Response of potato cultivars to *Ditylenchus destructor* isolated from groundnut

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SUMMARY

The reproduction and effect of *Ditylenchus destructor* isolated from groundnut in South Africa on seven commercial potato cultivars, BP 1, Buffelspoort, Kimberley Choice, Late Harvest, Sackfiller, Up-to-date and Vanderplank, was studied in the greenhouse. All cultivars tested were poor hosts and no damage was caused to the potato tubers. The South African population of *D. destructor* isolated from groundnut is considered a new race. *Ditylenchus destructor* reproduced on callus tissue initiated from the potato cultivars BP 1, Buffelspoort, Kimberley Choice and Late Harvest.

RÉSUMÉ

Réactions de cultivars de pomme de terre à une souche de Ditylenchus destructor *isolée d'arachide*

La reproduction et l'action d'une souche de *Ditylenchus destructor*, isolée d'arachide en Afrique du Sud, sur sept cultivars de pomme de terre — BP 1, Buffelspoort, Kimberley Choice, Late Harvest, Sackfiller, Up-to-date, Vanderplank — ont été étudiées en serre. Tous les cultivars testés sont de mauvais hôtes et le nématode n'a pas causé de dommages. La souche de *D. destructor* provenant d'Afrique du Sud est considérée comme une nouvelle race. Cette race se reproduit sur tissus de cals de pomme de terre des cultivars BP 1, Buffelspoort, Kimberley Choice et Late Harvest.

Ditylenchus destructor Thorne, the potato rot nematode, is a serious pest of potatoes (*Solanum tuberosum* L.) in parts of Europe and the Soviet Union (Hooper, 1973). In the United States, it was first found on potatoes in Wisconsin in 1953 but a fumigation-quarantine programme stopped its spread (Darling, Adams & Norgren, 1983). *D. destructor* has only occasionally been reported outside the northern hemisphere (Jatala, Arens & Pretel, 1977; Foot & Wood, 1982). However, it was recently discovered in large numbers in hulls and seeds of groundnut in the Republic of South Africa (Jones & De Waele, 1988; De Waele *et al.*, 1989). Although *D. destructor* appears to be widespread in South Africa, no damage to potatoes has been reported and *Globodera rostochiensis* (Wollenweber) Behrens, *Meloidogyne* spp. and *Pratylenchus* spp. are considered the most important pathogenic nematodes on potato (Keetch & Heyns, 1982). To determine whether *D. destructor* from groundnut is a potential threat to potato, its reproduction and effect on seven commercial potato cultivars was studied in the greenhouse. In addition, the reproduction of *D. destructor* on callus tissue initiated from some of these commercial potato cultivars was also determined.

Materials and methods

POT EXPERIMENTS

Sound, unblemished seed-tubers of seven locally available potato cultivars (*Solanum tuberosum* L. cvs BP 1, Buffelspoort, Kimberley Choice, Late Harvest, Sackfiller, Up-to-date, Vanderplank) and nematode-free seeds of groundnut (*Arachis hypogaea* L. cv. Sellie) were planted in 20-cm-diameter plastic pots filled with steam sterilized sandy soil (93 % sand, 4 % silt, 3 % clay). One tuber was planted per pot; groundnut seedlings were thinned to one per pot after emergence. Each pot was regularly irrigated with a hydroponic nutrient (6.5 % N, 2.7 % P, 13 % K) dissolved in tap water. Pots were maintained in a greenhouse at 17-25 °C and a 13-hour photoperiod. Inoculum of *D. destructor* was obtained from monoxenic cultures on groundnut callus tissue (Van der Walt & De Waele, 1989). One week after planting, eight replicates of each potato cultivar and of the Sellie groundnut were inoculated with 10 000 nematodes of mixed life stages by pipetting nematodes in 10-ml aqueous suspensions into holes in the soil around

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the roots. The pots were layed-out in a randomized block design. Eight weeks after inoculation, four replicates were harvested and fresh root weights determined. Nematodes were extracted from 200-cm^3 soil subsamples by a modified decanting and sieving method (Flegg, 1967) using 710 µm-pore and 45-µm-pore sieves, followed by the centrifugal-flotation method (Jenkins, 1964) and from 5 g fresh roots using the centrifugal-flotation method (Coolen & D'Herde, 1972) and counted. Sixteen weeks after inoculation, the remaining four replicates were harvested and treated as described above. In addition, all newly-formed potato tubers were examined for nematode damage and potato peelings and groundnut hulls and seeds were soaked in water in Petri dishes for 24 h at room temperature and the numbers of nematodes that emerged were counted (Bolton, De Waele & Basson, 1990). Root population data were transformed to $\log_e$ before analysis. The experiment was repeated with twenty replicates of each potato cultivar and of groundnut cv. Sellie, and inoculated with 10 000 nematodes of mixed life stages one week after planting. After eight weeks, ten replicates were harvested and the remainder after sixteen weeks.

Callus culture

The medium for the callus tissue cultures of the potato cvs BP 1, Buffelspoort, Kimberley Choice, Late Harvest and the groudnut cv. Sellie consisted of the basic salts and vitamins of Murashige and Skoog's (1962) medium supplemented with 3 mg dm^{-3} 2,4-dichlorophenoxyacetic acid and 0.2 mg dm^{-3} kinetin. Potato callus tissue was initiated from stem internodes sectioned from *in vitro* grown plants. Groundnut callus tissue was initiated from excised embryos sterilized in 70 % ethanol for 1 min and in 1 % NaOCl for 15 min, and rinsed three times in sterile distilled water. The cultures were incubated in the dark at 26 °C for 4 weeks and then subcultured. After another 4 weeks, four replicates of each potato cultivar and the groundnut were inoculated with 750 ± 50 nematodes of mixed life stages and 200 ± 50 eggs of *D. destructor* obtained from monoxenic cultures on groundnut callus tissue (Van der Walt & De Waele, 1989). After incubation for 8 weeks in the dark at 26 °C, the nematodes in the agar and callus were counted.

Results

Few *D. destructor* (< 35/200 cm^3) were extracted from soil in both greenhouse tests except from groundnut in the first test when an average of 125 *D. destructor*/200 cm^3 were found 16 weeks after inoculation. Significantly ($P = 0.05$) fewer *D. destructor* were recovered from potato than from groundnut roots (Table 1). At 16 weeks after inoculation, small numbers of *D. destructor* (35-100/5 g fresh tissue) were extracted from one newly-formed tuber each of the cultivars BP 1, Buffelspoort, Late Harvest and Vanderplank in the first

Table 1

Root population densities of *Ditylenchus destructor*, isolated from groundnut, on seven potato cultivars and groundnut cultivar Sellie, measured 8 and 16 weeks after inoculation with 10 000 nematodes.

Cultivar	*Test 1*				*Test 2*			
	Nematodes/ 5 g roots		*Root fresh weight (g)*		*Nematodes/ 5 g roots*		*Root fresh weight (g)*	
	8 wks	*16 wks*	*8 wks*	*16 wks*	*8 wks*	*16 wks*	*8 wks*	*16 wks*
POTATO								
BPl	1 *a*	18 *a*	5.7	6.3	1 *a*	1 *a*	13.2	9.2
Buffelspoort	3 *a*	38 *ab*	5.3	3.8	1 *a*	4 *a*	9.9	3.5
Kimberley Choice	2 *a*	51 *b*	4.7	1.9	1 *a*	2 *a*	8.6	6.2
Late Harvest	4 *a*	65 *b*	6.8	3.3	1 *a*	4 *a*	9.2	4.3
Sackfiller	1 *a*	9 *a*	10.0	1.7	1 *a*	7 *a*	9.6	4.4
Up-to-date	6 *a*	14 *a*	6.6	2.7	1 *a*	3 *a*	9.1	7.9
Vanderplank	2 *a*	14 *a*	8.3	1.8	1 *a*	1 *a*	6.5	4.7
GROUNDNUT								
Sellie	138 *b*	126 *a*	6.5	5.8	127 *b*	118 *b*	6.1	5.1

Numbers are the means of four (Test 1) and ten (Test 2) replicates. Column means followed by the same letter do not differ significantly ($P = 0.01$) according to the Student-Newman-Keuls range test.

test, and from one newly-formed tuber of the cultivar Late Harvest in the second test. However, no external or internal symptoms such as skin cracking, sub-cutaneous infestation sites or tissue breakdown were observed. The hulls and seeds of groundnut contained an average of 3991 and 3382 *D. destructor* per 5 g fresh tissue, respectively, after 16 weeks in the first test, and 18 369 and 7 047 *D. destructor* per 5 g fresh tissue, respectively, in the second test.

D. destructor reproduced on callus tissue initiated from all four potato cultivars (Table 2). However, they reproduced much more on callus from the cultivar Late Harvest than that from the cultivar BP 1 (51-fold increase *vs* 11-fold increase). There was a 57-fold increase on callus initiated from the groundnut.

Table 2

Number of nematodes (mixed life stages) and eggs of *Ditylenchus destructor*, isolated from groundnut, recovered from potato and groundnut callus tissue cultures, measured 8 weeks after inoculation with 750 ± 50 nematodes and 200 ± 50 eggs.

Cultivar	*Nematodes*	*Eggs*
POTATO		
BP1	8 458 *a*	528 *a*
Buffelspoort	37 009 *b*	8 547 *b*
Kimberley Choice	26 527 *b*	3 374 *ab*
Late Harvest	38 505 *b*	46 970 *c*
GROUNDNUT		
Sellie	42 708 *b*	23 970 *c*

Numbers are the means of four replicates.

Discussion

The culturing of *D. destructor* on aseptic potato callus tissue has been reported previously (Faulkner & Darling, 1961) and a greater rate of reproduction on callus tissue than on roots of the same plant have been observed previously (Krusberg & Babineau, 1977). Callus tissues of plants that are resistant to, or are non-hosts of a nematode in nature will frequently support good reproduction of that nematode. Webster and Lowe (1966) suggested that plant growth regulating substances, such as 2,4-D, may play a role in making incompatible cells compatible to nematodes in callus tissue cultures.

Our data indicate that under greenhouse conditions all potato cultivars tested were poor hosts of *D. destructor* isolated from groundnut and that the nematode caused no damage to the potato tubers. In contrast, *D. destructor* populations in the northern hemisphere and New Zealand infected most local potato cultivars (Moore, 1978; Foot & Wood, 1982). The low rate of infection of plants that have been reported as hosts by other workers may be due to differences in inoculation methods. During the present study, healthy tubers were exposed to infection by *D. destructor* in the absence of other pathogens. Wu (1960) inoculated *D. destructor* in a strip of burnt tuber tissue after having observed that the nematodes did not reproduce well in healthy tissue. Faulkner and Darling (1961) reported that it was unusual to find large numbers of *D. destructor* in potato tubers unless fungi were present. Most workers, however, obtained severe damage to healthy tubers and high infestation levels of *D. destructor* in the absence of fungi (Faulkner & Darling, 1961; Smart & Darling, 1963; Moore, 1978; Foot & Wood, 1982).

Since *D. destructor* isolated from groundnut is morphometrically and morphologically similar to the type population (De Waele *et al.*, 1989), the South African population is considered a race. Races of phytonematodes are defined by their ability to reproduce on certain members of a set of differential hosts (Dropkin, 1988). Races of *D. destructor* have been reported in the United States (Smart & Darling, 1963) and their existence has been suggested by Duggan and Moore (1962). Since there may be physiological differences between *D. destructor* populations occurring in the temperate regions of the northern hemisphere and those in South Africa, the presence of ecotypes which may or may not be manifest as distinct races separated by their reproduction on differential sets of hosts, was suggested (De Waele & Wilken, 1990). The discovery of this new race of *D. destructor* is important for the development of an effective management strategy, including quarantine measures, crop rotation and breeding for resistance.

ACKNOWLEDGEMENTS

The authors thank P. J. Steyn, Vegetable and Ornamental Plant Research Institute, Pretoria, for supplying the potato cultivars; D. Keetch and K. Kleynhans, Plant Protection Research Institute, Pretoria, for critical reading of the manuscript; R. Swanepoel, R. Jantjies, E. Swart, E. Selthare and S. Kwena for technical assistance.

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Accepté pour publication le 13 février 1990.

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