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Minimizing Damage by *Ditylenchus destructor* to Peanut Seed with Early Harvest[1]

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Abstract: Greenhouse and microplot experiments were conducted to evaluate the damage potential of *Ditylenchus destructor* on four South African commercial peanut cultivars as influenced by harvest date. The cultivars Sellie and Harts should be harvested by 150 and 120 days after planting, respectively. Losses were 12–13% with early harvest, but a 15-day delay resulted in losses of 45–49%. Harvest of Natal Common and Norden at 125 and 145 days after planting, respectively, resulted in the highest seed grade. By normal harvest time (140 and 160 days, respectively) these two cultivars were downgraded to crushing seed quality. Even though seed weight increases with time, a net loss occurs if harvest is delayed.

Key words: Arachis hypogaea, Ditylenchus destructor, economic loss, nematode, peanut.

The peanut (*Arachis hypogaea* L.) cultivar Sellie is produced on 97% of the 200,000 hectares grown to this crop in South Africa. Three other cultivars also grown commercially are Harts, Natal Common, and Norden. The damage caused by the seed-borne endoparasitic nematode, *Ditylenchus destructor* Thorne, 1945, has been established for the four cultivars (9). In that greenhouse study, the increased percentage of blemished seed resulted in quality downgrading of seed. An initial nematode infestation of 1,000 nematodes/3 liters of soil resulted in losses of 12% in early-maturing cultivars and 59% in late-maturing cultivars. Early harvesting may minimize these losses (1).

The objective of this research was to determine the influence of harvest date and *D. destructor* on marketable peanut yield.

MATERIALS AND METHODS

Greenhouse trial: Nematode-free seeds of peanut cultivar Sellie were planted in sixty 3-liter plastic pots (three/pot) in steam-sterilized sandy soil (93% sand, 4% silt, 3% clay). The seeds were coated with *Bradyrhizobium* sp., a nitrogen-fixing bacteria. Seedlings were thinned to one per pot 2 weeks after planting. Half of the pots were inoculated 3 weeks after planting with 500 *D. destructor*. Inoculum of *D. destructor* consisting of various life stages was obtained from monoxenic cultures by macerating the peanut leaf callus tissue (7). Nematodes were pipetted into holes in the soil around the roots of seedlings.

Plants were fertilized weekly with a hydroponic nutrient solution (6.5% N, 2.7% P, 13% K), watered three times a week, and maintained at 20–25 C with a 13-hour photoperiod. Pots were arranged in a completely randomized design with six replications. Twelve pots were harvested on each of five harvest dates at 10-day intervals beginning at 130 days after planting.

Mature pods and seeds were rated for disease severity on a 0–10 scale (8). The seed weight per plant was determined.

Nematodes were extracted from 200 cm^3 soil subsamples by a modified decanting and sieving method (4) using 710-μm-pore and 45-μm-pore sieves. Final separation of nematodes from soil was by centrifugal flotation (5). Nematodes were extracted from 5 g fresh roots by maceration and separated from the roots with 710-μm-pore and 45-μm-pore sieves followed by a modified centrifugal flotation method (3). Nematodes were extracted from 5 g fresh hulls and seeds by soaking them for 24 hours at 22 C in petri dishes with sufficient water to cover hulls or seeds (2).

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Final populations (Pf) per hull or seed between the five harvest dates were analyzed using analyses of variance (ANOVA). Pod and seed disease severity and percentage seed weight (percentage of single seeds of inoculated plants compared to those of uninoculated plants) were analyzed with Kruskal-Wallis tests for nonparametric data (6). Spearman's rank correlations (6) were made between pod disease severity and Pf per hull, seed disease severity and Pf per seed, and percentage seed weight and Pf per seed.

Microplot trial: Microplots (5-liter plastic pots with bottoms removed) were placed in a nonfumigated, nematode-free field. Each had a 3-cm rim above the field soil. The microplots were then filled with steam-sterilized sandy soil (93% sand, 4% silt, 3% clay). Three seeds each of four peanut cultivars, Sellie, Harts, Natal Common, and Norden, were planted in each microplot. Seedlings were thinned to one per plot 2 weeks after planting. Half of the microplots were inoculated 3 weeks after planting with 3,500 *D. destructor* of various life stages. Plants were watered at planting, and thereafter natural precipitation was the only source of water. The microplots were arranged in a randomized block design with eight replications. Microplots of Harts were harvested at 105, 120 (normal harvest), and 135 days after planting (DAP), Natal Common at 125, 140, and 155 DAP, Sellie at 135, 150, and 165 DAP, and Norden at 145, 160, and 175 DAP.

The seeds harvested from the microplots were rated for disease severity. Calculation of the relative market value of seed was based on official grading regulations using disease severity (DS) as the primary parameter: DS $<$ 1.000—choice edible seed, DS $\geq$ 1.000 and $<$ 2.000—standard edible seed, DS $\geq$ 2.000—crushing seed. The 1991–92 producer prices for choice edible, standard edible, and crushing seed are US $602.35, $532.00, and $247.10/metric ton, respectively.

Nematodes were extracted from the seeds (2). Seed weight and number of seeds per plant were also determined.

Nematode numbers and seed weight for the three harvest data were analyzed with the appropriate ANOVA. Seed disease severity and percentage seed weight (percentage of single seeds of inoculated plants compared to those of uninoculated plants) were analyzed using Kruskal-Wallis tests (6). Spearman's rank correlations (6) were calculated between seed disease severity and Pf per seed, and percentage seed weight and Pf per seed. Data were analyzed separately for each cultivar.

Results

Greenhouse trial: The pod disease severity of Sellie increased at each sampling date between 130 and 170 days after planting (Fig. 1A). The final population (Pf) of *D. destructor* per hull varied over this time (Fig. 1A). The highest population density ($P < 0.05$) was at 140 days. The positive correlation (r = 0.76–0.87) between pod disease severity and Pf per hull was significant ($P < 0.05$) for all dates, except at 150 days ($r = 0.41$).

There was an increase in seed disease severity over time, with the highest levels occurring at the last three harvest dates (Fig. 1B). The Pf per seed decreased between 130 and 140 days, but thereafter increased until 170 days (Fig. 1B). The positive correlation (r = 0.70–0.81) between seed disease severity and Pf per seed was significant ($P < 0.05$) throughout the trial, except at 140 days ($r = 0.18$).

The weight of single seeds of inoculated plants (as a percentage of those of each uninoculated control) did not differ (P = 0.05) between harvest dates (Fig. 2). It was consistently lower (12% to 21%) than those of the uninoculated control plants. The negative correlation of seed weight and Pf per seed increased at each sampling date. It was −0.21 at day 130, −0.42 at day 140, −0.61 at day 150, −0.76 at day 160, and −0.80 at day 170.

Microplot trial: The weight of single seeds of the inoculated plants was not much different from that of the uninoculated controls (Fig. 3). Single seed weight was not correlated ($P > 0.05$) with Pf in any of the cultivars.

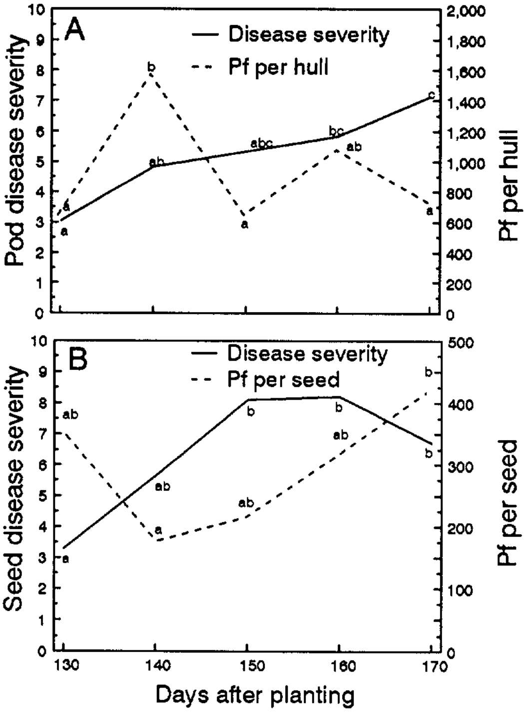

FIG. 1. Disease severity and final population density of *Ditylenchus destructor* on Sellie peanut grown in the greenhouse in relationship to time (normal harvest is 150 days) A) Pod. B) Seed. Points on the same line, followed by the same letter, are not significantly different ($P < 0.05$).

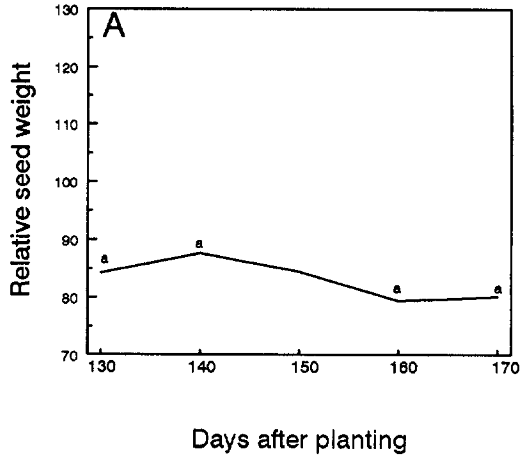

FIG. 2. Relative seed weight (weights of single seeds of inoculated plants expressed as a percentage of those of the uninoculated control) of Sellie peanut grown in the greenhouse in relationship to time (normal harvest is 150 days). Points on the same line, followed by the same letter, are not significantly different ($P < 0.05$).

The seed disease severity of Sellie differed little between 135, 150, and 165 days after planting (Fig. 4A). It was positively correlated to Pf per seed ($P < 0.05$) at 135 ($r = 0.93$) and 165 days ($r = 0.90$). Seed disease symptoms at 150 days were characteristic of inoculated plants, however, and were not evident on the seeds of the control plants. Seed was classified as standard edible at 135 and 150 days, and as crushing seed at 165 days.

Seed disease severity, Pf, and seed weight of Harts was not different ($P = 0.05$) between the three harvest dates (Fig. 4B). The Pf at 120 days showed great variation (97 ± 114). Disease severity correlated ($P < 0.05$) to Pf per seed at 120 ($r = 0.85$) and 135 days ($r = 0.83$). Seed was classified as standard edible at 105 and 120 days, and as crushing seed at 135 days.

The maximum seed disease severities of Natal Common (Fig. 4C) and Norden (Fig. 4D) were higher than those of Sellie or Harts. Disease severity was not correlated to Pf per seed, except at 125 days for Natal Common ($r = 0.78$). Symptoms were produced only on plants inoculated with *D. destructor*. Seed weight increased with time, but only significantly ($P < 0.05$) for Natal Common. The Pf was greater at 125 days than at 140 and 155 days on Natal Common (Fig. 4C). It was highest at 175 days on Norden (Fig. 4D).

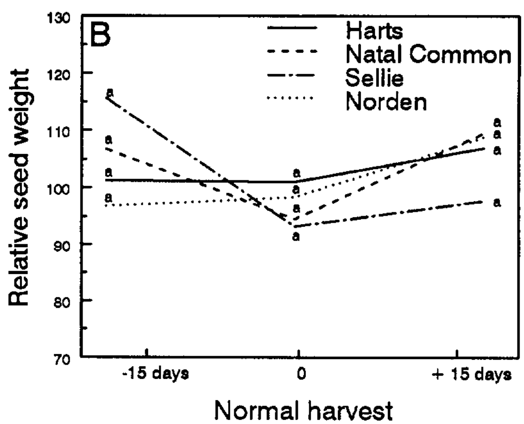

FIG. 3. Relative seed weight (weights of single seeds of inoculated plants expressed as a percentage of those of the uninoculated control) of Harts, Natal Common, Sellie, and Norden peanut grown in field microplots in relationship to time (at normal harvest, 15 days prior, and 15 days post). Points on the same line, followed by the same letter, are not significantly different ($P < 0.05$).

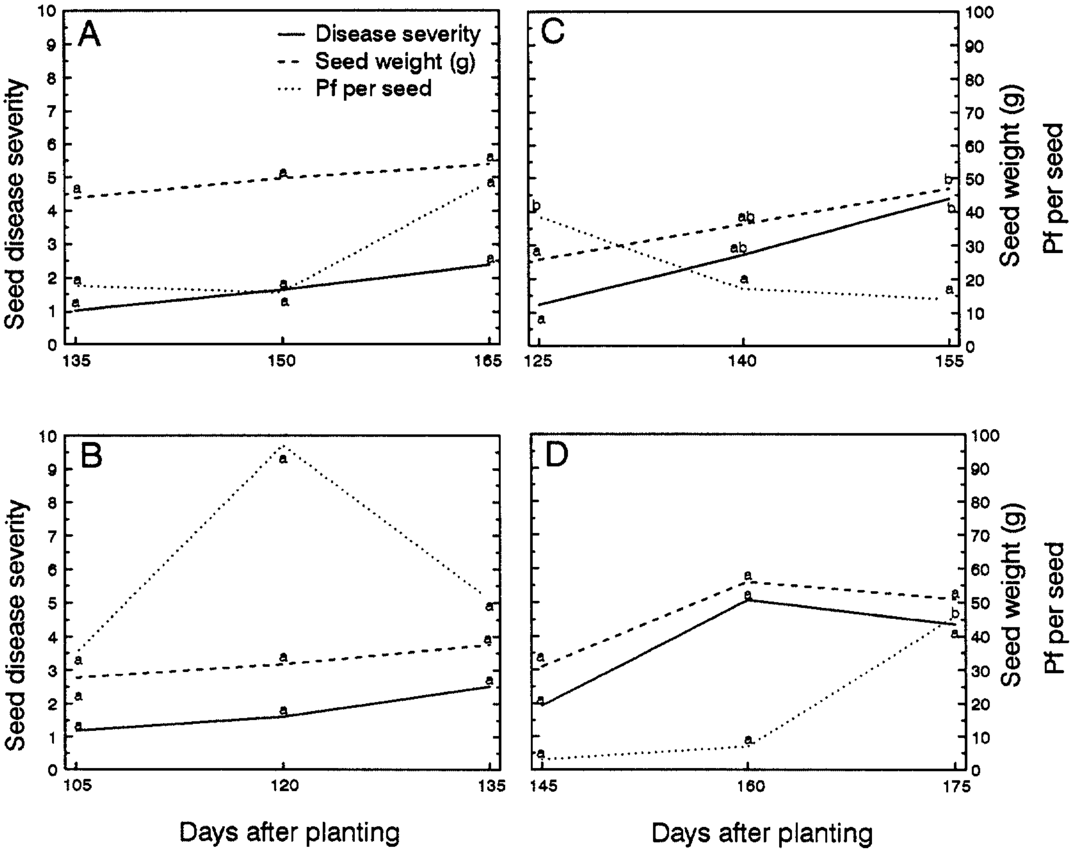

FIG. 4. Seed disease severity, seed weight per plant, and Pf per seed of microplot-grown peanut cultivars as influenced by harvest date. A) Sellie. B) Harts. C) Natal Common. D) Norden. Points on the same line, followed by the same letter, are not significantly different ($P < 0.05$).

The seed of Natal Common were classified as standard edible at 125 days and as crushing seed at 140 and 155 days. The seed of Norden were classified as standard edible at 145 days and as crushing seed at 160 and 175 days.

DISCUSSION

The final numbers of *D. destructor* (Pf) in the hulls and seeds of Sellie peanut grown in the greenhouse were poorly correlated with disease severity when numbers of nematodes were lowest. Because *D. destructor* migrates between hulls and seeds and between the hulls and soil during plant growth and maturation (1), the nonsignificant correlations may be considered the result of temporary population fluctuations due to emigration and (or) nematode death. These observations also show that conclusions on the damage potential of *D. destructor* based on only one harvest date could be incorrect.

Poor correlations between the seed disease severity and Pf per seed in all four cultivars tested agrees with previous research done in the greenhouse (9). Disease symptoms, however, were typical of those caused by *D. destructor.*

Generally, the seed disease severity can be greater in Natal Common and Norden than in Sellie and Harts. Venter et al. (9) also found the seed disease severity of Norden, but not Natal Common, to be high compared to that of Sellie and Harts.

Timely harvest, which results in the highest quality seed for all four cultivars, gives the best economic return. It is important to note that relative income per ton is much greater with the early harvest because seed quality is high. The income/ton of Sellie at 135 and 165 days was 88% and 51% of that at 150 days (normal harvest), respectively. The income/ton of Harts at 105 and 135 days was 87% and 55% of that at 120 days, respectively. The income/ton of Natal Common harvested at 140 and 155 days was 65% and 85% of that at 125 days, respectively. For Norden, relative economic return was 83% and 76% for the 160- and 175-day harvests compared with that at 145 days, respectively.

Timing of harvesting *D. destructor*-infested peanut is critical for maximizing net return. This attention to timing for each cultivar may also help prevent a large increase in nematode population density.

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