Characteristics of bioecological development of legume pests and their control

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Abstract. According to the research and observations, the pest damage of peanut varieties planted in the experimental field of the institute was different. Peanut oil is used in all areas of the national economy for the preparation of food, canning, varnish, soap, linoleum, perfumery, printing ink, medicine, and vegetable oil or animal fat. Oilseeds are not limited to obtaining oil, their pulp is a nutritious feed for livestock and a raw material for the processing industry. Compared to other crops (wheat, corn), oilseeds contain protein (45-50%) and oil (25-30%), and their total amount is on average 70-80%. In the article, 24 species of pests specialized in soybeans and peanuts were observed. Among the encountered pests, 8 types of pests with high economic damage were identified. These include *Setona sylindricollis* Fahr, *Callosebruchus maculates* Z, *Acyrthosiphon onobrychis* Fonse, *Adelphocoris lineolatus* Goes, *Liriomysa cicerina* Rond, *Odontothrips intermedins* Uzel, *Cicadella virdis* L, and *Heliothis armigera* Hb. Moreover, 6 types of pests, namely, *Dociostaurus maroccanus* Thunb, *Setona cylindricollis* Fahr, *Sitona lineellus* Bansd, *Adelphocoris lineolatus* Goes, *Heliothis armigera* Hb, and *Agrotis segetum* Schiff, were observed in soybean and peanut crops.

Keywords. Legumes, pests, degree of damage, bracons, biological efficiency.

1 Introduction

Today, global changes in the environment around the world lead to an increase in the scope of pests in cultivated plants in the agricultural sector [1]. In this regard, as a result of the impact of pests, a sharp decrease in the productivity of cultivated plants is observed in the agricultural sector. The development of effective methods of prevention and countermeasures against damage to agricultural crops by pests is of significant scientific and practical importance [2].

Agrotechnical measures are one of the main factors of high yield of soy and peanut crops, the technology of peanut cultivation will give the expected results if it is carried out in time and with good quality [3]. Another important condition for obtaining the expected harvest is the selection of varieties that are suitable for soil and climatic conditions, resistant to pests and diseases. Planting near peanuts and perennial legumes is also not recommended, as there is a high risk of damage by harmful organisms [4]. It is recommended to replant soybeans in

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the place where they were originally planted or where other oil crops were planted after at least 2 years [5].

It is desirable to use bacterial fertilizers (nitragin) with the best active strains of beneficial bacteria, such as soy and peanut legumes. When the seeds are planted, the adhesives are moistened with added water at the rate of 0.6-0.7 l per 1 quintal of seeds, and rhizotorphin is added according to the hectare rate and mixed thoroughly [6].

Among all agricultural crops, the peanut plant is also heavily damaged by harmful insects. Peanut crop is a productive crop for agriculture. In the agrocenosis where this crop is grown, there are more than 30 types of pests that kill up to 40-50% of the crop. Therefore, the development of an ecologically safe system of protection of soy and peanut from pests is one of the important tasks of today [7].

Pests cause serious damage to the crops, especially in the United States, India, China, Japan, Korea, Russia, Ukraine and other countries where peanuts and soybeans are grown more than legumes. Many scientists have shown that they are mainly polyphagous insects and cause damage to more than 90 species of legumes [1-4].

Among the main pests that cause great damage to legumes and peanuts planted in Uzbekistan, the *Curculionidae*, bean moth, and cotton moth cause serious damage to legumes [8]. Among these, it is permissible to pay particular attention to the Curculionidae, showing that their beetles are also harmful along with their worms [9]. It was pointed out more than 29 types of pests that cause damage to peanuts, including 4 types of moths, 7 types of cankers, 4 types of orthoptheras, 3 types of aphids, more than 10 species belonging to the family of hardy, spider mites and other pests [10, 11].

In the conditions of Uzbekistan, studies were carried out on the species composition of pests causing damage to leguminous crops, bioecological development features, the criterion of the amount of economic damage and measures to combat them.

2 Materials and methods

Our research was conducted to study the species composition, bioecology, distribution of dominant species and the damage caused by the pests of the stream in the conditions of the Tashkent region, Uzbekistan.

Counting and application of entomophages was carried out according to the method of Bey-Bienko et al. and Adashkevich and Shiyko [4-6]. Experimentation and efficiency assessment were carried out based on the methods of Khojaev et al. and Abbot [7-10].

In our 2020-2022, damage to plants belonging to the legume family was observed in laboratory conditions and during crop storage and plant growth. Pests causing damage to peanut and soy crops were determined according to the phase of plant development. *Curculionidae* beetles, which damage the roots and young shoots of the saplings, moths, khumkalla (kravchik) beetles which damage the young shoots, depending on the calculation of the hectare (50x50 cm), 10 samples were taken from every 50 points per hectare and the upper layer of the soil (5-10 cm). After the worms and sponges taken for the sample were raised in laboratory conditions and brought to adulthood, their species were determined.

3 Results and discussion

In the course of research, it was observed that soy crops are damaged by a number of specialized pests in field conditions, during grain storage in warehouses and private homes. These pests are mainly moths, spider mites, click beetles, aphids, weevils, moths, and cicadas (cankerworms), which have been found to severely damage soy crops. In the studies, 24 types of pests belonging to different families were recorded (Table 1).

Table 1. Types of insect pests considered in legumes.

#	Pest species	Soy	Peanut
1	*Dociostaurus maroccanus* Thunb.	+	+++
2	*Dociostaurus kraussii* Lng.	+	+
3	*Tettigonia viridissima* L.	+	++
4	*Setona cylindricollis* Fahr.	+++	+++
5	*Sitona lineellus* Bansd.	++	+++
6	*Agriotes meticulosus* Cand.	+	+
7	*Lethrus pygmaecus* Ball.	++	++
8	*Dailognatha nasute* Men.	+	+
9	*Blapsholaphila* F.W.	+	+
10	*Bruchus pisorum* L.	++	++
11	*Callosebruchus maculates* Z.	+++	++
12	*Acyrthosiphon onobrychis* Fonse.	+++	+
13	*Aphis fabae* Scop.	++	+
14	*Aphis medicaginis craccivora* Koch.	+	+
15	*Aphis gossupi* Glon.	++	++
16	*Halyomorpha halys* Stal.	+	+
17	*Lygus pratensis* L.	++	++
18	*Adelphocoris lineolatus* Goes.	+++	+++
19	*Liriomysa cicerina* Rond.	+++	-
20	*Trialeurodes vaporariorum* Westw.	++	++
21	*Odontothrips intermedins Uzel.*	+++	+
22	*Cicadella virdis* L.	+++	++
23	*Heliothis armigera* Hb.	+++	+++
24	Agrotis segetum Schiff.	++	+++
Note: + - rare, ++ - moderately common, +++ - most common, - types of pests encountered in our research for the first time.			

Several types of *Lepidoptera* insects live by damaging legumes. The most important of these are the autumn and cotton moths. *Agrotis segetum* Schiff is one of the common pests in cultivated lands. Its worms damage the young shoots of several crops belonging to 34 families. Including legumes, causing damage to roots and young shoots, causing thinning of seedlings and death of crops in young shoots. *Heliothis armigera* Hb is a dangerous pest of several agricultural crops and legumes. Among the legumes, the cotton moth is widespread in the areas where peas, soybeans and beans are planted, and they severely damage the grain during the ripening period. This insect appears in legumes in mid-June and lays its eggs one by one on the young leaves, between the pods. On average, in 4-5 days, worms emerge from the eggs and feed on the young leaves of the plant, then they pierce the pods and feed on the grain.

Based on the preliminary observation results, it can be said that the harmful entomofauna of the biocenosis of the river plant is diverse and the damage they cause is different. They cause damage in all phases of plant development. That is, pests that damage the root part of the plant, during germination, and damage all vegetative and generative organs. Among them, arachnids can be highlighted. Because this pest is the most damaging.

In 2020-2022, laboratory (lysimeter) and open field studies were conducted in order to study the types of pests found in peanut from plants belonging to the legume family and their level of damage in different peanut varieties. In laboratory experiments, the damage caused by spider mites, autumn moths, cotton moths, aphids, and *Curculionidae* from the most common pests in peanut crops during the season of peanut varieties grown in Uzbekistan is presented in Table 2 below.

Table 2. Pest infestation level of different crop varieties.

#	Varieties	Average number of plants per 1 m²	Names of pests and their degree of damage to the peanut plant, %					Yield obtained from 1 m², g
			Spider mite	Autumn moth	Cotton moth	Setona cylindricollis	Root aphid	
1	Toshkent-112	42.2	29.3	3.8	14.3	34.8	43.8	215.0
2	Salomat	40.2	32.6	3.1	12.1	42.3	27.9	262.5
3	Mumtoz	49.0	19.4	1.9	3.8	23.9	6.6	292.5
4	Kibray-4	49.1	18.1	1.4	3.2	21.6	0.0	315.25

Most representatives of the order *Coleoptera* damage the leguminous grain crop. These are: moths, *Curculionidae*, *Lethrus pygmaecus* and others. Among these pests, young Curculionidae severely damage legumes and can kill 40-50% of the harvested crop.

The family *Curculionidae* are insects belonging to the subfamily *Curculionidae adelognathi* and the genus *Sitones Schonh*. The larvae of these insects are also named *Curculionidae* because they feed on nitrogen-fixing nodules formed in the roots of leguminous plants.

During our research, we conducted observations to study some bioecological features of *Curculionidae*. Our initial observations focused on determining the timing of their exit from winter diapause. For this purpose, during our experiments, we made observations on various pulses and legumes. During this time, features such as winter diapause of young *Curculionidae*, wintering conditions, movement of this pest during winter hibernation due to changes in air temperature, periods of exiting wintering and their migration from perennial legumes to annual legumes were observed.

As a result of our experiments conducted in the winter months, when the young *Curculionidae* collected from the field were fed with clover leaves in laboratory conditions, after 3-5 days they were observed to mate and lay eggs. *Curculionidae* first appear in early spring on perennial cultivated and wild legumes. Then there is a transition to one-year cultivated leguminous crops. During our observations, it was found out that young *Curculionidae* emerge from winter diapause in early spring when the average air temperature in alfalfa crops is +5-7ºC.

All young *Curculionidae* overwinter as adults under stumps and in soil crevices, in fields or partially among plant debris around them. During the observations, most of the *Curculionidae* were found in the phase of wintering in diapause around the stem of alfalfa. Overwintering *Curculionidae* awaken in early spring when temperatures exceed 5-70°C and become very active before legumes begin to turn green. During our research, it was observed that *Curculionidae* beetles feed out of diapause even in the winter months when the air temperature rises (Figure 1).

Figure 1. *Setona cylindricollis* Fahr.

In some cases, *Curculionidae* beetles were also observed to lay eggs when the warm days lasted longer (4-5 days). The beetles begin feeding as the legumes begin to grow, eating the above-ground portion of the legumes, the first leaf, the growing point, and the seed coat. In early spring, beetles mate and begin to lay eggs, which were observed to partially hatch even on warm winter days. When we observed the newly hatched larvae, they were very active, quickly entered the soil, and passed along the roots to the nodules or root hairs, where they began to feed.

In order to study the development period of *Curculionidae*, we conducted experiments in laboratory conditions in 2019. In this case, beetles in the state of sexual population from different crops were collected and placed in separate glass containers, and their development period was monitored. Female beetles were fed with plant leaves and syrup to achieve maximum oviposition. Worms hatched from eggs were placed in pots of plants (peanut) grown in the laboratory and the length of larval and pupal periods was observed. Air temperature and humidity were recorded during the experiment (Table 3).

Table 3. Developmental period of *Curculionidae*.

Crop types	Time of placement of 1 pair (♀:♂), day	Egg-laying period, day	Emergence of worms, day	Caterpillar period, day	Hatching, day	Development period of one generation, days	Sum of useful temperature, °C
Peanut	Apr 14	1.2	16.8	28.8	12.4	58.0	826.8
Mung bean	May 19	2.8	15.4	32.2	14.2	61.8	882.4

It can be concluded that the period of development from egg to adult of the same species of *Curculionidae* beetles fed on different plants at the same temperature and humidity varies. One generation of *Curculionidae* beetles takes 58-65 days and 826ºC – 921ºC. The reason for this also depends on the physiological composition of the fed plant. During the research, it was found that the young Curculionidae beetles develop by giving 2 generations in a year.

Adult species of *Curculionidae* feed on leguminous grasses, and larvae feed on nitrogen-fixing nodules in the root part of the plant, and after 4 years on young roots and nodules. During the period when the larvae of this pest multiply, the nitrogen-accumulating nodules of legumes are completely destroyed. In such cases, the importance of alternating planting of legumes with cotton is lost. According to the results of the research, on average, 36.3 sprouts sprouted per 1 m^2 in the experimental field of the Research Institute of Plant Genetic Resources. It was found that during the season, 58.4% of peanut seedlings were damaged, and 6.4% of seedlings in the control variant were damaged. The number of sprouts per $1m^2$ in the mung bean planted fields of the "Center for Innovative Developments and Consultations in Agriculture" SUE experimental field farm of Tashkent State Agrarian University (TSAU) was 39.1 units. During the season, it was found that 56.2% of these seedlings were damaged, and 4.7% in the control variant. It was revealed in our research that 63.3% of mung bean plants from 30.0 pieces per 1 m^2 in the experimental area of the Institute of Plant Protection, and 3.7% of seedlings in the control variant were infected with *Curculionidae* (Table 4).

It can be concluded from our observational studies that in the conditions of Uzbekistan, one of the main pests of legumes, *Curculionidae* beetles damage 56.2-58.4% of mung bean seedlings. In regularly chemically treated fields, the damage of the plant by the young *Curculionidae* reaches 3.7-6.4%.

Table 4. Infestation of peanut by *Curculionidae* (Tashkent region, Kibray district, 2021).

Experimental farms	Average number of plants per $1m^2$				Damage degree, %	
	Total		Infected plants			
	Exp	Cont	Exp	Cont	Exp	Cont
Research Institute of Plant Science	36.3	35.9	21.2	2.3	58.4	6.4
"Center for Innovative Developments and Consultations in Agriculture" SUE, TSAU	39.1	40.6	22.0	1.9	56.2	4.7
Note: In the control variant, regular chemical treatment was performed						

According to the results of our experiments on the use of the bracon parasite in field conditions against the cotton moth, the main pest of rice, against middle-aged and adult cotton moth worms in different proportions, the efficiency was 62.6% on the 5th day, and 62.6% on

the 10th day when the ratio of free-feeding and host insects was 1:5. and 75.9%, and 81.2% biological efficiency on the 15th day. When the parasite is applied at a ratio of 1:10, biological efficiency is 50.9% on day 5, 59.3% on day 10, and 63.3% on day 15 (Table 5).

Table 5. Biological efficacy of Bracon's mullein against cotton bollworms in legumes.

Options	Average number of worms in 100 plants				Efficiency, %		
	Pre-exp.	Days after the experiment					
		5	10	15	5	10	15
Control	14.3	14.3	14.0	11.7	-	-	-
Bracon was distributed in a ratio of 1:5	18.2	6.8	4.3	2.8	62.6	75.9	81.2
Bracon was distributed in a ratio of 1:10	15.3	7.5	6.1	4.6	50.9	59.3	63.3

The biological efficiency of 56.1-75.0 was achieved when the bracon parasite was used against cotton moth worms in soybeans in ratios of 1:5-1:10 and 1:15.

4 Conclusions

Summarizing the results of our scientific research, it was observed that legumes are damaged by a number of specialized pests during field storage, grain storage in warehouses and private homes. These pests are mainly moths, spider mites, click beetles, aphids, *Lethrus pygmaecus* beetles, canadillas, *Curculionidae*, moths, and cicadas (cankerworms), which have been found to cause severe damage to soy crops. 18 types of pests belonging to different families were recorded in the research. Biological efficiency reaches 85-90% when sowing seeds against the main pest of soybeans, the autumn moth, with insecticide seed treatment preparations Dalucho 70% (at the rate of 5.0 L/t consumption), Kruizer Ekstra 362 (3.0 L/t preparations, and protects the stream during the entire vegetation period and prevents damage from pests.

According to the results of our experiments on the use of bracon parasite in field conditions against cotton moth, the main pest of rice, against middle-aged and adult cotton moth worms, the efficiency was 29.8% on the 3rd day, and 29.8% on the 7th day when the ratio of free-feeding and host insects was 1:5. 44.5%, and 75.0% biological efficiency on the 10th day. When the parasite was applied at a ratio of 1:10, the biological efficiency was 20.7% on the 3rd day, 42.1% on the 7th day, and 68.0% on the 10th day. In the observations, when the latter option is used at a ratio of 1:15, the parasites are effective at 20.3% on the 3rd day, 34.4% on the 7th day, and 56.1% by the 10th day.

References

1. Ribeiro-Costa, C. S., & Almeida, L. M. (2012). Seed-Chewing Beetles (Coleoptera: Chrysomelidae: Bruchinae). Insect bioecology and nutrition for integrated pest management, 325-352.
2. Khan, I., Nawaz, M., Zamir, M. S. I., Bibi, F., Mahmood, F., Ali, M., ... & Usman, S. (2021). Bioecology and Agronomy of Winter Fodder Crops. In Sustainable Winter Fodder (pp. 15-30). CRC Press.
3. Khojaev Sh.T. Methodological guidelines for testing insecticides, acaricides, biologically active substances and fungicides. (revised and supplemented II edition). - Tashkent, 2004. - pp. 3–30.
4. Makhmudho'dzhaev N.M., Sagdullaev A.U.- Control of the main pests and diseases of legumes. Recommendation. Tashkent-2012. -pp. 4-13.
5. Popova L.M. Chemical means of plant protection. - St. Petersburg: SPbGTURP, 2009. - 96 p.
6. Dusmanov S. - The effect of seed-fertilizing preparations against legume pests.//Journal of Agro science. - Tashkent, 2014. - #1(29). - pp.36-37.
7. Dusmanov S. The main pests of legumes (peas, beans, mung beans).// Journal of Agro science.-Tashkent, 2014.-№ 4(32).- pp 45-46.
8. Khudoykulov, A., Anorbaev, A., & Kholikova, G. (2021). Bioecological properties of underground pests in cultivation of potatoes planted after grain. In E3S Web of Conferences (Vol. 244, p. 02033). EDP Sciences.
9. Yuldasheva, S. Q. (2021). Bioecological features of the bracanoid family in Fergana Valley. Asian journal of multidimensional research, 10(4), 965-968.
10. Makhmudova, S., & Ergasheva, K. (2021). Main pests of mung bean and the effectiveness of chemicals use in pest management. In E3S Web of Conferences (Vol. 284, p. 03020). EDP Sciences.
11. Xolliev, A. T., Maxmudova, S. A., & Irgasheva, N. (2020). Harm of grain bruxes in legumes and the effectiveness of fertilizing drugs in managing their quantity. Solid State Technology, 63(5).