Influence of Nitrogen Fertilizing on Occurrence of Fungi Infecting Parsley Seedling Roots (*Petroselinum sativum* Hoffm.)

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Abstract

The three years experiments based on parsley roots of cultivars: Omega, Berlińska and Vistula. Nitrogen fertilizer was used in different levels (0, 100, 200, 300 and 400 kg/ha). Results of autumn analysis indicate that differentiated nitrogen fertilizing has no significant effect on health status of parsley roots. Spring examinations showed increase percentage of ill roots. Lower root infestation of each cultivar was in the combinations: 100 kg/ha and control without nitrogen fertilizations. Omega showed the best soundness. Experiments indicated that cultivar plays a more significant role than nitrogen fertilizing level. From ill parsley roots, the most often were isolated fungi: *Alternaria radicina*, *Fusarium avenaceum* and *F. oxysporum* during spring; bacteria and fungi species: *Sclerotinia sclerotiorum, Rhizoctonia solani* and *Alternaria radicina*.

Keywords: parsley root; nitrogen fertilizing; fungi; root rot

INTRODUCTION

The health status of parsley seeds harvested from seed plantation often depends on quality of seedlings roots. There is lack of information about parsley vulnerability to root putridity. This problem is commonly investigated on carrot (GLASER *et al*. 1982; KUĆMIERZ & BARTYŃSKA 1988). Soundness of parsley seedling roots can be decided by such factors as forecrop (NAWROCKI *et al*. 1996), cultivar (NAWROCKI 2000) and root storage conditions (MAZUR *et al*. 1998). Many times chemical protection of parsley seedling roots is not always effective (NAWROCKI 1998). Therefore, the authors decided to search for an alternative method to enhance quality of seedling roots. One of such method consists in application of appropriate nitrogen fertilizing levels, that can be an important factor in integrated protection against diseases. This subject was described earlier but in respect of other plants (KUĆMIERZ & MIKULSKA 1983; MAZUR *et al*. 1994). Previous authors investigations on this problem based only on one year experiments (MAZUR *et al*. 1999, 2000). This paper contains three years research on the effect of different nitrogen fertilizing levels on soundness of parsley roots during vegetation and storage.

MATERIAL AND METHODS

The analyses were based on parsley seedling roots of three cultivars: Omega, Berlińska and Vistula taken from the own crops. Field experiments was conducted beetween 1998–2000 at the fields of the Experimental Station of Department of Plant Protection, University of Agriculture of Cracow on light sandy soil. Before sowing all field combinations were fertilized with potassium sulphate, triple superphosphate and dolomite. Winter wheat was used as a forecrop. The experiment was carried out by using the method of randomly chosen blocks in three repetitions. The following nitrogen fertilizing levels were applied in the form of ammonium nitrate: 100, 200, 300 and 400 kg of nitrogen per hectare. Plants without fertilizing were used as control group. Agrotechnical measures, including chemical weeding, were carried out in accordance with recommendations adopted for

this plant. Roots were digged up at the beginning of October and subjected to examination. 50 roots were taken from each field (150 from combination). The percentage of diseased roots and infestation index were calculated according to the method described by KUĆMIERZ *et al*. (1987). Diseased roots were subjected to laboratory microbiological analysis according to procedure presented by KUĆMIERZ and BARTYŃSKA (1988). From the remaining sound roots a samples of 150 were taken for each combination and clamped until end of march or beginning of April next year. Then its soundness was examined and microbiological analysis was carried out by using the same methods as previously.

RESULTS AND DISCUSSION

The results of autumn analyses (directly after digging up) indicate that differentiated nitrogen fertilizing have no significant effect on soundness of parsley roots. Infestation indices of diseased roots were similar every year (Table 1). The lowest infestation indices of each parsley cultivar were in 1999 particularly parsley roots cultivar Omega (in combination 100, 200 and 300 kg N/ha) and Vistula (400 kg N/ha and control). In autumn 2000 the best health status had parsley roots cv. Berlińska. The highest infestation indices had roots cv. Vistula in autumn 1998 in the combination 100, 200, 300 and 400 kg N/ha and also roots cv. Berlińska in combination 400 kg N/ha. When comparing number of percentage of diseased roots during autumn analysis the results are similar (Table 3). The lowest number of roots with diseases symptoms were in 1999 and the highest in 1998 of each cultivars and combinations. Relatively low number of diseased roots had cv. Omega and high cv. Vistula and Berlińska especially in 1998. Such result might indicate that the form of nitrogen

Table 1. The effect of nitrogen fertilization on index of roots infestation – autumn analyses

Rate N (kg/ha)	Omega			Berlińska			Vistula		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
0 (control)	17.3 a	12.3 a	10.6 a	32.6 abcd	15.4 a	12.4 ab	31.3 abcd	10.4 a	19.4 abc
100	18.3 a	12.7 a	13.2 ab	34.3 abcd	13.4 a	11.9 ab	40.6 cd	16.1 a	19.2 abc
200	24.3 abc	11.4 a	13.4 ab	28.6 abcd	14.2 a	17.5 abc	43.6 d	14.4 a	24.2 c
300	29.3 abcd	11.4 a	17.5 abc	29.6 abcd	10.7 a	13.9 abc	39.6 bcd	14.4 a	17.8 abc
400	33.3 abcd	18.6 a	13.1 ab	40.6 cd	15.8 a	12.8 ab	39.0 bcd	11.4 a	21.7 bc

Means followed by the same letter do not differ at 5% level of significance (Duncan's multiple range test). Estimation of differences separately for each years

Table 2. The effect of nitrogen fertilization on index of roots infestation – spring analyses

Rate N (kg/ha)	Omega			Berlińska			Vistula		
	1999	2000	2001	1999	2000	2001	1999	2000	2001
0 (control)	36.7 a	40.5 abc	59.0 bc	60.0 cde	45.0 cd	42.0 a	55.8 bcd	35.0 a	48.7 ab
100	37.5 a	36.0 ab	55.0 abc	57.5 cde	49.0 de	45.5 ab	67.6 def	41.5 bc	58.8 bc
200	53.3 bc	43.0 cd	53.5 abc	86.6 h	58.7 f	44.3 a	77.3 fgh	44.0 cd	48.1 ab
300	44.2 ab	43.0 cd	55.0 abc	68.3 efg	53.0 ef	52.5 abc	80.0 gh	36.5 ab	65.0 c
400	38.3 a	49.0 de	78.3 d	81.7 h	45.0 cd	49.7 ab	85.7 h	43.0 cd	81.9 d

Note: see Table 1

Table 3. The effect of nitrogen fertilization on number percentage of diseased roots – autumn analyses

Rate N (kg/ha)	Omega			Berlińska			Vistula		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
0 (control)	56.0 ab	25.6 b	32.3 a	78.6 abc	35.9 de	32.2 a	70.6 abc	49.4 g	46.7 a
100	52.0 a	38.5 def	41.4 a	82.6 abc	33.7 cd	33.3 a	81.3 abc	14.6 a	45.6 a
200	72.0 abc	36.6 def	43.5 a	70.0 abc	40.0 def	37.8 a	98.6 c	34.4 cd	54.4 a
300	78.6 abc	35.5 de	50.1 a	84.0 abc	28.2 bc	45.5 a	89.3 abc	36.6 def	43.3 a
400	74.6 abc	52.2 g	37.8 a	93.3 bc	42.2 ef	30.0 a	90.6 bc	42.2 ef	50.0 a

Note: see Table 1

Table 4. Microorganisms mostly isolated from diseased parts of parsley roots – autumn analyses

Microorganismus	Omega				Berlińska				Vistula			
	1	2	3	4	1	2	3	4	1	2	3	4
Alternaria alternata (Fr.) Keissler	+				+			+	+		+	
A. chartarum Preuss					+				+			
A. radicina Meier. Drechsler & Eddy	+	+			+	+		+	+			+
Aspergillus niger v. Tieghem	+			+	+				+			
Cladosporium cladosporioides (Fres.) de Vries	+	+							+			
Cylindrocarpon destructans (Zinssm.) Scholten	+				+	+			+			
C. didymum (Harting) Wollenw.	+				+		+		+	+		
Fusarium avenaceum (Fr.) Sacc.	+	+		+	+	+	+		+	+		+
F. culmorum (W.G. Sm.) Sacc.				+			+	+	+	+		
F. oxysporum Schlecht.	+	+			+	+	+		+	+	+	
F. semitectum Berk. et Rav.	+	+							+			
F. solani (Martius) Sacc.		+	+		+	+		+	+	+		
F. verticillioides (Sacc.) Nirenberg						+				+		
Mucor sp.	+	+			+			+	+			
Penicillium sp.				+		+	+		+	+	+	
Penicillium wortmannii Klocker	+	+							+			
Phoma sp.	+											+
Rhizoctonia solani Kuhn			+		+	+			+			
Rhizopus sp.		+	+									
Sclerotinia sclerotiorum (Lib.) de Bary	+				+	+			+	+		
Trichoderma harzianum Rifai				+	+				+			
Bacteria		+	+			+	+			+	+	

Note: Part of root 1 – epidermis ; 2 – cortex; 3 – central cylinder; 4 – rootlets; + occurrence of a species

fertilizing, contrary to nitrogen doses, has an effect on infestation by disease agents (DARWINKEL 1980). Spring examinations showed increase percentage of ill roots (close to 100%), expressed with higher indices of infestation every year. The lower root infestation of each parsley cultivar were in the combinations: 100 kg N/ha and control without nitrogen fertilizations (Table 2). When comparing individual cultivars Omega showed the best soundness, both in autumn and spring that was demonstrated by a significantly lower infestation especially in season 1998/1999. This results confirm, that the level of infestation index and percent of diseased roots depended more on the cultivar than nitrogen dose (NAWROCKI *et al.* 2001). Also disease symptoms were differentiated to larger extent due to more developed process of tissue rotting. These relationships have confirmed our earlier studies of parsley (MAZUR *et al.* 1996) and carrot (KUĆMIERZ & BARTYŃSKA 1988). This effect is caused by higher exacerbation of microorganisms in diseased roots after clamping. The greatest number of fungi colonies was determined in autumn, while bacteria were rarely isolated mostly from the roots with intense soft rot. This dependence was founded out earlier by MARZIANO *et al.* (1992) on carrot. From microorganisms isolated from rotting tissues of parsley roots, the most often were fungi: *Alternaria radicina*, *Fusarium avenaceum*, *F. oxysporum*; less were: *Alternaria alternata*, *Rhizoctonia solani*, *Cylindrocarpon* spp. and *Penicillium* spp. (Table 4). In spring the increasing contribution of bacteria and species *Sclerotinia sclerotiorum, Rhizoctonia solani* and *Alternaria radicina* was observed. While in autumn these microorganisms occupied mainly epiderm and perenchymal tissue in upper and central parts of roots, in spring they were isolated from all anatomic layers.

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