

SPREAD AND DEVELOPMENT OF LATE BLIGHT DISEASE IN
POTATOES

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Annotation: Potatoes are considered one of the staple food products in the daily life of the global population, as they are a valuable source of essential carbohydrates, vitamins, proteins, and other nutrients. Potatoes are one of the most important agricultural crops and are rightfully referred to as the “second bread.” China, India, Russia, the USA, Germany, Bangladesh, Poland, France, and the Netherlands are among the leading producers of potatoes. Uzbekistan ranks 23rd on this list. To achieve high yields and ensure domestic supply of locally grown potatoes, the implementation of several effective measures is necessary. This article presents the monitoring results of studies conducted on the spread and development of late blight disease in potato fields in the Samarkand region during 2022–2024.

Keywords: Late blight, vitamin, monitoring, mineral, disease, fungus, Chromista, phylum, Oomycota, Perenomycetidae, Pythiales, Pytiaceae, *Phytophthora*.

Introduction: Scientific research is being conducted at the “International Potato Center (CIP) in Peru,” the Azerbaijan Vegetable Research Institute, VNIIF, and KazNIIKO centers on the evolution, bioecology, epidemiology, and genetics of fungal pathogens affecting potatoes [10]. Evidence of this can be seen in the notable reduction of crop losses caused by fungal diseases of potatoes. In protecting potatoes from diseases, it is crucial to understand the dynamics of disease spread and development in order to apply chemical control measures properly. This is especially important today, as the indiscriminate use of chemical agents can have negative impacts on the environment, humans, livestock, and domestic animals, and must be strictly regulated [5]. The protection of potatoes from diseases is closely linked to their nutritional importance, as potato tubers contain essential substances for the human body such as vitamins, minerals, and organic acids. According to V.F. Lishenko, potatoes contain sufficient amounts of minerals like K, Ca, P, Mg, Na, Mn, Zr, F, and I, as well as vitamins such as thiamine (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), and folacin (B9), making them a vital nutritional source for

human health. In addition, potatoes are classified as a dietary food product due to their low fat content, which is significant since high levels of fats are generally considered harmful to the body. According to British dietitians, maintaining a proper balance of different food groups in the human diet is of great importance. A healthy and balanced diet should ideally consist of the following proportions: potatoes, bread, and other cereal products – at least 33%; vegetables and fruits – 33%; dairy products – 15%; meat, fish, and other protein alternatives – 12%; and products containing fats and sugars – 7% [4], [6]. Given the importance of potatoes in human nutrition, fungal diseases are recognized as a major factor in yield reduction. Most fungi persist in plant residues and soil, and due to nutrient deficiencies, their potential to spread increases significantly [1], [6], [7].

Symptoms of late blight in potatoes first appear during the budding and flowering stages, initially manifesting as irregularly shaped spots on the upper parts of the plant and along the leaf edges. After a short period, water-soaked lesions develop on the leaves, which then gradually turn dark brown or deep brown with a narrow yellow border. In humid weather conditions, the undersides of the leaves are often covered with a soft, thin, whitish-gray mold layer [3], [7].

At present, plant diseases play a significant role in the sharp decline of potato yields. These diseases also cause substantial damage during the storage period of crops. Among the pathogenic microorganisms, *Phytophthora infestans* stands out for its negative impact on productivity during both the vegetation and storage phases. The disease caused by *Phytophthora infestans* is known as **late blight**. The species *Phytophthora infestans* is currently taxonomically classified as follows: **Kingdom** – Chromista, **Phylum** – Oomycota, **Class** – Perenomycetidae, **Order** – Pythiales, **Family** – Pytiaceae, **Genus** – *Phytophthora* [8].

Study Area and Research Methods

During the years 2022–2024, a study was conducted to monitor the spread, development, and disease index of late blight (*Phytophthora infestans*) in potato fields across various districts of the Samarkand region. Monitoring was carried out in the following locations: **Jomboy district**: “Bozorov Zohid Zamini,” “Nush Agro Grand,” “Farangiz Nurli Zamin,” “Kamola,” “Ravshan,” “O‘razali Fayz Dalasi”, **Narpay district**: “Ro‘zimurod Dehqon,” “G‘alaba Qahramon Ota,” “Ravshanbek Dalalari,” “Amirxon Asl Agro,” “Samandar Rahmon,” “Azimjon Tojiev,” “Amirxon Mirbozor Dalalari,” “Narpay Yaxshi Niyat”, **Payariq district**: “Saxovatli Pangat Zamini,” “Musabek Chorva Kompleksi”, **Pastdargom district**:



“Shomurod Bobo”, **Samarkand district**: “Qurbonboy Mitinovich,” “Hakimov Abduhalim”, **Oqdaryo district**: “Ezozbek Asl Dalalari,” “Temurxon Mullaxo‘ja”, **Toyloq district**: The Research Institute of Vegetable, Melon, and Potato Crops, Samarkand Experimental Research Station. As a result of this monitoring, data were collected on the spread of late blight in potato fields, including the disease index and its rate of development.

Research Results

In order to assess the spread and development of late blight disease (*Phytophthora infestans*), 50 potato plants were selected from five different diagonal points in each field (10 plants per point). Symptoms of late blight were recorded on infected leaves and stems, and disease development was evaluated using a 5-point scale.

2022 Results. In 2022, among all monitored locations in Samarkand region, the **highest incidence and severity** of late blight were observed in the **‘Nush Agro Grant’ farm in Jomboy district**, particularly in the **‘Umid’** variety. Out of 50 observed plants, 15 (30.0%) showed symptoms of the disease. Of those: 2 plants were infected up to score 1, 4 plants up to score 2, 5 plants up to score 3, 4 plants up to score 4. Disease development reached **20.5%**, and the disease index was calculated at **6.2%** (Table 4.15). Other varieties in the same district showed lower disease incidence: **‘Rozara’** – 14.0% incidence, 4.0% development, **‘Sante’** – 10.0% incidence, 2.5% development, **‘Gala’** – 18.0% incidence, 5.0% development. The second-highest rate of late blight was recorded in **Pastdargom district**, at the **‘Shomurod Bobo’** farm with the **‘Aqrab’** variety. 14 of 50 plants (28.0%) were affected: 2 plants scored up to 1, 3 up to score 2, 5 up to score 3, 4 up to score 4. The disease index here was **5.5%**. The **lowest incidence and mildest development** were observed at the **‘Ro‘zimurod Dehqon’** farm in **Narpay district**, with the **‘Picasso’** variety: only 4 plants (8.0%) were infected, and disease development was 3.0%. In the same district, the **‘Romano’** variety at **‘G‘alaba Qahramon Ota’** farm showed: 20.0% incidence, 7.0% development, 1.4% disease index. At **‘Ravshanbek Dalalari’** and **‘Amirxon Asl Agro’** farms, late blight incidence ranged between 12.0–14.0%, and development was 4.0–4.5%. In **Payariq district**, the **‘Evolution’** variety at **‘Saxovatli Pangat Zamini’** farm showed 18.0% infection (9 out of 50 plants).

At **‘Musabek Chorva Kompleksi’**, the **‘Gala’** variety had 22.0% incidence. Disease development in both cases was **6.5%**. In **Samarkand district**, at the **‘Qurbonboy Mitinovich’** and **‘Hakimov Abduhalim’** farms growing the **‘Sante’**

variety, late blight incidence ranged between 16.0–18.0%, development between 5.0–5.5%, and disease index ranged from 0.1–0.8%. Infection levels did not exceed score 2. In **Oqdaryo district**, '**Fusarium**' incidence ranged from 14.0–18.0%, with 5.0–7.5% development in '**Ezozbek Asl Dalalari**' and '**Temurxon Mullaxo'ja**' farms. In the '**Picasso**' variety, 9 out of 50 plants were affected (mostly up to score 1 or 2). In the '**Romano**' variety, 7 plants were infected, 4 up to score 1 and 3 up to score 2 (Table 1).

2023 Results. In 2023, widespread and severe late blight infections were again observed in the '**Umid**' variety, especially at '**Nush Agro Grant**' farm in **Jomboy** and '**Hakimov Abduhalim**' farm in **Samarkand district**. '**Nush Agro Grant**': 15 out of 50 plants (30.0%) infected, 11.0% disease development, **3.3% disease index**. '**Hakimov Abduhalim**': 16 out of 50 plants (32.0%) infected, 11.5% development, **3.7% disease index** (Table 2). In **Narpay district**, the '**Aqrab**' variety again showed significant infection: 13 out of 50 plants (26.0%) infected. 2 plants up to score 1, 3 up to score 2, 4 up to score 3, and 4 up to score 4. **Disease index: 4.7%**. At '**Ro'zimurod Dehqon**', the '**Picasso**' variety had: 12.0% incidence, 4.0% development, 0.5% disease index (max score 2). The '**Romano**' variety at '**G'alaba Qahramon Ota**' farm showed: 18.0% incidence, 5.5% development. At '**Ravshanbek Dalalari**', the '**Evolution**' variety showed: 8.0% incidence, 2.0% development, 0.2% disease index. In **Payariq district**, at both '**Saxovatli Pangat Zamini**' (var. '**Evolution**') and '**Musabek Chorva Kompleksi**' (var. '**Gala**'), moderate disease incidence was observed (12.0–20.0%) with development between 3.5–5.5%. At '**Qurbonboy Mitinovich**' in **Samarkand district**, the '**Sante**' variety showed no symptoms of late blight. At '**Shomurod Bobo**' in **Pastdargom**, only 2 of 50 plants (4.0%) of the '**Sante**' variety were affected, each with up to score 1 or 2. In **Oqdaryo**, at '**Ezozbek Asl Dalalari**', the '**Picasso**' variety had: 16.0% incidence, 4.0% development, 0.6% disease index. At '**Temurxon Mo'llaxo'ja**', the '**Romano**' variety showed: 8.0% incidence, 2.0% development.

In 2024, the **highest incidence** of *Phytophthora infestans* (late blight) on potato fields (32.0%) was recorded in the '**Umid**' variety cultivated at the farms of '**Qurbonboy Mitinovich**' in **Samarkand district** and '**Temurxon Mo'llaxo'ja**' in **Oqdaryo district**. In both farms, 16 out of 50 observed plants (32.0%) showed symptoms of late blight (see Table 3). The **most severe disease development** was observed in the '**Aqrab**' variety at '**Saxovatli Pangat Zamini**' farm in **Payariq district** – 20.0%, and the '**Evolution**' variety at '**Shomurod Bobo**' farm in **Pastdarg'om district** – 15.5%. In '**Saxovatli**

Pangat Zamini, among the 15 infected plants: 3 were affected up to score 1, 3 up to score 2, 5 up to score 3, 4 up to score 4. In **'Shomurod Bobo'**, out of 15 infected plants: 6 scored up to 1, 4 up to 2, 3 up to 3, 2 up to 4. In **'Qurbonboy Mitinovich'**, the **'Umid'** variety had: **32.0% incidence, 12.0% development**. However, in the same district, the **'Hakimov Abduhalim'** farm growing the **'Sante'** variety showed **no signs of late blight**. In **Jomboy district**, late blight incidence ranged between **6.0–22.0%**, and disease development ranged from **1.5–9.0%**. Specifically: **'Gala'** – 12.0% incidence, 3.5% development, **'Sante'** – 6.0% and 18.0% incidence, 1.5% and 5.5% development, **'Aqrab'** – 18.0% incidence, 6.5% development, **'Evolution'** – 22.0% incidence, 9.0% development. In **Narpay district**, late blight incidence ranged from **4.0–20.0%**, and disease development between **1.0–6.5%**: **'Picasso'** – 16.0% incidence, 6.0% development, **'Romano'** – 18.0% incidence, 6.5% development, **'Sante'** – 20.0% incidence, 6.5% development, **'Rozara'** – 4.0% incidence, 1.0% development. In **Payariq**, at **'Saxovatli Pangat Zamini'**, the **'Aqrab'** variety showed: 30.0% of plants (15 out of 50) infected, scoring: 3 up to 1, 3 up to 2, 5 up to 3, 4 up to 4, **disease index: 6.0%**. At **'Musabek Chorva Kompleksi'**, the **'Gala'** variety showed: **24.0% incidence, 8.0% development, and disease index: 1.9%**. In **Oqdaryo district**, the **'Picasso'** variety at **'Ezozbek Asl Dalalari'** showed high **Fusarium** infection: **28.0% incidence, 14.5% development**. Among the 14 infected plants 6 scored up to 1, 3 up to 2, 3 up to 3, 2 up to 4. The **disease index was 4.1%**. In the same district, the **'Umid'** variety showed: **32.0% incidence, 14.5% development, disease index: 4.6%**.

1-table

The spread and development of late blight disease in potato fields of some districts of Samarkand region in 2022

№	Districts	Farm name	Variety of potato	Total number of studied plants, units	Number of plants by degree of infection (individual stems, stalks, and leaves), units					Kt, %	Kr, %	Ki, %
					Infection rating							
					0	1	2	3	4			
1	Jomboy	“Bozorov Zoxid zamini” f/x	Rozara	50	43	6	1	0	0	14,0	4,0	0,6
		“Nush agro grant” f/x	Umid	50	35	2	4	5	4	30,0	20,5	6,2
		“Farangiz nurli zamin” f/x	Aqrab	50	40	5	5	0	0	20,0	7,5	1,5
		“Kamola” f/x	Sante	50	45	5	0	0	0	10,0	2,5	0,3
		“Ravshan” f/x	Gala	50	41	8	1	0	0	18,0	5,0	0,9
2	Narpay	“Ro‘zimurod dexqon” f/x	Pikasso	50	46	2	2	0	0	8,0	3,0	0,2
		“G‘alaba Qaxramon ota” f/x	Ramano	50	40	7	2	1	0	20,0	7,0	1,4
		“Ravshanbek dalalari” f/x	Evolyush n	50	43	6	1	0	0	14,0	4,0	0,6

		"Amirxon asl agro" f/x	Rozara	50	44	3	3	0	0	12,0	4,5	0,5
3	Payariq	"Saxovatli pangat zamini" f/x	Evolyushn	50	41	6	2	1	0	18,0	6,5	1,2
		"Musabek chorva kompleksi" f/x	Gala	50	39	9	2	0	0	22,0	6,5	1,4
	Samarqand	"Qurbonboy Mitinovich" f/x	Sante	50	41	7	2	0	0	18,0	5,5	1,0
		"Hakimov Aduhalim" f/x	Sante	50	42	6	2	0	0	16,0	5,0	0,8
4	Pasdarg'om	"Shomurod bobo" f/x	Aqrab	50	36	2	3	5	4	28,0	19,5	5,5
5	Oqdaryo	"Ezozbek Asl dalalari" f/x	Pikasso	50	41	5	2	2	0	18,0	7,5	1,4
		"Temurxon Mo'llaxo'ja" f/x	Ramano	50	43	4	3	0	0	14,0	5,0	0,7

Note: Kt, % – disease incidence; Kr, % – disease severity; Ki, % – disease index.

2-table

The spread and development of late blight disease in potato fields of some districts of Samarkand region in 2023

№	Districts	Farm name	Variety of potato	Total number of studied plants, units	Number of plants by degree of infection (individual stems, stalks, and leaves), units					Kt, %	Kr, %	Ki, %
					Infection rating							
					0	1	2	3	4			
1	Jomboy	“Bozorov Zoxid zamini” f/x	Gala	50	42	6	2	0	0	16,0	5,0	0,8
		“Nush agro grant” f/x	Umid	50	35	10	3	2	0	30,0	11,0	3,3
		“Farangiz nurli zamin” f/x	Rozara	50	41	6	3	0	0	18,0	6,0	1,1
		“Kamola” f/x	Sante	50	43	7	0	0	0	14,0	3,5	0,5
		“Ravshan” f/x	Gala	50	44	5	1	0	0	12,0	3,5	0,4
2	Narpay	“Ro‘zimurod dexqon” f/x	Pikasso	50	44	4	2	0	0	12,0	4,0	0,5
		“G‘alaba Qaxramon ota” f/x	Ramano	50	41	7	2	0	0	18,0	5,5	1,0
		“Ravshanbek dalalari” f/x	Evolyushn	50	46	4	0	0	0	8,0	2,0	0,2
		“Amirxon asl agro” f/x	Aqrab	50	37	2	3	4	4	26,0	18,0	4,7
3	Payariq	“Saxovatli pangat zamini” f/x	Evolyushn	50	44	5	1	0	0	12,0	3,5	0,4
		“Musabek chorva kompleksi” f/x	Gala	50	40	9	1	0	0	20,0	5,5	1,1
	Samarqand	“Qurbonboy Mitinovich” f/x	Sante	50	50	0	0	0	0	0,0	0,0	0,0
		“Hakimov Aduhalim” f/x	Umid	50	34	11	3	2	0	32,0	11,5	3,7
4	Pasdarg‘om	“Shomurod bobo” f/x	Sante	50	48	1	1	0	0	4,0	1,5	0,1
5	Oqdaryo	“Ezozbek Asl dalalari” f/x	Pikasso	50	42	8	0	0	0	16,0	4,0	0,6
		“Temurxon Mo‘llaxo‘ja” f/x	Ramano	50	46	4	0	0	0	8,0	2,0	0,2

Note: Kt, % – disease incidence; Kr, % – disease severity; Ki, % – disease index.

3-table Spread and Development of Late Blight Disease in Potato Fields in Certain Districts of Samarkand Region in 2024.

№	Districts	Farm name	Variety of potato	Total number of studied plants, units	Number of plants by degree of infection (individual stems, stalks, and leaves), units					Kt, %	Kr, %	Ki, %
					Infection rating							
					0	1	2	3	4			
1	Jomboy	“Bozorov Zoxid zamini” f/x	Gala	50	44	5	1	0	0	12,0	3,5	0,4
		“Nush agro grant” f/x	Sante	50	47	3	0	0	0	6,0	1,5	0,1
		“Farangiz nurli zamin” f/x	Aqrab	50	41	5	4	0	0	18,0	6,5	1,2
		“Kamola” f/x	Sante	50	41	7	2	0	0	18,0	5,5	1,0
		“Ravshan” f/x	Evolyushn	50	39	6	3	2	0	22,0	9,0	2,0
2	Narpay	“Ro‘zimurod dexqon” f/x	Pikasso	50	42	4	4	0	0	16,0	6,0	1,0
		“G‘alaba Qaxramon ota” f/x	Ramano	50	41	6	2	1	0	18,0	6,5	1,2
		“Ravshanbek dalalari” f/x	Sante	50	40	7	3	0	0	20,0	6,5	1,3
		“Amirxon asl agro” f/x	Rozara	50	48	2	0	0	0	4,0	1,0	0,0
3	Payariq	“Saxovatli pangat zamini” f/x	Aqrab	50	35	3	3	5	4	30,0	20,0	6,0
		“Musabek chorva kompleksi” f/x	Gala	50	38	9	2	1	0	24,0	8,0	1,9
	Samarqand	“Qurbonboy Mitinovich” f/x	Umid	50	34	10	4	2	0	32,0	12,0	3,8
		“Hakimov Aduhalim” f/x	Sante	50	50	0	0	0	0	0,0	0,0	0,0
4	Pasdarg‘om	“Shomurod bobo” f/x	Evolyushn	50	35	6	4	3	2	30,0	15,5	4,7
5	Oqdaryo	“Ezozbek Asl dalalari” f/x	Pikasso	50	36	6	3	3	2	28,0	14,5	4,1
		“Temurxon Mo‘llaxo‘ja” f/x	Umid	50	34	9	3	2	2	32,0	14,5	4,6

Note: Kt, % – disease incidence; Kr, % – disease severity; Ki, % – disease index.

Conclusion. In 2022, the incidence of late blight (*Phytophthora infestans*) in potato fields across Samarkand region ranged from **8.0% to 30.0%**, with disease development levels ranging from **3.0% to 20.5%**. The **highest incidence (30.0%)** and **most severe development (20.5%)** were observed in the **'Umid' variety** cultivated at the **'Nush Agro Grant' farm** in **Jomboy district**. The **lowest incidence (8.0%)** and **mildest development (3.0%)** were recorded in the **'Picasso' variety** grown at the **'Ro'zimurod Dehqon' farm** in **Narpay district**. In 2023, late blight incidence across potato fields in Samarkand region ranged from **0.0% to 32.0%**, and disease development from **0.0% to 18.0%**. The **highest incidence (32.0%)** was recorded in the **'Umid' variety** at the **'Hakimov Abduhalim' farm** in **Samarkand district**, while the **most severe development (18.0%)** occurred in the **'Aqrab' variety** at the **'Amirxon Asl Agro' farm** in **Narpay district**. The **lowest incidence (0.0–4.0%)** and **mildest**

development (0.0–1.5%) were observed in the **‘Sante’** variety. In 2024, the incidence of late blight in Samarkand region ranged from **0.0% to 32.0%**, and disease development ranged from **0.0% to 20.0%**. The **highest incidence (32.0%)** was found in the **‘Umid’** variety at the **‘Qurbonboy Mitinovich’** farm in **Samarkand district**, while the **highest disease development (20.0%)** was recorded in the **‘Aqrab’** variety at the **‘Saxovatli Pangat Zamini’** farm in **Payariq district**. The **lowest incidence (0.0–4.0%)** and **mildest development (0.0–1.0%)** were again observed in the **‘Sante’** and **‘Rozara’** varieties.

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