Plant Bugs (Heteroptera: Miridae) Development and Damage to Cotton Crop in Uzbekistan

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Abstract: - This article provides information on the types of plant bugs, their damage, and measures to combat them in cotton agrobiocenoses of Uzbekistan. As a result of the conducted research, 15 species of bugs, of which *Eurystylus bellevoyei* (Reuter, 1879) species were identified for the first time in the cotton fields of Uzbekistan. In special experiments in the cages, it was determined that when 100-150 bugs correspond to 100 cotton plants during the vegetation stage of the cotton plant, cotton yield decreases to 32.3-36.4% owing to the effect of alfalfa bug (*Adelphocoris lineolatus*) and 8.6-13.5% owing to the plant bug (*Lygus. protensis*). If cotton is infected with a cotton shredder bug (*Creontiades pallidus*) in the early period (June), the yield of cotton decreases from 61.6% to 88.9%, if there are 30 to 150 plant bugs per 100 cotton plants. If it is infected later (July-August), the yield of cotton decreases from 38.0 to 50.2%. If fine fiber cotton is damaged by bugs (100-150 specimens per 100 cotton plants) during the vegetation stage, the cotton yield will decrease by 55.5-65.3% compared to the control variant. The most effective drugs against plant bugs are: Safegor, 40% (98.3%), Ribo Super, 25% (93.4%), Transform, 50% (92.5%), and Mosetam 20 (82.8-81.9%). Arvilmek 1.8 (active substance- abamectin), Lead, 5% (substance-pymetrozine), Imido Star, 20% (imidacloprid) were found to have unsatisfactory (below 70.0%) results against cotton bugs.

Key-Words: - miridae, cotton bugs, cotton crop, dynamics, agrobiocenosis, population, economic loss, entomological cage.

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1 Introduction

Otherwise, insect pests were estimated to cause an average annual loss of 7.7% in crop production in Brazil alone, corresponding to a total annual economic loss of approximately US$17.7 billion, [1].

The Heteroptera, commonly called true bugs, are one of four suborders in the order Hemiptera. They are one of the most diverse groups of hemimetabolous insects, comprising more than 45000 species in 91 families worldwide (http://heteroptera.org/). Globally, the study and assessment of hemiptera, as well as the preservation of their biological diversity is a global problem of modern biology and ecology. They deplete plants and reduce yields by feeding on the sap of their generative organs and seeds. The most dangerous pests of agricultural crops belong to the family's plant bugs (Miridae) and shield bugs (Pentatomidae), [2].

The plant bugs (Miridae) are the largest family of true bugs (Hemiptera: Heteroptera), comprising nearly 10 000 described species in approximately 1400 genera, [3]. In China, more than 20 species of mirid bugs have been detected in cotton. Mirid bugs are polyphagous insects with more than 200 species of host plants, including cotton, Chinese date, grape, apple, pear, peach, and many other crops, [4]. Plant bug *Apolygus lucorum* alone is held responsible for cotton yield losses of up to 20–30% every year. The main control measures for *Apolygus lucorum* in cotton fields in China include chemical control, cultural control (e.g., intercropping with trap crops), physical control (e.g., light traps and sticky traps), and biological control (e.g., releasing parasitic wasps and conserving and utilizing natural enemies). The purpose of reducing the damage of *A. lucorum* on cotton yield in China is the highest results were achieved by chemical treatment with neonicotinoids of seeds, [5].

Within the Miridae and Pentotomidae families there is enormous variation in diet and feeding behavior, including species that are major crop pests as well as important predators of crop pests, [6]. Several predatory mirids have been used as biological controls for pest control, while some omnivorous species have been considered both a pest and an important predator of other pest species, depending on conditions, [7]. Many phytophagous mirids are globally important pests of crops such as cotton, lucerne, soybean, mungbean, strawberry, sorghum, cocoa, apples and tea, and these species show enormous variation in diet, ranging from monophagy to polyphagy, [8].

Nowadays, in cotton-producing countries, the species of *Creontiades pallidus*, *Creontiades biseratense*, *Creontiades dilutus*, *Lygus lineolaris*, *Lygus hesperus*, *Lygus dessinus*, which belong to the *Miridae* family of *Creontiades* and *Lygus* geneus cause serious damage to the cotton crop. As a result, they cause a 30-50% reduction in cotton yield and up to 80% in common cotton cultivation areas, [9]. Goodman (1953), *Creontiades pallidus* (Rambus) was extensively distributed throughout the Anglo-Egyptian Sudan and it was also recorded in Egypt and the Belgian Congo as a cotton pest. Stamp reported that crop losses of up to 54 % have been observed at these stages (1987) however, according to [10], losses have been higher (82 %) if the pest damages the plant during the flowering period. *Creontiades biseratense* has been found in the Karnataka, Tamil Nadu, Andhra Pradesh, and Maharashtra provinces of the Arabian Sea of India, causing severe damage to Bt cotton, [11]. As reported by [12], the mirid bug, *C. biseratense* incidence on 50 days old cotton crop reached its highest point during November's last week (17.2 bugs/10 squares) and thereafter, the population declined. Observed the infestation of mirid bug, *C. biseratense* in an epidemic form in Coimbatore on Bt cotton hybrids during December 2006, [13].

The Australian cotton industry faces several problems in fighting against pests. These include damage from key pests, such as the mirid bug, *Creontiades dilutus*. Tarnished plant bug (*Lygus lineolaris*) caused significant damage to the cotton balls in the cotton fields, [14], [15]. Since 2000, scientists have conducted a lot of research to save cotton from *Creontiades pallidus* in south Adana Province Qukurova Region, Turkey, and south Sabzevar, Razavi Khorasan Province, Iran, [16]. Nowadays, the broaden of the habitat of the pest is being observed under the influence of various ecological factors, [17].

In particular, the migration of pest from southern to central regions and northern regions were observed *C. pallidus* and *C. dilitus* in Australia, recpectivly. A survey conducted in Uzbekistan revealed that agricultural crops were attacked by 19 species of mirids. The predominant species on cotton included *Adelphocoris lineolatus* (Goeze) *Adelphocoris jakovlevi* (Reuter), *Lygus pratensis (*Linnaeus), *Lygus gemellatus* (Herrich-schaeffer), *Lygus rugulipennis* (Poppius), *Orthotylus flavosparsus* (Sahlberg) and *Poeciloscytus cognatus* (Fieb). Field trials indicated different losses in seed caused by mirids on medium and thin fibre cultivars, [18], [19].

In particular, *Creontiades pallidus*, which penetrated the southern Surkhandarya and Kashkadarya regions of Uzbekistan from the Middle East through Turkmenistan in 2000–2005, has been harming cotton production for the last 10 years, [20], [21]. The analysis of Surkhandarya region in the 2016–2019 study reveals that up to 60% of the cotton crop was lost in some areas. *Creontiades pallidus* spread over 143714 hectares in 2017 and 78500 hectares of cotton in 2019, resulting in over 10 billion dollars spent on controlling against it. Today, the development of effective methods to control the bioecology and damage of cotton shedder bug, [22].

2 Material and Methods

The research was conducted in 2020–2022 at the Scientific Research Institute of Agrotechnology of Crop Breeding and Breeding in the Surkhandarya region. Use of an entomological insect net of 38 cm in diameter to determine and distribute cotton shedder bug in cotton and alfalfa fields. In this case, the average number of bugs in 10 pairs of insect net from five areas of the field was calculated. In cotton, 10 places (a total of 100 plants) were harvested from 10 places on a 1 m white cloth (Beat Sheet method) and the average number of bugs per 100 plants was calculated.

Surkhandarya region accounts for 7% of the cotton area in Uzbekistan. 85–90% of farms in Surkhandarya region specialize in growing cotton and grain. It is no secret that Uzbekistan is one of the world's leading cotton-growing countries, producing about 3.3–3.4 million tons of raw cotton annually. At present, mainly medium-stapled cotton is cultivated in large areas of the country, but in the past, the cultivation of fine-stapled cotton varieties in the southern region - Surkhandarya region - also played a special role. More than 315000 tons of fine-fiber cotton is grown in the CIS countries, 116000 tons in the United States, 36000 tons in China, 31000 tons in Israel, 24000 tons in Peru, 295 000 tons in Egypt and 314000 tons in Australia. As the area of fine-stapled cotton in the region expands, we have studied the damage that cotton shedder bugs can cause to this variety of cotton crop, as well as chemicals that have high biological effectiveness in combating it.

The experiments were conducted in the SP-1607 fine-stapled cotton plant which was planted in 90 cm rows. The special entomologic cages (Fig. 1) are 120 cm X 120 cm X 120 cm and are installed in cotton rows 2 to 5 cm (total 10 pairs) to 25-30 cm tall (Fig.1).

Fig. 1: Special cages set up to study the damage that bugs do to the cotton crop

The special entomologic cages were surrounded by a small poor cloth, and a special entry to put bug inside was placed on one side to examine the damage. Adult bugs were placed on each bale at a ratio of 0 (control) 10, 30, 50 (early), and 0 (control), 3, 5, and 10 in cultivation late time of the plant. The damage to the cotton crop of cotton shredder bug (*Creontiades pallidus*), alfalfa bug (*Adelphocoris lineolatus*) and plant bug (*Lygus pratensis*) was calculated as a control.

3 Results

3.1 Monitoring of the True Bugs Distributed in the Cotton Fields of Uzbekistan

The monitoring of the species composition of heteropteras distributed in the cotton fields was carried out in Surkhandarya, Kashkadarya, Navoiy, Bukhara, Tashkent, Ferghana regions, and Karakalpakistan during the years 2020-2022. The scientific significance of these studies is to develop effective control measures for cotton agrobiocenosis, and prevent the spread of harmful species and damage to other regions.

According to the results, 15 types of bugs were found in the cotton agrobiocenosis, 6 of which were phytophagous (*Adelphocoris lineolatus*, *Creontiades pallidus*, *Lygus gemellatus*, *Lygus pratensis*, *Orthotylus flavosparsus*, *Eurystylus bellevoyei*, *Trigonotylus ruficornis*, *Dolycoris baccarum*), 3 zoophaguous (*Orius niger*, *Nabis palifer*, *Geocoris after*) and 4 zoophytophagous (*Campylomma diversicorne*, *Campylomma verbasci*, *Psallus cognatus*, *Deraeocoris punctulatus*) (Table 1).

Table 1. The distribution of bugs by species in the cotton agrobiocenosis in the regions of our republic

Species of bugs	**Karakalpakistan**	**Surkhandarya**	**Kashkadarya**	**Bukhara**	**Navoiy**	**Tashkent**	**Ferghana**
Adelphocoris lineolatus	++	+	+	++	++	+	+++
Creontiades pallidus	-	+++	+++	+	+	-	-
Lygus gemellatus	+	+	++	++	++	++	++
Lygus pratensis	++	+	++	++	+	+	++
Orthotylus flavosparsus	+	+	+	+	+	+	+
Campylomma diversicorne	++	+++	++	++	++	++	++
Campylomma verbasci	+	+++	++	++	+	+	+
Trigonotylus ruficornis	+						
Eurystylus bellevoyei	-	+	-	-	-	-	-
Dolycoris baccarum	+	-	-	-	-	++	-
Psallus cognatus	-	++	++	+	+	+	+
Deraeocoris punctulatus	++	++	++	++	++	++	++
*Orius niger **	+++	+++	+++	+++	+++	+++	+++
*Nabis palifer **	+	+	+	+	+	+	+
*Geocoris after**	+	+	+	+	+	+	+

*Note: +- less common, ++-moderately common, +++- common, *- predator bugs*

As a result of the research, in the season of 2022, *Eurystylus bellevoyei*, belonging to the Miridae family, was identified for the first time in Angor district, Surkhondarya region in the coordination 37°24′56.63". N, 67°09′45.68" E. In Uzbekistan (Fig.2).

Fig. 2: Eurystylus bellevoyei, a new species for Uzbekistan

In our republic *Lygus pratensis* in the northern regions, *Adelphacoris lineolatus* in the central regions, and *Creontiades pallidus* (cotton bug) in the southern regions dominate the harmful phytophagous species and they were 90-95% in cotton compared to other species. During the years 2016-2019, it was observed that the cotton bugs spread mainly in the southern Surkhandarya and partly in the Kashkadarya regions of Uzbekistan. In the course of our research in 2020, for the first time, the cotton bug was found at an altitude of 306 m above sea level in Qorovulbazar district of Bukhara region at the coordinates 39°33'3,47"C, 64°47'43,12"B and in Kyziltepa district of Navoi region, it was found to be distributed at the coordinates 39°33'3,47"C, 64°47'43,12"B at an altitude of 238 m above sea level. This indicates that the *Creontiades pallidus*, which has been spreading widely in Uzbekistan in recent years, has adapted to the natural climatic conditions of Uzbekistan and is increasing its distribution area (Fig.3).

1 2

Fig. 3: Distribution map of *Creontiades pallidus* (1) in Bukhara and Navoi regions (2).

A similar situation was previously observed in other pests, such as the melon fly and the mulberry moth. On the one hand, this means that the *Creontiades pallidus* is in danger of spreading to all regions of Uzbekistan, and on the other hand, it may not spread widely throughout Uzbekistan due to the fact that it is a species adapted to live only in the southern (desert) regions, based on the biology of the insect. In general, by today, the spread of *Creontiades pallidus* is observed in 4 regions of Uzbekistan, mainly in Surkhandarya, Kashkadarya, and partially in the desert districts of Bukhara and Navoi regions near the Todakol reservoir (Fig. 4).

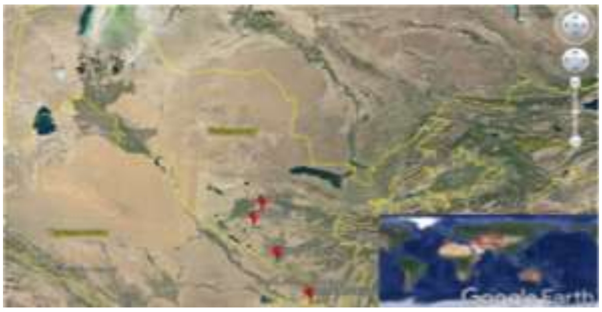

Fig. 4: The spread of *Creontiades pallidus* Uzbekistan

3.2 The Development Dynamics of the Main Harmful Species of Bug

In the conditions of Uzbekistan, the study of the development dynamics of the main harmful species of bugs was carried out in the southern regions. The first issue was to study the development and quantity of bugs from the appearance of the first species of alfalfa, field, and *Creontiades pallidus*, which emerged from the winter, until the end of the season, in crops other than weed, alfalfa, and cotton. The obtained results were scientifically analyzed at the end of the season. According to the results, in the conditions of the southern districts of Surkhandarya region, the migration of the *Creontiades pallidus* to the cotton fields from the weeds scattered around the field (*Glycyrrhiza*, *Alhagi*, *Medicago*) and from alfalfa and other cultural plants planted in the plots of the population is observed from the second decade of May. The number of bugs corresponded to an average of 1-2 pieces per 10 pairs of movements of the entomological brush.

During our observations, the first-generation larvae of the *Creontiades pallidus* began to appear in the second decade of June. The maximum increase in the number of cotton bugs in cotton corresponded to the third decade of July and the first decade of August when its average number increased to 25-30 per 10 plants. Later, after the defoliation of cotton in September, the number of cotton bugs decreased sharply (on average 3-5 per 10 plants) due to unfavorable conditions for the development of cotton bugs in the cotton fields.

In the cotton agrocenoses of the northern districts of Surkhandarya region (Shorchi, Denov, Sariosiyo, Uzun), it was observed that the dates and quantity (number) of the *Creontiades pallidus* were significantly different from those of the southern districts. In the northern regions, the initial appearance of the *Creontiades pallidus* was observed from the third decade of June, when their number was 2-3 per 10 pairs of movements of the entomological brush. Later, their number in the cotton was observed to increase, reaching 20-25 in 10 bushels of cotton at the end of July and the beginning of August.

In general, the emergence of bugs from wintering coincided with March-April, when they were observed to develop in the surrounding weeds and early cultivated crops. Their transition to cotton corresponded to the period of formation of the generative organs of cotton, i.e. May-June. This is the time when the second generation of bugs in nature develops. This year, it was observed that the bugs left wintering early. After leaving wintering in June 2021, the first generation of larvae began to emerge in cotton in July. We made calculations comparing the number of bugs leaving wintering and the number of encounters in previous years. It was observed that the 2022 *Creontiades pallidus* came out of wintering early, and its number was large. It can be seen that 2021 came out of wintering later than 2020 and encountered very little (Fig. 5).

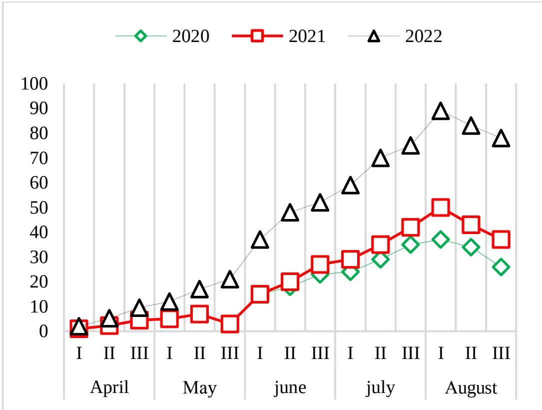

Fig. 5: Development dynamics of *Creontiades pallidus* between 2020-2022 y. in the South of Uzbekistan

The spread of *Adelphocoris lineolatus* in northern districts was observed 15-20 days before cotton bugs. However, it was observed that the number of *Adelphocoris lineolatus* in cotton during the season in northern and southern districts is significantly less than that of cotton bugs, i.e., it does not exceed 1-2 in 10 plants on average. The main reason for this is that the *Adelphocoris lineolatus* is considered an phytophagous insect and has tropical contact with plants belonging to the leguminous family. The number of *Lygus protensis* in cotton is significantly less than that of cotton bugs, and only in the northern districts, it is slightly more common than *Adelphocoris lineolatus*.

In the course of our research, we studied the development levels of all three bug species in agricultural crops (*Phaseolus aureus*, *Phaseolus*, *Zea mays*, *Medicago*, *Panicum*) that develop before moving to cotton, and in weeds around cotton. According to the obtained results, it was observed that from the first decade of April, from the period of wintering, weed bugs were found in weeds scattered among fields, ditches, and winter wheat, and in alfalfa plants planted in residential plots.

All species of bugs that winter in the form of eggs was initially found in the above-mentioned places and plants. From the 3rd decade of April, the adult varieties of alfalfa bugs began to be found in the alfalfa field in very small quantities (an average of 5-7 pieces).

In early May, the first generation of herbivorous bugs began to breed en masse around the fields, ditches, and alfalfa plots. During this period, the average number of alfalfa bugs was 25-30, field bugs were 8-10. In the southern districts of the Surkhandarya region, *Creontiades pallidus* was observed almost a month earlier than in the northern districts, and it was observed in small numbers (1-2 units) from the second decade of April.

The mass reproduction of the *Adelphocoris lineolatus* was observed at the end of June and the beginning of July, and the average number in 10 pairs of movements of the entomological brush reached 90-100. Unlike *Adelphocoris lineolatus*, the maximum number of the *Creontiades pallidus* occurred at the end of July and the beginning of August, and it was 35-40 on average, while the maximum number of field bugs was found in the second decade of June, and it was 15-20 on average. While the number of alfalfa and field bugs is observed to decrease sharply by the autumn months, the number of cotton bugs was found to be more than other bugs in our observations.

In general, the release of bugs from wintering coincides with March-April, and at this time, it was observed that they develop in the surrounding weeds and early cultivated crops. Their transition to cotton corresponded to the period of formation of cotton's generative organs, i.e. June. This is the time when the second generation of bugs in nature develops. But later, if we observe their distribution in cotton, we can see that the *Creontiades pallidus* develops in more numbers than other species. Taking this into account, we have carried out special calculations to study the ratio of these three species in the cotton field.

Experiments in this regard were conducted in the southern regions of our republic in the conditions of Surkhandarya and Kashkadarya (Karshi, Nishon districts), and in the northern regions of Tashkent and Fergana regions. In this case, 100 cotton bugs were collected from the cotton fields grown in the researched regions using an entomological comb, and the percentage differences of all three species were calculated. According to the obtained results, it was found that in the southern regions of Uzbekistan, the largest amount was occupied by *Creontiades pallidus* - on average 90-95%, *Adelphocoris lineolatus* 0.5-1.0%, *Lygus protensis* 4.0-8.0%.

3.3 Determining the Damage Caused by Herbivorous Bugs to the Cotton Crop

More than 25 percent of the world's cotton, that is, about 6.5 million tons of cotton per year, is grown in China. More than 100 000 farmers work for this, and it is worth noting that China has been able to achieve high efficiency in this regard in a very short time. Today, Uzbekistan ranks sixth in the world in terms of cotton cultivation, after China, India, the USA, Pakistan, and Brazil. Currently, an average of 1.1-1.2 million tons of cotton is harvested throughout the republic (5-6 million tons were harvested during the USSR). Cotton is the main export product of our republic. Also, in our country, three types of valuable products are produced from cotton raw materials, that is, raw materials for textile products - fiber, oil for food, and animal feed. However, in recent years, due to drought, environmental factors, and pests, cotton cultivation is becoming more complicated. In particular, the impact of harmful weeds on the yield and quality of cotton is increasing (Fig.6).

Fig. 6: External and internal views of a cotton plant affected by *Creontiades pallidus*.

Determining the possible damage caused by cotton bugs to the cotton crop is of great practical importance. In the 2020-2022 season, we conducted research aimed at studying the damage caused by cotton bug species to the cotton crop in the conditions of Uzbekistan.

The research was carried out on 20 hectares of cotton fields at the Surkhandarya experimental station of the Scientific Research Institute of Agrotechnology of Cotton Breeding, Seeding and Cultivation (SRI ACBSC). Experiments were carried out on medium-fiber “UzPITI-1604” and fine-fiber “SP 1607” varieties of cotton planted between rows of 90 cm. First, special tents with a height and width of 120 cm were prepared for the experiments. Tents were installed in two rows during the formation of the elements of the cotton crop before the period of migration of the cotton fields. In all the tents, 5 rows of 10 bunches of cotton were left in two rows, and they were surrounded by a net with a small mesh that the bugs could not penetrate. A special opening and closing place was left on one side of the tents to specially insert the handcuffs and monitor the damage levels of the cotton crop. Cotton crop elements (cotton flower, comb, and boll) are opened on one side of the cages to study the degree of damage caused by bollworms.

The place (lock, door) is set. The damage caused by the plant bugs to the cotton crop was calculated in each decade of the month compared to the control option (cages installed without the plant bugs).

3.4 Identify the Damage Caused by Cotton Bugs to Medium Fiber Cotton Variety (*Gossypium hirsutum*)

In the area taken for the experiment (in the tents), the density of cotton seedlings was 55,000 bushels per hectare. To the tents, the types of plant bugs (cotton, alfalfa, and field bugs) are distributed in the proportion of 0.3-0.8-0.5-1.0-1.5 pieces per bush of cotton (the number of bugs is suitable for 10 cotton bushes), taking into account the spread over time, we conducted our experiments in earlier and later periods.

In the experiment, each tent has a special value, therefore, each tent was numbered and the classification of the experiment placed inside it was written down. In the experiments, each option was carried out in 3 replications, and the plants of the control option were left clean (without pests). During the season, every ten days, the appearance of crops, damage, spillage, and the opening of pods were calculated, and the biological productivity was concluded.

In the first experiment of the first option conducted in the ratio of 1:1 (10 specimens of bugs per 10 cotton plants) of alfalfa and field bugs, there was a decrease of 69.9% of cotton bolls and flowers, and - 41.2% of cotton bolls compared to the control options. The second option for alfalfa bugs, i.e., in experiments with 15 bugs for 10 cotton plants, it was found that the number of cotton stalks and flowers decreased by 82.2%, and the number of bolls decreased by - 21.1% compared to the control. In the end, the biological productivity obtained from the first and second harvests compared to the control in 1/ha centner was -9.6 c/ha (-32.3%) in the 1:1 ratio experiment, and the yield obtained from the 1:1.5 ratio experiment compared to the control options was -10.8 c/ha or -36.4% less compared to the obtained yield. The same experiment was carried out simultaneously in the field bugs. In 1:1 ratio experiments of field bugs, it was observed that there was a -80.8% reduction of bolls and flowers, and a -2.6% reduction of cotton bolls compared to the control options.

The second option for field bugs, i.e., in experiments with a cotton ratio of 1:1.5, the cotton grew by +12.5 cm compared to the control, the number of bolls and flowers decreased by -91.8%, and the number of pods decreased by -4.4%. At the end of the field experiments, the biological yield obtained from the first and second harvests compared to the control in 1/ha centner was - 2.6 c/ha (-8.6%) in the 1:1 ratio experiment, in the 1:1.5 ratio experiment it was determined that the yield was -4.0 c/ha or - 13.5% less than the yield obtained from the control variants.

In the conditions of the Surkhandarya region, in the cotton agrocenoses, the spread of the cotton bugs in comparison to other herbivorous plants and its appearance in different periods in the northern and southern districts was observed. Based on the above circumstances, we carried out the cotton bugs in early and slightly later periods and greater proportions (1:0.3, 1:0.8, 1:1 until the end of the season, 1:1 within a month, 1:1.5). We have also studied the possible damage of this type of cotton bugs to the cotton crop due to the expansion of thin fiber cotton fields in Surkhandarya region in recent years.

In an experiment conducted on June 30th of cotton bugs in the medium-fiber cotton variety at a ratio of 1:03 (3 bugs per 10 bushels of cotton), by August 29, compared to the control, it was observed that the length of the cotton increased by +14.9 cm, nodes, and flowers -61.6%, bolls - 51.8% compared to the control. At a ratio of 1:08, the height of cotton increased to +15.2 cm, the number of nodes and flowers decreased by - 71.2%, and the number of bolls decreased by - 62.3%.

At the end of the experiments carried out for cotton bugs, as in the case of alfalfa and field bugs, in comparison with the first and second harvest control, in the experiment it was found that the yield decreased by -18.3 c/ha (by -61.6%)

at a ratio of 1:0.3, by -19.8 c/ha (-66.7 %) at a ratio of 1:0.8 and by -23.2 c/ha (-78.1) at a ratio of 1:1 (until the end of the season), -21.2 c/ha. When this ratio is carried out for one month, the decrease was 21,2 c/ha (-71,4 %), this ratio in later experiments was 11.3 c/ha (-38.0 %), in the 1:1.5 ratio -26,4 c/ha (-88,9 %), this ratio in later experiments was 14.8 c/ha (50.2%).

3.5 Identify the Damage of Cotton Bugs (*Gossypium barbadense*) to the Fine-Fiber Cotton Crop

Only *Lygus protensis*, *Adelphocoris lineolatus* are included in the list of pests of a cotton plant in the Republic of Uzbekistan. Several local scientists have conducted scientific research on the damage and control system of these plant bugs species to cotton. It is known that all pests are combated only when they reach the Economic Injury Level. In all the old literature available to us, it was stated by local scientists that it is necessary to fight against *Adelphocoris lineolatus* only when there are 100-150 cotton bolls per 100 cotton plants, and this was followed. However, in recent years in the south of our republic, a new species of plant bugs (*Creontiades pallidus*) appeared in the cotton fields and began to cause great damage. Based on old data, agricultural experts used to control *Creontiades pallidus* in cotton fields only when there were 100-150 plants per 100 cotton plants, resulting in major crop losses was observed. Today, we conducted our scientific research in order to study the level of damage to the cotton crop when there are 100 or more bollworms per 100 cotton plants.

The study of the damage of cotton bugs to the fine-fiber cotton crop was carried out at two ratios of 10:10 (10 bugs per 10 plants) and 10:15. The experiments were conducted in the third decade of June. Spills of cotton lye elements (boll, flower) lyre by cotton handcuffs were calculated every 10 days against control. Prior to the experiments, the combs and flowers were made of cotton elements in each ratio at almost the same rate of 10x10, 10x15, and in the control, respectively, at 6.7-7.2-7.0, and the cotton stalks at 1.3-1.1-1.0. A sharp decrease in cotton yield was observed by handcuffs every 10 days compared to the control. Two months later, the experimental cotton stalks and flowers were placed in both ratios at a rate of 79.5% in the 10x10 ratio and 89.7% (0.8-0.4-3.9) in the 10x15 ratio, a decrease of 59.6% (9.4-9.2-22.4) was observed (Table 2).

Table 2. Effect of the yield of fine-stapled cotton on a cotton shaft on yield Southern Uzbekistan, Surkhandarya region, 2020

Cotton-bugs	Number of flowers and stems per plant						
ratio	20,1	30,1	10,1	22,1	28,1	17,1	29,1
10:10	6,7	12,3	10,6	2,1	1,5	1	0,8
10:15	7,2	13,1	10,5	2	0,5	0,1	0,4
Control	7	13,2	13,4	9,9	9,6	8,4	3,9

The average number of cotton balls per plant						
20,1	30,1	10,1	22,1	28,1	17,1	29,1
1,3	4,9	9,5	12,4	9,4	9,5	9,4
1,1	3,9	8,1	10,2	9,3	9,1	9,2
1	4,3	8,5	13,1	14,5	20,2	22,8

The difference from control

Control	Bud, difference in flower, %					
10:10	6,8	20,9	78,8	84,4	88,1	79,5
10:15	0,8	21,6	79,8	94,8	98,8	89,7
Control	-	-	-	-	-	-

Difference in balls,%						
-	12,2	10,5	5,3	35,2	53	58,8
-	9,3	4,7	22,1	39,9	55	59,6
-	-	-	-	-	-	-

At the end of the experiments, the cotton fiber in all tents was harvested in late September and mid-October and calculated for control. Cotton yields were found to be - 14.7 c/ha (55.5%) and - 17.2 (65.3%) loss, respectively, compared to the control in the 10 x 10 and 10 x 15 ratios with the plant.

3.6 Identify the Effect of Insecticides against Bugs

The main sucking insect pests of cotton belong to the orders Hemiptera and Thysanoptera, and include aphids, leafhoppers, silverleaf whitefly, sucking bugs (mirids, green vegetable bugs), and thrips, [23]. In China, mirid bugs were the primary pests after the adoption of Bt cotton and the subsequent reduction in insecticide used to manage *H. armigera*. In addition to mirid bugs, the number of other sucking pests, such as aphids, mealy bugs, planthoppers, and silverleaf whiteflies, increased about three years after the introduction of Bt cotton, [24]. In Australia, the importance of the green vegetable bug *Nezara viridula* L. and the green mirid *Creontiades dilutus* (Stål) have increased since the adoption of Bt cotton. Studied the bioefficacy of insecticides against mirid bug *C. bisertense* in irrigated *Bt* cotton and reported that fipronil 5 SC @ 25 g ai/ha was recorded lowest mirid population (0.52/15 square) with the highest yield (34.31 q/ha), [25], [26].

Suggested a similar approach that 32 *Bt* and non-*Bt* cotton hybrids against mirid bug incidence was recorded on five squares from the top canopy of each plant. It was also reported that NCHB-990 recorded the least number of mirid bug (5.30 mirid/5squres) of all hybrids. However, non *Bt* hybrid DCH-32 and DHB-105 recorded a high incidence of mirid bug (11.5-11.2 mirid/5 squares). Whereas, shedding varied, with least being observed on MRC-6918 followed by DCH-32, [8].

The bio-efficacy of certain insecticides against mirid bug, *P. biseratense* and the economic feasibility were also studied by B. Prajna Devaiah *et al.*, in Mandya city of India. Their studies showed that among nine insecticide molecules tested for their bio-efficacy against mirid bug, the seed treatment along with foliar sprays of imidacloprid 60 FS and thiamethoxam 25 WG @ 0.3 g/l found to be effective and this was followed by flonicamid 50 WG @ 0.4 g/l, imidacloprid 60 FS + acetamiprid 20 SP @ 0.3 g/l and clothianidin 50 WDG @ 0.1 g/l, [22].

Lygus protensis and *Adelphocoris lineolatus* were considered the main pests of cotton fields in Uzbekistan. Chemical preparations recommended for all sucking pests of cotton (aphid, thrips, spider mite, spider mite) are used in the fight against them. The effectiveness of chemical preparations has given the intended result. However, in recent years, in the south of our republic regions (mainly desert areas) in the cotton fields, the species *Creontiades pallidus*, introduced from neighboring countries, began to spread widely and cause great damage. Cotton farmers have been fighting *Creontiades pallidus* with chemicals used in other regions to control *Lygus protensis* and *Adelphocoris lineolatus* and have not achieved the expected positive results.

To determine the cause of the above problem, we studied the biological effectiveness of several classes of chemical preparations against *Creontiades pallidus*.

In our research, we studied the effectiveness of several chemical drugs against phytophagous bugs, which are causing great damage to the cotton crop today. 300 liters of working fluid (Water) per hectare were used for processing using an OVX-600 tractor sprayer. Calculations were made on pretreatment and posttreatment days, and efficacy was calculated using Abbot's formula, which provides a control option.

In the experiment, 7 drugs that have been proposed to combat the pests of cotton in recent years in Uzbekistan were tested (Table 3).

Table 3. Biological efficacy of insecticides against *Creontiades pallidus* in cotton plants

Variants	Active substance	Drug use, *kg, l/ha*
Transform, 50%.w.s.g.	sulfoxaflor	0.15
Lead, 5% w.s.g.	pymetrozine	0.2
Ribo super, 25% s.c	chlorpyrifos	2.0
Imido, 35% s. c	imidocloprid	0.135
Safegor, 40% e. c	dimethoate	1.0
Malation, 57% e. c	malathion	0.6
Sumi alfa, 20% e. c	esfenvalerate	0.1
Control (without insecticides)	-	-

As a result of experiments, Transform, Transform, 50% water soluble granules (active substance sulfoxaflor) had a satisfactory effect of 89.8-92.5-77.6% at a rate of 0.15 kg/ha, Safegor, Safegor, 40% emulsion concentrate (98.3%) and Ribo Super, 25% suspension concentrate (93.4 %) had a good effect. Lead, 5% water soluble granules had 59.0-31.8%, Imido, 35% suspension concentrate had (18.9%), Malation had 73.4-58.8%, Sumi alfa had 66.4-20.3% unsatisfactory results, taking into account the high damage of boll, this result will not be sufficient (Fig.7).

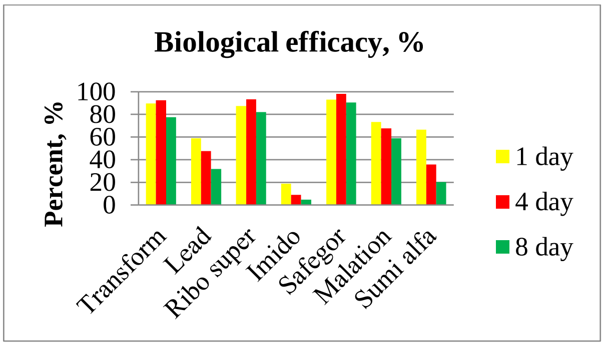

Fig. 7: Biological effectiveness of chemical preparations against harmful *Creontiades pallidus*

As a result of the scientific research conducted to determine the effectiveness of chemical preparations against Creontiades pallidus, we were convinced that this type of plant bugs is more resistant to drugs than other plant bugs (*Lygus protensis*, *Adelphocoris lineolatus*). Since this plant bugs population is resistant to chemical preparations belonging to the organophosphorus class, the biological effectiveness of Transform 50%, Ribo Super 25%, and Safegor 40% drugs showed high results. On the other hand, *Creontiades pallidus* showed low efficiency due to strong resistance to pyrethroid and neonicotinoid chemicals (Imido, 35%, Sumi alfa, 20%). From this, it can be concluded that in the southern regions of the republic where *Creontiades pallidus* is spread, it is impossible to fight with complex chemical preparations against all sucking pests. In farms, it is necessary to fight against them with chemical preparations belonging to the organophosphorus class, which have been highly effective in separate tests.

4 Conclusion

As a result of the conducted research, 15 species of cotton bugs were identified in the cotton fields of Uzbekistan, of which the species *Eurystylus bellevoei* was identified for the first time. It was determined that the yield of alfalfa (*A. lineolatus*) decreases by 32.3-36.4%, and by 8.6-13.5%, when there are 100-150 bugs per 100 cotton plants during the cotton picking period. If cotton is infected with cotton bugs (*C. pallidus*) in the early period (June), the yield of cotton decreased from 61.6% to 88.9%, if there are 30 to 150 bugs per 100 cotton plants, and if it is infected later (July-August) a decrease from 38.0 to 50.2% was observed. If fine fiber cotton is damaged by cotton bugs (100-150 specimens per 100 bushels) during the vegetation period, the cotton yield is reduced by 55.5-65.3%.

The obtained results show that in our republic, agricultural experts fight against bollworms based on old data, i.e. not when there are more than 100 bollworms per 100 cotton bushes, but when they first appear in small numbers in the fields, will have to fight against.

The most effective drugs against heteroptera are: Safegor, 40% emulsion concentrate (98.3%), Ribo Super, 25% suspension concentrate (93.4%), Transform, 50% water soluble granules (92.5%), and Mosetam 20 SP (82.8-81.9%). Arvilmek 1.8 EC (active substance- abamectin), Lead, 5% water soluble granules (active substance-pymetrozine), Imido Star, 20% suspension concentrate (i.e. imidacloprid) were found to have unsatisfactory (below 70.0%) results against cotton heteropteras.

Based on the obtained results, it is not possible to fight with complex chemical preparations against all sucking pests in the areas where *Creontiades pallidus* is spread in the south of Uzbekistan. In farms, it is necessary to fight against them with chemical preparations belonging to the organophosphorus class, which have been highly effective in separate tests.

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References:

[1] Devaiah, B. P., Kumar, L. V., Sunil, K., & Manjunath, G. Bio-efficacy of selected new insecticides against mired bug *Poppiocapsidea biseratense* (Distant) and cost economics of mirid bug management in sesame. International Journal of Chemical Studies, 8(4), 2020, pp.144–150. doi.org/10.22271/chemi.2020.v8.i4c.9881
[2] Akbar, W. A new transgenic trait protects cotton from thrips and Lygus damage. International Congress of Entomology., 2016. doi.org/10.1603/ice.2016.112914
[3] Cassis, G., & Schuh, R. T. Systematics, Biodiversity, Biogeography, and Host Associations of the Miridae (Insecta: Hemiptera: Heteroptera: Cimicomorpha). Annual Review of Entomology, 57(1), 2012, pp. 377–404. doi.org/10.1146/annurev-ento-121510-133533
[4] Zhang, Z., Wang, Y., Zhao, Y., Li, B., Lin, J., Zhang, X., Liu, F., & Mu, W. Nitenpyram seed treatment effectively controls against the mirid bug *Apolygus lucorum* in cotton seedlings. Scientific Reports, 7(1). 2017, doi.org/10.1038/s41598-017-09251-9
[5] Jiang, Y. Y., Lu, Y. H. & Zeng, J. Forecast and management of mirid bugs in multiple agroecosystems of China. China Agriculture Press: 2015, pp. 92–98.
[6] Meisner, M. H., Zaviezo, T., & Rosenheim, J. A. Landscape crop composition effects on cotton yield, *Lygus hesperus* densities and pesticide use. Pest Management Science,

73(1), 2016, pp.232–239. doi.org/10.1002/ps.4290

[7] Saeed, R., Razaq, M., & Hardy, I. C. W. The importance of alternative host plants as reservoirs of the cotton leaf hopper, Amrasca devastans, and its natural enemies. Journal of Pest Science, 88(3), 2014, pp.517–531. doi.org/10.1007/s10340-014-0638-7

[8] Rohini & Mallapur, C.P. Reaction of cultivated *Bt* cotton hybrids to mirid bug, *Creontiades biseratense* (Distant) (Miridae: Hemiptera). Karnataka Journal of Agricultural Sciencis. - India. 23(1): 2013, pp.133-134.

[9] Cappadonna, J. K., Miles, M. M., Hereward, J. P., & Walter, G. H. Invasions of green mirid (*Creontiades dilutus*) (Stål) (Hemiptera: Miridae) into cotton – perceptions of Australian crop consultants. Agricultural Systems, 166, 2018, Pp.70–78. doi.org/10.1016/j.agsy.2018.07.017

[10] Abdulla Iskandarov, Lola Gandjaeva, Dilshod Musaev, Gulnara Mirzayeva, Bakhtiyor Kholmatov, Hasan Jumanazarov, Aygul Jangabaeva, Kahramon Razzakov, Ulmasbek Abdullaev, Ikram Abdullaev. Updated Checklist of the Pentatomidea (*Heteroptera: Pentatomomorpha*) of Uzbekistan. Wseas Transactions on Environment and Development. Volume 18, 2022., pp. 1283-1295. 10.37394/232015.2022.18.121

[11] Saeed, R., Razaq, M., & Hardy, I. C. W. The importance of alternative host plants as reservoirs of the cotton leaf hopper, Amrasca devastans, and its natural enemies. Journal of Pest Science, 88(3), 2014, pp.517–531. doi.org/10.1007/s10340-014-0638-7

[12] Hill, L. Migration of green mirid, Creontiades dilutus (Stål) and residence of potato bug, Closterotomus norwegicus (Gmelin) in Tasmania (Hemiptera: Miridae: Mirinae: Mirini). Crop Protection, 96, 2017, pp.211–220. doi.org/10.1016/j.cropro.2017.02.006

[13] Efil, L., & Bayram, A. Factors affecting the distribution of two mirid bugs, *Creontiades pallidus* (Rampur) and *Campylomma diversicornis* (Reuter) (Hemiptera: Miridae) and notes on the parasitoid *Leophron decifiens* Ruthe (Hymenoptera: Braconidae). Entomologica Fennica, 20(1), 2009, pp.9–17. doi.org/10.33338/ef.84454

[14] Ravi, P. R., Patil, B. V., Narayanaswamy, K. S., Sowmya, E., Lepakshi, N. M., & Sajjan, P. S. Biology of mirid bug, *Creontiades biseratense* (Hemiptera: Miridae). International Journal of Bioresource Science, 2(3), 2015, pp.157. doi.org/10.5958/2454-9541.2015.00011.0

[15] Musaev D., Kholmatov B., Sattarov N., Amirov I., Musayeva M. & Abdurakhmonov Sh. Cotton shredder bug *Creontiades pallidus* (Rambur, 1839) damage to cotton crop in Surkhandara region of South Uzbekistan. EurAsian Journal of BioSciences. Turkey. 14. 2020, pp. 4683-4687.

[16] Varshney, R., & Budhlakoti, N. Biology and functional response of the predator, Dortus primarius (Distant) (Hemiptera: Miridae) preying on Frankliniella schultzei (Trybom) (Thysanoptera: Thripidae). Egyptian Journal of Biological Pest Control, 32(1). 2022, doi.org/10.1186/s41938-022-00531-9

[17] Oliveira CM, Auad AM, Mendes SM, Frizzas MR Crop losses and the economic impact of insect pests on Brazilian agriculture. Crop Prot. 2014. pp.56:50. doi.org/10.1016/j.cropro.2013.10.022

[18] Bouagga, S., Urbaneja, A., & Pérez-Hedo, M. Comparative biocontrol potential of three predatory mirids when preying on sweet pepper key pests. Biological Control, 121, 2018, pp.168–174. doi.org/10.1016/j.biocontrol.2018.03.003

[19] Varshney, R., & Budhlakoti, N. Biology and functional response of the predator, Dortus primarius (Distant) (Hemiptera: Miridae) preying on Frankliniella schultzei (Trybom) (Thysanoptera: Thripidae). Egyptian Journal of Biological Pest Control, 32(1). 2022, doi.org/10.1186/s41938-022-00531-9

[20] Ruzmetov, R., Matyakubova, Y., Abdullaev, I. 2020 Cytosporosis diseases of apple trees (Reinette Simirenkomalus) and its distribution in the lower Amudarya region // nternational Journal of Current Research and Review, 12 (14), 62–67.**DOI.** 10.31782/IJCRR.2020.121413

[21] Abdullaev U.R., Abdullaev I.I., Gandjaeva L.A. The Social WASP Fauna of Riparian Tuqai Forestin Khorezm region Uzbekistan (Hymenoptera, Vespidae) International Journal of Current Research and Review Vol 12, Issue 14, 2020, pp. 96-99. DOI: 10.31782/IJCRR.2020.121420

[22] Hosseini, S. M., Asadi, H. B., Kaunail, K., Shojaii, M., & Hadiostvan. Study on bioecology of cotton shedder bug *Creontiades pallidus* (Rambur). (Heteroptera: Miridae) in cotton fields of Khorassan. Journal of Agricultural Sciencis. Iran. 8(2), 2022, pp. 9–10.

[23] Hill, L. Migration of green mirid, Creontiades dilutus (Stål) and residence of

potato bug, Closterotomus norwegicus (Gmelin) in Tasmania (Hemiptera: Miridae: Mirinae: Mirini). Crop Protection, 96, 2017, pp.211–220. doi.org/10.1016/j.cropro.2017.02.006

[24] Musser, F. R. Integrating multiple strategies for *Lygus lineolaris* management in cotton. 2016 International Congress of Entomology.https:doi.org/10.1603/ice.2016.93445

[25] Sahana K B, Navi, S., L, V., Kumar C, S., Kumar V B, S., G, S., & N M, C. Resistance to Mirid Bug *Creontiades biseratense* (Distant) in Cotton. Indian Journal of Entomology, 2022, pp. 1–4. doi.org/10.55446/ije.2022.671

[26] Rasheed, I. Screening of different insecticides against *Helicoverpa armigera* (Hubner), (Lepidoptera: Noctuidae) and its effect on yield of tomato crop. Pure and Applied Biology, 7(4). 2018, https://doi.org/10.19045/bspab.2018.700208

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