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# Fauna and Seasonal Dynamics of the Collembolans of Uzbekistan

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**Abstract:**
The article provides information on the species and quantitative composition of the collembolan communities of various soil layers of agrocenoses and natural ecosystems of northeastern Uzbekistan. As a result of research, 33 species were found in the clover agrocenosis soil layers, 30 in the soil layers of cotton fields, 31 species in the soil layers of apple orchards, and 49 soil species were found in the soil ecosystems of natural ecosystems. The agrocenoses and soil layers of natural ecosystems were dominated by such species as Isotoma notabilis, Isotomiella (Isotoma) minor, Folsomina onychiurina, Frisea (Triaeana) mirabilis, Xenyllodes armatus, Folsomina candida, Willmia anophtalma, Xenylla maritima, Oligaphorura (Lipura) groenlandica, Isotomodella pusilla, Panchaetoma (Isotoma) communa, Schoettella (Achorutes) ununguiculatus, Acherontiellina (Acherontiella) sabina. When studying the number of collembolans by seasons, the peak period of their seasonal dynamics is observed in spring and autumn, and when studying soil layers (10-20 cm), the number of collembolans was at its maximum, in spring and autumn in agrocenoses and soils of natural ecosystems in soil at a depth of 10-20 cm number of collembolans in spring was on average 3558 copies, and in the autumn there were 3298 copies.

**Keywords:** *Collembola, agrocenosis, soil, seasonal dynamics, sample, wheat, Uzbekistan*

## 1. Introduction

Collembola belong to the collembola order - Collembola of the insect class (Insecta) of the arthropod type (Arhtropoda) (A. Babenko et al., 1994). All their representatives together with oribatid mites and slug species form the soil microfauna (M.S. Gilyarov et al., 1985). Collembolans - the most ancient of arthropod animals that have passed to the land way of life. Their bodies are covered with a cuticle with hard chitin. A waterproof epicuticle on the surface of the cuticle protects insects from drying out (Striganova B.R., 1980). Due to their endurance to adverse environmental conditions, they are widespread and diverse. Species living in tropical climates are resistant to +40° C heat. They are abundantly found mainly in moist forest soils. The biomass of collembolans in forest litter is 10-15% of the total biomass of invertebrates (M.M. Aleynikova, 1976). During the year 2-3 generations of collembolans develop. By the method of distribution in the soil horizons collembolans are divided into litter, litter-soil and soil groups (Hopkin S.P., 1997).

The bodies of the species inhabiting the litter have a darkish shade and they are covered with a

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thick cover. Collembolans of this group are mainly composed of saprophages (Ananyeva, SI, 1978). The species found in the soil have a whitish cover and because it is thin it is very sensitive to soil moisture. Litter-soil species are intermediate forms between the two groups mentioned above. Collembolans are very demanding on the type of food (Stebaeva SK, 1970). They can be divided into true phytophagous and hypha-eating fungi, yeast, spores, pollen, lichens and algae. They widely mastered the humus and mineral parts of the soil. Under favorable conditions, they can reach up to 1 m of soil depth (Stebaeva SK, 1987). However, the active participation of collembolans in soil formation processes was recognized (Gilyarov MS, 1984).

Despite the difference between the surface living and soil types of the collective collembolans, all their groups can be classified as r-strategists. The following signs point to this: high reproductive ability, high growth rate of the population, weak mechanisms for regulating the number of a species, and polyvoltainess of many species (Hopkin S.P., 1997). The data on the habitat of collembolans in various successions (Chernova NM, 1966, Chernova NM, 1997, Dunger W et al., 2002), agrocenoses (Chernov Yu.I., 1984, Frampton GK, 1997) were presented. , household waste (Dunger W., 1986, Babenko AB, 1984), in the soil-grounds of cities (Sterzynska M., 1987, Kuznetsova NA, 1994), dumps (Bugrov SA, etc., 1996, Sharin VG and others., 2000) and in various littered places.

The number of collembolans in 1 $m^2$ soil layer exceeds 1 million. The size of all collembolans is on average 1 mm, and the smallest 0.2-0.7 mm, and the largest reaches 5-9 mm in length. They are closer to typical insects due to the division of their bodies into three parts (Rusek J., 2007). They play an important role in increasing the content of humus in the soil (Aytekova M. 2008). In addition, collembolans, like other microorganisms, serve as an indicator in determining the environmental disturbance of anthropogenic territories (Gilyarov MS, 1976). Therefore, their study is an important urgent task (Babenko AB, and others 1988).

## 2. Materials and methods

Research materials were collected during 2004-2016. in the vicinity of the industrial complex Angren-Almalyk of Tashkent region, in the agrocenoses of Bekabad and Parkent regions, as well as in the soil layers of natural ecosystems. Samples were collected in soil layers of 0-10 cm, 10-20 cm, 20-30 cm of agrocenoses and natural ecosystems, five times from 1 $dm^3$ of soil. Soil samples were taken from pre-set points, placed in pouches and marked with a paper label. The paper label contains the date, the names of the place from which the samples were taken, the names of the agrocenosis or natural ecosystem, and other data. In the above-mentioned territories, route and stationary methods were used to study the species composition and ecology of collembolans (Kuznetsova N. 1995).

The conventional Berleze – Tulgren apparatus was used at isolation of collembolans from soil samples. This unit consists of the following parts (installations): tripod, large funnel, sieve, glass bottle. Initially, the funnel was attached to a tripod, then a sieve was placed on the funnel and a soil sample was poured onto it. On the bottom of the funnel is placed a glass bottle with a fixing fluid (alcohol). The principle of operation of this apparatus is that as the soil samples that are poured into the sieve from top to bottom dry, small animals in the soil also begin to move from top to bottom. Then they fall into dishes with 70-80° of ethyl alcohol. Small invertebrates that fall into the collecting vessel are placed in a Petri dish and are examined under a binocular microscope and are collected. Then, in order to determine their species composition, permanent preparations are prepared. (Petersen H., 2002).

The definition of taxonomic groups of collembolans (family, squad or species) placed in

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permanent preparations is carried out using a DN-300M 18x100 binocular. Determination of the species composition of collembolans was carried out using special determinants of collembolans (AB Babenko et al., 1988, Fjellberg A., 2007).

**Mathematical data processing**

Statistical methods were used according to a number of manuals (Kendal, M., 1975, Terentyev, P.V., et al., 1977, Abbott, G.A., et al., 1985, Blagoveshchenskii, Yu.N., et al., 1987**)**.

**The threshold of dominance.** The relative abundance of species was expressed as a percentage of the total content. To isolate the dominant species, the Engelmann scale was adopted (Engelmann H.D., 1978).

0-1.3% sub-rare or rare;

1.31-3.9% - reduced or small;

3.9-12.4% subdominant;

12.4-39.3% is dominant;

39.4-100% is eudominant species.

The last two groups were accepted as dominant groups.

Morphometric data were statistically processed using modern programs (Biostat, 2007; Microsoft Office Excel, 2003; Microsoft, USA, Origin Pro B 9.4, 2014**)**.

**The results and their analysis.** In the cotton, wheat, clover and apple agrocenoses and natural ecosystems of Northeastern Uzbekistan, 49 species of collembolans were found in the depth of 0-30 cm of soil. Identified species belong to 4 sub-orders (Poduromorpha, Entomobryomorpha, Metaxypleona, Neelipleona), 8 families (Hypogastruridae, Onychiuridae, Neanuridae, Odontellidae, Isotomidae, Entomobryidae, Poduridae, Neelidae) and 45 genera (Triacanthella, Schoettella, Hypogastrura, Choreutinula, Willemia, Xenylla, Pseudacherontides, Acherontiellina, Hymenaphorura, Oligaphorura, Protaphorura, Paronychiurus, Uralaphorura, Onychiurus, Neotullbergia, Stenaphorura, Brachystomella, Frisea, Ceratrimeria, Pseudachorutes, Anurida, Micranurida, Odonitella, Xenyllodes, Pentacanthella, Anurophorus, Folsomina, Pseudanurophorus, Isotomodes, Isotomurus, Cruptopygus, Istomodella, Panchaetoma, Istoma, Seira, Entomobroides, Drepanosira, Corynothrix, Haloentomobrya, Orchesella, Sinella, Podura, Megalothorax, Neelus, Neelides) of Collembola order.

Suborder Poduromorpha Springtails genera consists of families Hypogastruridae- (8 species), Onychiuridae - (8 species), Neanuridae - (6 species), Odontellidae - (2 species), and of the families Entomobryomorpha suborder - Isotomidae - (14 species), Entomobryidae - (7 species), suborder Metaxypleona from Poduridae families - (1 species), suborder Neelipleona from the Neelidae family - (3 species). As a result of scientific research of collembolans, a high diversity of species of the Isotomidae family of the suborder Entomobryomorpha was revealed.

In the soils of agrocenoses and natural ecosystems of Northeastern Uzbekistan, collembolan societies differ in species composition and content. In the soil layers of clover agrocenosis, 31 species were identified, in the soil layers of wheat fields 33 species, in the soil layers of cotton fields 30 species and in the soil layers of apple orchards 31 species of collembolans were found.

In the soil layers of the natural ecosystems of Angren territory, 33 species were identified, in the natural ecosystems of Almalyk territory there are 30 species, in the soil layers of the natural ecosystems of Parkent area 41 species, In the soil layers of the natural ecosystems of Bekabad territory 48 species, in Mirzaabad region of Syrdarya region in stagnant waters and accumulated trench water was detected 1 species (table 1).

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**Table 1**
**Distribution of species of collembolans in agrocenoses and natural ecosystems**

| | Species | Clover agrocenosis | Wheat agrocenosis | Cotton agrocenosis | Apple agrocenosis | Natural ecosystem |
|---|---|---|---|---|---|---|
| 1 | Triacanthella michaelseni | - | + | - | + | + |
| 2 | Schoettella (Achorutes) ununguiculatus | - | + | + | - | + |
| 3 | Hypogastrura (Achorutes) viaticus | - | + | + | - | + |
| 4 | (Achorutes) Choreutinula inermis | + | - | - | - | + |
| 5 | Willemia anophthalma | + | + | + | + | + |
| 6 | Xenylla maritima | - | + | + | - | + |
| 7 | Pseudacherontides zenkevitchi | - | - | + | - | + |
| 8 | Acherontiellina (Acherontiella) sabina | - | + | - | + | + |
| 9 | Hymenaphorura (Lipura) sibirica | + | + | - | + | + |
| 10 | Oligaphorura (Lipura) groenlandica | + | + | + | + | + |
| 11 | Protaphorura (Lipura) armata | - | - | + | + | + |
| 12 | Paronychiurus (Onychiurus) ramosus | + | + | - | + | + |
| 13 | Uralaphorura (Uralia) schilov | - | - | - | + | + |
| 14 | Onychiurus (Podura) ambulans | - | - | + | + | + |
| 15 | Neotullbergia (Tullbergiya) tricuspis | + | + | + | - | + |
| 16 | Stenaphorura japygiformis | + | - | + | - | + |
| 17 | Brachystomella maritima | + | + | + | + | + |
| 18 | Frisea (Triaeana) mirabilis | + | + | + | - | + |
| 19 | Ceratrimeria (Schoetella) maxima | + | + | + | + | + |
| 20 | Pseudachorutes subcrassus | + | + | + | - | + |
| 21 | Anurida (Achorutes ) maritimus | + | + | + | - | + |
| 22 | Micranurida pygmaea | + | + | + | - | + |
| 23 | Odonitella ewingi | + | + | + | + | + |
| 24 | Xenyllodes armatus | + | + | + | + | + |
| 25 | Pentacanthella decemoculata | + | + | + | + | + |
| 26 | Anurophorus laricus | + | + | + | + | + |
| 27 | Folsomina candida | - | + | - | + | + |
| 28 | Folsomina onychiurina | + | + | + | + | + |

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| | | | | | | |
|---|---|---|---|---|---|---|
| 29 | Pseudanurophorus boerneri | - | - | - | + | + |
| 30 | Isotomodes (Istoma) producta | - | - | - | + | + |
| 31 | Isotomurus (Podura) palustris | + | + | + | - | + |
| 32 | Cruptopygus antarcticus | + | + | + | + | + |
| 33 | Isotomodella (Isotomodella) pusilla | + | + | + | - | + |
| 34 | Isotomiella (Isotoma) minor | + | + | + | + | + |
| 35 | Panchaetoma (Isotoma) communa | + | + | + | - | + |
| 36 | Isotoma sensibilis | + | + | + | + | + |
| 37 | Isotoma notabilis | + | + | + | + | + |
| 38 | Desoria saltans | + | + | + | + | + |
| 39 | Entomobryidae (Digeeria) domestica | + | + | + | + | + |
| 40 | Entomobroides (Digeeria) muscorum | - | + | - | + | + |
| 41 | Drepanosira (Parasira) ornate | - | + | - | + | + |
| 42 | Corynothrix borealis | - | - | - | + | + |
| 43 | Haloentomobrya (Entomobrya) dollfusi | - | - | - | + | + |
| 44 | Orchesella (Podura) cincta | - | - | - | + | + |
| 45 | Sinella curviseta | + | - | - | + | + |
| 46 | Podura aquatica | - | - | - | - | + |
| 47 | Megalothorax minimus | + | - | - | - | + |
| 48 | Neelus murinus | + | - | - | - | + |
| 49 | Neelides forsomi | + | - | - | - | + |
| Total | | 31 | 33 | 30 | 31 | 49 |

The analysis of our data showed that the following dominant species of collembolans, identified in the soil layers of agrocenoses and natural ecosystems, can be used to assess the state of the soils of a given territory.

The clover agrocenosis of Almalyk is dominated by species (Isotoma notabilis and Isotomiella (Isotoma) minor), and the clover agrocenosis is dominated by species (Isotomiella (Isotoma) minor, Folsomina onychiurina). The change in the number of dominant species of Isotoma notabilis and Fisomina onychiurina). High occurrence of these two species is observed in spring. The highest occurrence of the species Folsomina onychiurina was in autumn.

It was found that the dominant Isotoma notabilis and Isotomiella (Isotoma) minor soil layers of the clover fields of Angren and Almalyk territories belong to the Collembolan subgroup living on the surface layer of the soil litter, and Folsomina onychiurina belongs to the group of collembolans inhabiting the vegetation cover and belongs to the vegetation cover group, inhabiting the vegetation cover.

In the wheat agrocenoses of Angren-Almalyk territory, the species Frisea (Triaeana) mirabilis and Xenyllodes armatus are dominant species. Of the dominant species, Xenyllodes armatus makes up 32% of the common species and it belongs to the subgroup of collembolans

inhabiting the surface layer of the soil litter; Frisea (Triaeana) mirabilis species accounts for 35% of the total number of species and belongs to the subgroup of collembolans inhabiting the lower layers of the soil.

In wheat agrocenoses of Parkent district - Isotomiella (Isotoma) minor, Folsomina candida (30, 34%), and in the wheat agrocenoses of Bekabad district -Isotomiella (Isotoma) minor и Folsomina onachiurina Denis (36, 39%) are dominant species. High prevalence of dominant species Frisea (Triaeana) mirabilis, Xenyllodes armatus, (Isotoma) minor, Folsomina candida, Folsomina onachiurina falls on spring.

In the soil layers of the wheat fields of Almalyk, Parkent, and Bekabad areas the dominant species Xenyllodes armatus, Isotomiella (Isotoma) minor belong to the Collembola subgroup of the surface layers of the soil litter; Folsomina onychiurina and Folsomina candida species belong to the collembolan subgroup living under vegetation and in the soil; Frisea (Triaeana) mirabilis belongs to the subgroup of collembolans inhabiting deep layers of soil.

In the cotton agrocenoses of Angren regions, the species of Willmia anophtalma and Xenylla maritima were 34 and 39%, respectively, in the cotton agrocenoses of Almalyk region — Willmia anophtalma, Oligaphorura (Lipura) groenlandica were 34, 37%, respectively. High incidence of dominant species occurs in autumn.

In apple agrocenoses of Parkent and Bekabad areas, the dominated species are Isotomiella (Isotoma) minor, Folsomina candida, Folsomina onychiurina Denis, 1931 (18 and 32%, respectively). In the apple agrocenoses of Bekabad district - Isotomiella (Isotoma) minor, Folsomina onachiurina (18%). In apple agrocenoses of Parkent district - Folsomina candida (32%). High prevalence of dominant species of Isotomiella (Isotoma) minor, Folsomina candida, Folsomina onychiurina is observed in spring.

In apple fields, located in Parkent and Bekabad areas, the dominant Isotomiella (Isotoma) minor species belong to the collembolan subgroup living on the surface layers of the soil litter; Folsomina onychiurina, Folsomina candida belong to the subgroup of collembolans living under vegetation and in the soil.

In the soil layers of the natural ecosystem of Angren region - Isotomodella (Isotomodella) pusilla, Panchaetoma (Isotoma) communa (24, 26%). High prevalence of dominant species of Isotomodella (Isotomodella) pusilla, Panchaetoma (Isotoma) communa is observed in autumn.

In the soil layers of the natural ecosystem of Angren region - Isotomodella (Isotomodella) pusilla, Panchaetoma (Isotoma) communa, belong to the collembolans subgroup of the surface layers of the soil litter.

In the soil layers of the natural ecosystem of Almalyk territory - Schoettella (Achorutes) ununguiculatus, Panchaetoma (Isotoma) communa (34, 39%). High prevalence of dominant species of Schoettella (Achorutes) ununguiculatus, Panchaetoma (Isotoma) communa is observed in autumn.

In the soil layers of the natural ecosystem of Almalyk region - (Schoettella (Achorutes) ununguiculatus, Panchaetoma (Isotoma) communa) belong to the collembolans subgroup living on the surface layers of the soil litter.

In the soil layers of the natural ecosystem of Parkent region - Acherontiellina (Acherontiella) sabina, Folsomina onychiurina, Isotomiella (Isotoma) minor (39, 42%). High incidence of dominant species Acherontiellina (Acherontiella) sabina, Folsomina onychiurina, Isotomiella (Isotoma) minor Schaffer, 1896 is observed in autumn.

In the soil layers of the natural ecosystem of Parkent region the dominant species - Acherontiellina (Acherontiella) sabina belong to the subgroup of collembolans living on the surface layers of the soil litter; Folsomina onychiurina belongs to the subgroup of

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collembolans living under vegetation and in the soil; Isotomiella (Isotoma) minor belongs to the subgroup of collembolans inhabiting the surface layers of the soil litter.

In the soil layers of the natural ecosystem of Bekabad region there are Oligaphorura (Lipura) groenlandica, Isotomiella (Isotoma) minor, Folsomina onychiurina Denis, 1931 (33, 44%, respectively). The high occurrence of dominant species Oligaphorura (Lipura) groenlandica Tullberg, 1876., Isotomiella (Isotoma) minor Schaffer, 1896., Folsomina onychiurina Denis, 1931 is observed in autumn

In the soil layers of the natural ecosystem of Bekabad region the dominant species Oligaphorura (Lipura) groenlandica Tullberg, 1876, belongs to the subgroup of collembolans inhabiting the surface layers of the soil litter; Folsomina onychiurina Denis, 1931, belongs to the subgroup of collembolans living under vegetation and in the soil; Isotomiella (Isotoma) minor Schaffer, 1896 belong to the subgroup of collembolans living on the surface layers of the soil litter.

It was studied the seasonal dynamics of the number of collembolans in the soil layers to a depth of 30 cm of clover, wheat, cotton, apple agrocenoses and natural ecosystems of Angren-Almalyk, Parkent and Bekabad areas of Tashkent region of northeast Uzbekistan. In winter, i.e. in December, February in agrocenoses and natural ecosystems of the territory of Angren and Almalyk in soil layers of 1 $m^2$ on average there are 1706 copies, in agrocenoses and natural ecosystems of Parkent and Bekabad areas in soil layers of 1 $m^2$ on average 8060 sps. of collembolans (table 2).

Table 2

The number of collembolans in the soil layers of agrocenosis and natural ecosystems of the territory of Angren-Almalyk in winter

| Soil layer | Wheat agrocenosis | | Cotton agrocenosis | | Clover agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|---|---|
| | XII* | II | XII | II | XII | II | XII | II |
| 0-10 cm | 100** | 200 | 300 | 350 | 400 | 460 | 200 | 300 |
| 10-20 cm | 600 | 1000 | 500 | 560 | 1080 | 1200 | 800 | 1000 |
| 20-30 cm | 200 | 800 | 300 | 400 | 600 | 900 | 600 | 800 |
| Total | 900 | 2000 | 1100 | 1310 | 2080 | 2560 | 1600 | 2100 |

* - the ordinal number of the months of the year

** - in 1 $m^2$

In agrocenoses and natural ecosystems of Angren and Almalyk territory in soil layers of 0-30 cm occurs in 1 $m^2$ an average of 1706 sps. of collembolans, in December in wheat agrocenoses of 900 copies, in fields after cotton 1100 copies, in clover agrocenoses of 1100 copies, 1600 in soil layers of natural ecosystem, 2000 sps. in wheat agrocenosis in February, 1310 sps. in fields after cotton, 2560 sps. in clover agrocenoses, and 2100 sps. in soil layers of natural ecosystems.

In winter, i.e. in December and February, in clover, wheat, cotton, apple agrocenoses and natural ecosystems in the soil layers up to 10–20 cm depth, a high occurrence of collembolans, i.e. in 1 $m^2$ of wheat agrocenosis' soil 800 copies, in cotton agrocenoses 530 copies, in clover agrocenoses 1140 and in soils of natural ecosystems up to 900 collembolans on average. In the soil horizons up to 0-10 cm collembolans are less common than in other layers.

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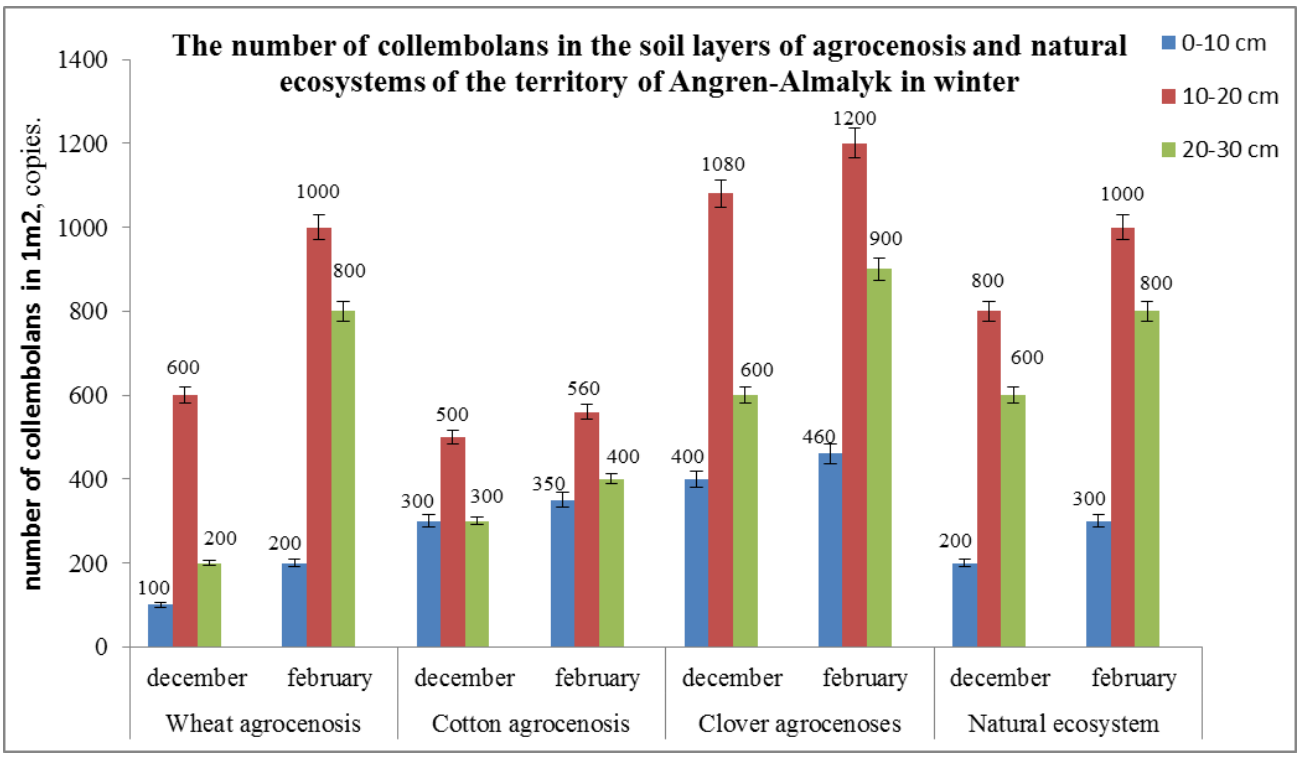


Fig. 1. The number of collembolans in the soil layers of agrocenosis and natural ecosystems of the Angren-Almalyk territory in winter

In winter, in the wheat and apple agrocenoses and natural ecosystems of Parkent and Bekabad areas in the soil layers up to 0-30 cm per 1 $m^2$ there are an average of 1,683 collembolans (table 3).

Table 3

The number of collembolans in the soil layers of agrocenosis and natural ecosystems of the Parkent-Bekabad territory in winter

| Soil layer | Wheat agrocenosis | | Apple agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|
| | XII* | II | XII | II | XII | II |
| 0-10 cm | 200** | 200 | 300 | 400 | 300 | 500 |
| 10-20 cm | 800 | 1200 | 1200 | 1400 | 1000 | 1400 |
| 20-30 m | 400 | 600 | 800 | 1000 | 800 | 1000 |
| Total | 1400 | 2000 | 2300 | 2800 | 2100 | 2900 |

* - the ordinal number of the months of the year

** - in 1 $m^2$

In winter, i.e. in December and February, in wheat and apple agrocenoses and the natural ecosystems of Parkent and Bekabad areas in the soil layers up to 10-20 cm deep, there is a high occurrence of collembolans, i.e. in 1 $m^2$ of wheat agrocenosis soil is 1,700 copies, in apple agrocenoses there are 2,550 copies, and in soils of natural ecosystems there are up to 2,500 collembolans on average. In soil horizons up to 0-10 cm, collembolans are less common than in other layers.

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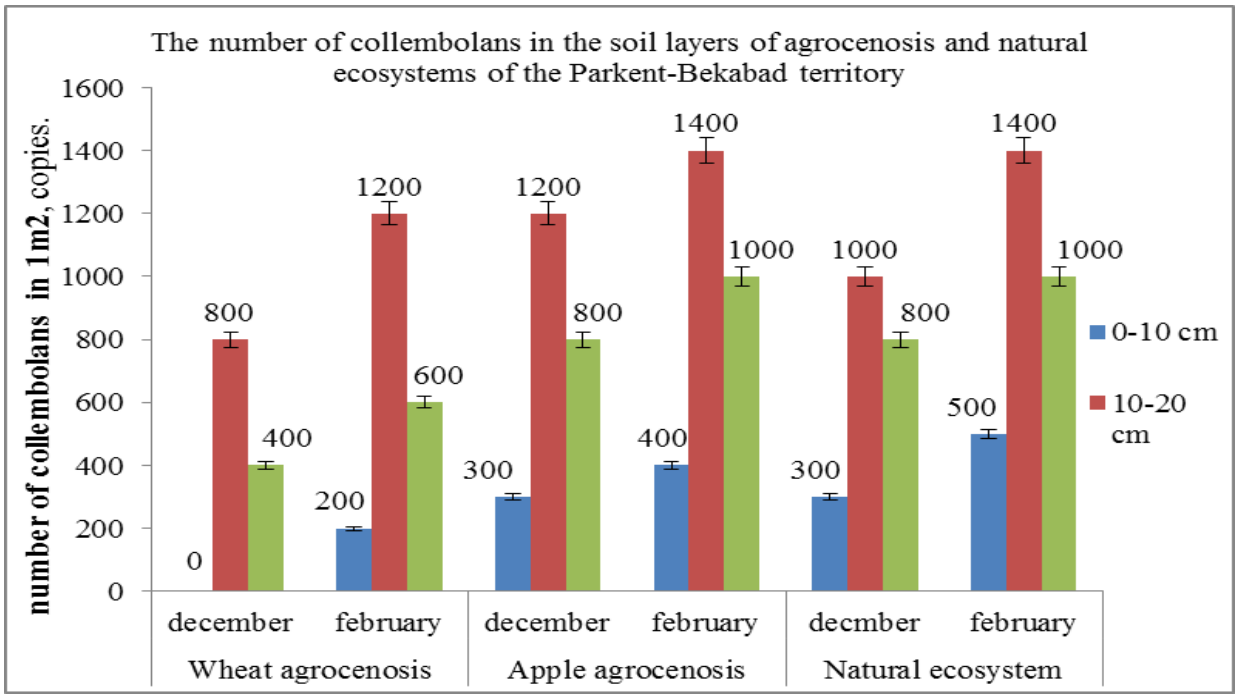


Fig. 2. The number of collembolans in the soil layers of agrocenosis and natural ecosystems of Parkent-Bekabad territory in winter

In agrocenoses and natural ecosystems of territory of Angren and Almalyk of Tashkent region, in soil layers up to 0-30 cm in 1 $m^2$ of wheat fields an average of 1,500 occur in April, in May 6,400 copies, in soil layers up to 0-30 cm in 1 $m^2$ clover 2800 copies in April in average, 7600 copies in May; 5-30 copies in soil layers up to 0-30 cm; 5,000 copies occur in 1 $m^2$ of cotton fields in April; 7000 copies in May; in April, in soil layers of natural ecosystems a depth of 0-30 cm in 1 $m^2$ there are 12,400 copies in May, on average, 9,700 copies met per 1 $m^2$ (Table 4).

Table 4

The number of collembolans in the soil layers of agrocenosis and natural ecosystems of Angren and Almalyk territory in the spring

| Soil layer | Wheat agrocenosis | | Clover agrocenosis | | Cotton agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|---|---|
| | IV * | V | IV | V | IV | V | IV | V |
| 0-10 cm | 300** | 400 | 400 | 1600 | 600 | 2200 | 900 | 1900 |
| 10-20 cm | 800 | 2700 | 1500 | 3200 | 2400 | 3100 | 8300 | 4400 |
| 20-30 cm | 400 | 3200 | 900 | 2800 | 2000 | 1900 | 3200 | 3400 |
| Total | 1500 | 6400 | 2800 | 7600 | 5000 | 7200 | 12400 | 9700 |

* - the ordinal number of the months of the year

** - in 1 $m^2$

In the spring, i.e. in April-May, in the soil layers in 10–20 cm depth, there is a high occurrence of collembolans, i.e. 1 $m^2$ of soil in wheat fields in April, an average of 800 copies, in May, 2,700 copies; in clover fields in April, an average of 1,500 copies, in May, 3,200 copies; in

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the soils of cotton agrocenoses in the depth of 10–20 cm in April 2,400, in May 3,100 copies; in April, 10–20 cm of soil in natural ecosystems, 8,300 specimens in April; 4,400 collembolans specimens in May. In the soil horizons to 0-10 cm, collembolans are less common than in other layers, and in May collembolans are more common than in April.

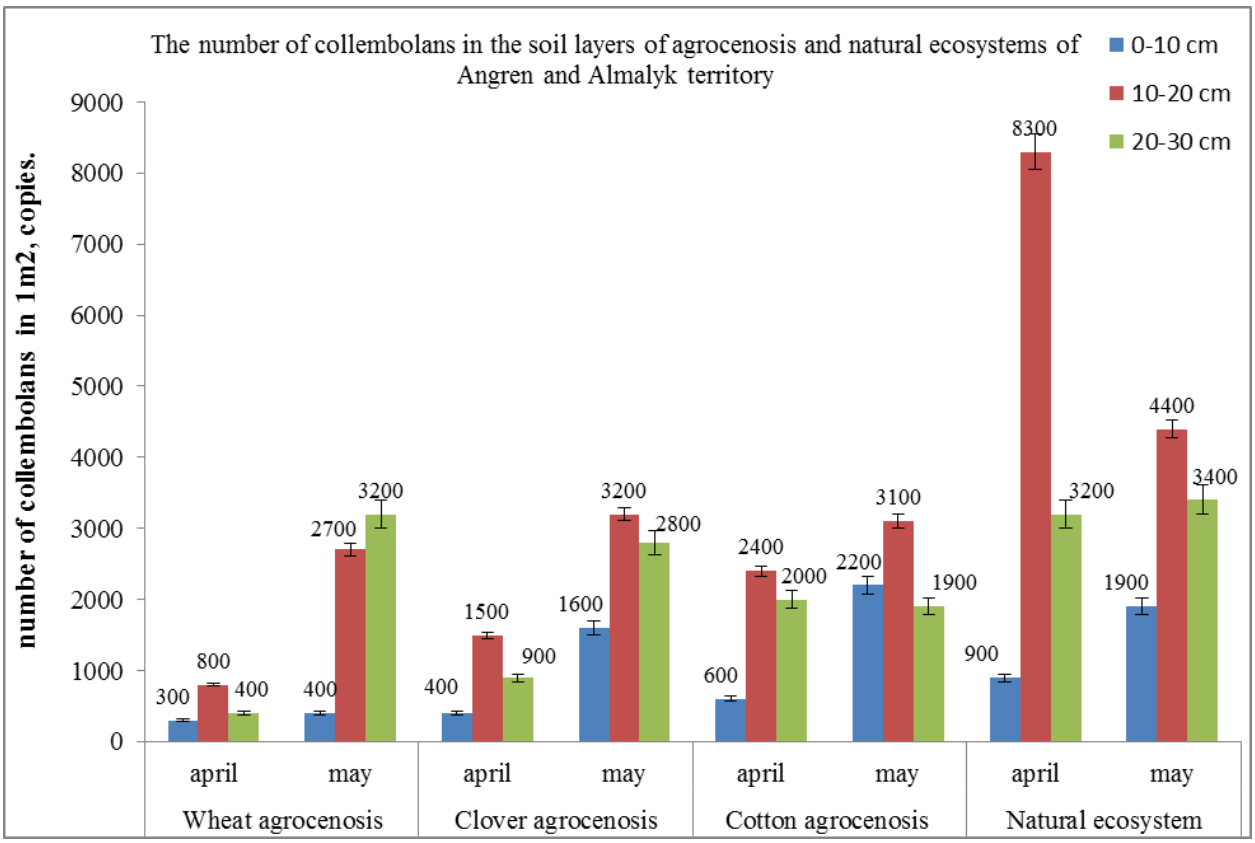


Fig. 3. The number of collembolans in the soil layers of agrocenosis and natural ecosystems of the Angren and Almalyk territory in the spring period

In the spring, in the wheat and apple agrocenoses and natural ecosystems in Parkent and Bekabad areas in the soil layers up to 0-30 cm per 1 $m^2$ there is an average of 7066 collembolan specimens (table 5).

Table 5

The number of collembolans in the soil layers of agrocenoses and natural ecosystems of the Parkent and Bekabad areas in the spring

| Soil layers | Wheat agrocenosis | | Apple agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|
| | IV* | V | IV | V | IV | V |
| 0-10 cm | 600** | 1400 | 600 | 2200 | 900 | 1800 |
| 10-20 cm | 1600 | 2000 | 2400 | 3100 | 9000 | 4800 |
| 20-30 cm | 900 | 800 | 2000 | 1900 | 3000 | 3400 |
| Total | 3100 | 4200 | 5000 | 7200 | 12900 | 10000 |

* - the ordinal number of the months of the year

** - in 1 $m^2$

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In the spring, i.e. in April-May, in Parkent and Bekabad areas in the soil layers of wheat and apple agrocerosis and natural ecosystems in 10–20 cm deep, there is a high occurrence of collembolans, i.e. in 1 $m^2$ of soil of wheat fields in April, an average of 1600 copies, in May, 1600 copies; in the apple agrocenosis in April, an average of 2,400 copies, in May, 3,100 copies; in soils of natural ecosystems in every 1 $m^2$ m in April 9000, in May 4800 copies. In soil horizons up to 0-10 cm, collembolans are less common than in other layers.

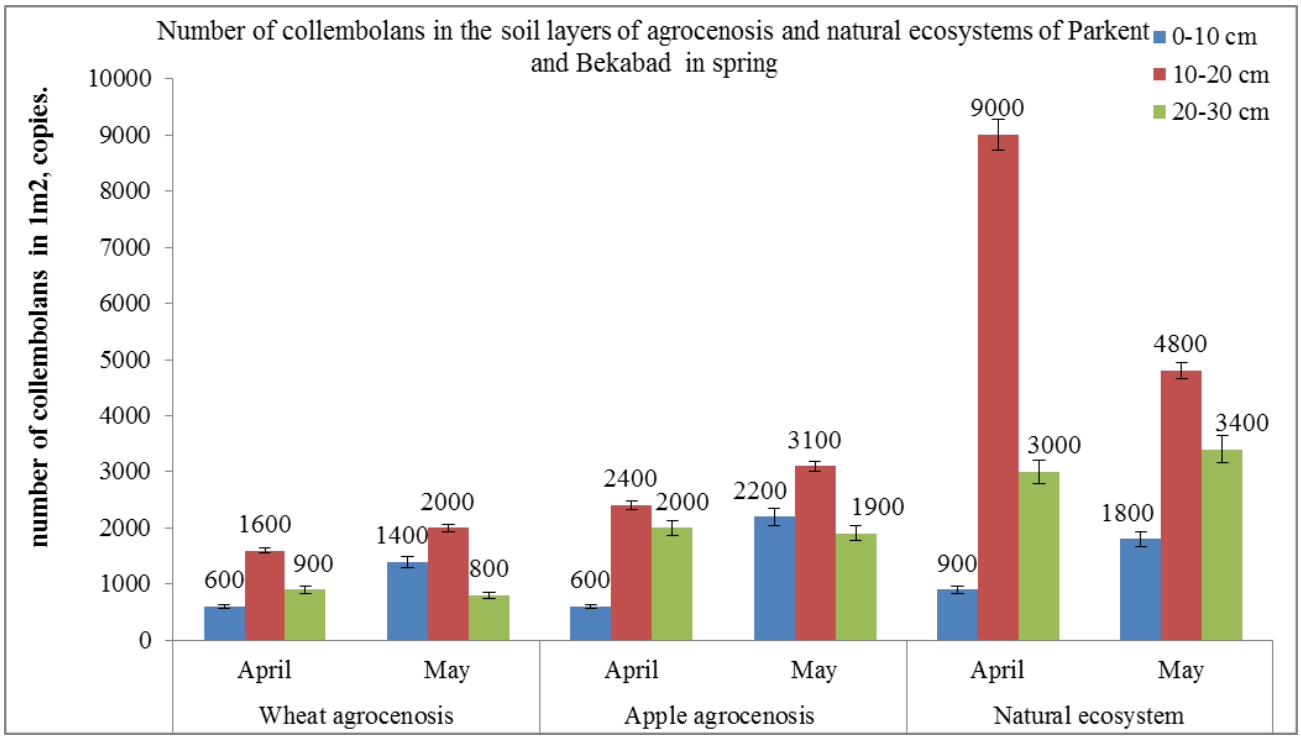


Fig 4. The number of collembolans in the soil layers of agrocenoses and natural ecosystems of the Parkent and Bekabad areas in the spring

In agrocenoses and natural ecosystems of the Angren and Almalyk territory of the Tashkent region, in soil layers 0-30 cm in 1 $m^2$ of wheat fields there are an average of 7300 sps. in July, 6100 specimens in the soil layers in 1 $m^2$ of clover fields on average in April 7,800 sps. are found, in May, 7,300 copies, in layers of soil in 1 $m^2$ of cotton fields, an average of 6,540 sps. occurs in April, 7,500 specimens in May, and in soil layers of natural ecosystems in April in 0-30 cm deep 8000 copies, in May per 1 $m^2$ in average it met 9700 sps. (table 6).

Table 6
The amount of collembolans in the Angren and Almalik territories during summer

| Soil layers | Wheat agrocenosis | | Clover agrocenosis | | Cotton agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|---|---|
| | VII* | VIII | VII | VIII | VII | VIII | VII | VIII |
| 0-10 cm | 200** | 300 | 600 | 500 | 640 | 1000 | 600 | 800 |
| 10-20 cm | 3000 | 2600 | 3000 | 3200 | 2000 | 3100 | 3200 | 4300 |
| 20-30 cm | 4100 | 3200 | 4200 | 3600 | 3900 | 3400 | 4200 | 4600 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Total | 7300 | 6100 | 7800 | 7300 | 6540 | 7500 | 8000 | 9700 |

* - the ordinal number of the months of the year

** - in 1 $m^2$

In the summer, in July and August, there is a large number of collembolans colonies in the 20-30 cm soil layer, i.e., 4100 sps. in July, on average, on wheat fields per 1 m2, and in August - 3200 sps.; in clover fields of 4,200 sps. in July and 3,600 sps. in August; in the soils of cotton agrocenoses in 20-30 cm is 3900 sps. in July and 3400 in August. In July, the 10–20-centimeter soil layer of the natural ecosystem in July was 4200 sps. and 4600 sps. of collembolans in August. In soil layers up to 0-10 cm, as compared with other layers, it is less common and in wheat and clover agrocenoses in August compared to July, in the soils of cotton agrocenoses and natural ecosystems in July compared to August there were more collembolans.

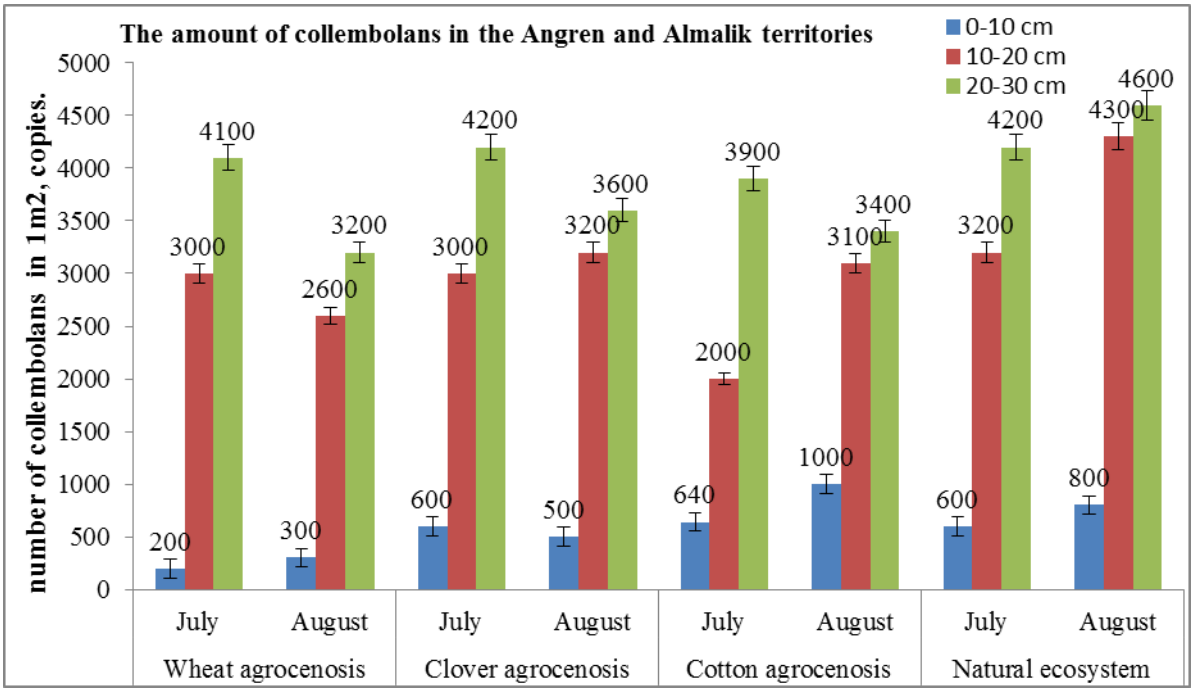


Fig.5. The content of collembolans in cenoses of Angren and Almalyk territories in summer

During the summer months, 5,450 copies of collembolans were found in the wheat and apple agrocenoses of Parkent and Bekabad regions in soil layers of 0-30 cm on average per 1 $m^2$ of land (table 7).

Table 7

The number of collembolans in the layers of soil Parkent and Bekabad areas in the summer

| Soil layers | Wheat agrocenosis | | Apple agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|
| | VII* | VIII | VII | VIII | VII | VIII |
| 0-10 cm | 400** | 200 | 600 | 600 | 400 | 300 |
| 10-20 cm | 800 | 600 | 2400 | 2200 | 4000 | 3800 |
| 20-30 cm | 1400 | 800 | 2800 | 2600 | 4800 | 4000 |
| Total | 2600 | 1600 | 5800 | 5400 | 9200 | 8100 |

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* - the ordinal number of the months of the year
** - in 1 $m^2$

In the summer, i.e. in July and August, there were a large number of collembolans in the soil layers of 20-30 cm of wheat and apple agrocenoses and natural ecosystems of Parkent and Bekabad areas, that is, 1,400 copies in July per 1 $m^2$ in the wheat agrocenosis and 800 copies in August; in July on the apple agrocenosis an average of 1 $m^2$ is 2,800 copies in July, 2,600 copies in August; In July, an average of 4,800 specimens per $m^2$ was observed in the soils of natural ecosystems, and 4,000 copies in August.

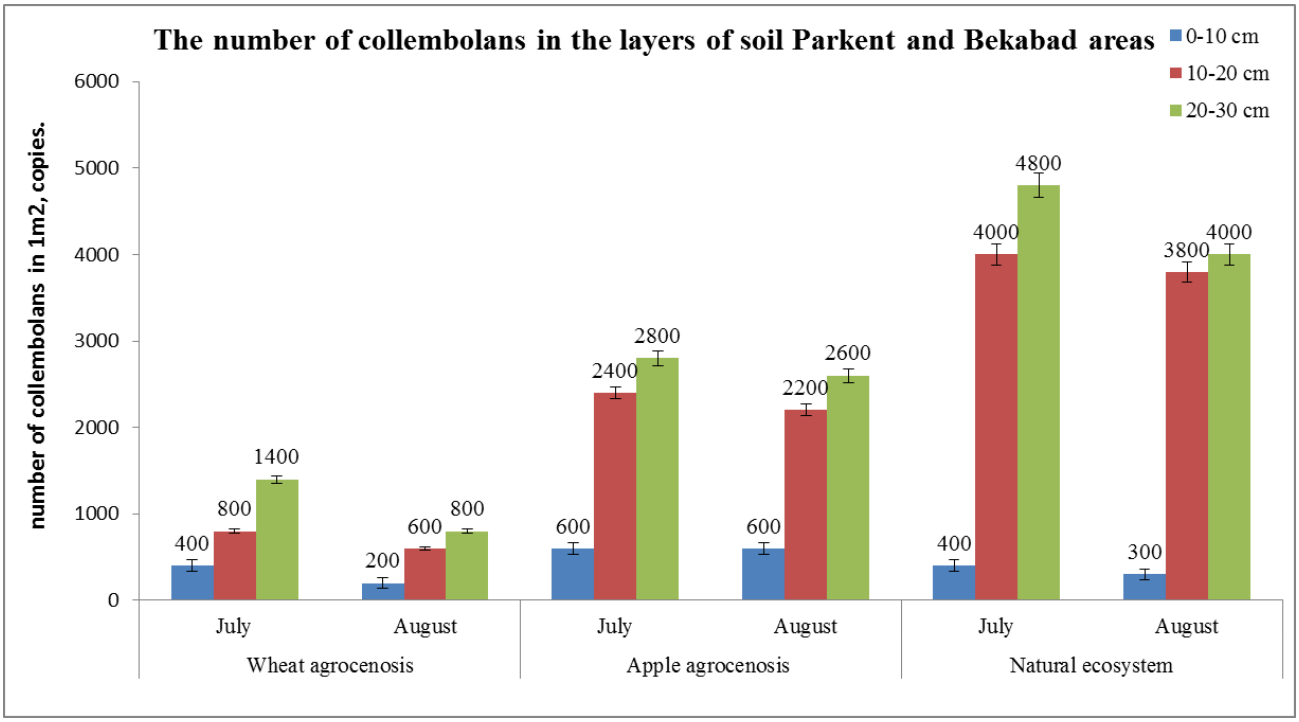


Fig. 6. Content of collembolans in coenoses of Parkent and Bekabad areas in summer

In Angren and Almalyk areas of Tashkent region, on average in wheat fields of agrocenoses and natural ecosystems in soil layers from 0-30 cm per $m^2$, in October there were 4,600 copies, in November 9000 copies, in October, clover agrocenoses in October, an average of 7,700 specimens per 1 $m^2$, 4100 copies in November; in cotton agrocenoses in layers of 0-30 cm an average of 4,000 copies per $m^2$ in October, 7,700 copies in November, in soils of natural ecosystems an average of 4,100 copies per $m^2$ in October and an average of 8,100 copies per $m^2$ in November (Table 8 ).

Table 8

Collembolans content in cenoses of the Angren and Almalyk sites in autumn

| Soil layers | Wheat agrocenosis | | Clover agrocenosis | | Cotton agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|---|---|
| | X** | XI | X | XI | X | XI | X | XI |
| 0-10 cm | 1400 | 1600 | 1400 | 1000 | 1100 | 1500 | 1200 | 1500 |
| 10-20 cm | 1600 | 4800 | 3800 | 1500 | 1500 | 3800 | 1500 | 4000 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20-30 cm | 1600 | 2600 | 2500 | 1600 | 1400 | 2400 | 1400 | 2600 |
| Total | 4600 | 9000 | 7700 | 4100 | 4000 | 7700 | 4100 | 8100 |

* - the ordinal number of the months of the year

** - in 1 $m^2$

In autumn, that is, in October-November, a large number of collembolans is observed in the 10–20 centimeter layer of the soil, that is, on average, in wheat agrocenoses per $m^2$ in October 1600 copies, in November 4800 in November; in clover fields of 3,800 copies in October and 1,500 in November; in 10-20 cm soil layers of cotton agrocenoses - 1500 specimens in October and 3800 in November; In the 10-20 cm soil layer of the natural ecosystem, 1500 specimens were observed in October and 4000 collembolans in November. In the 0-10 cm soil layer, the occurrence of collembol was lower than in other layers.

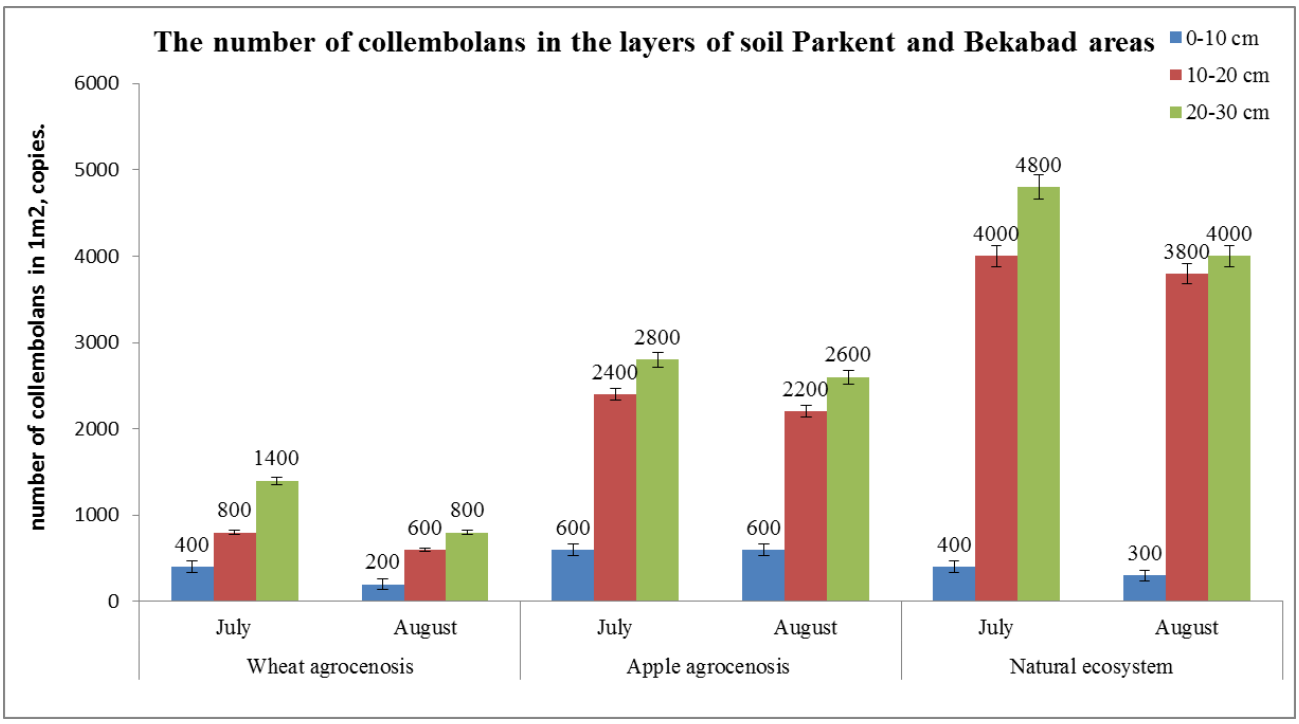


Fig. 7. Content of collembolans in cenoses of Angren and Almalyk areas in the autumn period

During the autumn season, it was found that in soil layers of 0-30 cm per 1 $m^2$ of wheat and apple agrocenoses, as well as in the natural ecosystems of Parkent and Bekabad areas, an average of 7733 collembol are observed (table 9).

In autumn, that is, in October and November, in the areas of Parkent and Bekabad, in wheat and apple agrocenoses and soils of natural ecosystems, a large number of collembol are observed in layers of 10–20 cm, i.e. 4,000 copies per 1 $m^2$ of wheat agrocenoses in October and 3,500 in November; in apple agrocenosis in October, an average of 3,600 specimens per $m^2$ and 3,800 specimens in November were observed; in soils of natural ecosystems, an average of 7,600 specimens per 1 $m^2$ in October and 8,300 specimens in November.

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Table 9
Collembolans content in soil layers of agrocenoses and natural ecosystems of Parkent and Bekabad areas in autumn

| Soil layers | Wheat agrocenosis | | Apple agrocenosis | | Natural ecosystem | |
|---|---|---|---|---|---|---|
| | X* | XI | X | XI | X | XI |
| 0-10 cm | 1600** | 1400 | 1200 | 1400 | 1400 | 1500 |
| 10-20 cm | 4000 | 3500 | 3600 | 3800 | 3800 | 4000 |
| 20-30 cm | 2600 | 2800 | 2400 | 2200 | 2400 | 2800 |
| Total | 8200 | 7700 | 7200 | 7400 | 7600 | 8300 |

* - the ordinal number of the months of the year
** - in 1 $m^2$

Thus, as a result of studying the seasonal dynamics of collembolans content in soil layers up to 30 cm of clover, wheat, cotton, apple agrocenoses and natural ecosystems of Angren-Almalyk, Parkent and Bekabad areas of Tashkent region of northeast Uzbekistan, we can come to the following conclusions.

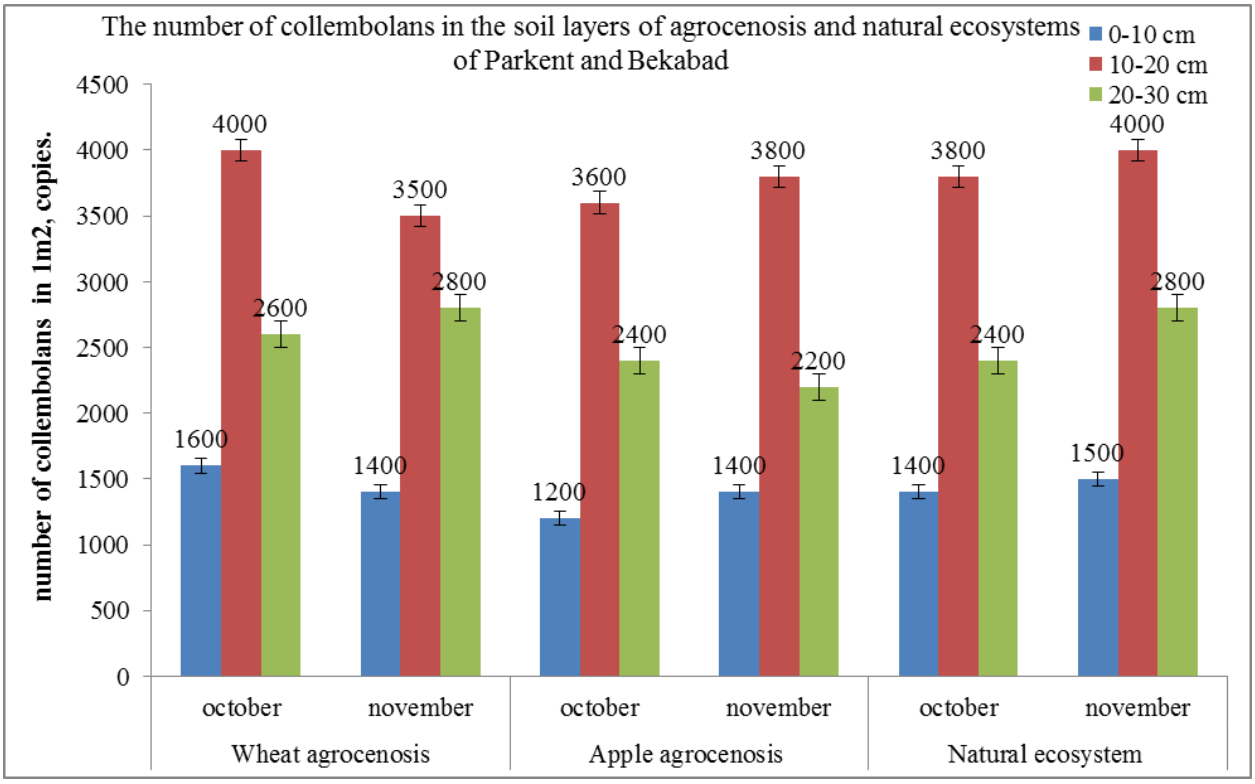


Fig. 8. The number of collembolans in soil layers of agrocenoses and natural ecosystems of Parkent and Bekabad areas in autumn

## 3. Conclusion

In the soil layers of cotton, wheat, clover, apple agrocenoses and natural ecosystems of northeastern Uzbekistan, 49 species were identified, belonging to 4 suborders, 8 families and 45 genera. In the studied areas, the suborders

Poduromorpha (24 species) and Entomobryomorpha (21 species) were distinguished by high species diversity.

As can be seen from the data obtained as a result of research, dominate in the clover fields - (Isotoma notabilis, Isotomiella (Isotoma) minor, Folsomina onychiurina). In the soil layers of wheat agrocenoses, species dominate - Frisea (Triaeana) mirabilis, Xenyllodes armatus, Isotomiella (Isotoma) minor, Folsomina candida, Folsomina onachiurina. Willmia anophtalma, Xenylla maritima, Oligaphorura (Lipura) groenlandica dominate in the soil layers of cotton agrocenoses. In the soil layers of the agrocenoses of apple orchards, the dominance of the species is observed - Isotomiella (Isotoma) minor, Folsomina candida, Folsomina onychiurina. The soil layers of natural ecosystems dominated by species Isotomodella (Isotomodella) pusilla, Panchaetoma (Isotoma) communa, Schoettella (Achorutes) ununguiculatus, Acherontiellina (Acherontiella) sabina, Folsomina onychiurina, Isotomiella (Isotoma) minor, Oligaphorura (Lipura) groenlandica.

In the soil layers of clover, wheat, cotton, apple agrocenoses and natural ecosystems of Angren-Almalyk area and Parkent and Bekabad areas of Tashkent region of northeastern Uzbekistan, when studying the seasonal dynamics of the number of collembolans, the following were identified. When studying the number of collembolans by seasons, their peak period is observed in spring and autumn. When studying by the soil layers, in the middle layers of the soil (10-20 cm), their maximum number is observed. In spring and autumn, in the 10-20 cm soil layers of agrocenoses and natural ecosystems, an average of 1 $m^2$ revealed 3,558 specimens, and in autumn 3298 specimens.

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