# SPECIES COMPOSITION AND DISTRIBUTION OF PHYTONEMATODES OF FRUIT TREES IN THE SOUTHERN REGIONS OF UZBEKISTAN

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**Abstract:** The article provides data on the fauna and distribution of phytonematodes of fruit trees in the southern regions of Uzbekistan. As a result of the study, 49 species of plant nematodes belonging to 2 subclasses, 6 orders, 19 families and 27 genera were found. The main community of phytonematodes in the root soil and the root system of fruit trees are species *Eudorylaimus pratensis, Cephalobus persegnis, Eucephalobus oxyuroides, Chiloplacus sclerovaginatus, Panagrolaimus rigidus, Rhabditis brevispina, Aphelenchus avenae, Aphelenchoides parietinus, A. bicaudatus, A. blasthophthorus, A. composticola, A. graminis, A. limberi, Quinisulcius capitatus, Helicotylenchus erythrinae, Pratylenchus pratensis* and *Ditylenchus dipsaci.*

**Keywords:** phytonematodes, fruit trees, apple trees, common apricot, common peach, root soil, root system, phytohelminths of non-specific pathogenic effect, phytohelminths of specific pathogenic effect.

## Introduction

Today, plant helminthiases caused by roundworms (nematodes) are a serious problem in the world, both for large agricultural enterprises and ordinary summer residents: according to experts, phytoparasitic nematodes "eat up" up to 10% of the world's crop!

Phytonematodes that feed on plants are microscopic organisms, their length does not exceed 0.5–2 mm. The body is filamentous and fusiform, gradually tapering at the ends, round in cross section, therefore they are sometimes called roundworms. Gall and cyst nematodes are pear- and spherical in shape.Their body is not segmented, its walls are a skin-muscular sac without visible appendages. In the body, there are 3 sections that do not have sharp boundaries between themselves - anterior, middle and posterior. The anterior head

section contains the mouth opening and sensory organs. In the oral cavity there is a special needle-like organ - a stylet, designed to pierce plant tissue and absorb food. In the middle section are the middle intestine (tube, often with a reservoir), sex glands and other internal organs. The midgut passes into the hindgut, which opens outward through the anus.

Phytonematodes are dioecious animals and reproduce sexually. In individual development, they go through the phase of eggs, larvae and adults. One female can lay up to 2500 eggs. Hatching larvae molt several times and gradually turn into adult nematodes. They usually develop in several generations, and the rate of their development depends on environmental conditions, mainly temperature. Under adverse conditions, they are able to fall into a state of suspended animation, which increases resistance to low and high temperatures. Phytonematodes not only damage plants, but can also be active carriers of infectious plant diseases, in particular viral ones.

In Uzbekistan, phytonematodes of fruit trees have been little studied. Phytohelminthological studies on phytonematodes of fruit trees of southern Uzbekistan were carried out by Sh.Kh. Khurramov, A.S. Bekmurodov [10, P. 98-102.], A.S. Bekmurodov, M.I. Abduzhalilova [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].

The material for this work was samples of some fruit trees (apple (*Malus domestica* L.), (common apricot (*Prunus armeniaca* L.), common peach (*Persica vulgaris* Mill.)) collected in orchards in the southern regions of Uzbekistan.

## Methods

**Sample collection and sample analysis methods.** When performing the ecological and faunal part of the work, to identify the species composition of phytonematodes and the patterns of their distribution in the root system and root soil of fruit trees, the route method, widely used by phytohelminthologists of the CIS countries, was used.

**Route method.** Faunal studies were carried out by the generally accepted route method [8; 447 p., 9; 521 p., 12; P. 3-11]. This method was used for the purpose of a wide phytohelminthological survey of fruit trees in the southern regions of Uzbekistan (especially the territory of the Surkhandarya region).

The studies by the route method covered orchards of Termez, Angor, Sherabad, Muzrabad, Kizirik, Bandykhan, Baysun, Jarkurgan, Kumkurgan, Shurcha, Denau, Altynsay, Sariassy and Uzun districts of Surkhandarya region for the periods from April 25 to September 25, 2020 and 2022.

When examining fruit trees, samples were taken along the diagonal of orchards, depending on the area of the latter, at 50 and 100 m. 5 m from the trunk or samples were taken with a soil drill in triplicate. The volume of the soil sample with broken roots was about 1 kg. The roots were completely taken out, washed, and 20 g of them were placed for the isolation of nematodes. To isolate plant nematodes from the soil, 3 samples of 20 $cm^3$ were taken.

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

**Methods of extraction, fixation, preparation of preparations and study of 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 phytonematodes. Then, the root soil and plant roots were examined separately.

For the extraction of plant nematodes from soil and plant samples, mainly the modified Berman funnel method was used. Nematodes were clarified in a mixture of glycerol and alcohol (1:3), and permanent preparations on glycerol were prepared for laboratory processing of the material according to the Seinhorst method [15; P. 67-69]. Samples of soil (20 $cm^3$) and cut roots (20 g) (pieces of roots 0.5-1 cm long) were placed in glass funnels 15 cm in diameter 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 $20^0$C). At 24-48 hour exposure, the best results were obtained. During this period, motile nematodes emerged from the soil or roots into the water and settled at the narrow end of a funnel with a rubber tube and clamp. After the expiration of the exposure period, the clamp at the narrow end of the funnel was opened, and the nematodes settled there were poured into a test tube with a certain amount of water. Soil samples for the presence of cyst nematodes were analyzed according to the Dekker method [4; 445 p.].

A 4–5% formalin solution was used to fix the nematodes.

Two days later, the nematode was transferred to a glass slide with a drop of glycerol-gelatin, slightly warmed up and covered with a coverslip. Each preparation was outlined with ink on the reverse side of the glass slide and labeled.

Anatomical and morphological study of plant nematodes was carried out on freshly prepared temporary preparations on a water drop or on permanent preparations in glycerol-gelatin.

For the preparation of permanent preparations, at the beginning of the nematode, using an entomological needle under a binocular, they were transferred into a clearing liquid (a mixture of water, 96% alcohol and glycerol in a ratio of 20:1:1) and left in the mixture for 2-3 days until complete evaporation from the water 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. Species were identified using morphometric parameters obtained according to the generally accepted De Man formula [5; 104 p.] in its modification according to Micoletzky [7; 650 p.]. In the formula, L is the total length of the body; a is the ratio of body length to its greatest width; c - the ratio of body length to the length of the esophagus; c - ratio of body length to tail length; V is the position of the vulva as a percentage of the total length, starting from the anterior end of the body.

In parasitic phytonematode species, the length of the stylet, spicule, number of lateral fields, and shank 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 individual species to the number of all detected by Witkowsky [6; 53 p.]. At the same time, species that make up more than 10% of all detected species are dominant and or eudominant, 5.1-10% dominant, 2.1-5% subdominant, 1.1-2% precedents, subrecedent or rare species less than 1 % of individuals.

## Results and Discussion

As a result of phytohelminthological studies in fruit crops of the southern regions of Uzbekistan, we found 49 species of plant nematodes belonging to 27 genera, 19 families, 6 orders and 2 subclasses.

The obtained data 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 [11; pp. 338-369, 13; 480 pp., 14; – 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 root soil of fruit trees.** In the root soil of fruit trees, 3256 individuals (70.5% of the total number of plant nematodes found) belonging to 49 species were registered. Of the pararhizobionts, *Eudorulaimus parvus, E. pratensis, E. similis*, *Aporcelaimellus obtusicaudatus, Tylencholaimus minimus*, and *Diphtherophora communis* were often encountered. The devisaprobionts are dominated by *Cephalobus persegnis*, *Eucephalobus oxyuroides, Acrobeloides buetschlii, Chiloplacus quintastriatus, Ch. sclerovaginatus* and *Panagrolaimus rigidus*, while *Rhabditis brevispina* was common among eusaprobionts.

*Aphelenchus avenae, Aphelenchoides parietinus, A. blasthophthorus, A. composticola, A. graminis, A. limberi* and *Ditylenchus myceliophagus* prevailed among the representatives of phytohelminths of nonspecific pathogenic effect, and *Bitylenchus dubius, Quinisulcius capitatus, Helicotylenchus dihystera, H. erythrinae, Pratylenchus pratensis, Paratylenchus hamatus* and *Ditylenchus dipsaci.*

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

In the root soil of fruit trees, out of 6 orders of the nematode class, the most diverse orders are Tylenchida-15 species, Rhabditida-12, Dorylaimida-10, and Aphelenchida-9. Among the above orders, in terms of species composition, representatives of the order Tylenchida dominate, containing 30.6% of all found species in the root soil. While, in terms of the number of individuals, representatives of the Aphelenchida order predominate, which is 39.1% of all registered individuals in the root soil of fruit trees (Table 1.).

**Table 1**

**Phytonematodes found in the root soil of fruit trees by orders**

| Orders | Number of species | % | Number of individuals | % |
|---|---|---|---|---|
| Enoplida | 1 | 2,0 | 13 | 0,4 |
| Dorylaimida | 10 | 20,4 | 411 | 12,6 |
| Plectida | 2 | 4,1 | 23 | 0,7 |
| Rhabditida | 12 | 24,5 | 723 | 22,2 |
| Aphelenchida | 9 | 18,4 | 1274 | 39,1 |
| Tylenchida | 15 | 30,6 | 812 | 25,0 |
| Total: | 49 | 100 | 3256 | 100 |

Faunistic and ecological analysis of plant nematodes in the root system of fruit trees. In the root system of fruit trees, 1363 individuals (29.5% of the total number of plant nematodes found) belonging to 29 species were found. Among pararhizobionts, only *D. communis* occurs in the root system. From the group of devisaprobionts, *C. persegnis, E. oxyuroides, A. buetschlii, Ch. quintastriatus, Ch. sclerovaginatus* and *P. rigidus*. Among the eusaprobionts, *Rh. brevispina*.

*A. avenae, A. parietinus, A. bicaudatus, A. blasthophthorus, A. composticola, A. graminis*, and *A. limberi* dominate among representatives of phytohelminths with a nonspecific pathogenic effect. Of the group of phytohelminths with a specific pathogenic effect, *Q. capitatus, H. erythrinae, P. pratensis*, and *D. dipsaci* predominated.

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

In the root system of fruit trees, out of 6 orders of the nematode class, the most diverse orders are Tylenchida-11 species, Rhabditida-7 species, and Aphelenchida-9 species. Among the above orders, species composition is dominated by representatives of the order Tylenchida, containing 38.0% of all found species in the root system of plants. In terms of the number of individuals, representatives of the order Aphelenchida prevail, which is 48.3% of all registered individuals in the roots of fruit trees (Table 2.).

**Table 2**

**Phytonematodes found in the root system fruit trees by orders**

| Orders | Number of species | % | Number of individuals | % |
|---|---|---|---|---|
| Dorylaimida | 2 | 6,9 | 31 | 2,3 |
| Rhabditida | 7 | 24,1 | 233 | 17,1 |
| Aphelenchida | 9 | 31,0 | 677 | 49,6 |

| | | | | |
|---|---|---|---|---|
| Tylenchida | 11 | 38,0 | 422 | 31,0 |
| Total: | 29 | 100 | 1363 | 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. blasthophthorus, A. composticola, A. graminis, 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 49 species of plant nematodes belonging to 2 subclasses, 6 orders, 19 families and 27 genera. All found phytonematodes by orders are distributed as follows: Order Tylenchida is represented by 15 species, Rhabditida-12, Dorylaimida-10, Aphelenchida-9, Plectida-2 and Enoplida-1 (Table 3.).

**Table 3**

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

| Orders | Number of species | % | Number of individuals | % |
|---|---|---|---|---|
| Enoplida | 1 | 2,0 | 13 | 0,3 |
| Dorylaimida | 10 | 20,4 | 442 | 9,6 |
| Plectida | 2 | 4,1 | 23 | 0,5 |
| Rhabditida | 12 | 24,5 | 956 | 20,7 |
| Aphelenchida | 9 | 18,4 | 1951 | 42,2 |
| Tylenchida | 15 | 30,6 | 1234 | 26,7 |
| Total: | 49 | 100 | 4619 | 100 |

The results of the research show that among the orders in terms of species composition, the order Tylenchida occupies the first place, accounting for 30.6% of all detected species of fruit tree nematodes. Then follows the order Rhabditida (24.5%), then Dorylaimida (20.4%) and the order Aphelenchida (18.4%).

In terms of the number of individuals among the orders, the first place is occupied by the order Aphelenchida - 42.2% of the total number of plant nematodes found. Then the orders Tylenchida - 26.7%, Rhabditida - 20.7% and Dorylaimida - 9.6%.

In the faunistic complex, phytonematodes of fruit trees are represented by 19 families. The most diverse in terms of species composition is the family Cephalobidae, which makes up 16.7% of all found species of plant nematodes of fruit trees. Then Aphelenchoididae-12.4%, Qudsianematidae-9.3, Tylenchidae-7.2 and Anguinidae 5.4%.

In terms of the number of individuals among the families, Aphelenchoididae occupies the first place. It contains the main number (34.6%) of plant nematodes, followed by Cephalobidae-15.7%, Aphelenchidae-8.9%, Anguinidae-6.4% and Hoplolaimidae-5.2% of individuals.

## Conclusion

During the study period, on fruit crops in the southern regions of Uzbekistan, we identified 49 species of plant nematodes belonging to 2 subclasses, 6 orders, 19 families and 27 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. blasthophthorus, A. composticola, A. graminis, A. limberi, Q. capitatus, H. erythrinae, P. pratensis*, and *D. dipsaci*.

The analysis of the conducted studies showed that in the conditions of the southern regions of Uzbekistan, phytonematological studies of fruit trees have not been studied enough. Therefore, conducting large-scale phytohelminthological studies, determining the faunistic complex of phytonematodes of fruit trees in a given territory and substantiating measures to combat parasitic species is of great scientific and practical importance in the fruit growing of the Republic.

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