RELATIVE SUSCEPTIBILITY OF SELECTED CULTIVARS OF POTATO TO PRATYLENCHUS PENETRANS (NEMATODA:PRATYLENCHIDAE)

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ABSTRACT

Investigations were carried out to determine the effects of initial nematode densities (Pi = 0, 0.2, 0.4, 0.8, 1.6, 3.2 and 6.4 / g of soil) of *Pratylenchus penetans* on yields of five selected potato cultivars. In comparison with noninfested controls, initial nematode densities of *P. penetrans* - 0.4 / g soil suppressed yields of Agria, Van Gog and Arnova, and Pi = 0.8 and 1.6 / g soil suppressed yields of Impala and Sante, respectively. Highest nematode densities were found in the roots of Van Gog; the next highest, in succeeding order, were found in roots of Agria, Impala, Arnova and Sante. Symptoms of nematode invasion were confined to losses of tuber yield and root weight.

Key words: *Pratylenchus penetrans*, potato culrivars, *Solarium tuberosum*, tolerance

Potato (*Solanum tuberosum* L.) is of major economic importance, especially in the semi-mountainous and mountainous regions in Bulgaria where it is mainly produced as a monoculture (Stoyanov, 1980). Plant-parasitic nematodes are a severe problem in potato production (Samaliev and Stoyanov, 2008). In the eighties and nineties, nematode counts in soil and in potato root samples indicated that potato cyst nematodes (*Globodera rostochiensis* (Wollenweber) Skarbilovich), and some other plant-parasitic nematodes (*Globodera pallida* Stone and *Meloidogyne hapla* Chitwood) were the major pests of the potato in major potato-producing regions in Bulgaria (Stoyanov, 1980, Samaliev et al., 1995**,** Samaliev, 1997, 1997a, Samaliev and Stoyanov, 2008). A recent survey of nematodes associated with potato conducted in four major potato-producing regions (Plovdiv, Smolyan, Pazardjik and Samokov) show that *Pratylenchus penetrans* (Cobb) Filipjev and Schuurmans Stekhoven was another one of the most frequently encountered nematode plant pests with frequency of occurrence 16% and range of population density from 10 to 560 nematodes per 100 cm^3 soil (Samaliev, 2011). Potato tuber losses, although not experimentally determined, reached up to 28-30% in some heavily *P. penetrans* infested potato fields (Samaliev, unpublished date).

Information on host suitability of potato cultivars grown in our potato fields to *P. penetrans* is not available in Bulgaria. However, the reaction of initial population density of some other potato cultivars and clones to some *P. penetrans* has been reported (Oostenbrink, 1966, Olthof et al., 1973, Olthof and Potter, 1973). The purpose of this study was to determine the effects of initial population density of *P. penetrans* on final population density and yields of selected potato cultivars.

MATERIALS AND METHODS

Five commercial potato cultivars Impala, Arnova, Sante, Agria and Van Gogh were evaluated for suitability to *P. penetrans.* The tests were conducted in the period of 2007 in the laboratory of nematology of the Department of Entomology - Agricultural University and experimental field – Plovdiv potato-producing region. Individual tuber seeds of each cultivar were planted in 20 cm/d microplots filled disposed so as to stick out 5 cm from the soil) with 5 kg sandy clay loam soil, preliminary sterilized. The distance between the microplots was 60/30 cm). After that a mixture of adults and juveniles *P. penetrans* was added to each microplot, so we obtained inoculums of initial population density (Pi): 0, 0.2, 0.4, 0.8, 1.6, 3.2 and 6.4 nematodes / g of soil. The *P. penetrans* used in these studies originated from a single female isolated from potato plantation soil (from Smolyan potato producing regions) and maintained in bean (*Phaseolus vulgaris* L., cv. Frenchie). Potato tuber seeds of different cultivars were planted singly (as whole seed to a depth of 6 cm) in each microplot on 2 March with four plants/treatment - variety combination and arranged in a completely randomized design. Microplots of each cultivar were harvested when plants of a given cultivar exhibited signs of dieback. Impala, Arnova, Sante, Agria and Van Gogh were harvested 85, 90, 100, 110 and 115 days after planting, respectively. Foliage, roots, and tubers were weighed separately.

After harvesting, final population densities (P_f) of *P. penetrans* per g of the root were determined for each plant by staining the roots. For the purpose, after being washed free of soil, blotted dry, and weighed, entire root systems were stained with acid fuchsin in lactoglycerol (Bridge et al., 1982). Root systems were submerged in the stain and heated for 2 minutes in a 600-watt microwave. After staining, the root systems were macerated for three 10-second intervals in a blender. The macerated root suspension was poured onto a 250 μm screen and rinsed into a beaker, and the volume was brought to 200 ml. The number of eggs and vermiform nematodes were counted in three 1-ml aliquots of the suspension from each root system and the counts were averaged. After that the nematodes per g root were counted. Soil removed from each microplot and checked by Baerman pan method (Seinhorst, 1950) had relatively small numbers of nematodes.

Data were analyzed by analysis of variance, using procedures of the SPSS-12 programme, significance being determined at $P \leq 0.05$.

RESULTS AND DISCUSSION

The results show that the initial population density of P. *penetrans* influenced tuber growth of five cultivars (Table 1). Yield losses of Arnova were 20-31% at all Pi's, whereas yields were less affected by low densities. In comparison to the controls, yield of Van Gogh was enhanced at a Pi of 0.4/g of soil, but higher Pi caused marked losses. Enhanced root growth has been reported for crops infected with *Meloidogyne* spp. (Madamba et all., 1965). In our study, moderate nematode densities may have stimulated root proliferation and increased tuber growth. Losses in tuber growth of Agria were apparent at and above Pi of 0.4/g of soil.

Table 1. Effects of initial population level (Pi) of *Pratylenchus penetrans* on the tuber yield of selected potato cultivars

Pi/g soil	Tuber yield (g)*				
	Impala	Arnova	Sante	Agria	Van Gogh
0.0	592	608	685	872	910
0.2	612	575	695	867	912
0.4	591	415	690	841	928
0.8	576	438	686	820	850
0.16	559	468	668	780	808
3.2	525	481	629	725	742
6.4	480	480	599	655	703
Reduction (%)**	19.1 b	21.0 bc	12.5 a***	24.9 d	22.8 c

*Numbers are the means of root systems of four plants; **Compared to the control; ***The mean values with different letters have significant difference ($P \leq 0.05$) according to Duncan's Multiple Range Test.

Final root weight of Arnova, Agria and Van Gogh was suppressed but that of Impala and Sante was not significantly affected (Table 2). Stunting of roots was primarily attributable to the absence of many of the finer lateral roots. There was no observable root necrosis, as is usually reported for diseases caused by this nematode (Mountain and Patrick, 1959), nor were there any effects on top growth.

Final nematode densities in roots of harvested plants (Table 3) could not be correlated either with initial densities or tuber weights. However, severity of losses in these cultivars may be related to plant susceptibility and Pi. The lowest Pi caused losses in Arnova, the cultivar with the lowest Pf. Conversely, Sante supported the highest populations with no significant loss in yield. Thus the ability of these infected cultivars to produce acceptable yields is related to plant tolerance, rather than resistance, to *P. penetrans*.

Table 2. Effects of initial population density (Pi) of *Pratylenchus penetrans* on root growth of selected potato cultivars

Pi/g soil	Fresh root weight (g)*				
	Impala	Arnova	Sante	Agria	Van Gogh
0.0	10.9 a**	11.3 a	11.9 a	12.3 a	13.0 a
0.2	8.3 a	6.2 b	10.2 a	7.6 b	8.0 b
0.4	9.1 a	6.9 b	11.0 a	7.0 b	7.6 b
0.8	8.2 a	6.2 b	10.4 a	6.9 b	7.8 b
0.16	8.3 a	6.3 b	8.8 a	7.1 b	8.1 b
3.2	8.4 a	6.0 b	9.6 a	6.8 b	7.5 b
6.4	8.0 a	5.7 b	8.9 a	6.2 b	6.4 b

*Numbers are the means of root systems of four plants; **The mean values with different letters have significant difference (P≤0.05) according to Duncan's Multiple Range Test.

Although variations in Pf, for each cultivar were too great for a numerical estimation of equilibrium densities, relative tolerances of these cultivars to infection can be assigned: Sante is the most tolerant; Impala, Van Gog, Agria and Arnova follow in descending order of tolerance.

These results are comparable to those of Olthof and Potter (1973), who used the cultivar 'Sebago'. They found an equilibrium density of 1200-1300/g root, with yield losses occurring at a Pi of 67/100 g of soil. Thus, Sebago's tolerance to *P. penetrans* is low, only slightly better than that of Sante.

Table 3. Effects of selected potato cultivars on the final population density (P_f) of *Pratylenchus penetrans* in microplots at different initial population density (Pi)

Pi/g soil	P_f/g fresh root*				
	Impala	Arnova	Sante	Agria	Van Gogh
0.2	2410	2210	1910	2622	3220
0.4	2212	1518	1032	2221	3032
0.8	2009	1912	912	2315	3129
0.16	2610	1721	2720	2620	3700
3.2	1915	2410	1015	2100	2520
6.4	1421	2009	1120	1810	2030
Mean	2096 b	1963 b	1451 a	2281 bc	2417 c

*Numbers are the means of roots of four plants; **The mean values with different letters have significant difference (P≤0.05) according to Duncan's Multiple Range Test.

Information on the relative tolerance of potato cultivars to *P. penetrans* and other nematode pests should prove to be useful in areas where such problems exist. By combining this knowledge with an estimation of costs for control and other peripheral operations, growers should be able to choose cultivars both for yield potential and sensitivity to nematode infection. Field trials are an obvious future step in the evaluation of cultivar tolerance to *P. penetrans*.

CONCLUSION

Initial nematode densities of *P. penetrans* - 0.4 / cm³ soil suppressed yields of Agria, Van Gog and Arnova, and Pi = 0.8 and 1.6 / cm³ soil suppressed yields of Impala and Sante, respectively. Highest nematode densities were found in the roots of Van Gog; the next highest, in succeeding order, were found in roots of Agria, Impala, Arnova and Sante. Symptoms of nematode invasion were confined to losses of tuber yield and root weight. The development or introduction of suitable resistant cultivars of potato is essential for the management of *P. penetrans* in our potato fields.

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