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Assessing the Economic Injury Level of Pests in Vegetable Crops (Tomatoes, Cabbage)

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Abstract: This article presents the results of research conducted to assess the Economic Injury Level (EIL) of key pests affecting vegetable crops, specifically tomatoes and cabbage. During the study, the damage caused by each pest to the yield was determined, and their Economic Threshold (ET) was established. Furthermore, effective control measures were substantiated through monitoring, pest population counting, and analyzing their impact on yield. Based on the obtained results, recommendations were developed to improve the biological and integrated pest management systems for vegetable crops. This work holds significant importance in increasing economic efficiency in agriculture and ensuring the rational use of chemical agents.

Keywords: Vegetable, potato, trap crop, natural enemy, pest, parasitoid, predator, agrobiocenosis, moths, phytophages, entomofauna.

Introduction: our country, special attention is being paid to the production of organic products free from synthetic chemical compounds. Particular emphasis is placed on creating and applying environmentally friendly, biologically harmless technologies instead of artificial fertilizers that pollute the environment and soil. A glance at the organic agriculture market shows that in 2019, the international market turnover for organic agriculture reached 96.7 billion Euros. Worldwide, 2.8 million producers were engaged in this activity across 71.5 million hectares of land. Experts state that the global organic products market has been growing at an average rate of 15% annually since 2016. By the end of 2022, its turnover had reached 183.35 billion dollars.

It should be specifically noted that our country has abundant fertile land suitable for organic fruit production. However, the mere availability of land is not sufficient for producing organic products. Today, a crucial issue in global practice is the application of technologies for plant protection that are free from harmful chemicals, which could otherwise transfer to the human body through nature and agricultural products. One such technology is the use of "trap

crops" to protect fruit and vegetable products from insect pests in agriculture.For pest control in organic product cultivation, the primary reliance is on landscaping around the cultivated area and applying other biological control methods (Zehnder et al., 2007). In certain regions, planting diverse crops (polyculture) has been found to result in less pest damage compared to monoculture (Andow, 1991; Letourneau et al., 2011). Polycultures can enhance biological control by attracting natural enemies and simultaneously complicate the living environment for pests (Root, 1973).

Geographical Description of Research Sites

Tashkent Province was established on January 15, 1938, and is located in the northeastern part of Uzbekistan. The province borders Kazakhstan's Shymkent Province to the north and northwest, Kyrgyzstan's Osh Province to the northeast, Namangan Province to the east, and Syrdarya Province to the south. Tashkent Province, situated in the northeastern part of Uzbekistan, includes the Western Tian Shan mountains and foothills, as well as the Angren and Chirchik river valleys. The northeastern and eastern parts are occupied by the Chatkal, Kurama, Pskem, and Ugam mountain ranges, while the area sloping down towards the Syrdarya River to the south and southwest consists of piedmont plains.

Samarkand Region was established on January 15, 1938. It borders Navoiy Region to the north and west, Qashqadarya Region to the south, and Jizzakh Region to the southeast. The Qarnobcho'l desert occupies its southwest, while its north adjoins the fringes of the Kyzylkum Desert. The central part of the region is dominated by oases and foothills stretching from east to west between the Zarafshan and Turkestan mountain ranges. A significant portion of the region's irrigated lands is located in this central area.

Andijan Region was established on March 6, 1941. The region borders the Kyrgyz Republic to the northeast and south, Fergana Region to the west, and Namangan Region to the northwest.

The surface of Andijan Region is primarily flat. Its current relief and surface geological formations were created by the activity of large and small rivers and their tributaries during the Quaternary geological period. The western part of the region consists of a hilly plain (elevation 400-500 m), while the eastern part (east of Andijan city) is composed of branches of the Fergana and Alay mountain ranges.

METHODS

The primary methods for applying trap crops in our research were classified based on plant characteristics and their placement in the field. According to plant characteristics, they are categorized as conventional, genetically engineered, and "Dead-end" trap crops. Based on field placement, they are classified into strategies such as complex, perimeter, sequential, and two-tactic ("push-pull") strategies [Shelton, Badenes-Peres, 2006].

To determine the species composition, distribution, and damage of pests in vegetable crops (tomatoes and cabbage), and for sample collection, the methods of G.M. Yaroslavtsev, S.G. Boinskaya, V.F. Paliy, B.P. E.S. Shyiko, G.S. Posypanov, G.Ya. Bey-Bienko, S.M. Volkov, and L.M. Kopaneva were utilized. For studying the bioecological characteristics of subterranean pests of potatoes planted as a second crop after cereals and for compiling phenological tables of insects, the methods of K.K. Fasulati and A.N. Kozhchanov were employed [8; p.238, 9; p.286, 10; p.269, 11; p.189, 12; p.177, 13; p.175, 14; pp.120-300, 15; pp.47-59, 16; p.76, 17; pp.40-42, 18; 19; pp.26-27].

RESULTS

The research was conducted in vegetable-cultivated areas of Tashkent, Samarkand, and Andijan regions. According to our observations carried out in the fields of the Tashkent State Agrarian University's educational-experimental farm in Kibray district, Tashkent region, the Economic Injury Level (EIL) for representatives of the Lepidoptera order, Noctuidae family, specifically the turnip moth (Agrotis segetum Den. et Schiff) and the heart and dart moth (A.exclamationis.L), was determined to be 2-3 individuals per square meter (Table 1).

Table 1

Economic Injury Level of Pests in Vegetable Crops (Tomatoes, Cabbage)

(Tashkent State Agrarian University's Educational-Experimental Farm, Kibray District, Tashkent Region, 2023-2024)

№	Category	Family	Type		IZMM number per, 1 m^2 number per 100 plants, number per leaf,
			Uzbek name	Latin name	
1.	*Leridoptera*	*Noctuidae*	Autumn armyworm	*Agrotis segetum* Den.et Schiff	2-3
2.			Eksclamation mark moth	*A.exclamationis.* L	2-3
3.			Cottan bollworm	*Heliothis armigera* Hb	3-4
4.	*Coleoptera*	*Elateridae*	Turkestan click beetle	*Agrotis meticulosus* Cond	3-4
5.			Moustached click beetle	*Slon cerambycinus* Sem	3-4
6.		*Scarabagidae*	March beetle	*Melonotha afflicta* Ball	3-4
7.			Pest beetle	*Polyphilla adspersa* Motsch	3-4
8.			May beetle	*Melonotha melonotha, M. hypocastani*	3-4
9.	*Orthoptera*	*Gryllotalpidae*	Tailed beetle	*Gryllotalpa gryllotalpa* L.	2-3
10.	*Diptera*	*Agromyzidae*	Stinging flies	*Liriomyza sativae* B.	On one leaf 1,0-2,0
11.	*Leridoptera*	*Plutellidae*	Diamondback moth	*Plutella maculipennis* Curt	3-5
12.		*Pieridae*	Cabbage white butterfly	*Pieris brassicae* L.	5-7

For two species of wireworms from the family Elateridae (order Coleoptera) – the Turkistan wireworm (Agrotis meticulosus Cond) and the longhorn beetle-like wireworm (Slon cerambycinus Sem) – the Economic Injury Level (EIL) was 2-3 individuals per square meter.

Among the Scarabaeidae family (also within the order Coleoptera), the EIL for the March cockchafer (Melolontha afflicta Ball), the harmful cockchafer (Polyphylla adspersa Motsch), and the May beetle (Melolontha melolontha, M. hypocastani) was determined to be 3-4 individuals.

For the mole cricket (Gryllotalpa gryllotalpa L.) from the family Gryllotalpidae (order Orthoptera), the EIL was 2-3 individuals. Furthermore, for one species of leaf-mining fly (Liriomyza sativae B.) observed on tomato crops in the experimental field, the EIL was 1.0-2.0 individuals per leaf.

According to the conducted research, for cabbage crops in the experimental field, the EIL for the diamondback moth (order Lepidoptera) was observed to be 3-5 individuals per leaf, while for the cabbage white butterfly, the EIL was 5-7 individuals.

During our observations in the cultivated fields of "Bozorov Zoxid Zamini" farm in Jambay district, Samarkand region, the EIL for the turnip moth (Agrotis segetum Den. et Schiff) and the heart and dart moth (A. exclamationis L.), both belonging to the order Lepidoptera, was 1.5-2 individuals per square meter.

For two species of wireworms from the family Elateridae (order Coleoptera) – the Turkistan wireworm (Agrotis meticulosus Cond) and the longhorn

beetle-like wireworm (Slon cerambycinus Sem) – the EIL was 2-3 individuals per square meter.

Among the Scarabaeidae family, the EIL for the March cockchafer (Melolontha afflicta Ball), the harmful cockchafer (Polyphylla adspersa Motsch), and the May beetle (Melolontha melolontha, M. hypocastani) was 2-3 individuals.

For representatives of the Orthoptera order, specifically the Gryllotalpidae family, the Economic Injury Level (EIL) for the mole cricket (Gryllotalpa gryllotalpa L.) was 2-3 individuals (Table 2).

Table 2

Economic Injury Level of Pests in Vegetable Crops (Tomatoes, Cabbage)

(Bozorov Zoxid Zamini Farm, Jambay District, Samarkand Region, 2023-2024)

№	Category	Family	Type		IZMM number per, 1 m^2 number per 100 plants, number per leaf,
			Uzbek name	Latin name	
1.	*Leridoptera*	*Noctuidae*	Autumn armyworm	*Agrotis segetum* Den.et Schiff	1,5-2
2.			Eksclamation mark moth	*A.exclamationis.* L	1,5-2
3.			Cottan bollworm	*Heliothis armigera* Hb	3-4
4.	*Coleoptera*	*Elateridae*	Turkestan click beetle	*Agrotis meticulosus* Cond	2-3
5.			Moustached click beetle	*Slon cerambycinus* Sem	2-3
6.		*Scarabagidae*	March beetle	*Melonotha afflicta* Ball	2-3
7.			Pest beetle	*Polyphilla adspersa* Motsch	2-3
8.			May beetle	*Melonotha melonotha, M. hypocastani*	2-3
9.	*Orthoptera*	*Gryllotalpidae*	Tailed beetle	*Gryllotalpa gryllotalpa* L.	2-3
10.	*Diptera*	*Agromyzidae*	Stinging flies	*Liriomyza sativae* B.	On one leaf 1,0-2,0
11.	*Leridoptera*	*Plutellidae*	Diamondback moth	*Plutella maculipennis* Curt	3-5
12.		*Pieridae*	Cabbage white butterfly	*Pieris brassicae* L.	5-7

On the experimental tomato plot, the Economic Injury Level (EIL) for one species of leaf-mining fly (Liriomyza sativae B.) was found to be 1.0-2.0 individuals per leaf. According to the conducted research, on the

experimental cabbage plot, the EIL for the diamondback moth (order Lepidoptera) was 3-5 individuals per leaf, while for the cabbage white butterfly, the EIL was observed to be 5-7 individuals.

During the research at the educational-experimental farm of the Asaka branch of the Cotton Breeding, Seed Production, and Cultivation Agrotechnologies Scientific Research Institute (PSUEAITI), our observations showed that the EIL for the turnip moth (Agrotis segetum Den. et Schiff) and the heart and dart moth (A. exclamationis L.), both belonging to the order Lepidoptera, was 2-3 individuals per square meter. The EIL for the cotton bollworm (Heliothis armigera Hb) was 3-4 individuals.

For two species of wireworms from the family Elateridae (order Coleoptera) – the Turkistan wireworm (Agrotis meticulosus Cond) and the longhorn beetle-like wireworm (Slon cerambycinus Sem) – the EIL was 4-5 individuals per square meter.

Among the Scarabaeidae family, the EIL for the March cockchafer (Melolontha afflicta Ball), the harmful cockchafer (Polyphylla adspersa Motsch), and the May beetle (Melolontha melolontha, M. hypocastani) was 4-5 individuals.

For the mole cricket (Gryllotalpa gryllotalpa L.) from the Gryllotalpidae family (order Orthoptera), the EIL was 4-5 individuals (Table 3).

The research findings indicate that during the vegetation period of vegetable crops (tomatoes, cabbage), the Economic Injury Level (EIL) for pests such as the turnip moth (Agrotis segetum Den. et Schiff) and the heart and dart moth (A. exclamationis L.) was 2-3 individuals per square meter.

For the Turkistan wireworm (Agrotis meticulosus Cond) and the longhorn beetle-like wireworm (Slon cerambycinus Sem), the EIL was observed to be 4-5 individuals per square meter. Similarly, for the March cockchafer (Melolontha afflicta Ball), the harmful cockchafer (Polyphylla adspersa Motsch), and the May beetle (Melolontha melolontha, M. hypocastani), the EIL was also 4-5 individuals.

Table 3

Economic Injury Level of Pests in Vegetable Crops (Tomatoes and Cabbage) (Experimental Field of the Cotton Breeding, Seed Production, and Cultivation Agrotechnologies Scientific Research Institute (PSUEAITI) Andijan Region, Asaka District, Branch, 2023-2024)

№	Category	Family	Type		IZMM number per, 1 m^2 number per 100 plants, number per leaf,
			Uzbek name	Latin name	
1.	*Leridoptera*	*Noctuidae*	Autumn armyworm	*Agrotis segetum* Den.et Schiff	2-3
2.			Eksclamation mark moth	*A.exclamationis.* L	2-3
3.			Cottan bollworm	*Heliothis armigera* Hb	3-4
4.	*Coleoptera*	*Elateridae*	Turkestan click beetle	*Agrotis meticulosus* Cond	4-5
5.			Moustached click beetle	*Slon cerambycinus* Sem	4-5
6.		*Scarabagidae*	March beetle	*Melonotha afflicta* Ball	4-5
7.			Pest beetle	*Polyphilla adspersa* Motsch	4-5

8.			May beetle	*Melonotha melonotha*, *M. hypocastani*	4-5
9.	*Orthoptera*	*Gryllotalpidae*	Tailed beetle	*Gryllotalpa gryllotalpa* L.	4-5
10.	*Diptera*	*Agromyzidae*	Stinging flies	*Liriomyza sativae* B.	On one leaf 1,5-2,0
11.	*Leridoptera*	*Plutellidae*	Diamondback moth	*Plutella maculipennis* Curt	4-5
12.		*Pieridae*	Cabbage white butterfly	*Pieris brassicae* L.	5-6

The Economic Injury Level (EIL) for the mole cricket (Gryllotalpa gryllotalpa L.) was 4-5 individuals. If the number of pests in the vegetable field exceeds this established EIL, it's recommended to implement control measures.

Furthermore, on the experimental tomato plot, the EIL for one species of leaf-mining fly (Liriomyza sativae B.) was found to be 1.5-2.0 individuals per leaf.

According to the conducted research, on the experimental cabbage plot, the leaf damage threshold for the diamondback moth (order Lepidoptera) was 4-5 individuals, while the EIL for the cabbage white butterfly was observed to be 5-6 individuals.

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