Development characteristics of underground pests of root vegetable and potato crops

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Abstract. The present article delves into a comprehensive examination of the species composition of pests prevalent within fields cultivating root vegetables and potatoes. Through systematic scrutiny, the study reveals the presence of pest representatives spanning three distinct classes, six genera, eleven families, and twenty-nine species within a potato field subject to repeated cultivation. Among these discerned species, a detailed analysis is focused on sixteen varieties of subterranean pests originating from four distinct genera. Concurrently, the research encompasses a decade-long assessment of the prevalence of subterranean autumn and exclamatory moths, facilitated by the use of pheromone traps. Over this span, observations indicate that the occurrence of autumn moths reached a count of 4.4 units, with spring moths totaling 1.1 units. Additionally, the study delves into the developmental attributes of root vegetables and potato crops, garnering insights into their growth patterns and characteristics. The culmination of this research brings about tangible and applicable insights. The acquired findings not only contribute to the knowledge regarding the pests affecting these agricultural sectors but also furnish practical recommendations and suggestions for enhancing production practices. The article not only underlines the significance of understanding the intricacies of pest dynamics but also reinforces the need for informed agricultural management practices to mitigate their impact and bolster crop productivity.
Keywords. Root vegetables, potatoes, underground pests, fall moth, exclamation moth.

1 Introduction

Due to the harmful effects of pests and diseases on agricultural crops, 30-40% of crops are lost every year [1]. Despite the timely control of these pests, the development of integrated control measures against them remains relevant today [2]. Today, not only in Europe, but also in the countries of Central Asia, it is urgent to ensure food safety by developing environmentally safe measures to fight against rodent and sucking pests of root vegetables and potatoes [3].

According to the long-term research of scientists, it was found that the population density of underground pests is not uniform in all areas where root vegetables and potatoes are planted, and the population density is relatively high in the areas located far from residential

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areas [4]. In particular, the population density of root-gnawing moths from underground pests also depends on the plant species, and it was observed that the fertility of female breeds doubles in nectar-rich plant species [5]. 51 types of pests belonging to 15 families were recorded in crops belonging to the Solanum family. Of them, 40 types of pests were found to damage tomatoes and eggplants, and 48 types were found to damage potatoes [6].

Fall moth (*Agrotis segetum* Den. et Schiff) and exclamation moth (*A. exlamationis* Den. et Schiff.) 2-5 generations per year, these pests damage potatoes, tomatoes, eggplants and other crops. In some years, the yield of potatoes decreases by 7-12% due to the damage of root-gnawing moths [7].

Heterodera marioni Cornu., *Poeciloscytus cagnatus* Fieb., *Tetranychus urticae* Koch., *Gryllotalpa gryllotalpa* L., *Agriotes meticulosus* Cond., *Clon cerambycinus* Sem., which causes swelling of root vegetables and potato crops in the conditions of Uzbekistan, gnaws and damages the roots and crops of potatoes around ditches and ponds and in wet areas [8].

Taking into account the above, studies were conducted in 2021-2022 in order to systematically analyze the distribution and damage of omnivorous underground pests in the repeatedly planted root vegetable and potato fields in the Samarkand and Tashkent regions of Uzbekistan [9, 10].

The studies were conducted at the "Farangiz Nurli Zamini" farm, Jomboy District, Samarkand Region, Uzbekistan, and the educational experimental farms of Tashkent State Agrarian University, Qibray District, Tashkent Region, Uzbekistan.

2 Materials and methods

For the experimental endeavor, specific fields were designated, focusing on a plot designated for root vegetables and potatoes, following the cultivation of grains. The research commenced by extracting soil samples from the designated area. This extraction involved digging soil samples from layers spanning 5, 10, 15, 20, and 25 centimeters, employing a diagonal (checkerboard) pattern with a grid spacing of 25 x 25 centimeters. Subsequently, the gathered soil samples underwent a meticulous process involving passing them through a fine wire sieve, aimed at refining the extracted material [6].

With the collected data at hand, the average quantity of subterranean pests present within a designated area of 1 square meter was meticulously tallied. This calculation was conducted for both the interior of the field and its peripheral surroundings. Furthermore, the species density was meticulously quantified within the potato field that followed varying previous crops, alongside the field that had undergone winter grain cultivation.

This systematic approach to soil analysis and pest density determination establishes a solid foundation for comprehending the intricate interplay between soil conditions, crop rotation, and the prevalence of underground pests. The methodology ensures a meticulous examination of factors contributing to pest dynamics, ultimately enabling a more nuanced understanding of pest-related challenges faced within the context of root vegetable and potato cultivation.

3 Results and discussion

In the course of research, the species composition of pests distributed in the repeatedly planted potato fields after the experimental grain was systematically analyzed. According to him, representatives of pests belonging to 3 classes, 6 genera, 11 families and 29 species were identified in the repeatedly planted potato field. The majority of species belongs to the family of moths (*Noctuidae*), which comprised 10 species.

Notably, 2 types of pests belonging to the *Gelechiidae* family of representatives of the

Lepidoptera family were identified. In the course of research, 3 species of the orthoptera family belonging to the *Aphididae* family and 2 species from the *Aleyrodidae* family were identified. 4 species of representatives of the Elateridae family of the Coleoptera order were identified in repeatedly planted potato fields. 1 species of members of the *Chrysomelidae* family, 3 species of the *Scarabagidae* family, 1 species of the *Orthoptera* family, 2 species of the *Acariphormes* family, and 4 species of the *Tylenhida* family were identified (Table 1).

Table 1. Incidence of pests in root vegetables and potato fields (Samarkand and Tashkent regions, Uzbekistan in 2021-2022).

#	Name of pests	Incidence
I. Class: *Insecta: Lepidoptera*. Family: *Noctuidae*		
1	*Agrotis segetum* Den.et Schiff	+++
2	*A. obesa.* Bd.	++
3	*A.exclamationis.* L	++
4	*A.ipsilon*. Rtt.	++
5	*Autographa gamma*. L	+
6	*Mamestra suase* Schiff	+
7	*Ochropleura flammarta* Schiff	+
8	*Pusia chrvsitis*. L	+
9	*Agrotis C – nigrum* L	++
10	*Agrotis conspicua* Hb.	++
Lepidoptera*. Family: *Gelechiidae		
11	*Phthorimaea operculella* Zell	++
12	*Tuta absoluta*	++
Homoptera*. Family: *Aphididae		
13	*Aphis craccivora* Koch	++
14	*Aphis gossypii* Glov	++
15	*Myzodes persicae* Sulz	+++
Homoptera*. Family: *Aleyrodidae		
16	*Trialeurodes vaporarioum* West	+++
17	*Bemisia tabaci* Genn.	+
Coleoptera*. Family: *Elateridae		
18	*Agrotis meticulosus* Cond	+++
19	*Clon cerambycinus* Sem	++
20	*Blaps halophila* F.W.	++
21	*Dailognatha nasute* Men	+
Coleoptera*. Family: *Chrysomelidae		
22	*Leptinotarsa decemlineata* Say	+++
Coleoptera*. Family: *Scarabagidae		
23	*Melonotha afflicta* Ball	++
24	*Polyphilla adspersa* Motsch	++
25	*Melonotha melonotha,M. Hypocastani*	++

Orthoptera.* Family: *Gryllotalpidae		
26	*Gryllotalpa gryllotalpa* L.	++
II. Class: *Arachnoidea: Acariphormes*. Family: *Tetranychidae*		
27	*Tetranychus urticae* Koch	++
Acariphormes*. Family: *Eriophyidae		
28	*Aculops Lycopersici* Massee	++
III. Class:. *Nematoda: Tylenhida.* Family: *Meloidogynidae*		
29	*Meloidogyne incognita* Cofoid et White.	+
Incidence rate: +++ - high, ++ - moderate, + - low		

Based on the analysis of underground pests of potatoes, the distribution and damage of underground pests in the researched areas was systematically analyzed. According to it, representatives of 2 classes, 4 genera, 5 families and 16 species of underground pests damaging repeatedly planted potatoes were identified. In terms of species, the dominance belongs to the family of moths (*Noctuidae*), which made up 7 species.

3 species of representatives of the *Scarabagidae* family were identified. According to the results of the conducted research and analysis, 1 species of representatives of the *Gryllotalpidae* family of the semicolloptera family was identified. 1 species of the *Meloidogynidae* family was identified from representatives of the *Nematoda* class (Table 2).

Table 2. Incidence of underground pests in potato fields (Samarkand and Tashkent region in Uzbekistan, 2021-2022).

#	**Name of pests**	**Incidence**
1	*Agrotis segetum* Den.et Schiff	+++
2	*A.exclamationis.* L	+++
3	*Agrotis C - nigrum* L	++
4	*Agrotis conspicua* Hb.	++
5	*A. obesa.* Bd.	++
6	*A.ipsilon* Rtt.	++
7	*Ochopleura flammarta* Schiff	+
8	*Agrotis meticulosus* Cond	+++
9	*Clon cerambycinus* Sem	++
10	*Blaps halophila* F.W.	++
11	*Dailognatha nasute* Men.	+
12	*Melonotha afflicta* Ball	++
13	*Polyphilla adspersa* Motsch	++
14	*Melonotha melonotha* M. *hypocastani*	++
15	*Gryllotalpa gryllotalpa* L.	++
16	*Meloidogyne incognita* Cofoid et White.	+
Incidence rate: +++ - high, ++ - moderate, + - low		

Based on the systematic analysis of the species composition of underground pests of potatoes, the following conclusions were reached. Based on the analysis of potato pests, 29 types of pests of 6 categories were analyzed.

Based on the systematic analysis of underground pests in potato fields, 16 types of underground pests of 4 categories were identified. In the course of our research, in order to study the damage and development phases of the eggs and larvae of subterranean moth butterflies in the potato crop, research was conducted on 1.5 hectares of repeatedly planted and potato crop fields of the farm "Maqsudjon Porloq Zamini", Urgut District, Samarkand Region.

According to him, after sorting the tubers of the "Santa" variety, the potatoes were planted in the experimental field. In a potato field planted on 15 June 2021 and fully matured on 01 July, fall and exclamation moth sex pheromone traps were installed and the flight of pest butterflies was recorded. The results showed that in the newly sprouted potato field, the number of fall moths on the traps was on average 9.0 per trap on July 5, and 0.5 on the 10th day of the counting day.

Therefore, it was observed that the flight dynamics of fall moths decreased in the second half of August. A similar situation was observed in traps with exclamation moth sex pheromones. While the number of exclamation moths was 2.1 on day 1, it was observed that it decreased slightly to 0.1 on day 10 of our observations (Table 3).

Table 3. Landing of fall and exclamation moth butterflies on traps with sex pheromone (Samarkand region Urgut district "Maqsudjon porloq zamini" farm, "Santa variety" potato, planting date June 15 2021-2022).

Pests	Average number of moths caught in 1 trap on control days										Total in 10 days	Average per day
	July 5	July 6	July 7	July 8	July 9	July 10	July 11	July 12	July 13	July 14		
Fall moth	9.0	7.0	6.5	5.2	4.2	4.0	3.5	2.0	1.2	0.5	43.1	4.3
Excl. moth	2.1	2.0	1.6	1.5	1.2	1.0	0.7	0.5	0.3	0.1	11.0	1.1

Observations were continued in order to determine the appearance and prevalence of autumn and exclamation moths in fully germinated seedlings in the potato field. According to him, the average number of fall moths per 1 m2 in the potato field was 0.3 pieces in the first decade of July, 0.5 pieces in the 2nd decade, and 0.8 pieces in the 3rd decade. These indicators are proportionally 0.2 for exclamation moth worms; It was 0.7 and 0.8 units (Table 4).

The average number of fall moth eggs per 1m2 was 0.4 pieces in the first decade of July, 0.7 pieces in the 2nd decade, and 1.2 pieces in the 3rd decade.

Table 4. Amount of fall moth in the potato field (Maqsudjon Porloq Zamini farm, Urgut District, Samarkand Region, Potatoes "Santa variety", planting date June 15 2021-2022).

Pilot fields (1 m^2)	July					
	Decade 1		Decade 2		Decade 3	
	Worm	Egg	Worm	Egg	Worm	Egg
#1	0.4	0.6	0.8	1.0	1.2	1.5
#2	0.2	0.4	0.1	0.6	0.7	1.1
#3	0.1	0.4	0.1	0.4	0.6	1.1

#4	0.5	0.8	0.1	0.5	0.8	1.2
#5	0.2	0.4	0.7	1.1	0.8	1.1
#6	0.3	0.4	0.8	1.2	0.9	1.3
#7	0.2	0.3	0.6	0.9	0.6	0.9
Average	0.3	0.4	0.5	0.7	0.8	1.2

It can be observed that the number of worms of the pest has increased. In order to monitor the development of the number of moths in other areas, researches were conducted in the potato field planted after the grain of the Faradis Thresher farm, Upper Chirchik District, Tashkent Region. Potato seeds were sown on July 16, which coincided with the germination period of potato development (Table 5).

Table 5. Number of fall moths in the potato field (Faradis threshing farm, Upper Chirchik district, Tashkent region, July 16 2021-2022).

Pilot fields (1 m^2)	**August**					
	Decade 1		**Decade 2**		**Decade 3**	
	Worm	**Egg**	**Worm**	**Egg**	**Worm**	**Egg**
#1	0.9	1.2	1.5	2.0	2.5	3.1
#2	1.1	1.4	2.0	2.2	2.1	2.4
#3	0.7	1.0	0.8	1.2	1.5	1.8
#4	0.6	1.0	2.1	2.5	1.4	1.7
#5	1.0	1.3	1.5	1.9	2.8	3.3
#6	0.6	0.9	1.9	2.3	2.9	3.1
#7	0.9	1.1	1.8	2.3	3.2	3.5
Average	0.8	1.3	1.6	2.5	2.3	2.7

According to Table 5, 7 samples per diagonal of the cultivated area were taken in 3 returns. According to the observed samples, the average number of fall moths was 0.8 pieces per 1 m2 in the first ten days of August, 1.6 pieces in the second decade, and 2.3 pieces in the third decade of August. The average number of fall moth eggs per 1m2 was 1.3 eggs in the 1st ten days of July, 2.5 eggs in the 2nd ten days, and 2.7 eggs in the 3rd ten days of July.

4 Conclusions

Based on the findings garnered from the comprehensive research, a significant observation emerges regarding the disparity in the presence of rootworms between two distinct potato planting timeframes. Specifically, the relatively lower number of rootworms detected in the potatoes planted on June 15 as opposed to those planted on July 15 can be attributed to a key factor.

The study discerns that this variation in rootworm population can be attributed to the synchronicity between the germination period of the potato plants and the prevalence of moth butterflies. This simultaneous occurrence led to a consequential increase in the population of pests, notably reflected in the augmented pest density within subsequently planted crops.

This discovery underscores the intricate relationship between the timing of potato cultivation and the presence of pests, particularly moth butterflies. The study illuminates how such ecological nuances can significantly impact pest dynamics and ultimately influence the overall effectiveness of cultivation practices. This nuanced insight has profound implications for optimizing planting schedules and pest management strategies within repeated crop cycles, contributing to enhanced crop yield and quality.

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