Pests of *Helicoverpa armigera* (Hübner) and *Spodoptera exigua* (Hübner) in Pepper Fields in Armenia

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ABSTRACT

Background: Between 2021-2023, the harmfulness of Helicoverpa armigera (Hübner) and *Spodoptera exigua* (Hübner) on different varieties of pepper was studied in the pepper fields of Khoronk community.

Methods: Studies on the harmfulness of *H. armigera* (Hübner) and *S. exigua* (Hübner) were carried out in 2021-2023 in the pepper fields of Khoronk community of Armavir marz. Experiments were carried out on the main 7 varieties cultivated in the community, to the methodology adopted in entomology.

Result: As a result of studies, it was revealed that both pests damage plants in the larval stage. They feed on the vegetative and generative organs of the plant. Young larvae of *S. exigua* (Hübner) feed on newly opened leaves, enter into the leaves, cover them with a web and feed inside it. They then come out and spread over the plant and feed on leaves of different heights, as a result of which scratches of irregular shape and size occur on the leaves. Most mature larvae enter the fruit, feed on the seeds, because of which the fruit rot. Larvae of *H. armigera* (Hübner) initially feed on flowers and flower buds, and after some time they move on to leaves. Larvae feed on the upper and epidermis of the leaf, leaving the lower unharmed. As a result of the damage, the dries up, falls off, and the leaves look porous. Mature larvae mostly damage the fruit. Larvae enter the fruit from anywhere in the fruit, opening deep holes. They feed on seeds in the fruit. Damaged fruits begin to ripen prematurely, various harmful pathogens penetrate from the damaged areas, as a result of which the fruits rot. According to the results of studies carried out on 7 different varieties of pepper during the period of intensive development of *H. armigera* (Hübner) and *S. exigua* (Hübner), the most significant damage by pests was recorded in Hayk variety, and the least in Arevaham variety.

Key words: Damage, Fruit, Larva, Leaf, Variety.

INTRODUCTION

S. exigua (Hübner) and *H. armigera* (Hübner) belong to the Noctuidae family of the Lepidoptera order. They damage both in the open field and in the greenhouse (Han *et al.*, 2014, Kumar *et al.*, 2020).

S. exigua (Hübner) is an omnivorous pest (Guerrero *et al.*, 2014, Chena *et al.*, 2019, Hafeez *et al.*, 2021, Rajesh Chowdary *et al.*, 2024). Due to its global distribution and omnivorous behavior, this pest causes significant economic losses in crop production worldwide (Hafeez *et al.*, 2021), causing yield reduction.

S. exigua (Hübner) damages the leaves and fruits of many crops (Rabelo *et al.*, 2022), including vegetables, field crops, ornamental plants (Pogue, 2002, Capinera, 2024). They prefer leguminous plants as well as the plants of family Solanaceae, Poaceae, Malvaceae (Artokhin *et al.*, 2017), Liliaceae, Rubiaceae, Umbellíferae, Asteráceae (Shankar *et al.*, 2014, Mehta *et al.*, 2021).

Damages more than 185 species of plants belonging to 50 families (Kuznetsov, 1999) including 133 species of cultivated plants. In North America alone, it damages more than 90 species of plants in 18 families (Greenberg *et al.*, 2001, Navasero *et al.*, 2019) . They feed on crops such as tomato, corn, (Zhang *et al.*, 2021), broccoli, peanut, melon (Dalip, 2014), chickpea, maize, sunflower, spinach (Rajesh Chowdary *et al.*, 2024), cabbage, alfalfa (Shankar *et al.*, 2014), pepper (Terlemezyan and Ghazaryan, 2023), eggplant (Mehrkhou *et al.*, 2015), onion (Navasero *et al.,* 2019), tobacco, cotton (Hafeez *et al.,* 2021), potato (Kumar *et al.*, 2020), *etc.* Larvae also feed on a number of weeds during their development (Capinera, 2024).

S. exigua (Hübner) damages plants in the larval stage (Greenberg *et al.*, 2001, Kumar *et al.*, 2020, You *et al.*, 2020, Rajesh Chowdary *et al.*, 2024). Young larvae feed in groups (Simon *et al.*, 2021). The caterpillars feed mainly on the reverse side of the leaves, leaving behind small silk webs. They feed in such a way that the leaves become skeletonized, all the tissues of the leaves are destroyed,

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only the leaf veins remain, which preserve the shape of the leaf. Sometimes the larvae connect several leaves together with a silk thread to make a temporary cocoon, in which they can feed safely (Capinera, 2006, Natwick *et al.*, 2012).

When feeding on fruits *S. exigua* (Hübner) larvae leave not deep wounds on the surface (Showler 2001; Natwick *et al.*, 2012). Sometimes *S. exigua* (Hübner) larvae even eat each other, especially when food supplies are scarce (Hua *et al.*, 2013).

Their feeding and behavior are directly or indirectly dependent on temperature fluctuations (Rathore *et al.*, 2013).

H. armigera (Hübner) is an omnivorous pest (Kriticos *et al.*, 2015). It is one of the most dangerous pests of agricultural crops in the world (Karim, 2000; Krinski and Godoy, 2015), causing a global economic loss of 2-3 billion USD annually (Tay *et al.*, 2013, Riaz *et al.*, 2021).

H. armigera (Hübner) damages 68 plant families (Cunningham and Zalucki, 2014). According to Tai *et al.* (2013), the *H. armigera* (Hübner) damages more than 180 plant species belonging to 45 families; according to Krinsky and Godoy (2015) - 67 plant families; according to Kuznetsov (1999) damages more than 350 species of plants.

The main damage is caused by larvae (Artokhin *et al.*, 2017, Suzana-Milan *et al.*, 2022; Trujillo *et al.*, 2024), which feed on vegetative parts of plants: upper parts of shoots, leaves of different heights (Salvadori *et al.*, 2013) and with generative organs: buds, inflorescences, fruits, pods (Suzana-Milan *et al.*, 2022).

Insect damage has been reported on both cultivated and uncultivated plants (Salvadori *et al.*, 2013), which belonged to Solanaceae, Fabaceae, Asteraceae, Malvaceae and Poaceae families (Krinski and Godoy, 2015). It also causes economic damage to agricultural crops such as corn, tomato, legumes, tobacco, sorghum, fruit trees (Lammers and MacLeod, 2007; Specht *et al.*, 2013), pumpkin, zucchini, alfalfa (Artokhin *et al.*, 2017), pigeon pea (Pandey, 2016; Amit *et al.*, 2022), pepper (Ghazaryan, 2023), as well as flowers: Carnation, Gerbera, Gladiolus, Chrysanthemum (Pal and Sarkar, 2009), Rosa (Eswara Reddy *et al.*, 2021), Pelargonium (Lammers and MacLeod, 2007). They also damage some types of weeds (CABI, 2007).

H. armigera (Hübner) causes serious economic damage, especially in open field conditions. In 2003, this type was a serious pest of pepper in the Metaponto region of Italy, with reported plant damage of 30% fruit and 70-80% (Lammers and MacLeod, 2007). Second and third instar larvae can cause cotton yield losses of up to 65% (Ting, 1986). Chickpea crop loss is 20-90% (Tripathi *et al.*, 2023). In South Asia, East Africa and Latin America, it is the only pest that causes the loss of pea crops to 100%, which is about 300 million dollars annually (Thomas *et al.*, 1997).

In recent years, a significant increase in the damage to the leaves and fruits of pepper caused by *H. armigera* (Hübner) and *S. exigua* (Hübner) has been observed in Armenia. Almost all varieties cultivated in the country are damaged. Global climate change, incorrect timing of control measures and wrongly applied preparations have greatly contributed to the rapid development of pests.

The aim of the research is to study the degree of harmfulness of *H. armigera* (Hübner) and *S. exigua* (Hübner) on different varieties of pepper, the nature of the damage they cause.

As a result of the research, we will also record the varieties that are most damaged by *H. armigera* (Hübner) and *S. exigua* (Hübner) and as well as the more resistant ones, which in turn will contribute to the correct organization of further work.

Materials and Methods

Studies on the harmfulness of *H. armigera* (Hübner) and *S. exigua* (Hübner) were carried out in 2021-2023 in the pepper fields of Khoronk community of Armavir marz. Experiments were carried out on the main 7 varieties cultivated in the community, 4 of which are sweet varieties: Hayk, Zmrukht, Milli, Mira and 3 are spicy varieties: Haykakan sabi, Arevaham, Arevaashogh.

Enumerations of damaged plants in the fields were conducted according to the methodology adopted in entomology (Forecast of Occurrence and Accounting of Pests and Diseases of Agricultural Crops, 1958). Data calculations were conducted in the entomology laboratory of Armenian National Agrarian University.

Damage of plants by pests was determined according to the ratio of plants inhabited by pests to the total number of examined plants. The degree of damage by individual pests was determined by checking 300 plants from each variety (fruit, leaf) arranged in a checkerboard pattern. The degree of harmfulness of the plants was evaluated on the following point scale:

1 point - Very weakly damaged plants (up to 5%).
2 points - Slightly damaged plants (from 5 to 25%).
3 points - Moderately damaged plants (from 25 to 50%).
4 points - Heavily damaged plants (from 50 to 75%).
5 points - Very heavily damaged plants (75% or more).

The degree of plant damage was determined using the following formula:

$$V = \frac{\sum abc}{C \times 5} \times 100$$

V = Degree of average damage.
$\sum$ abc = Sum of points.
C = Total number of counted plants.
5 = Highest point (Pikushova and Veretelnik, 2009).

Results and Discussion

During the vegetation period of 2021-2023, the harmfulness of *H. armigera* (Hübner) and *S. exigua* (Hübner) on different varieties of pepper was studied in the pepper fields of Khoronk community. The latter damage plants in the larval stage. They feed on the vegetative and generative organs of the plant.

According to our research, *S. exigua* (Hübner) larvae go through 5 instars or molts during their development.

The first, second and third instar larvae mainly damage the leaves, buds and flowers of plants, while the fourth and fifth instar larvae damage the fruits.

The newly hatched larvae feed on the newly opened leaves, enter them, cover them with a web and start feeding inside. Some of the larvae continue their development in the web, passing through several molts, while others emerge, spread on the plant and start active feeding. Second instar larvae prefer to feed on newly opened young leaves, causing skeletonization of the leaves.Third instar larvae feed on leaves of various ages, both old and young. Scratches of irregular shape and size appear on the damaged leaves (Fig 1).

Third instar larvae molt after feeding, after which some part of them climbs to the upper part of the plant and continues feeding there. Some of the larvae continue to feed on the fruit and some on the leaves. Larvae find a suitable place on the fruits, gnaw the flesh and enter them. They feed on the seeds in the fruit, causing the fruit to rot and become unfit for consumption (Fig 2).

According to our research, *H. armigera* (Hübner) larvae feed on the vegetative and generative organs of the plant. The newly hatched larvae initially feed on flowers and flower buds and after some time they move to the leaves. Young larvae feed on the upper leaf blade and epidermis, leaving the lower leaf intact. However, after some time, the leaf blade dries up and falls off and the leaves take on a porous appearance (Fig 3). In case of strong infection, they can destroy the whole plant.

Mature caterpillars mostly damage the fruit, although there are cases when small caterpillars also damage the fruit, but the newly formed and small fruits. Larvae enter the fruit from anywhere in the fruit, opening deep holes. They feed on the seeds in the fruit, filling the fruit with their excrement (Fig 4). Damaged fruits begin to ripen prematurely, various harmful pathogens penetrate from the damaged areas, as a result of which the fruits rot. Damaged fruits remain on the plant and subsequently fall off at the slightest touch.

During June-August months of 2021-2023, during the period of rapid development of *H. armigera* (Hübner) and *S. exigua* (Hübner), the degree of their harmfulness was studied on 7 varieties of pepper (Table 1, 2). 300 plants of each variety were studied.

From the data in Table 1, we can see that the most damage by *S. exigua* (Hübner) was observed in the Hayk variety in all 3 years and the least in the Arevaham variety.



Fig 1: *S. exigua* (Hübner) larvae damage to pepper leaves.



Fig 2: Fruit damage caused by *S. exigua* (Hübner) larvae.



Fig 3: Damage caused by *H. armigera* (Hübner) larvae to pepper leaves.



Fig 4: The damage caused by *H. armigera* (Hübner) larvae to the pepper fruit.

Table 1: The average damage of different varieties of pepper by *S. exigua* (Hübner) (Khoronk Community, 2021-2023, average data).

Variety	Degree of harmfulness, %					
	2021		2022		2023	
	Leaf	Fruit	Leaf	Fruit	Leaf	Fruit
Hayk	58.2	53.0	60.4	54.3	52.6	47.4
Zmrukht	29.6	21.8	34.7	28.5	24.2	19.8
Milli	42.1	37.4	48.4	41.4	38.0	30.6
Mira	34.4	27.5	38.2	32.6	37.1	31.8
Haykakan sabi	52.7	46.2	56.2	50.8	48.3	44.2
Arevaham	19.8	14.1	24.5	18.5	16.2	11.9
Arevashogh	20.6	18.3	27.4	21.9	22.9	18.4

Table 2: The average damage of different varieties of pepper by *H. armigera* (Hübner) (Khoronk community, 2021-2023, average data).

Variety	Degree of harmfulness, %					
	2021		2022		2023	
	Leaf	Fruit	Leaf	Fruit	Leaf	Fruit
Hayk	54.4	49.5	56.2	52.0	53.4	48.1
Zmrukht	29.2	24.3	32.6	26.6	27.6	21.9
Milli	46.5	40.0	40.1	36.4	40.6	32.3
Mira	38.9	32.8	39.5	35.2	41.3	35.8
Haykakan sabi	49.3	44.7	51.3	45.3	47.1	41.6
Arevaham	17.6	14.7	26.4	15.7	18.6	13.7
Arevashogh	21.4	19.1	27.7	20.8	23.8	17.5

Based on the data in the table, we can see that during the 3 years of the test, the most damaged by *H. armigera* (Hübner) was again observed in the Hayk variety and the least in the Arevaham variety.

Conclusion

H. armigera (Hübner) and *S. exigua* (Hübner) cause serious damage to pepper plants in Armenia. These pests damage plants only in the larval stage. They feed on the vegetative and generative organs of the pepper plant. As a result of their nutrition, irregularly shaped scratches appear on the leaves, sometimes complete skeletonization of the leaf mass of the plant is observed. While feeding on fruits, they gnaw the flesh, open deep holes, enter them and feed on the seeds. As a result of the damage, the fruits rot and become unfit to use.

During the vegetation period of 2021-2023, the degree of damage of *H. armigera* (Hübner) and *S. exigua* (Hübner) on 7 different varieties of pepper was studied in the pepper fields of Khoronk community, during the period of intensive development of pests (June-August). According to the results of the experiments, Hayk variety was the most damaged by pests in all 3 years and Arevaham the least.

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Conflict of interest

The authors declare that there is no competing interest.

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