Original Article

Integrated Study of Vine Plants Phytonematodes Under the Conditions of the Surkhandarya Valley

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Abstract

The article analyzes the faunistic complex of grape phytonematodes collected in the period from 2018 to 2020. From 14 districts and 28 farms of the Surkhandarya Valley. During the study period, we found 118 species of phytonematodes belonging to 54 genera, 33 families, 9 orders and 2 subclasses on grape agrocenoses. The degree of dominance of registered phytonematodes in the roots and root soil of grapes, as well as the ecological classification based on the trophic relationships of nematodes with plants or other soil organisms, was studied.

Keywords: Fauna, Phytonematodes, Grapes, Ecological Classification, Degree of Dominance.

INTRODUCTION

In the Republic of Uzbekistan, along with other tasks in the field of agriculture, the need has been put forward to increase the average annual volume of production in order to improve and meet the needs of the population with a variety of healing foods.

In the republic, much attention is paid to providing the population with high-quality fruits and vegetables, in particular, like grapes. In addition, targeted measures have been developed to solve economic and social problems in the development of viticulture and, first of all, to provide the population with high-quality fresh and dried products, raw materials for the processing industry, as well as export to the world market to increase the export potential of Uzbekistan and the economic efficiency of viticulture [8]. Grapes are a cultivated plant that grows in temperate and subtropical regions, widely cultivated in many countries on all continents. Due to its valuable taste, dietary and medicinal properties, it is of great importance and occupies an important place among other agricultural crops [7]. The Action Strategy for the Further Development of Uzbekistan defines the task of "...expanding research work to create and introduce into production new breeding varieties of agricultural crops that are resistant to diseases and pests, adapted to local soil, climatic and environmental conditions, and animal breeds with high productivity" [1]. Based on these tasks, in particular, for the implementation of these needs includes increasing the efficiency of viticulture directly with the introduction of new, more suitable grape varieties for certain environmental conditions, resistant to adverse abiotic and biotic environmental factors, as well as increased productivity in combination with good crop quality. In addition, the productivity of grape plants and the quality of their berries and clusters from biotic factors can be limited by the wide spread of pests and diseases on them, the most dangerous of which are plant-eating nematodes that infect plants caused by phytohelminthiasis [2,3]. They cause numerous and varied damages in the root system of the plant, in addition, they play an even greater role in the spread of fungal, viral, bacterial and other diseases. The qualitative and quantitative composition of plant nematodes is diverse; they are found in all biotopes of the planet. Phytonematodes, being the main members of soil biogeocenosis, play an important role in metabolism. According to foreign researchers, pathogens of phytohelminthiasis lead to a sharp decrease in productivity and cause significant damage to the quality of berries and grapes [4,5].

When studying the literature data, information about plant nematodes in the vineyards of Uzbekistan has not been sufficiently studied. Therefore, carrying out phytohelminthological studies on this crop, studying the faunal complex of phytonematodes of grape plants and identifying parasitic species is relevant in viticulture.

Based on this, we carried out a comprehensive faunistic study to study the fauna of phytonematodes of the root system and root soil of vineyards and identify phytoparasitic species in the conditions of the Surkhandarya valley.

MATERIAL AND METHODS

On the territory of the Surkhandarya Valley, a comprehensive study in this direction was carried out by us for the first time. Field studies were carried out in the period from 2018 to 2020. Faunistic studies were carried out by the generally accepted route method [10]. The material of phytohelminthological studies was the root and soil samples of grape plants (from Sarts taifi, Husaine white, grape and black raisins) collected in 14 districts (Termez, Angor, Sherabad, Muzrabad, Kizirik, Bandykhan, Baysun, Zharkurgan, Kumkurgan, Shurchinsky, Denau, Altynsay, Sariassy, Uzun,) and 28 farms of the Surkhandarya valley. In general, the amounts are taken for analysis from soil and plant samples in a total amount of 50 grams. During the phytohelminthological study, 1280 samples of soil and the root system of grape plants were collected and analyzed. For this purpose, in each surveyed farm, two sites with similar soil conditions were chosen to collect plant and soil samples. To identify the phytohelminthological situation, 12 samples were taken from each plot for analysis from the root system and the arable (0-30 cm) layer of root soil. In the field, each soil sample, along with the roots, was placed in a separate plastic bag and labeled.

The collected samples were analyzed in the phytohelminthological laboratory. First, the roots of the plant were carefully examined for infestation with nematodes. Then, the root soil and the root system were studied separately. To isolate nematodes from the soil and the root system of plants, a modified Berman funnel method was used [12]. Exposure at room temperature + 250C was 20-28 hours, at +300 + 350C - 10-12 hours. Soil samples for the presence of the cyst nematode were usually analyzed according to the Dekker method [9]. To fix nematodes, 4-6% formalin or TAF (a mixture of triethanolamine + water + formalin) 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 [11]. Preparations for determining the species of root-knot nematodes were prepared according to the well-known method of E.S. Kiryanova, E.L. Krall [6].

The species composition of nematodes was studied under an MBR-3 microscope using light filters and a phase contrast device. When determining the species affiliation of phytonematodes, the works of domestic and foreign authors were used, as well as the atlas of phytonematodes compiled at the Institute of Problems of Ecology and Evolution named after A.N. Severtsov" RAS. Species were identified using morphometric parameters obtained by the generally accepted de Mann formula modified by Micoletzky [13].

The degree of dominance of plant nematodes in roots and soil samples was determined by the percentage of individuals of certain species to the number of all detected [14]. At the same time, species that make up more than 10% of all detected species are dominant or eudominant, dominant - 5.1-10%, subdominant - 2.1-5%, subrecedent less than 2.1% of individuals.

RESULTS AND DISCUSSION

As a result of phytohelminthological studies in grape agrocenoses in the southern region of Uzbekistan, we have found 118 species of plant nematodes belonging to 54 genera, 39 subfamilies, 33 families, 20 superfamilies, 13 suborders, 9 orders and 2 subclasses.

In total, the detected nematodes are distributed by orders as follows: Order Monhysterida is represented by 5 species, Enoplida-1, Mononchida-6, Dorylaimida-23, Alaimida-5, Rhabditida-7, Teratocephalida-25, Aphelenchida-19 and Tylenchida-27 species.В нашем материале подкласс Adenophorea представлен 4 отрядами: Monhysterida, Enoplida, Mononchida, Dorylaimida и Alaimida.

The order Monhysteri is represented by 2 families: Plectidae, Monhysteridae; 4 genera: Anaplectus, Plectus, Proteroplectus, Monhystera; 5 species (which is 4.2% of the total number of species) and only 176 specimens (1.3% of the total number of plant nematodes found). The order Enoplida includes one family: Onchulidae; one genus: Prismatolaimus and 1 species (0.9%), total 28 specimens (0.2%) of plant nematodes. The order Mononchida includes 2 families: Mononchidae, Mylonchulidae; 3 genera: Mononchus, Clarcus, Mylonchulus and 6 species (5.1%), total 153 specimens (1.2%) of plant nematodes.

The order Dorylaimi is represented by 8 families: Encholaimidae, Nygolaimidae, Dorylaimidae, Qudsianematidae, Aporcelaimidae, Discolaimidae, Nordiidae, Xiphinemidae; 11 genera: Enchodelus, Nygolaimus, Paradorylaimus, Mesodorylaimus, Dorylaimellus, Eudorylaimus, Aporcelaimus, Aporcelaimellus, Discolaimium, Longidorella, Xiphinema; 23 species (19.5%), total 844 individuals (6.3%) phytonematodes. The order Alaimida includes 2 families: Alaimidae, Diphtherophoridae; 2 genera: Alaimus, Diphtherophora and 5 species (4.2%), total 110 specimens (0.8%) of plant nematodes.

The subclass Secernentea includes the orders Rhabditida, Teratocephalida, Aphelenchida, and Tylenchida. The order Rhabditida includes 2 families: Rhabditidae, Diplogasteroididae; 4 genera: Mesorhabditis, Pelodera, Rhabditis, Mesodiplogaster; 7 species (5.9%), total 697 individuals (5.3%) phytonematodes. The order Teratocephalida is represented by

3 families: Panagrolaiminae, Cephalobinae, Acrobelinae; 8 genera: Panagrolaimus, Heterocephalobus, Cephalobus, Eucephalobus, Acrobelides, Chiloplacus, Acrobeles, Cervidelus; 25 species (21.2%), total 3747 individuals (28.9%) phytonematodes. The order Aphelenchida is represented by 3 families: Aphelenchidae, Paraphelenchidae, Aphelenchoididae; 4 genera: Aphelenchus, Paraphelenchus, Aphelenchoides, Bursaphelenchus; 19 species (16.1%), total 2070 individuals (15.8%) phytonematodes. Order Tylenchida includes 8 families: Tylenchidae, Dolichodoridae, Psilenchidae, Hoplolaimidae, Rotylenchulididae, Pratylenchidae, Meloidogynidae, Paratylenchidae; 13 genera: Tylenchus, Filenchus, Aglenchus, Lelenchus, Tylenchorhynchus, Bitylenchus, Psilenchus, Helicotylenchus, Rotylenchus, Pratylenchus, Pratylenchoides, Meloidogyne, Paratylenchus; 27 species (22.9%), total 5261 specimens (40.2%) of phytonematodes.

The above analysis shows that among the orders in terms of species composition, the order Tylenchida occupies the first place, which makes up 22.9% of all detected species of vine plant nematodes. Then the order Teratocephalida (21.2%), the order Dorylaimida (19.5%) and the order Aphelenchida (16.1%).

In terms of the number of individuals among the orders, the order Tylenchida occupies the first place, which is 40.2% of the total number of plant nematodes found. Then the order Teratocephalida (28.9%), the order Aphelenchida (15.8%) and the order Dorylaimida (6.3%).

The degree of dominance or the frequency of occurrence of the detected plant nematode species in root and soil samples dominating or eudominant species are absent. In the root soil of grapes, only one species dominates (in descending order): Ditylenchus dipsaci. Of the subdominants of the rhizosphere of the plant, 10 species were found: Panagrolaimus rigidus, Cepholobus persegnis, Chiloplacus propinquus, Aphelenchus avenae, Filenchus filiformis, Bitylenchus dubius, Helicotylenchus dihystera, Pratylenchus pratensis, Pratylenchoides crenicauda and Ditylenchus myceliophagus. The remaining registered species (108 species) are classified as subrecedents.

In the root system of grapes, the following three species are dominant: Aphelenchus avenae, Pratylenchus pratensis and Ditylenchus dipsaci. Among the species found in the roots, the subdominants are the following: Rhabditis brevispina, Panagrolaimus multidentatus, P. subelongatus, Cepholobus persegnis, Acrobeloides buetshlii, Chiloplacus propinquus, Filenchus filiformis, Bitylenchus dubius, Helicotylenchus dihystera, H. multicinctus, D. dipsaci (total 11 species). In the root system of grapes, all other species of phytonematodes registered (73 species) are classified as subrecedents.

The species composition of plant nematodes of the root system and root soil of grapes differs significantly from each other both in terms of species composition and the number of individuals. In the root soil of grapes, 9456 nematodes belonging to 118 species were recorded. The main faunistic complex of phytonematodes in the root soil is Panagrolaimus rigidus, P. multidentatus, P. subelongatus, Cephalobus persegnis, Heterocephalobus elongatus, Arobeloides buetschlii, A. nanus, Chiloplacus propinquus, Aphelenchus avenae, Aphelenchoides parietinus, Tylenchus davainei, Filenchus filichusformis brassicae, Helicotylenchus dihystera, H. erythrinae, H. multicinctus, Pratylenchus pratensis, P. neglectus, Neotylenchus abulbosus, Ditylenchus dipsaci, D. myceliophagus, etc. (22 species in total). Of the above species, such as Panagrolaimus rigidus, Cephalobus persegnis, Aphelenchus avenae, Helicotylenchus dihystera, Pratylenchus pratensis and Ditylenchus dipsaci belong to mass species and form the largest biomass in the soil.

The fauna of the root soil is characterized by an abundance of species from the families Panagrolaimimidae, Cephalobidae, and Aphelenchidae, in particular, the species P. rigidus and Cephalobus persegnis.

In the root system of the vineyards, 3630 nematodes belonging to 84 species were found. There are no mass species in the root system. Panagrolaimus rigidus, P. subelongatus, Cephalobus persegnis, Aphelenchus avenae, Bitylenchus dubius, Helicotylenchus dihystera, Pratylenchus pratensis, Ditylenchus dipsaci and others are often found. The species composition is dominated by the families.

Aphelenchoididae and Cephalobidae. Phytonematodes unite very different ecological groups. Paramonov proposed an ecological classification based on the trophic relationships of nematodes with plants or other soil organisms and identified 5 ecological groups: pararhizobionts, free-living soil forms; eusaprobionts are real inhabitants of a putrefactive environment; devisaprobionts - semi-saprobiotic inhabitants; phytohelminths of non-specific pathogenic effect or non-specific parasites; phytohelminths with a specific pathogenic effect are real plant parasites [13].

Phytonematodes identified from the root system and rhizosphere of grape plants, according to the ecological classification, are distributed as follows: pararhizobionts - 29 species (24.6% of the total number of species), 970 individuals (7.4% of the total number of plant nematodes found); devisaprobionts - 11 species (9.3%), 797 individuals (6.1%) of phytonematodes; eusaprobionts - 29 species (24.6%), 3871 individuals (29.6%) of phyto-nematodes; phytohelminths of nonspecific pathogenic effect - 30 species (25.4%), 3661 individuals (28.0%) of phytonematodes; phytohelminths of a specific pathogenic effect - 19 species (16.1%), 3787 individuals (28.9%) of phytonematodes (Table 2.).

Pararhizobionts belong to the orders: Monhysterida, Enoplida, Mononchida, Alaimida, Dorylaimida and are represented by the families Monhysteridae, Onchulidae, Mononchidae, Mylonchulidae, Encholaimidae, Nygolaimidae, Dorylaimidae, Qudsianematidae, Aporcelaimidae, Discolaimidae, Nordiidae, Alaimidae, Diphtherophoridae.

Table 2. Qualitative and quantitative ratio of nematodes vineyards by ecological groups

№	Environmental groups	Number of species	%	Number of individuals	%
1	Pararhizobionts	29	24,6	970	7,4
2	Eusaprobionts	11	9,3	797	6,1
3	Devisaprobionts	29	24,6	3871	29,6
4	Phytohelminths of nonspecific pathogenic effect	30	25,4	3661	28,0
5	Phytohelminths of specific pathogenic effect	19	16,1	3787	28,9
	Total:	118	100	13086	100

Representatives of this ecological group were found mainly in the rhizosphere, where 94.6% of the total number of nematodes were recorded.

Species Monhystera filiformis, Prismatolaimus intermedius, Clarcus papillatus, Mesodorylaimus bastiani, M. parasubulatus, Eudorylaimus centrocercus, E. kirjanovae, E. paraobtusicaudatus, E. parvus, E. pratensis, Aporcelaimus superbus, Aporcelaimellus abtusicaudatus, A. obscurus and Discolaimium cy root soil in large numbers.

Species Anaplectus granulosus, Proteroplectus parvus, Mylonchulus parabrachyurus, Nygolaimus brachyuris, Paradorylaimus filiformis, Dorylaimellus mirus, Alaimus striatus are the smallest in terms of the number of individuals.

The group of eusaprobionts in the material studied by us turned out to be the group with the smallest number of species (11 species), only 9.3% of the total number of species. The representatives of this group include the family Rhabditidae (6 species). Of the eusaprobionts Rh. brevispina is found in large numbers in the root system of plants and root soil. Species Mylonchulus parabrachyurus, M. solus were found only in the rhizosphere, and in the smallest number of individuals.

The group of devisaprobionts includes 29 species (only 24.6% of the total number of species), which belong to the orders Plectida and Teratocephalida; family Plectidae, Cephalobidae and Paragrolaimidae. They were found in the root system and rhizosphere of plants.

Species Panagrolaimus rigidus, P. multidentatus, P. subelongatus, Heterocephalobus elongatus, Cephalobus persegnis, Acrobelides buetschlii, A. Nanus, Chiloplacus propinquus found in the rhizosphere and root system of grape plants were the most numerous in terms of the number of individuals.

Species Panagrolaimus armatus, P. spondyli, Chiloplacus lentus, Cervidelus insubricus were in insignificant numbers in terms of the number of individuals.

Species Chiloplacus summetricus and Acrobeles ciliatus are found only in the rhizosphere of plants.

The group of phytohelminths with a nonspecific pathogenic effect was the most numerous in terms of the number of species, including 30 species belonging to the orders Aphelenchida and Tylenchida; families Aphelenchidae, Paraphelenchidae, Aphelenchoididae, Tylenchidae, Psilenchidae. Among the families in terms of the number of individuals and species composition, Aphelenchoididae occupies the first place, which is 63.3% of the total number of species and 8.3% of the total number of individuals of the found phytonematodes.

Species Aphelenchus avenae, A. cylindricaudatus, Paraphelenchus pseudoparietinus, Aphelenchoides clarolineatus, A. dactylocercus, A. limberi, A. parietinus, A. parasubtenuis, A. trivialis, Tylenchus davainei, Filenchus filiformis, Aglenchus thornei, Neotylenchus abulbosus, Ditylenchus intermedius, Ditylenchus intermedius myceliophagus, D. tulaganovi, Nothotylenchus allii were found in the rhizosphere and the root system of grapes, and were the most numerous in terms of the number of individuals.

Phytonematodes Paraphelenchus tritici, Aphelenchoides helophilus, A. parabicaudatus, A. pusillus, A. sacchari, A. teres, Bursaphelenchus talonus were insignificant in number of individuals.

Phytohelminths with a specific pathogenic effect, including 19 species belonging to the orders Dorylaimida and Tylenchida; families Xiphinematidae, Dolichodoridae, Hoplolaimidae, Rotylenchulididae, Pratylenchidae, Meloidogynidae, Paratylenchidae, Anguinidae were found in a large number of plant nematodes.

The true parasites were dominated by the species Tylenchorhynchus capitatus, T. brassicae, Bitylenchus dubius, Helicotylenchus dihystera, H. erythrinae, H. multicinctus, Pratylenchus pratensis, P. neglectus, Ditylenchus dipsaci. They were found in the rhizosphere and the root system of plants, and were the most numerous in terms of the number of individuals.

Species Meloidogyne arenaria, Pratylenchoides crenicauda, Paratylenchus amblycephalus and P. macrophallus were found in a small number of plant nematodes.

Thus, in a comprehensive study of the nematode fauna of the root and root soil of vineyards, 118 species of plant nematodes were identified. The analysis of the conducted studies shows that the nematode fauna of the root system of vineyards differs from the nematode fauna of the root soil in terms of species diversity and number of individuals. The reason for this is the unequal hydrothermal regime of the soil, and plant roots are also the optimal habitat for a normal population of phytonematodes in deep horizons. Different ecological groups of plant nematodes react differently to such external factors.

During the study period, 19 species (representatives of the genera Xiphinema, Tylenchorhynchus, Bitylenchus, Helicotylenchus, Rotylenchus, Pratylenchus, Pratylenchoides, Paratylenchus, Meloidogyne, Ditylenchus) were registered from real parasites that consume the juices of living cells of plants, among which the population density was significant in those like Tylenchorhynchus capitatus, T. brassicae, Bitylenchus dubius, Helicotylenchus dihystera, H. erythrinae, H. multicinctus, Pratylenchus pratensis, P. neglectus, Ditylenchus dipsaci. Since these species are considered economically important parasites of plants and their widespread occurrence in agrocenoses in this territory, they harm not only the development of viticulture in the republic, but also many vegetables - melons and other agricultural crops.

The scientific novelty of the study is as follows: for the first time in the Surkhandarya region, based on an analysis of the current state of phytonematodes common in the vineyard and its root soil, 118 species of phytonematodes were identified; plants, revealed seasonal changes in the dynamics of the population of phytonematodes during the growing season of plants, developed integrated methods for combating parasitic phytonemoids identified in grape agrocenoses.

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