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Possibilities for Control of Corky Root (*Pyrenochaeta lycopersici* Schn., Gerl.) in Tomato Grown in Cultivation Facilities

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Abstract

A study for establishment of the effect of variety and fertilization on the index of infestation by corky root (*Pyrenochaeta lycopersici Schn., Gerl.*) in tomato plants grown in cultivation facilities was carried out. The experiment was performed in the conditions of natural infestation with 14 tomato varieties and lines at three systems of fertilization – mineral, integrated and organic. Effective microorganisms (EM) were applied additionally in the variants with integrated and organic production. The studied varieties were divided in four groups depending on the susceptibility to the agent of corky root: with index of infestation up to 20%; from 21 to 40%; from 41 to 60% and over 61%. The lowest index of infestation is recorded in the variants with integrated and organic production including the application of vermicompost, rock phosphate and EM. The yield recorded in this variant was lower compared to the variant with mineral fertilization but the differences were not mathematically significant.

Keywords: *Pyrenochaeta lycopersici,* tomato variety, vermicompost, effective microorganisms, yield

Introduction

Corky root is a strongly harmful disease in tomato grown in open field and in greenhouses as a soil-grown culture. It is caused by soil-borne fungus *Pyrenochaeta lycopersici* Schn., Gerl. (Gerllach and Schneider, 1964). It was isolated at first in 1929 from tomato plants in England and was originally known as the grey sterile fungus. Later (in 1966), based on the morphological characteristics of the pycnidia, conidiophores and conidia, fungus was identified as *Pyrenochaeta lycopersici* (Schneider and Gerlach, 1973). The last reports for new spread of the pathogen have been since 2008 from Australia (Golzar, 2009). The disease damages the root system, and yield losses could reach up to 40-70% (Workneh et al., 1993).

Moreover the tomato pathogen attacks also other culture species such as pepper, eggplant, melon, cucumber, squash, but there is no economic importance to them (Grove and Campbell, 1987; Shishkoff and Campbell, 1990). It attacks the root system of plants, and causes brown lesions and rotting of the smaller roots and corky lesions on larger roots (Pohronezny and Volin, 1997). The control of pathogen is very difficult because it is very persistent in soil and cannot be controlled by breakcrops or crops rotation in the greenhouse (Grove and Campbell, 1987). The most effective control is steaming the soil or treating with volatile chemicals (Haine et al., 1968). Other methods for control of the disease are development of resistant varieties. Alternatively, in the Netherlands and the USA are grown tomatoes on resistant rootstocks grafted plants (Smith and Proctor, 1965). Giotis et al. (2009) have established that biological products, based on *Bacillus subtilis* and *Pythium oligandrum* have no efficient result on the soil-borne pathogens *P. lycopersici* and *Verticillium albo-atrum.* They recommend an organic materials (substances) to be applied (composts of manure, living wastes, fresh plant remains (wastes) from cabbage crops) individually or in combination with chitin/chitosan as a method for control of these diseases. In searching of opportunities for control of this dangerous disease Hasna et al. (2007) have established a good effect from compost based on garden wastes while the compost from horse manure stimulates this pathogen. The low concentration of NH4-N,

total carbon and higher concentrations of Ca in the substrate correlates with lower level of disease progress, and the increased microbial activity of the soil and compost did not decrease the disease progress.

The aim the present study was to establish the possibility for control of corky root (*Pyrenochaeta lycopersici*) by applying of different systems for growing and resistant varieties.

Table 1. Yield – early and total, kg/da

Variant	Early yield	Yield of fruits with weight:			Total yield
		> 100 g	50-100 g	< 49 g	
I.1	4749.1 a	6702.5 a	452.8 ns	56.9 ns	7212.2 ns
II.2	3749.4 ab	6326.3 ab	455.0 ns	0.0 ns	6781.3 ns
II.3	2559.4 b	4797.2 b	378.5 ns	52.5 ns	5228.2 ns
III.4	3893.8 ab	6348.1 ab	610.3 ns	70.0 ns	7028.5 ns
III.5	3252.9 ab	5033.5 ab	595.0 ns	17.5 ns	5646.0 ns

a,b.. – Duncan's Multiply Range Test, $P<0.05$ (n=4)
ns –the average values are statistically indistinguishable

Materials and Methods

I. Effect of different systems of growing on yield and degree of infestation by corky root in tomato.

The experiment was conducted during the period 2012 – 2013 in unheated greenhouses with tomato variety Despeardo F_1 as soil grown culture. The trial was set by the method of long plots in 4 replications.

Conditions of the experiment:

Mineral fertilization – in the experimental plots were applied synthetic fertilizer with rapid effect in the amount defined on the basis of agrochemical analysis of the soil. During the vegetation, the nutrition with 5 kg/da NH_4NO_3 and K_2SO_4 were performed weekly;

Integrated fertilization – the basic fertilization was applied with rock phosphate (phosphorite) determined on the basis of agrochemical analysis of the soil. Nutrition during the vegetation - every week with 5 kg/da NH_4NO_3 and K_2SO_4. Vermicompost and efficient microorganisms according to the variant of the experiment were used both before transplanting of tomato plants and in the phase blossoming of 3-4 bunch.

Organic fertilization – the basic fertilization was applied with phosphorite determined on the basis of agrochemical analysis of the soil. Vermicompost and efficient microorganisms according to the variant of the experiment were used both before transplanting of tomato plants and in the phase blossoming of 3-4 bunch;

Treatments:

I. Mineral fertilization (MF)

I.1. Control – fertilization according to the adopted technology

II. Integrated fertilization (IF)

II.2. Vermicompost 3 kg/m

II.3. Vermicompost 3 kg/m + efficient microorganisms (EM) 27 L/da

III. Organic fertilization (OF)

III.4. Vermicompost 6 kg/m

III.5. Vermicompost 6 kg/m + efficient microorganisms (EM) 27 L/da

- Efficient microorganisms (EM) – it is a microbiological product containing combination of photosynthezing bacteria, milk acid bacteria, yeasts, actinomycetes, fungi.

The Vermicompost is a product from manure (beef) that is processed by red California worms (*Lumbricus rubellus* Hoffmeister, 1843). It is approved for organic agriculture according to Regulation (EO) № 889/2008.

- Rock phosphate Evrobio is a soft ground phosphorite, containing: 26% P_2O_5. The product is approved for biological agriculture, according to regulation 22.

II. Effect of tomato variety on degree of infestation from corky root (*P. lycopersici*).

The experiment was carried out in the period 2012 – 2013 in unheated greenhouses in conditions of soil cultivation with 14 tomato varieties by the method of long plots in 4 replications.

Studied varieties:

1. Matias F_1
2. Axiom F_1
3. Kiveli F_1
4. Ponderosa
5. Ligura F_1

6. Dimerosa F_1
7. Desperado F_1
8. BSS713
9. BSS714
10. Plovdivska karotina
11. Shifuku F_1
12. Kanpuku F_1
13. Alia
14. Ruby Rush

III. Recorded indexes:

- Index of corky root infestation by five rating scale (0-4). The index of infestation by McKinney is calculated.
- Yield (total and early).
- It was applied Duncan's multiple range test by a programme product SPSS.

Table 2. Index of infestation from corky root *Pyrenochaeta lycopersici* in different system of fertilization

Variant	Index of infestation %		
	2012	2013	Average
1	45.83±2.59 a	66.67±7.66 a	56.26±2.61 a
2	29.16±2.77 b	45.83±3.68 b	37.50±0.46 bc
3	29.34±4.04 b	50.10±3.43 b	39.72±2.37 b
4	24.98±1.16 b	45.83±3.63 b	35.41±2.35 c
5	12.49±2.05 c	36.49±2.17 c	24.49±0.56 d

a,b.. – Duncan's Multiply Range Test, P<0.05 (n=4)

Table 3. Index of infestation from corky root *Pyrenochaeta lycopersici* in tomato – variety experiment

Variety, hybrid, breeding line	Index of infestation %		
	2012	2013	Average
Matias F_1	45.75±4.04 c	29.16±3.61 ef	37.46±1.00 de
Axiom F_1	29.23±2.70 d	45.95±2.15 d	37.59±2.42 de
Kiveli F_1	25.82±4.16 de	44.60±3.73 d	35.21±2.19 ef
Ponderosa	66.66±8.34 a	82.00±6.43 a	74.33±1.15 a
Liguria F_1	54.06±3.53 b	70.15±4.58 bc	62.11±3.75 bc
Dimerosa F_1	54.16±4.17 b	63.16±3.68 c	58.66±.47 c
Desperado F_1	21.22±2.78 e	45.16±3.22 d	33.19±2.97 ef
BBS 713	13.16±3.22 f	34.66±6.43 e	23.91±1.81 j
BBS 714	12.83±2.68 f	28.83±2.68 ef	20.83±2.67 jh
Shifuku F_1	58.72±5.75 b	73.86±3.20 b	66.29±1.39 b
Kanpuku F_1	58.16±4.31 b	64.60±7.83 c	61.38±1.78 c
Plovdiska karotina	32.57±3.53 d	50.53±3.30 d	41.55±3.41 d
Alia	29.05±2.85 d	35.49±4.50 e	32.27±3.68 f
Ruby Rush	10.29±1.87 f	24.41±3.48 f	17.35±2.38 h

a,b.. – Duncan's Multiply Range Test, P<0.05

Results and Discussion

I. Effect of different systems of growing on the yield and degree of infestation of corky root in tomato.

In the system integrated fertilization, the control variant differs with the highest early yield while the variant with vermicompost + effective microorganisms is with the lowest one (Table 1). The same tendency is observed regarding the yield of fruits with weight over 100 g. The highest total yield is recorded in the variant with conventional fertilization (Control variant). – 7212.2 kg/da. In the two variants with application of vermicompost, the yield is similar to those of the control, 6781.3 kg/da in the integrated fertilization and 7028.5 kg/da in organic system of fertilization, respectively. The combination vermicompost + effective microorganisms results in decrease of total yield with 22-28% compared to the control in the both schemes of fertilization– integrated and organic but the differences were not significant statistically (Table 1). Similar results are recorded by Lindani et al. (2011), Lidani and Brutsch (2012). According to the authors the negative results could be due to the immobilization of N from EM as a result of which

the amount of accessible N for the plants is reduced.

The lowest infestation of corky root was established averagely for the two years in variant 5 – vermicompost 6 kg/m + effective microorganisms. In investigation of the roots of tomato plants in the end of vegetation it was established that the infestation of corky root was the lowest averagely for the two years in the variant 5 – vermicompost 6 kg/m + effective microorganisms (EM) 27 L/da (24.49%). The difference with the control is statistically significant. The infestation by the pathogen is reduced with 56.47% compared to the control variant. In the remaining variants of the experiment – vermicompost 3 and 6 kg/m and vermicompost 3 kg/m + EM the recorded index of infestation was also lower compared to the control. The difference is statistically significant. The infestation was reduced with 29.40% to 37.06%, respectively. The obtained results demonstrate depressive impact of vermicompost and EM towards *P. lycopersici*. Data for depressive effect of the composts from garden residues on the growth of pathogen are reported by Hasna et al. (2007). The reduction established by them is 13% for garden compost 1. In the remaining composts the authors have not established a reduction while in application of compost from horse manure they have established significant stimulation of the disease. The recorded index of infestation in 2013 was higher than that in 2012, but the tendency was kept. This is probably due to accumulation of inoculums in the soil (Table 2).

II. Influence of variety on the degree of infestation of corky root (*P. lycopersici*).

Plant resistance is an effective and long-lasting control strategy against plant diseases. The studied tomato varieties and hybrids could be grouped in 4 groups depending on their susceptibility to the agent of corky root *P. lycopersici* – with index up to 20%; from 21 to 40%; from 41 to 60% and over 61%. In the first group is only variety Ruby Rush (i = 17.35%). It belongs to variety type “cherry”. In the second group are two lines BBS 714 and BBS 713. Four varieties are in the last group as “Ponderosa" is with the highest index (i = 74.33%). The difference in the recorded index of infestation is statistically significant in all varieties (Table 3). The lines BBS 713 and BBS 714 are suitable for growing of infected areas. There are still no any breeding resistant varieties. Commercial cultivars of both processing and fresh market tomatoes are susceptible to corky root disease (Pohronezny and Volin, 1991).

Conclusion

The best effect against corky root (*Pyrenochaeta lycopersici)* is recorded in the variant fertilization with vermicompost 6 kg/m + effective microorganisms (EM) 27 L/da (i = 24.49%). The disease was reduced with 56.47% towards the control.

The lowest infestation from *Pyrenochaeta lycopersici* is observed in variety Ruby Rush (variety type “cherry”, i = 17.35%) and in lines BBS 713 (i = 23.91%) and BBS 714 (i = 20.83%). They are suitable for growing on infected areas.

The combination vermicompost + effective microorganisms both in integrated and in organic scheme of fertilization result in decrease of total yield with 22-28% compared to the control.

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