

Ecological Characteristics of Phytophagous Plants of the Onion Agrocenosis of Uzbekistan

Abdullaev Ikram^{1,2}, Jumanazarov Hasanboy¹, Abduraxmanov Dilmurod¹,
Iskandarov Abdulla^{1,2}, Aminov Muxammad¹, Sultanbaeva Jamila¹

¹Khorezm Academy of Mamun, Khiva, Markaz str.1, Uzbekistan

²Urgench State University, Urgench, Khamid Alimjan str.14, Uzbekistan

Abstract In the territory of northwestern Uzbekistan, 63 species of phytophages belonging to 8 orders, 29 families and 49 genera were identified. It was established that 5 species of phytophages are oligophages, 19 species are broadly polyphagous, 12 species are narrowly polyphagous. When determining the population density and dominance of the pest, it was noted that the species *Thrips tabaci* has the highest population density and dominance, the density of thrips per 1 m² of area was 448.8, which is 95.65% higher than the dominance of other species. It was proven that the most widespread after *Thrips tabaci* were *Liriomyza cerae* (1.7%), *Gryllotalpa gryllotalpa* (0.62%), *Agriotes lineatus* (0.42%) and *Ceuthorrhynchus jacovlevii* (0.41%). The harmfulness of 7 species of phytophages living at the initial stage of onion leaf development (BBCH scale 1-19) was studied. Late planting of onions leads to an increase in the number of pests and a decrease in yield. Their number in crops increases and damage by phytophages increases.

Keywords Onion pests, Exhauster, Light trap entomological net, BBCH, Dominance, Phase, Monophages, Poliphages, Oligophagous

1. Introduction

Onion (*Allium cepa* L.) is one of the most important bulb vegetables cultivated in India and many other parts of the world. India ranks first in cultivation area and second in production [23], with approximately 1.3 million hectares under cultivation and an annual production of 22.40 million tonnes [9,29]. In Uzbekistan, winter onions and garlic were planted on a total area of 88.2 thousand hectares and in the Republic of Karakalpakstan and the Khorezm region, onions - on 16,023 hectares, garlic onions - on 1,281 hectares [14]. Onion is attacked by number of insect pests including thrips, maggots, cut worms, leaf miner, aphids, beetles, earwigs and mites at different stages of crop growth, including seedling, bulbing and blooming. [24,31]. In addition to direct feeding damage, certain insect pests, such as thrips (*Thrips tabaci* Lindeman) and aphids (*Myzus persicae* (Sulzer) and *Aphis craccivora* C.L.Koch), acts as vector for devastating viral diseases, including iris yellow spot virus [31], and onion yellow dwarf virus [24]. Furthermore, some insect pests cause damage to harvested bulbs during storage, reducing both quality and export potential. As onion is a major commodity for domestic consumption, export, and even import to meet national demand, accurate knowledge of its insect pests is essential for effective pest management planning.

Therefore, an updated list of insect pests infesting onion in the field and storage is crucial for developing preventive and sustainable integrated pest management (IPM) strategies. This report presents a comprehensive list of onion insect pests [14].

2. Material and Methods

2.1. Study Area

The Republic of Uzbekistan is located between the Amudarya and Syrdarya Rivers, and has a total area of 448,900 km². The country extends approximately 1,425 km from east to west and 930 km from north to south [3,4,20,32]. The Northeast biogeographic region of Uzbekistan lies between the western part of the Tien Shan Mountains and the Syrdarya River [1,13,33].

Situated at the junction of several Central Asian biogeographical regions, Uzbekistan possesses remarkable richness in both flora and fauna. This diversity reflects the country's wide range of natural conditions, encompassing vast plains with various desert types, mountain steppes, forests, alpine meadows, tugai thickets, and aquatic ecosystems [10,11,21]. Tugai and flood-plain ecosystems persist as small areas along the Amudarya, Syrdarya, Zarafshan, Chirchik, and Akhangaran rivers, though their extent is shrinking due to agricultural expansion and domestic use by local communities.

Foothill plains and adyrs are located at the base of the western Tien Shan and Pamir-Alai ranges. These landscapes experience significant anthropogenic pressure from agriculture. Degraded low mountains and escarpments of the Ustyurt Plateau, situated within desert zones, harbor many rare species but are also under pressure from livestock grazing and mining activities (e.g., building stone, gypsum raw material). Alpine meadows, located 2,700 m above sea level. They are subject to significant pressure from animal husbandry.

Uzbekistan has a low forest cover, with only about 7% of its land area under forests; nevertheless, forest ecosystems play an important role in both the economy and environmental protection [2,12,27]. Agriculture is a key sector of the national economy, and the country's well-being and sustainable development depend greatly on the condition of its natural resources. More than 90% of crops are grown on irrigated land. Most natural ecosystems in Uzbekistan are highly vulnerable due to the arid climate, and their resistance to external pressures is low. Consequently, any anthropogenic activity serves as an additional driver of ecosystem degradation.

The distribution of species in Uzbekistan is generally described according to four major biogeographic regions: (A) Ustyurt Plateau, (B) Kyzylkum Desert, (C) Pomir-Alai, and (D) Tien Shan. These regions are illustrated in Figure 1.



Figure 1. Map Uzbekistan and location of North-western region of Uzbekistan

2.2. Methods

Studies on the species composition, as well as the morphological and ecological characteristics of onion phytophages inhabiting both soil and aerial parts of the plant, were conducted during 2023–2025. The research assessed their occurrence, mass reproduction, population density, and damage levels. Field surveys were carried out in onion plantations of the following farms: “Ogabek” and “Odamboy Hursand and Sayilkhon” in Qoshkopir District; “Beruniy Elita” in Khiva District; “Farrukh” in Urgench District; “Jumanov Anvar” in Beruniy District; “Alijon” in Ellikkal’a District; and “G’alabali Asadbek” in Tortkul District. Additional observations were conducted in onion fields belonging to the experimental base of the Khorezm Mamun

Academy (Fig. 2).

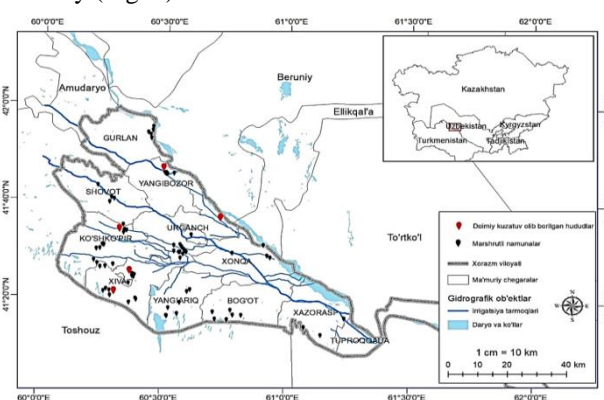


Figure 2. Map of the areas where the research was conducted

Onion growth stages were determined using the BBCH scale (the BBCH scale is a system used for standardized external phenological description of plant growth stages), and insect damage was assessed using generally accepted entomological methods [5]. The development and population density of phytophages were monitored following established guidelines [30]. The number of pests in onion agroecosystems were determined by soil sampling in the autumn and spring seasons. In each study field, pits measuring 50x50 cm and 50 cm deep were arranged in a checkerboard pattern. The soil from each pits was sifted, the number of larvae were counted, and their average number per 1 m² of area was calculated [26]. The abundance and harmfulness of the onion fly were assessed by collecting samples along two diagonals or at equal distances of 0.5 m in the middle rows of the field. Counts were made in a checkerboard pattern, examining 5 plants at each of 5 locations for a total of 25 onion plants (without picking them) [6,7,19]. For *Thrips tabaci* surveys, 20 plants were selected at each of 5 equidistant locations, and the number of individuals per plant was recorded. Surveys were conducted at least twice a week [22,28]. The density of phytophages was calculated using a formula based on the population index, defined as the proportion of infested plants in the surveyed population (P):

$$P = n/N \cdot 100,$$

P - is the proportion of infested plants in the population (in %), n is the number of plants in the sample infested by the pest, and N is the total number of plants in the sample. As described above, survey materials were collected from onion farms located in the Ellikkal’a, Beruniy, and Tortkul districts of the Republic of Karakalpakstan, as well as from various districts of the Khorezm region. During the course of the study, a total of 6,478 insects were visually recorded, of which approximately 3,000 were used as primary research specimens; the majority of the remaining insects were released back into the wild. Insect collection was conducted following standard entomological procedures [18,25]. The capture of insects employed traditional methods, including the use of entomological sweep nets, aspirators, and insect traps (Fig. 3).



Figure 3. Equipment used for collecting insects (A. Entomological net, B. Exhauster, C. Light trap)

When pest population were high, insects were collected by shaking onion leaves [8,14]. The species composition and taxonomic identification of onion pests were determined using standard zoological identification methods.

3. Results and Discussion

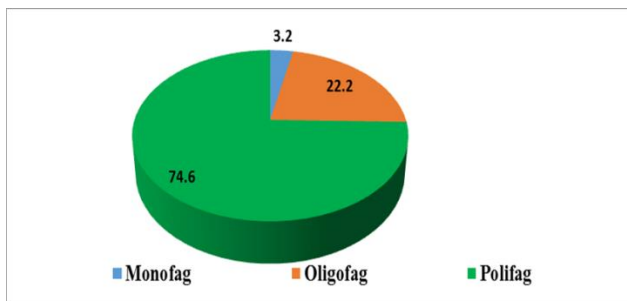


Figure 4. Trophic groups of pests

Depending on the trophic characteristics of the plant species that the pests damage, they can be divided into three groups: monophages, feeding on only one plant; oligophages, damaging plants belonging to one family, i.e. the Rhizophagidae family; and polyphages, damaging plants belonging to several families. In our studies, the phytophagous pests identified were 2 species belonging to the monophagous group (*Agriotes mancus*, *Suillia lurida*), or 3.2% of the total species, and 14 species of oligophagous pests (*Delia antiqua*, *Liriomyza cerae*, *Hydrellia griseola*, *Fannia canicularis*, *Fannia scalaris*, *Fannia leucosticta*, *Fannia manicata*, *Eumerus strigatus*, *Rhoralosirhum maidis*, *Acroleria sarrorensis*, *Acroleria asiatica*, *Mamestra brassicae*, *Pieris oligophagous*, *Ceutorrhynchus rare-wide oligophagous*, *Schizarchis ryri-tor oligophagous*) or 22.2% of all pests were recorded, polyphagous 47 species were recorded, accounting for 74.6% of the total species, of which 3 species were broad polyphagous (*Arhis gossyri*, *Myzus persicae*), 44 species were polyphagous (*Ceutorrhynchus jacoblevii*, *Agriotes lineatus*, *Lasioderma serricorne*, *Melolontha melolontha*, *Melolontha hirrocastani*, *Melolontha furicicauda*, *Rentodon bisrinus*, *Euborellia annulires*, *Delia rlatura*, *Drosophila busckii*, *Labidura riraria*, *Muscina assimilis*, *Muscina stabulans*, *Myzus ascalonicus*, *Aulacorthum solani*, *Bemisia tabaci*, *Emroasca decirines*, *Macrosteles quadrilineatus*, *Nezara viridula*,

Carrorhilus obsoletus, *Carrocoris fuscirinus*, *Dolycoris baccarum*, *Solenopsis sr*, *Srodothera exigua*, *Srodothera litura*, *Agrotis irsilon*, *Helicoverra armigera*, *Heliothis nubigera*, *Chrysodeixis chalcites*, *Chrysodeixis eriosoma*, *Noctua rronuba*, *Euxoa nigricans*, *Euxoa tritici*, *Hydraecia micacea*, *Trichorlusia ni*, *Hestia c-nigrum*, *Dolichovesrula sylvestris*, *Cryrtoblades bistriga*, *Erhestia kuehniella*, *Loxostege sticticalis*, *Gryllottra gryllotalpa*, *Gryllus desertus*, *Heteracris rterosticha*, *Thrips tabaci*) (Fig. 4).

Our studies determined the pest population density and dominance. It was noted that the species with the highest population density and dominance was the Thrips subfamily, i.e., the density of Thrips per 1 m² of area was 448.8, which was 95.65% more dominant than other species. After *Thrips tabaci*, it was proven that *Liriomyza cerae* accounted for 1.7%, *Gryllotalpa gryllotalpa* 0.62%, *Agriotes lineatus* 0.42%, and *Ceuthorhynchus jacoblevii* 0.41%. In our studies, the density and dominance of the following stage of pest reproduction were *Myzus ascalonicus* 0.4%, *Labidura riraria* 0.3%, *Delia ralatuta* 0.2%, *Gryllus desertus* 0.1%, *Delia antiqua* 0.08%, *Acroleria sarrorensis* was recorded at 0.06%, with very low occurrence of the remaining species (Table 1).

Table 1. Distribution density and dominance characteristics of onion pests

№	Types of pests	Population density per 1m ²	Dominance in %
1	<i>Thrips tabaci</i>	448,8	95,65
2	<i>Liriomyza cepae</i>	7,8	1,7
3	<i>G.gryllotalpa</i>	2,9	0,62
4	<i>A.lineatus</i>	2,0	0,42
5	<i>C.jakovlevi</i>	1,9	0,41
6	<i>M.ascalonicus</i>	1,8	0,4
7	<i>L.riparia</i>	1,3	0,3
8	<i>Delia platura</i>	1,1	0,2
9	<i>Gryllus desertus</i>	0,6	0,1
10	<i>Delia antiqua</i>	0,4	0,08
11	<i>A.sapporensis</i>	0,3	0,06
Total		469,2	100

Our research has studied the ecological characteristics of the main phytophagous pests. Particular attention has been paid to their lifestyle and behavior. It was noted that the 63 species of pests identified during our research, without causing direct harm to the plant, have a strong impact on its organs and development, and also have the properties of suppressing the immunity of onion plants. It was found that the first stage larvae of the beetles *Melolontha melolontha*, *Melolontha hirrocastani* and *Melolontha furicicauda*, belonging to the genus *Melolontha*, are found in early spring on rhizome shoots, sometimes in the lower part of the rhizome. Our study showed that these worms, without feeding directly on plant organs, can cause damage to it, pathogenic diseases and harm other insects. It was also found that such properties are observed in insects belonging to the genera *Rentodon*, *Euborellia*, *Drosophila*, *Fannia* and

Mammestra. Our studies show that due to the fact that onions is planted in the first days of spring, various castes of phytophagous insects, waking up early on warm days, affect the vegetative organs of onion, and then, if they feed, switch to other main hosts. The basis of our research was confirmed by the works of Karurraiya, Chavare, Soumya, Singh [16].

Our studies conducted in 2023-2025 to determine the dynamics of the number of dominant and other phytophagous plants in vegetative observation of the onion and its population made it possible to identify four important BBCH stages of phytophagous organogenesis. According to the BBCH scale (the BBCH classification system is a classification of plant development stages used worldwide), pest damage was determined at different stages of plant development. In this regard, the four most vulnerable stages of the growth and development of the plant by the main phytophagous organisms were identified in the BBCH stages (Fig. 5).

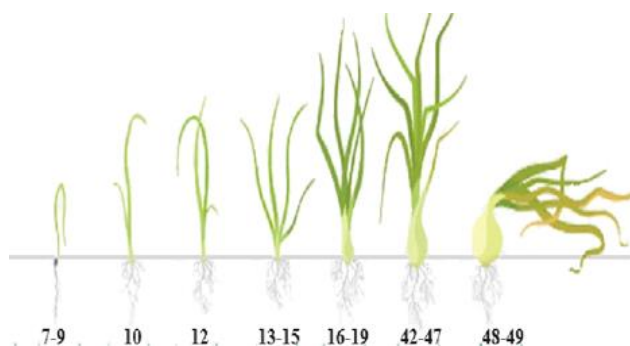


Figure 5. Damage to onions by phytophagous insects in the Khorezm oasis (according to the BBCH classification scale)

1. Phase of leaf development (main shoot) according to the BBCH 1-19 scale;
2. Thickening of the main leaf – shoot formation according to the BBCH 41-43 scale;
3. Phase of shoot formation and leaf unfolding according to the BBCH 45-47 scale;
4. Phase of completion of shoot growth and development (period of physiological dormancy) according to the BBCH 48-49 scale.

The most dangerous period for roliophage pests is the onion

leaf development stage 1-19 according to BBCH. According to literary data, the degree of onion damage depends on the planting dates (early or late) and the degree of mass flight of pests during the development phases [15,17,18]. Our research, in accordance with the data of this literature, shows that the degree of onion damage depends on its nature, sowing time (early or late) and the number of pests. It is noted that early-sown onions are damaged by phytophages less than late-sown onions. Therefore, the research was conducted in two versions. In our studies on the first option, it was noted that in early spring, during the period of early sowing of onions, that is, at the end of February - the first to second ten days of March, the density of larvae of the harmful beetle in the field was 0.5-1.8 individuals/m², while during the period of onion development - 0.8-2.5 individuals/m². The average number of *Ceuthorrhynchus jakovlevii* larvae before sowing was 0.8 individuals/m² while in BBCH phases 1–19 it was 1.0 individuals/m². The number of *Agriotes lineatus* larvae was 1.0 individuals/m² while in BBCH phases 1–19 it was 1.3 individuals/m². It was noted that the density of *Gryllotalpa* before sowing was 0.3 - 1.5 individuals/m², while in BBCH phases 1-19, this number was 1.3 - 2.5 individuals/m². In our variants of the second late sowing period (in the third ten-day period of March or at the beginning of April) before sowing onions, the density of *Ceuthorrhynchus jacovlevi* beetles was 0.5-1.5 specimens/m², in the BBCH 1-19 phases – 1.9 specimens/m², *Agriotes lineatus* – 1.0-1.6 specimens/m², in the BBCH 1-19 phases – 2.0 specimens/m², while the density of *Gryllotalpa gryllotalpa* was 1.5-1.8 specimens/m², and in the BBCH 1-19 phases 2.3-2.9 specimens/m² were noted (Table 2).

According to the results of our study (Table 2), the distribution of dominant pests of onion crops was recorded in stages 1-19 of BBCH. Thus, the number of dominant phytophagous insects was 1.5 individuals/m², and *Gryllotalpa gryllotalpa* L. was 2.5 individuals/m². Comparing different planting dates, it can be emphasized that pests are more likely to miss crops and cause more damage to crops planted late than to crops planted early. The reason was found to be that the increase in soil and air temperature leads to a significant increase in the daily activity of phytophagous insects and, as a result, to damage.

Table 2. Degree of damage to onion plants by phytophagous plants (Khiva district, experimental base of the Khorezm Academy of Mamun, 2023-2025)

Pest species	The situation with early planting of onions		The situation with late planting of onions	
	The number of pest species in the soil, units/m ²	BBCH phase 1-19 units/m ²	The number of pest species in the soil, units/m ²	BBCH phase 1-19 units/m ²
<i>Ceuthorrhynchus jakovlevi</i> Schultze, 1902	0,8±0,2	1,0±0,5	0,5-1,5±0,4	1,9±0,7
<i>Acanthurus lineatus</i> (Linnaeus, 1758)	1,0±0,1	1,3±0,3	1,0-1,6±0,5	2,0±0,8
<i>Gryllotalpa gryllotalpa</i> (Linnaeus, 1758)	0,3 - 1,5±0,4	1,3 - 2,5±0,7	1,5-1,8±0,8	2,3-2,9±0,9

The period of greatest activity of phytophages is considered to be the period of thickening of the leaf base - the stage of onion formation, or BBCH 41-43. In addition to pests living in the soil, the presence of *Delia antiqua*, *Ceuthorhynchus jacoblevii*, *Thrips tabaci*, *Eumerus strigatus* and other species living on agricultural crops has been noted. In particular, cases of mass infestation of onion crops by tobacco *Thrips tabaci* have been identified. Our research has shown that thrips larvae emerge from the soil and cause significant damage to crops during the onion harvesting period – the beginning of leaf rot (BBCH 45-47). At the end of this stage, a reduction in the number of *Delia antiqua* and the emergence of a new generation of *Ceuthorhynchus jacoblevii* were noted. The last stage is the final stage of growth and development of the insect (physiological resting state, BBCH 48-49 phase), and the characteristics of phytophagous insects in it were also studied. Our studies showed that tobacco *Thrips tabaci* and *Ceuthorhynchus jacoblevii* are the dominant phytophagous insects among the pests at this stage. According to the results of the monitoring, the *Delia antiqua* was identified as the main dominant pest during the studies conducted. The collection of phytophagous plants was carried out in the first and second decade of April after wintering, and the mass collection was carried out in the first and second decade of May, depending on weather conditions. In the spring of 2025, when the average daily air temperature was +18.7 °C and the humidity coefficient was 0.2, the highest density of the phytophagous was 17.6 individuals/plant. It was noted that the density of pests in onion crops was 36.7%, and plant damage was 25.2%. It was established that in the second ten-day period of May of the vegetation period of 2025, at an air temperature of +23.7 °C and a humidity coefficient of 2.1, the number of *Delia antiqua* larvae was 6.2 individuals/plant, and the percentage of crop infestation by pests was 12.9%, and the level of plant damage reached 20.3%. At the beginning of the 2025 onion growing season, the density of *Delia antiqua* was 1.2 individuals/m² and with a population of 8.9%, the degree of plant damage reached 3.9%. Thus, in our research, we have determined that weather conditions are one of the main factors affecting the development of phytophagous insects and the damage to plants.

The temporary abandonment of the wintering grounds by the phytophagous insects lasted for 25 days. In the early spring of 2024, at a constant daily temperature and rainfall, we determined that there were somewhat unfavorable conditions for the development of phytophagous insects, and their development stages slowed down compared to previous years. Thus, in the imago maturation phase, with a sharp change in temperature from +11.2 °C to +26.7 °C and relative air humidity of 50-54%, their number was 1.2 individuals/m²; the number in crops was 5.9%, and the degree of plant damage was 3.9%. In the bulbous (onion) phase, that is, at the beginning of leaf fall, we found an increase in the number of phytophagous insects according to the BBCH 45-47 scale. Thus, in 2024, with an average daily air temperature of +17.1-24.0 °C and a humidity

coefficient of 0.1-0.8, the density of larvae was 21.5 individuals/m²; the number in crops was 46.4%, and damage was 28.9%. A significant increase in the pest population was noted due to the appearance of the first and second generation larvae of *Delia antiqua*, which had a negative impact on onion crops and led to a sharp increase in harmfulness towards the end of the onion growing season. In 2025, with an average daily air temperature of +19.4-22.6 °C and a humidity coefficient of 0.06, this indicator was 2 times lower than last year, amounting to 11.5 units/m², while the number of pests in crops was 26.3%, and the level of damage to plants was 18.9%. It was noted that in 2024-2025 the number of phytophagous larvae decreased to 9.3 individuals/m², and crop rotation disruption and crop damage amounted to 10.8 and 15.4%, respectively. *Delia antiqua* dominance decreases towards the end of the onion growing season (BBCH 48-49). In 2023, with an average daily temperature of +21.4 °C and a humidity coefficient of 0.46, the density of larvae on the pest was 10.3 individuals/plant, the number of phytophages on the plant was 15.8%, and the degree of damage was 15.9%. In 2024, the number of larvae was 11.3 individuals/plant density, and damage to fruit crops was 17.2%. In 2025, at an air temperature of +21.6 °C and a humidity coefficient of 1.2, the density of pest larvae was 8.4 individuals/plant, while in 2024 this figure was 5 individuals/m². The number of phytophagous insects in crops was 11.0 and 4.0%, respectively, and damage to onion plants was 12.3 and 9.6%. Thus, our research shows that weather conditions (temperature and humidity) are one of the main factors influencing the development of phytophagous insects and the damage they cause to plants. In our studies, the density and abundance of *Thrips tabaci* were determined during the cultivation of onion crops in the conditions of the agrocenoses of the Khorezm oasis according to the BBCH scale. The average density of the phytophage according to the first BBCH 1-19 scale of onion vegetation is 7.9 individuals/plant, 27.3% of the crop is affected, which is 1.4 times higher than the economic threshold of harmfulness of the pest. Changes in air temperature in April and May had a significant impact on the development of pests. Thus, it was found that in April-May 2023, when there was excessive humidity, the humidity coefficient was 2.1 and the air temperature was +14.1 °C, the density of *Thrips tabaci* was 3.1 individuals/plant and the degree of plant damage was 25.8%. In 2024, during a period of low rainfall and dry May (humidity coefficient 0.2), the thrips density was 15.8 individuals/plant, plant damage was 42.9%, and an increase in damage by onion thrips was noted. In 2025, with an average daily air temperature of +19.6 °C, the highest density of onion thrips was 35.8 individuals/plant, and their harmfulness reached 63.0%.

At the stage of onion bulb formation (BBCH 45-47) - the beginning of leaf division - we observed more significant development and appearance of tobacco thrips on leaf crops. Thus, during the years of the study, the average pest density was 34.7 individuals/plant, which resulted in damage to 73.1% of the plants. When stored in this way, damaged

onion bulbs deteriorate in quality and increase susceptibility of onion bulbs to fungal and bacterial diseases. At the end of the growth and development of onion bulbs (BBCH 48-49), the third generation of onion thrips began. During this period, the average density of *Thrips tabaci* reached 58.4 individuals/plant, and the level of crop damage ranged from 80.7% to 89.5% (average 85.1%) (Table 3).

Table 3. Damage to onions by *Thrips tabaci* in onion agroecosystems of the Khorezm oasis (according to the BBCH scale)

Scale (level)	Temperature	Damage	
		individuals/ plant	Damage level %
BBCH 1-19	+18,6 °C	18,2±0,7	43,9±1,5
BBCH 45-47	+21,7 °C	34,7±1,2	73,1±1,7
BBCH 48-49	+28,4 °C	58,4±1,5	85,1±1,9

4. Conclusions

The activity of pest insects was studied in the territory of northwestern Uzbekistan, and 63 species of phytophagous insects belonging to 8 orders, 29 families, and 49 genera were identified. Based on the trophic characteristics of pests damaging plant species, 5 species of phytophagous pests are oligophagous, 19 species are broad-polyphagous, and 12 species are narrow-polyphagous. When determining the population density and dominance of the pest, it was noted that the species *Thrips tabaci* has the highest population density and dominance; the density of thrips per 1 m² of area was 448.8, which is 95.65% higher than the dominance of other species. It was proven that the species that spread the most after *Thrips tabaci* were *Liriomyza cerae* (1.7%), *Grylotalpa grylotalpa* (0.62%), *Agriotes lineatus* (0.42%), and *Ceuthorrhynchus jacovlevii* (0.41%). The harmfulness of 7 species of phytophagous insects living in the initial stage of development of onion plant leaves (BBCH scale 1-19) was studied. According to our research, late planting of onions can lead to an increase in pests and a decrease in yield. Their numbers in crops increase and damage by phytophagous insects increases.

ACKNOWLEDGMENTS

We would like to express our gratitude to the Agency for Innovative Development under the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan for funding this study under the project AL-19-562205691 Subject "Creation of agrotechnology for the combined protection of onion and garlic onion crops against pests".

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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