biomass of all weed species, except purple nutsedge, and peanut was higher in experiment 1 than in experiments 2 and 3, root biomass may have played an important role, as reported by Jaffee (13).

Cocklebur supported the lowest number of *D. destructor* in two of the three experiments. Common cocklebur, *X. pennsylvanicum* Walbr., supported the lowest numbers of *Meloidogyne incognita, Pratylenchus brachyurus, P. neglectus,* and *P. scribneri* compared with several other weed species (11). Leaf extract of cocklebur killed second-stage juveniles of *Meloidogyne javanica* (18). It is not known what caused this nematicidal effect, but the known natural nematicidal principles, a-terthienyl and 5-(3-buten-1-ynyl)-2,2′-bithienyl, were absent in cocklebur (8). Khaki weed supported the highest number of *D. destructor* in one of the three experiments. Khaki weed suppressed populations of *P. brachyurus* (9) and *P. zeae* (17).

None of the weed species studied can be considered a good host of *D. destructor*; however, our results show that the weeds can play an important role in the survival of *D. destructor* when peanut is not grown. Populations of *D. destructor* survived on all weed species tested, increased to large numbers in hulls and seeds of peanut grown after the weeds, and caused severe damage to the seeds. The short life cycle of *D. destructor,* only 6–7 days at 28 C (3), is responsible for the high reproductive potential. Some of the weed species tested, especially purple nutsedge which is very common in peanut fields in South Africa, can be used as indicator plants for the presence of *D. destructor.*

The large populations of *D. destructor* recovered from roots, pegs, hulls, and seeds of peanut grown in soil from which no nematodes were extracted before planting suggest that *D. destructor* was present either as eggs or anhydrobionts. Neither eggs nor

TABLE 4. Pod and seed ratings of peanut grown in soil following weeds or peanut, 20 weeks after planting.

Previous host	Pod rating†	Seed rating‡
Cocklebur	2.2	1.6
Khaki weed	1.5	2.4
Goose grass	3.0	4.5
Jimson weed	2.1	4.3
Purple nutsedge	1.2	2.8
Feathertop chloris	0.2	0.4
Peanut	4.0	7.1

Ratings are the means of eight replicates.

† Based on a scale where 0 = clean pod and 10 = black discoloration extending over more than 80% of pod surface.

‡ $\frac{\text{Number of discolored or sprouted seeds}}{\text{Total number of seeds}} \times 10.$

anhydrobionts can be extracted by the method used. Thorne (19) suggested that *D. destructor* overwinters in the soil as eggs, and coiled specimens have been observed (16).

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