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# Faunistic Analysis and Distribution of Phytonematodes of Some Fruit Trees of The Southern Regions of Uzbekistan

**Abdujabbor Sattorovich Bekmurodov[1*], Ma'suma Umarovna Raxmatova[2], Nilufar Ergashevna Iskandarova[3], Gulhayo Baxtiyorovna Aramova[4]**

*[1,2,3,4]Department of Zoology, Termez State University, Uzbekistan*

**Corresponding author's E-mail: babdujabbor@mail.ru*

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***Abstract***

*The article analyzes data on the faunal analysis and distribution of phytonematodes of some fruit trees in the southern regions of Uzbekistan. As a result of the study, 42 species of plant nematodes were identified, belonging to 2 subclasses, 5 orders, 17 families and 25 genera. The basal soil and root system of fruit trees are dominated by the species Cephalobus persegnis, Eucephalobus oxyuroides, Chiloplacus sclerovaginatus, Panagrolaimus rigidus, Rhabditis brevispina, Aphelenchus avenae, Aphelenchoides parietinus, A. bicaudatus, A. blastophthorus, A. composticola, A. limberi, Quinisulcius capitatus, Helicotylenchus erythrinae, Pratylenchus pratensis and Ditylenchus dipsaci.*

**Keywords:** *Phytonematodes, Fruit Trees, Cherry, Plum, Pear, Root Soil, Root System, Phytohelminths of Nonspecific Pathogenic Effect, Phytohelminths of Specific Pathogenic Effect*

## 1. Introduction

Plant nematodes are among the most economically important plant parasites with which they form long-term interactions.

Nematodes are the most numerous and widespread multicellular animals on Earth: the phylum Nematoda has at least 24 thousand described species, at least 20% of which feed phytotrophically [10, pp. 445-660]. So, all known plants can be "happy" hosts of one or even several species of plant nematodes [7, 206 p.]!

Plant-parasitic nematodes, or PPNs, although they are microscopic (0.25–3 mm) worms, are one of the most destructive agricultural pests worldwide: reduced production from pests Their damage averages 10–20%, and total losses exceed about 125 billion US dollars annually. Parasites cause the greatest damage to crop production and forestry, affecting a wide range of commercially important food and feed crops, such as tomatoes, potatoes, peppers, soybeans, cotton, sugar beets, rice, wheat, corn, etc. [15, P.10.]. Plant nematodes not only damage plants, but can also be active carriers of infectious plant diseases, in particular viral ones.

The impact of plant nematodes on plants is partly similar to viral and bacterial diseases and is expressed mainly in such general symptoms as yellowing of leaves, stunting and reduced yield. Therefore, unfortunately, very often plant diseases caused by nematodes go unnoticed, since the death of plants or inhibition of their vital activity is attributed not to true pathogens, but to other phytopathogens or unfavorable abiotic conditions [9, 369 p.], [8,386 p.].

In Uzbekistan, the fauna, ecology, distribution and other features of phytonematodes of fruit trees have been little studied. Phytohelminthological studies on phytonematodes of fruit trees in the southern regions of Uzbekistan were carried out by Sh.Kh. Khurramov, A.S. Bekmurodov [18, P. 98-102.], A.S. Bekmurodov, M.I. Abdujalilova [1, P.117-120], A.S. Bekmurodov, G.B.Aramova [2, P.47-49]. A.S. Bekmurodov, M.X. Yaxshiboyeva, L.A. Muhammadiyeva [3, P. 741-745], A.S.Bekmurodov, M.Ibrohimova, M.Turopova [4, P. 985-993], A.S. Bekmurodov, M. Yakhshiboeva, S. Topilova, D. Normatova [5, P. 838-845], A.S. Bekmurodov, D. Vohidova, M. Ergasheva [6, P. 25-28.].

The material for this work was samples of some fruit trees ((cherry (*Cerasus avium* L.), (plum (*Prunus*), pear (*Pyrus*)), collected in orchards in the southern regions of Uzbekistan.

## 2. Materials And Methods

**Methods for sample collection and sample analysis.** When performing the ecological and faunal part of the work, to identify the species composition of plant nematodes and the patterns of their distribution in the root system and root soil of fruit trees, we used the route method, widely used by phytohelminthologists in the CIS countries [21; 480 p.].

**Route method.** Faunal studies were carried out using the generally accepted route method [16; 447 p., 17; 521 p., 20; P. 3-11]. This method was used for the purpose of a wide phytohelminthological examination of fruit trees in the southern regions of Uzbekistan (especially the territory of Surkhandarya and Kashkadarya regions).

Research by route method covered orchards of Termez, Angor, Sherabad, Muzrabad, Kizirik, Bandykhan, Baysun, Jarkurgan, Kumkurgan, Shurchinsky, Denau, Altynsay, Sariassi and Uzun districts of Surkhandarya and Dekhkanabad, Guzar, Kamashi, Kitab, Karshi districts of Kashkadarya areas beyond periods from April 25 to September 25, 2020 and 2022.

When examining fruit trees, samples were taken along the diagonal of the gardens, depending on the area of the latter, at 50 and 100 m. At these points, the trees were dug up with a shovel to a depth of 40 cm, depending on the age of the plants (10-18 years) at a distance of 1-1. 5 m from the trunk or samples were taken with a soil drill in triplicate. The volume of the soil sample with dangling roots was about 1 kg. The roots were completely removed, washed, and 20 g of them were placed for nematode isolation. To isolate phytonematodes from the soil, 3 samples of 20 $cm^3$ each were placed.

In route faunal studies, a total of 700 samples were collected, including 350 soil and 350 plant samples.

**Methods for extracting, fixing, preparing preparations and studying nematodes.** The collected samples were analyzed in the phytohelminthological laboratory at Termez State University. First, the plants were carefully examined for infestation with gall and other parasitic plant nematodes. Then the root soil and plant roots were examined separately.

To extract phytonematodes from soil and plant samples, mainly the modified Berman funnel method was used. Clearing of nematodes was carried out in a mixture of glycerol and alcohol (1:3) and for office processing of the material, permanent preparations were prepared in glycerin according to the Seinhorst method [23; P. 67-69]. Samples of soil (20 cm3) and cut roots (20 g) (length of root pieces 0.5-1 cm) were placed in glass funnels with a diameter of 15 cm on metal meshes with milk filters, a rubber tube with a clamp was put on the narrow end and filled with tap water. Samples were left for 24 hours in summer, 48 hours in autumn-spring and 72 hours in winter at room temperature (up to 200C). With 24-48 hour exposure, the best results were obtained. During this period, mobile nematodes emerged from the soil or roots into the water and settled in the narrow end of a funnel with a rubber tube and clamp. At the end of the exposure period, the clamp at the narrow end of the funnel was opened and the nematodes settled there with a certain amount of water were poured into a test tube. Soil samples for the presence of cyst nematodes were analyzed according to Dekker's method [11; 445 p.].

To fix the nematodes, a 4-5% formalin solution was used. After two days, the nematode was transferred to a glass slide with a drop of glycerin-gelatin, slightly heated and covered with a coverslip. Each slide was outlined in ink on the back of the slide and labeled.

Anatomical and morphological study of phytonematodes was carried out on freshly prepared temporary preparations in a water drop or on permanent preparations in glycerin – gelatin.

O prepare permanent preparations, the nematodes were first transferred using an entomological needle under a binocular into a clearing liquid (a mixture of water, 96% alcohol and glycerin in a ratio of 20:1:1) and left in the mixture for 2-3 days until the water completely evaporated from the mixture. During this period, the internal organs become clear and become contrasting and clearly visible under a microscope.

To determine the species of plant nematodes, 625 total (glycerin-gelatin) and 950 temporary (water-glycerin) preparations were prepared.

The species composition of plant nematodes was studied under an MBR-3 microscope with a light filter. To identify species, we used morphometric indicators obtained using the generally accepted De Man formula [12; 104 p.] in its modification according to Micoletzky [14; 650 p.]. In the formula, L is the total length of the body; a is the ratio of the length of the body to its greatest width; c - the ratio of the body length to the length of the esophagus; c is the ratio of body length to tail length; V – position of the vulva as a percentage of the total length, starting from the anterior end of the body.

In parasitic species of plant nematodes, the length of the stylet, spicules, and the number of lateral fields and rudders were also measured. Quantitative analysis of the species composition and abundance of phytohelminths is based on the sum of species and individuals recorded in all samples. The degree of dominance of phytonematodes in plant and soil samples was determined from the percentage of individuals of certain species to the number of all detected by Witkowsky [13; 53 p.]. In this case, species that constitute more than 10% of all discovered species are dominant and or eudominants, dominants are 5.1-10%, subdominants are 2.1-5%, precedents are 1.1-2%, subprecedents or rare species are less than 1 % of individuals.

**3. Results and Discussion**

As a result of phytohelminthological studies in fruit crops of the southern regions of Uzbekistan, we discovered a total of 42 species of phytonematodes belonging to 25 genera, 17 families, 5 orders and 2 subclasses.

The research results show that phytonematodes of fruit trees and its root soil differ significantly from each other, both in species composition and in the number of individuals.

Phytonematodes identified from the roots and rhizosphere of fruit trees, according to the ecological classification of A.A. Paramonov [19; pp. 338-369, 21; 480 pp., 22; – 446 p.], belong to 5 ecological groups: *pararhizobionts, devisaprobionts, eusaprobionts, phytohelminths of nonspecific pathogenic effect and phytohelminths of specific pathogenic effect.*

**Faunistic and ecological analysis of phytonematodes in the root soil of fruit trees.** In the root soil of fruit trees, 2245 individuals were registered (70.0% of the total number of detected phytonematodes), belonging to 42 species. Of the pararhizobionts, *Eudorulaimus pratensis, E. similis, Aporcelaimellus obtusicaudatus, Tylencholaimus minimus* and *Diphtherophora communis* were often found. Among the devisaprobionts, the dominant species are *Cephalobus persegnis, Eucephalobus oxyuroides, Acrobelopides buetschlii, Chiloplacus quintastriatus, Ch. sclerovaginatus* and *Panagrolaimus rigidus,* and *Rhabditis brevispina* was often found among eusaprobionts.

Among the representatives of phytohelminths with a nonspecific pathogenic effect, *Aphelenchus avenae, Aphelenchoides parietinus, A. blastophthorus, A. composticola, A. limberi* and *Ditylenchus myceliophagus* predominated, and the most numerous of those with a specific pathogenic effect were *Bitylenchus dubius, Quinisulcius capitatus, Helicotylenchus dihystera, H. erythrinae, Pratylenchus pratensis, Paratylenchus hamatus* and *Ditylenchus dipsaci*.

The main faunal complex of phytonematodes in the root soil of fruit trees consists of the species *E. pratensis, D. communis, C. persegnis, E. oxyuroides, A. buetschlii, Ch. sclerovaginatus, P.rigidus, Rh.brevispina, A. avenae, A. parietinus, A.bicaudatus, A. blastophthorus, A. composticola, A. limberi, Q.capitatus, H. erythrinae, P. pratensis, D. dipsaci* and some relatively small species.

In the root soil of fruit trees, of the 5 orders of the class of nematodes, the orders Tylenchida-13 species, Rhabditida-10, Dorylaimida-9, Aphelenchida-8 are most diversely represented. Among the above orders, in terms of species composition, representatives of the Tylenchida order dominate, containing 31.0% of all detected species in the root soil. While, in terms of the number of individuals, representatives of the order Aphelenchida predominate, accounting for 39.3% of all registered individuals in the root soil of fruit trees (Table 1).

**Table 1** Phytonematodes found in the root zone soil of fruit trees by order

| Orders | Number of species | % | Number of individuals | % |
|---|---|---|---|---|
| Dorylaimida | 9 | 21,4 | 368 | 16,4 |
| Plectida | 2 | 4,8 | 20 | 0,9 |
| Rhabditida | 10 | 23,8 | 470 | 21,0 |
| Aphelenchida | 8 | 19,0 | 882 | 39,3 |
| Tylenchida | 13 | 31,0 | 505 | 22,4 |
| Total: | 42 | 100 | 2245 | 100 |

**Faunistic and ecological analysis of phytonematodes in the root system of fruit trees.** In the root system of fruit trees, 963 individuals were found (30.0% of the total number of detected phytonematodes), belonging to 24 species. Among pararhizobionts, only *D. communis* is found in the root system. The predominant group of devisaprobionts was *C. persegnis, E. oxyuroides, A. buetschlii, Ch. quintastriatus, Ch. sclerovaginatus* and *P. rigidus*. Among the eusaprobionts, *Rh. brevispina*.

Among the representatives of phytohelminths of nonspecific pathogenic effect, *A. avenae, A. parietinus, A. bicaudatus, A. blastophthorus, A. composticola* and *A. limberi* dominate. From the group of

phytohelminths with a specific pathogenic effect, *Q. capitatus, H. erythrinae, P. pratensis* and *D. dipsaci* predominated.

The main community of phytonematodes in the root system of fruit trees consists of the species *C. persegnis, Ch. sclerovaginatus, P. rigidus, Rh. brevispina, A. avenae, A. parietinus, A. bicaudatus, A. composticola, A. limberi, Q. capitatus, H. erythrinae, P. pratensis* and *D. dipsaci*.

In the root system of fruit trees, of the 5 orders of the nematode class, the orders Tylenchida-9 species, Rhabditida-6 species, Aphelenchida-7 species are most diversely represented. Among the above orders, the species composition is dominated by representatives of the order Tylenchida, containing 37.5% of all species found in the root system of plants. In terms of the number of individuals, representatives of the order Aphelenchida prevail, accounting for 48.5% of all registered individuals in the roots of fruit trees (Table 2).

**Table 2** Phytonematodes found in the root system fruit trees by order

| Orders | Number of species | % | Number of individuals | % |
|---|---|---|---|---|
| Dorylaimida | 2 | 8,3 | 22 | 2,3 |
| Rhabditida | 6 | 25,0 | 152 | 15,8 |
| Aphelenchida | 7 | 29,2 | 467 | 48,5 |
| Tylenchida | 9 | 37,5 | 322 | 33,4 |
| Total: | 24 | 100 | 963 | 100 |

**Taxonomic composition of fruit tree nematodes**. The following species dominate in the root soil and root system of fruit trees: *C. persegnis, Ch. sclerovaginatus, P. rigidus, Rh. brevispina, A. avenae, A. parietinus, A.bicaudatus, A.blastophthorus, A. composticola, A. limberi, Q. capitatus, H. erythrinae, P. pratensis* and *D. dipsaci*.

During the study period, on fruit crops in the southern regions of Uzbekistan, we identified 42 species of plant nematodes, belonging to 2 subclasses, 5 orders, 17 families and 25 genera. All discovered phytonematodes are distributed among orders as follows: The order Tylenchida is represented by 13 species, Rhabditida-10, Dorylaimida-9, Aphelenchida-8 and Plectida. (Table 3.).

**Table 3** Taxonomic composition of fruit tree nematodes (by orders)

| Orders | Number of species | % | Number of individuals | % |
|---|---|---|---|---|
| Dorylaimida | 9 | 21,4 | 390 | 12,2 |
| Plectida | 2 | 4,8 | 20 | 0,6 |
| Rhabditida | 10 | 23,8 | 622 | 19,4 |
| Aphelenchida | 8 | 19,0 | 1349 | 42,0 |
| Tylenchida | 13 | 31,0 | 827 | 25,8 |
| Total: | 42 | 100 | 3208 | 100 |

The research results show that among the orders in terms of species composition, the first place is occupied by the order Tylenchida, accounting for 31.0% of all discovered species of fruit tree nematodes. This is followed by the order Rhabditida (23.8%), then Dorylaimida (21.4%) and the order Aphelenchida (19.0%).

In terms of the number of individuals among orders, the first place is occupied by the order Aphelenchida - 42.0% of the total number of discovered plant nematodes. Then the orders Tylenchida - 25.8%, Rhabditida - 19.4% and Dorylaimida - 12.2%.

In the faunal complex, phytonematodes of fruit trees are represented by 17 families. The family Cephalobidae is the most diverse in species composition, accounting for 15.2% of all discovered species of plant nematodes in fruit trees. Then Aphelenchoididae -13.5%, Qudsianematidae -8.1, Tylenchidae -6.4 and Anguinidae 4.9%.

In terms of the number of individuals among families, Aphelenchoididae takes first place. It contains the main number (37.5%) of plant nematode individuals, followed by Cephalobidae-16.8%, Aphelenchidae-7.8%, Anguinidae-6.9% and Hoplolaimidae-6.1% individuals.

## 4. Conclusion

During the study period, on fruit crops in the southern regions of Uzbekistan, we identified 42 species of plant nematodes, belonging to 2 subclasses, 5 orders, 17 families and 25 genera.

The following species dominate in the root soil and root system of fruit trees: *C. persegnis, Ch. sclerovaginatus, P. rigidus, Rh. brevispina, A. avenae, A. parietinus, A.bicaudatus, A.blastophthorus, A. composticola, A. limberi, Q. capitatus, H. erythrinae, P. pratensis* and *D. dipsaci*.

An analysis of the conducted studies showed that in the conditions of the southern regions (Surkhandarya and Kashkadarya) of Uzbekistan, phytohelminthological studies of fruit trees have not been sufficiently studied. Therefore, conducting large-scale phytohelminthological studies to determine the faunal complex of phytonematodes of fruit trees in a given territory and justify measures to combat parasitic species is of important scientific and practical importance in fruit growing of the Republic of Uzbekistan.

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