PHYTONEMATODES FOUND IN POTATO SOIL AND ITS ROOT SYSTEM

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ABSTRACT

The article provides information about phytonematodes found in potato soils and its root system in the Bulungur, Tailak, Samarkand, Pastdargom districts of the Samarkand region. During the study, 109 species of plant nematodes were discovered. According to the ecological classification, among devisaprobionts - 33 species and phytohelminths - 26 species (ectoparasites, endoparasites) predominate, pararisobionts - 20 species, mycohelminths - 23 species, eusaprobionts - 7 species. In the studied regions, plant nematodes of potato crops differed from each other in the diversity of species and the number of individuals. In the fauna of potato nematodes and soils around its roots, the Tailak (62 species) and Samarkand (59 species) regions dominated in terms of species diversity and number of individuals, while in the Bulungur (52 species) and Pastdargom (52 species) regions these species were relatively poorly represented. The Samarkand and Tailak regions have the greatest similarity between the faunal complexes of the potato nematode (0.67), the Samarkand and Pastdargom regions have the least similarity between the faunal complexes (0.58), while the similarity between the Bulgur and Pastdargom regions is the least (0.48). The fact that phytonematodes have slight differences in similarity coefficients between faunal complexes was explained due to the fact that they are formed in the same region both by soil type and climatic conditions. Among the plant nematodes found in potatoes, relatively common endoparasite species *are Pratylenchus pratensis, Meloidogyne arenarai, Ditylenchus dipsaci* which pose a threat to plants.

Keywords: plant nematode, fauna, type, individual, potato (Solanum tuberosum L.), friction coefficient, soil, spreading, environmental groups

1. INTRODUCTION

Introduction. Today, the impact of plant parasitic nematodes on agriculture worldwide is becoming increasingly significant. Phytonematodes develop as a habitat, due to the fact that plants spend their life cycle, parasitic species cause damage to plants, as a result of which they die, and yields are reduced by 60-80% [15]. In natural ecosystems and agrocenoses, phytonematodes are to one degree or another associated with green plants. Many of them live freely in the soil and participate in the assimilation of plant residues. Others cause significant damage by parasitizing the roots, rhizomes, nodules, and sometimes stems, leaves, flowers and seeds of plants. Accordingly, in the regions it is considered important to comprehensively study the fauna, distribution patterns and ecology of parasitic species.

In the modern world, it is important to protect the main agricultural plants from pests and parasites. Potatoes occupy the main place in the production of plant products, along with wheat, corn and rice. Based on the needs of the population and the needs of the market, the cultivation of potatoes and vegetables is growing every year. In this regard, the area for growing potatoes and vegetables has expanded in Uzbekistan, and hundreds of new farms specializing in this area have been created. In increasing potato yields, scientifically based planned measures to combat pests, parasites and diseases are important. Great damage to the potato crop is caused by pests and diseases belonging to various systematic groups, among which nematodes belonging to the class of roundworms occupy a special place.

Therefore, it is important to carefully study pests and parasites of the potato crop, including phytonematodes.

Level of knowledge of the problem. Information about potato phytonematodes in Uzbekistan A.T. Tolaganov (1968) [8], S.M. Rizaeva (1986) [5], D.T. It is described in the works of Sidikov (1993) [7]. These scientific works are focused on the study of one or several species of potato parasites, and the available data on the study of potato phytonematodes cannot explain in detail the current situation with the types of phytonematodes found in potato crops. At the same time, the Samarkand region is one of the potato and vegetable growing regions of the republic. However, in Uzbekistan, in particular in the conditions of the Samarkand region, there have not been extensive studies of the abundance, ecology and taxonomy of the fauna of plant nematodes found in potato crops. Therefore, it was considered appropriate to analyze the fauna and ecological composition of phytonematodes found in the soil around potatoes and their roots in some areas of the Samarkand region, as well as the distribution of nematodes across regions.

2. MATERIAL AND METHODS

Research materials for 2022-2023 were collected in farms and private estates in the Bulungur, Taylok, Samarkand and Pastdargom districts of the Samarkand region. Two potato growing farms were selected in each district. Samples were taken diagonally [3] from leaves and stems, roots and soil around the roots of 20 plants from potato fields (Solanum tuberosum L.) (varieties “Arizona”, “Sante”). In this way, 60 were collected from each farm (leaves, stems - 20, roots - 20, soil - 20), 120 in each region, 480 samples of plants and soil. Nematodes were isolated from soil and plant samples using the Baermann funnel method; the isolated nematodes were fixed in test tubes in a 5-6% formaldehyde solution [3]. To identify nematodes isolated from samples, E.S. Kiryanova and E.L. Temporary and permanent microslides were prepared according to Krall’s method [3]. Determination of the species composition of nematodes was carried out according to generally accepted methods. When determining the species composition of nematodes, BX53, OLYMP, SC-180 (Japan, 2018) were studied using a light microscope.

Identification of similarities and differences between faunal complexes of nematodes in potato crops in the Samarkand region was determined by the Sorensen similarity coefficient (S). The similarity coefficient is calculated using the following formula:

$$C_s = 2j/(a+b)$$

where j is the number of species common to the two compared options; a – number of species in the first option; b – the number of all types in the second option. According to the similarity coefficient, if the index (S) is 0.73 and higher, the faunal complex of the compared options is close to each other, and if the index is 0.27 and lower, they conclude that the fauna of the compared options is significantly similar. different [1].

The Margalef index was used to calculate the species richness of the nematode fauna of the potato plant:

$$D_{Mg} = (S-1)/\ln N$$

where S is the number of identified species, N is the number of individuals of all identified species, ln is the natural logarithm. In this case, it is concluded that the types of biotopes are more diverse, which territory or plant has a higher index [1].

3. RESULTS AND DISCUSSION

As a result of a comprehensive study of potato phytonematodes and its soil around the roots of the Samarkand region, 2 subclasses (Adenophorea, Secernentea), 6 families (Chromadorida, Mononchida, Dorylaimida, Rhabditida, Aphelenchida, Tylenchida), 31 families, 109 species were identified. membership in 50 genera were identified. Among the identified families of plant nematodes, representatives of the family Rhabditida occupy a leading position (36 species) and account for 33.0% of the total number of identified species. The next places are occupied by Tylenchida (25; 22.9%), Aphelenchida (23; 21.1%) and Dorilaimida (12; 11.0%). The least abundant were Chromadorida (7; 6.4%) and Mononchida (6; 5.5%).

During research in the area, the species composition and distribution of plant nematodes identified in the soil around potatoes and their roots, as well as their ecological relationship with plants, were analyzed. The classification and description of 109 species of potato phytonematoda fauna into ecological groups according to nutritional and life characteristics was carried out mainly by. The works of A.A.Paramonov [4], G. Yeates [21, 22] and others [16, 19] were used. According to the system proposed by A.A.Paramonov (1962), plant nematodes are divided into pararhizobionts, eusaprobionts, devisaprobionts, mycohelminths and parasitic phytohelminths. These environmental groups, in turn, are divided into several subgroups. [4].

Pararhizobionts usually live freely in the soil around the root. Most species feed on the sap of plant cells, but do not cause serious harm to the plant. In our material, pararhizobionts represent a relatively diverse and numerous group, including 20 species. The diversity of pararhizobiont species and the number of individuals was 9 species in the Samarkand region, more in the Tailak and Pastdargom regions (11/10 species), and the smallest number of species (6 species) was noted in the Bulungur region (Table 1).

Table 1. Distribution of plant nematodes by ecological groups

Environmental groups	Districts				General
	Samarkand	Tailak	Bulungur	Pastdargom	
Pararhizobionts	9	11	6	10	36
Eusaprobionts	6	4	4	2	16
Devisaprobionts	31	22	19	20	92
Mycohelminths	7	11	14	7	39
Ectoparasites	13	10	6	11	40
Endoparasites	2	2	2	2	8
Total number of individuals	68	60	51	52	109

According to the method of feeding, pararhizobionts can be divided into subgroups of bacteriophages, detritivores, and predatory pararhizobionts. Bacteriotrophs, or free-living soil pararhizobionts, can feed on soil microorganisms (bacteria, viruses, single-celled animals), sometimes on plant cells. For this reason, some species belonging to this group are considered polytrophic in the scientific literature [13, 14, 17, 22]. In our materials, bacteriophages-pararhizobionts are represented by 11 species (*Alaimus primitivus, Tylencholaimus minimus, Eudorylaimus ettersbergensis, E. paraobtusicaudatus, E. kirjanovae, E. labiatus, E. monhystera, E. Muchabbatae, E. pratensis, E. sulfasae, Diphterophora communus*). Representatives of this group are nematodes, found mainly in the soil.

Detritivorous pararhizobionts feed on organic humus formed from plant residues in the soil or freshwater bottom [4]. In the soil around potatoes and roots, 4 species of detritivorous pararhizobionts were identified (*Monhystera filiformis, Prismatolaimus dolichurus, P. intermedius, Rhabdolaimus aquaticus*). *M. filiformis* and *P. intermedius* were found in

Samarkand, Tailak and Pastdargam, *P. dolichurus* - in Samarkand and Pastdargam, *Rhabdolaimus aquaticus* - in Samarkand and Bulungur.

Predatory pararhizobionts are armed with chitinous growths - teeth. These are mainly small nematodes, the larvae of which feed on unicellular organisms [4]. In our material, 5 species of predatory pararhizobionts were noted: *Mesodorilaimus bastian, M. clavicaudatus, Melonchulus sigmaturus, Clarcus papillatus, Aporcelaimellus obtusicaudatus. M. bastian, M. sigmaturus, C. papillatus* were found in Samarkand, Tailak, *M. clavicaudatus* in Pastdargom, and the species *A. obtusicaudatus* was found in Bulungur. Representatives of this group are nematodes that are very sensitive to environmental factors.

Eusaprobionts, that is, true saprobionts, feed on decaying plant debris in the soil and help speed up the decay process. They are also found in plant tissue that has been damaged by other pathogens and has begun to rot. Eusaprobionts are the least diverse group. In the samples we collected, 7 species from this group were found. Among eusaprobionts, in addition to *Mesorhabditis neglects* (found in Bulungur), 6 species were noted in the Samarkand and Tailak regions. This situation may be due to the fact that various plants are grown in these areas and relatively more plant residues accumulate in the soil. At the same time, Tailak district is a region specializing in growing potatoes.

Devisaprobionts, that is, immature saprobionts, live freely in the soil and are sometimes found in rotting residues even in healthy plant tissues [4]. In the samples we collected, devisaprobionts are more numerous than other ecological groups in terms of species diversity (34 species), but in terms of the number of individuals they are the largest ecogroup. Devisaprobionts are divided into unarmed and armed subgroups based on their morphological structure and nutritional characteristics [4].

Unarmed devisaprobionts feed on humus, like eusaprobionts, diseased parts of plants, and rotting plant debris in the soil [4]. The oral cavity (stomata) of nematodes of this group is wide and cylindrical. Our materials revealed 13 species belonging to the family Cephalobidae (*Cephalobus persegnis, C. Quadrilineates, Eucephalobus striatus, E. oxyroides, E. cornis, E. paraconitus, Heterocephalobus elongatus, H. filiformis. H. laevis, Panagrolaimusrigidus, P. subelongates , P. longicaudatus, P. armatus*). Among them there are relatively many species C. persegnis and P.rigidus.

Armed devisaprobionts are found mainly in the soil around plant roots, sometimes in tissues. In the front part of the body, they have chitinized growths - probolas. With the help of these growths, nematodes can penetrate plant tissues and feed on them [4]. During our research, 20 species of representatives of this group were found in the soil around potatoes and root crops: *Acrobeles ciliatus, Acrobeloides bütschlii, A. emarginatus, A. tricornis, A. nanus, A. labiatus, Chiloplacus propinguus, C. symmetricus, C. lentus* were found*, C. bibigulae, C. demani, C. minimus, C. bicaudatus, C. sclerovaginus, Cervidellus insubricus, C. vexiliger, Anaplectus granulosus, Plectus cirratus, P. parietinus, Proteroplectus parvus*. Among them, representatives of the genus Chiloplacus have a quantitative advantage.

Mycohelminths, that is, non-specialized parasites, feed primarily on fungal mycelium in places where saprobiotic processes occur. The stylet of these nematodes is also thin and delicate [4]. Mycohelminths can also penetrate the internal tissues of plants. In our material there are 23 species: *Aphelenchus avenae, A. solani, A. cylindricaudatus, A. paramonovi, Paraphelenchus pseudoparietinus, Aphelenchoides obtusicaudatus, A. cyrtus, A. helophilus, A.limberi, A. saprophilus, A. composticola. , A. dactylocercus*.

Ectoparasites. In the oral cavity of most ectoparasites there is a strong and large stinging organ - the stylet. Using a stylet, nematodes pierce plant cells and feed on the cytoplasmic fluid [4]. G.V. Yeates (1971) noted that some species of ectoparasites (representatives of the families Tylenchidae, Psilenchidae) feed only on the root epidermis or root hairs [21]. Some phytohelminthologists note ectoparasites as obligate parasites that form associations with plants. Most ectoparasites do not specialize in parasitizing a particular plant. They are called polytrophs. A. A. Paramonov describes such parasitic nematodes with a highly developed stylet as ectoparasitic perforators [4]. Our materials identified 23 species of ectoparasites.

These include Xiphinema index, *Megadorus megadorus, Aphelenchoides parietinus, Seinura citri, S. tenuicaudatus (family Aphelenchoididae), Tylenchus davaineii, Aglenchus agricola, A. thornei, Filenchus filiformis, Lelenchus leptosoma (Tylenchidae), Psilenchus clavicaudatus (Psilenchidae), Helicotylenchus dihystera*) include types. Among ectoparasites, *Aphelenchoides parietinus* is a common dominant species. Even if ectoparasites feed on living plant tissue, they cannot cause much harm to them. But some ectoparasites, along with parasitism, can also introduce the causative agent of a viral disease into plants. [2, 7].

Endoparasites penetrate plant tissue and feed by sucking out cell sap. The biological substances they produce negatively affect the growth and development of plants. In turn, this group is divided into sedentary and migratory endoparasites [21]. After penetrating the plant tissue, sessile endoparasites begin to feed on young root cells. The female nematode quickly grows to a pear-shaped form. Only one species from this group, *Meloidogyne arenarea,* was found in potato roots and soil around the roots of the Bulungur region. Migrating endoparasites can move through the tissues of plant organs and ascend to the top of the plant. In our materials, in all studied territories, the nematode fauna includes representatives of migratory endoparasites of the families Pratylenchidae and Anguinidae - the species *Pratylenchus pratensis* and *Ditylenchus dispsaci*.

Thus, nematodes identified in the soil around potatoes and its roots were divided into 6 main ecological groups: pararhizobionts, eusaprobionts, devisaprobionts, mycohelminths, ectoparasites and endoparasites, depending on their interaction with plants and feeding method. These groups are unevenly distributed across the study areas. The faunal complex of potato nematodes and the soil around its roots was dominated by devisaprobionts feeding on plant residues. Pararhizobionts and ectoparasites were also relatively numerous in the Samarkand and Tailak regions.

The quantitative and qualitative composition of phytonematodes depends on the nature of crop cultivation, the species specificity of phytonematodes, soil properties, plant growth and development, and environmental changes [6, 9, 10, 11, 12, 18]. Based on the results of our research, it was established that the nematode fauna of each region is distinguished by a certain group. The maximum number of species was noted in the Tailok and Samarkand regions (62/59 species), where typical gray soils are common. Potatoes were the first crop in the Tailak region, and vegetables were the first crop in the Samarkand region. In the lowland (formerly sown with cotton) and Bulungur regions (52/52 species) (formerly field crops), a small number of species (formerly field crops) were noted, in the first area - typical gray soils (dry), in the second - light gray soils. Due to the fact that the potato fields are located far from each other, one can think that the phytonematodes of each agrocenosis have their own faunal complex. To determine the similarity or difference of the studied faunal complexes of phytonematodes of potato plants, the Chekanovsky-Sørensen similarity coefficient formula was used. The similarity between the faunal complexes of potato nematodes in the Samarkand and Tailak regions is the greatest (0.67), the similarity between the faunal complexes in the Samarkand and Pastdargom regions is somewhat lower (0.58), the similarity between the faunistic complexes in the Bulungur and Pastdargom regions. districts had the smallest (0.48). Similarity coefficients show that the faunal complexes of phytonematodes of the analyzed potato agrocenoses differ little from each other, were formed under the influence of similar environmental conditions (soil, moisture, previous harvest) and were interconnected. For this reason, the similarity of faunal complexes of potato plants with the same types of soils (typical gray soils) was relatively high. The absence of differences in the coefficients of similarity between the faunal complexes of phytonematodes of the potato crop is due to their formation in the same type of soil, region and climatic conditions (Table 2).

Table 2 Identification of similarities between faunal complexes of nematodes

No.	Ecosystem studied	Number of species (a, b)	Total number of species (j)	Similarity coefficient
1	Samarkand district	59	40	

	Tailak district	62		0. 6 7
2	Samarkand district	59	27	
	Bulungur district	52		0.49
3	Samarkand district	59	32	
	Pastdargom district	52		0.58
4	Tailak district	62	28	0.49
	Bulungur district	52		
5	Bulungur district	52	25	0.48
	Pastargom district	52		
6	Tailak district	62	32	0.56
	Pastdargom district	52		

When comparing the nematode fauna according to the Margelef index, the potato crop of the Pastdargom region differed from the potatoes of other regions in the richness of species diversity (D Mg = 4.1). The diversity of potato species in the area was observed mainly in the soil around the roots, due to the fact that the cotton crop was planted in this area. It was found that the diversity index is average in the Tailok region (D Mg = 3.6), but almost at the same level (D Mg = 2.5-2.6) for potatoes in the Samarkand and Bulungur regions.

Of the 109 species of nematodes identified as a result of the research, 18 species are common and were noted to be found in potato crops in four regions. Species of nematodes *Eudorylaimus ettersbergensis, Acrobeloides labiatus, Panagrolaimus longicaudatus, Mesorhabditis monhystera, Paraphelenchus pseudoparietinus, Merlinius quadrifer, Psilenchus clavicaudatus, Helicotylenchus erythrinae, Deladenus obesus* were noted in the Samarkand region and not found in other regions, *Mesodorylaimus bastian, Tylencholaimus minimus, Eudorylaimus pratensis, E paracornutus., Ch. bicaudatus, Aphelenchus solani, Aphelenchoides composticola, Seinura citri, Helicotylenchus dihystera, H. pseudorabustus, Paratylenchus macrophalus*, nematode species *Ditylenchus myceliophagus* were found in Tailak area. Species of nematodes *Anaplectus granulosus, Tobrilus kirjanovae, Alaimus primitivus, Mesodorylaimus clavicaudatus, Neotylenchus obulbosus, Ditylenchus takanonovi, Nothotylenchus acris, nematodes N.thornei* in the Pastdorgom region and *Eudorylaimus muchabbatae, E. labiatus, Aporcelaimellus obtusicaudatus*, Xi phine ma index, *Chiloplacus sclerovaginatus, Cervidelus vexiliger* in Bulungur district. The nematode species *Mesorhabditis neglects, Aphelenchus paramonovi, Ektaphelenchus tenuidens, Bursaphelenchus talonus, Aphelenchoides cyrtus, A. tribuliis, A. hylophilus, A. sexlineatus, Megadorus megadorus, Meloidogyne arenarea* were found.

4. CONCLUSION

1. 109 species of phytonematodes were identified in the soil around potatoes and their roots in the Bulungur, Tailak, Samarkand and Pastdargom districts of the Samarkand region. The identified nematodes belong to two subclasses (Adenophorea, Secernentea), 6 families (Dorylaimida, Chromadorida, Mononchida, Rhabditida, Aphelenchida, Tylenchida), 31 families and 50 genera.

2. Based on nutritional and environmental characteristics, the identified phytonematodes were divided into pararhizobionts, eusaprobionts, devisaprobionts, mycohelminths, and phytohelminths (ectoparasites and endoparasites). Among the ecological groups, devisaprobionts dominate - 33 species and phytohelminths - 26 species, pararhizobionts - 20 species, mycohelminths - 23 species, eusaprobionts - 7 species. In terms of the number of individuals, pararhizobionts, devisaprobionts and ectoparasites predominate.

3. In the studied areas, phytonematodes of potato crops differ from each other in species diversity and number of individuals. In terms of species diversity and number of individuals, the phytonematode fauna of potato and its soil around the roots of the Tailak (62 species) and

Samarkand (59 species) regions, and in the Bulungur (52 species) and Pastdargom (52 species) regions dominated. species) there were relatively few species.

4. Pairwise comparison of faunal complexes of potato nematodes showed that they are neither absolutely similar nor very different from each other. The similarity between faunal assemblages of phytonematodes was moderate to high and ranged from 0.56 to 0.67%. This similarity indicates that their faunal complexes were formed in the same ecological environment.

5. In the Samarkand region, 26 species of phytonematodes parasitize potato crops; among the endoparasites, *Pratylenchus pratensis, Meloidogyne arenarea, Ditylenchus dispaci* are relatively common species and are dangerous parasites.

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