IRSTI 68.37.07 **DOI** https://doi.org/10.37884/2-2024/23

*G.N. Kairova[1] *, E.S. Ismagulova[1], S.N. Oleichenko[1], G.A. Suleimanova[1], H. Basim[2], M. Zh. Sarshayeva[3]*

[1] «Kazakh National Agrarian Research University», Almaty, Republic of Kazakhstan, gulshariya.kairova@kaznaru.edu.kz, elya_ismagulova@mail.ru, oleichenko@mail.ru, gulnur.suleimanova@kaznaru.edu.kz
[2]«Akdeniz University», Antalya, Turkey, hbasim@akdeniz.edu.tr
[3]LLP «Kazakh Research Institute for Fruit and Vegetable Growing» Almaty, Republic of Kazakhstan, moka-1993@mail.ru

RESISTANCE OF WALNUT VARIETIES TO WALNUT BLIGHT CAUSED BY *PANTOEA AGGLOMERANS* IN THE SOUTHERN HORTICULTURAL ZONE OF KAZAKHSTAN

Abstract

Walnut blight is a harmful disease that affects nut crops. It is caused by the bacterium *Pantoea agglomerans* and has become widespread in recent years, posing a serious threat to walnut plantations. The disease not only destroys more than half of the crop, but also causes bark cracking and slow crown desiccation, which can lead to further infections. One of the most important requirements for modern varieties of agricultural plants, including nut crops, is an increased level of resistance to diseases.

In Kazakhstan, there is currently no data on the spread of diseases of nut crops and resistance of varieties to harmful diseases. This makes it difficult to recommend a suitable variety for industrial and private nut orchards. Ipmroving the breeding process and increasing the productivity of walnut plantations, it is extremely relevant to assess the resistance of varieties to the most dangerous pathogens.

For the first time in Kazakhstan, a two-year monitoring study was conducted to assess the resistance of promising walnut varieties and forms to the *Pantoea agglomerans*, taking into account the prevailing weather and climatic conditions. The study was carried out on 23 varieties and forms in the main fruit-growing regions of the country.

It was found that the walnut blight caused by the bacterium *Pantoea agglomerans* annually damages walnut plants, and the degree of disease damage depends on the prevailing weather and climatic conditions.

The research results revealed that the Moldavian variety - Kazaku showed high resistance to walnut blight. Other resistant varieties are Miroslava, Ovidiu, Germisara, Yarivski, Peshanski, Kogylnichanu, 185, Lipin 2, Liaohe, Fernor, Plin, and Kishinevski. These varieties showed minimal damage, not exceeding 2 points, during the years of observation.

These varieties are recommended as suitable varieties for increasing the productivity of industrial and private nut orchards and improving the breeding process.

Key words: *walnut, variety, walnut blight, Pantoea agglomerans, resistance of varieties, disease development, disease prevalence.*

Introduction

Walnut, also known as *Juglans regia*, is a fruit tree that has been widely cultivated since ancient times due to its high nutritional and flavor properties [1]. In recent years, it has gained popularity in the Republic of Kazakhstan due to its increasing demand in both domestic and foreign markets.

As a result, there has been a growing interest among farmers and private agricultural producers in cultivating walnuts. This has led to research on the introduction, adaptation, and obtaining of quality planting material of walnut in Kazakhstan. Disease-resistant varieties are preferred over other

varieties due to their effectiveness in controlling nut crop diseases and ensuring environmental protection.

The Republic of Kazakhstan's natural and climatic conditions are favorable for the cultivation of almost all nut crops. However, introduced varieties may be susceptible or severely affected when introduced to new countries. Therefore, it is important to ensure that introduced varieties have high fruit quality and are fully resistant to the most harmful diseases **[2, 3].**

Currently, only the Thin-shell walnut variety is released in Kazakhstan's Turkestan region. This variety has no registered originator.

In the Nonchernozem region of the middle zone of Russia, walnut blights have been causing significant harm, with over 50% of fruits affected, leading to premature shattering [4]. Studies have identified the bacterium *Pantoea agglomerans* as a major cause of bacterial diseases in many plants including maize, banana, mango, and walnut [5, 6, 7].

Pantoea agglomerans is a significant cause of phytophthorosis of walnut, affecting the yield and quality of walnuts [8]. In Shandong Province, China, pathogens like *Alternaria* spp., *X. arboricola* pv. *juglandis*, and *Pantoea agglomerans* were isolated from unripe walnut fruits with incidences of 76%, 35%, and 45%, respectively, in walnut orchards [9].

In recent years, the Almaty region has also observed damage to walnut by walnut blight caused by the bacterium *Pantoea agglomerans*. Phytopathogen *Pantoea agglomerans* belongs to *Bacteria, Proteobacteria, Gammaproteobacteria, Enterobacterales, Erwiniaceae*.

We carried out an immunological evaluation of different walnut varieties to assess their resistance to walnut blight caused by the bacterium *Pantoea agglomerans* in farms located in Almaty region such as LLP "Integration - Turgen" and State Enterprise "Issyk State Dendrological Park," and in Turkestan region - in LLP "Saryagash zher syyy".

The objective of this research is to select the most resistant walnut varieties *to Pantoea agglomerans*-induced walnut blight based on field immunological evaluations done in the southern fruit-growing zone of Kazakhstan.

Methods and materials

In 2022-2023, a monitoring of the phytosanitary condition of walnut plantations was conducted through route surveys in various phases of plant development. The farms that were surveyed included LLP "Integration - Turgen" and State Enterprise "Issyk State Dendrological Park" in Almaty region, as well as LLP "Saryagash zher syyy" in Turkestan region. The assessment of plant disease infestation was conducted using the widely accepted five-point phytopathological scale, with prevalence (P) and development index (R) being calculated [10]. During the period of maximum disease development, the counting of walnut varieties lesions was conducted using the method developed by the All-Russian Research Institute of Fruit Crops Breeding in 1999 [11].

In the study, all varieties of walnut were categorized into four groups based on their resistance to walnut blight, depending on the lesion score. The four groups are as follows:

1. Immune or highly resistant varieties (0-1 point)
2. Sustainable (1.1-2 points)
3. Medium resistant (2.1-3 points)
4. Highly damaged (3.1-5 points)

A total of 23 varieties and forms of walnut were included in this study, and you can find them in Table 1.

Table 1 - Characteristics of introduced varieties and forms of walnuts

№	Name of walnut varieties	Description	Source

1	Kogylnichanu	The tree is medium grown. Type of fruiting - mixed. Flowering type - protogenic. Flowering of female flowers, prolonged, a good result is given using two pollinators: Moldavian lateral + Kazaku. Trifanov lateral + Yarivski. Characterized by consistently high-quality kernel, excellent flavor.	https://www.gospodarulrediu.com/?go=page&p=238&new_language=2
2	Peshanski	The tree is medium grown. The type of fruiting is mixed. The type of flowering is protogenic. Female flowers blossom first, flowering time is average. Flowering of female flowers is prolonged. A good result is given using two pollinators: Moldavian lateral + Kazaku. Trifanov lateral + Yarivski, Kernel quality is consistently excellent.	https://www.gospodarulrediu.com/?go=page&p=246&new_language=2
3	Yarivski	The variety was isolated by selection in Chernovitski Experimental Station, Ukraine and registered in 1995. The tree is weakly grown. Author Zatokova F.T. Type of fruiting - lateral. Type of flowering - protoandric. Recommended pollinators Codrene, Kogylnichanu, Chernovitski. Relatively resistant to the main nut diseases. Resistant to winter temperature drops.	https://www.gospodarulrediu.com/?go=page&p=241&new_language=2
4	Chernovitski	The variety was isolated by selection in Chernovitski Experimental Station, Ukraine and registered in 1997. The tree is medium-tall. Author Zatokova F.T. Recommended pollinators: Peschanski, Redinski full, Falesti lateral, Miroslava. Resistant to winter temperature drops.	https://www.gospodarulrediu.com/?go=page&p=233&new_language=2
5	Miroslava	The variety was bred at the research station Miroslava, Iasi, Romania. The type of fruiting is upward. The type of flowering is protogenitic. The first to bloom female flowers. Flowering dates are medium-early. Pollinators: Moldavian lateral, Trifanov lateral, Ovata.	https://www.gospodarulrediu.com/?go=page&p=245&new_language=2
6	Kazaku	The tree is strong growing, with a highly rounded, dense crown. Fruiting type, terminal, fruits are formed on the tops of annual growth. Type of flowering - protogenic. Pollinators: Moldavian lateral, Trifanov lateral. The variety is characterized by resistance to low temperatures, diseases, and drought.	https://www.gospodarulrediu.com/?go=page&p=232&new_language=2
7	Lateral lui Trifan	The tree is strong growing. The type of fruiting is mixed. The type of flowering is proto-andric. Male flowers bloom first. Female flowers bloom afterwards, which descrease the risk of spring frosts and ensures regular, abundant fruiting. Pollinators: Chernovitski, VT-10, Pollinator late warehouse.	https://www.gospodarulrediu.com/?go=page&p=244&new_language=2
8	Brichanski	The variety was bred in Moldova. It enjoys well-deserved popularity due to its large fruits, high yield, drought, and frost resistance. Advantages of the variety: the fruits are large, excellent commercial appearance, with good taste. Pollinators: Chisinau, Schinossi, Kogylnichanu, Peshanski.	https://biosad.com.ua/ua/p908563175-gretskij-oreh-brichanskij.html
9	Codrene	The tree is strongly statured. Fruiting type is mixed, combination of lateral and apical buds 30-70%. The variety is self-fruiting. Flowering time of female	https://www.gospodarulrediu.com/?g

		flowers is late. It is characterized by high winter hardiness and frost resistance, which, along with the late flowering time, makes it acceptable for cultivation in the most extreme climatic conditions.	o=page&p=235&new_language=2
10	Kishinevski	This walnut variety was bred in Moldavia. It enjoys well-deserved popularity due to its high yield, drought, and frost resistance. Advantages of the variety: high yield, unpretentiousness, self-pollination.	https://biosad.com.ua/ua/p908584721-gretskij-oreh-kishinevskij.html
11	Xin Xin 2	Dwarf elite soon-to-ripen Chinese variety. Nut diameter: 38-42 mm, nut weight 13-15 g. The share of the kernel is 55-60%. Shell thickness is 1.8-2.3 mm. Mass fraction of fat in the nut - 66,55%. The time of fruit ripening is August.	https://www.researchgate.net/publication/350459132_Katalog_sazencev
12	Milotai 10	Flowering time is medium-late (second decade of May). High-yielding variety with laterality of 70%, which gives stable yields of about 4 tons/ha. The variety is frost-resistant, tolerates temperatures up to 25 ^{0}C. Valued by breeders, as it has a high grafting rate after grafting.	https://www.researchgate.net/publication/350459132_Katalog_sazencev
13	Liaohe	Chinese low-growing variety that does not need large areas. Fruits average weight of 20 g, kernel yield is high, not less than 50%. The shell is quite thin.	https://www.researchgate.net/publication/350459132_Katalog_sazencev
14	Ovidiu	Origin: Romania, Iasi SCDP. Early variety. Fruits abundantly and continuously. Relatively late type of flowering.	https://agrocorp.ub.ua/ru/goods/view/10721542/all/sajency-oreha-sorta-ovidiu/
15	Fernor	French variety. A hybrid of Franket and Lara pollination. Combines late flowering and lateral fruiting. According to the character of flowering belongs to the group of proto-andric varieties. Pollinators Melanese, Ron de Montignac, Ivarto. Winters with frosts of -20 and below are considered critical for normal growth and fruiting of Fernor.	https://www.gospodarulrediu.com/?go=page&p=239&new_language=2
16	Lara	The Lara walnut variety was bred in France. It originates from a selection of seedlings harvested from American variety Payne walnuts that were seeded. This choice was made in the Lalanne French Nursery. Lara is a compact-growing, high-yielding type that fructifies on both the sides, or the lateral buds, as well as the terminal buds. Lara is a plant that works well in tiny gardens because of its compact growth.	https://www.walnuts-bulgaria.com/english/grafted-trees/lara/
17	185	China's most well-known variety of walnut. The walnut tree is planted in Xinjiang, China's region with the greatest sunshine hours and a most natural ecosystem. The primary location for 185 walnuts' production is Akesu City.	https://ru.youandmewalnut.com/products/185-walnut-in-shell.html
18	Plin	The tree is strong growing. The shape of the crown is broadly pyramidal. The type of fruiting is mixed. Yield is stably high. Fruit ripening is late. The type of	https://agrovektor.com/physical_product/1047729-

		flowering is protoandric. Flowering of female flowers is later.	sazhency-oreha-greckogo-plin.html
19	Jinlong	Selected from walnuts in Fenyang, Shanxi Province. High-yielding, strong-growing, late fruiting. Flowering is late. The share of lateral fruiting is 14%. Medium-sized fruit, shell is below average hardness. Oil content in the kernel is 65%.	136(6):422-428. 2011
20	Lipin 2	Considering the Liaoning variety as an example, the Liaoning Economic Forestry Research Institute started breeding walnuts in the 1970s, and since, has selectively bred a wide range of other superior walnut varieties including the Lipin Series (Lipin 1, Lipin 2). Late-ripening variety with high-quality, medium-sized fruits. Early vegetation and flowering, kernel oil content 70%.	https://www.ijabe.org
21	Velnica	Moldovan variety. Tree: semiviguros. Fruit size is large (13.5 g). Early variety bears fruit constantly and abundantly in VI-VII year after planting. Flowering type is medium. Resistant to bacteriosis, anthracnose.	https://agrovektor.com/physical_product/473539-greckiy-oreh-velnica.html
22	Germisara	In the ecological conditions of Romania, the local variety "Germisara" proved to be productive, resistant to diseases and had high granularity, high quality of nuts and kernels.	https://www.actahort.org/books/442/442_40.htm
23	CITH - W2	A promising variety from ICAR, Institute of Temperate Horticulture, Srinagar, Kashmir Province, India. High-yielding, large-fruited with paper-shell, low-growing and fast-fruiting.	Indiagardening.com

Results and discussion

The areas of walnut plantation surveys in the Turkestan and Almaty regions are suitable for growing walnuts with artificial irrigation. However, fruit crops, especially walnuts, are affected by the frequent return of spring frosts in April and early May, which has become more common in recent years. There are climatic data collection meteorological stations located in the towns of Turgen and Esik, covering the gardens of the Almaty region, and in the town of Saryagash, covering the gardens of the Turkestan region (https://www.kazhydromet.kz/en/meteo_db) [12]. The climate conditions in the Turkestan region are characterized by a pronounced continental climate, aridity, hot dry summers, and mild winters. Table 2 presents the meteorological observation data for the studied regions of the republic for the years 2022 to 2023.

Table 2 - Meteorological indicators for April-September 2022-2023 in Almaty and Turkestan regions according to Meteopost data.

Months	Average daily temperature (^{0}C)	Total precipitation (mm)	Air humidity, %	Average daily temperature (^{0}C)	Total precipitation (mm)	Air humidity, %
	2022			2023		
Almaty region, Turgen						
April	9,6	40	56,5	14,1	69	52,8
May	14,5	100	52,1	16,5	42	68,5

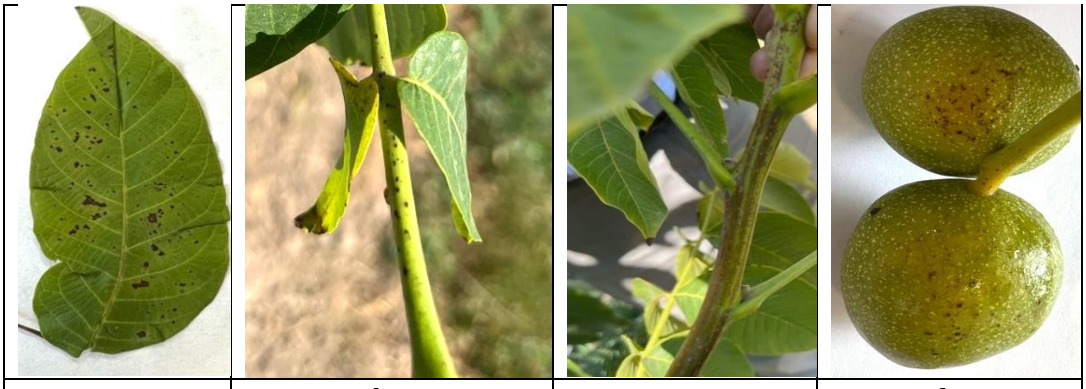
June	22,8	39	44,7	21,2	15,1	51,1
July	25,7	12	40,5	23,3	13,6	40,2
August	22,5	15	46,6	19,5	45,3	43,8
September	15,8	3	58,3	17,8	49,6	39
Almaty region, Esik						
April	15,2	42	51,5	10,3	70,8	59,5
May	17,5	134,5	61,7	15,5	40,2	45,7
June	22,3	42	47,4	22,7	12,3	39,1
July	24,4	14,6	37,5	25,2	18,7	39,4
August	20,7	17	41,3	23,0	48,1	41
September	19,3	3,9	37,0	15,8	54,8	59
Turkestan region, Saryagash						
April	18,2	61,2	60,2	15,0	43	56,4
May	20,0	147	60,0	20,3	69,9	41,8
June	25,9	41	42,0	27,2	5,9	25,8
July	28,7	3	27,0	29,8	12,5	26,6
August	25,1	5,8	27,9	25,3	4	34,1
September	22,8	0	29,5	19,1	0	46,1

The weather conditions in 2022 differed significantly from the average annual figures for 2023. During the first half of spring 2023, the weather was cool, with frosts as low as -5°C in early April in the Almaty region. However, warm weather prevailed during the second half of spring. In contrast, in April 2022, Esik and Saryagash experienced a slight temperature increase of +4°C on average compared to 2023. Moreover, humidity in these regions increased by at least 14% in late spring and early summer 2022, while precipitation increased threefold or more.

The summers of 2023 were dry and hot, with the average daily air temperature of the summer months being 2-3°C higher than the multiyear values. This had an adverse effect on vegetation and tree productivity, and contributed to the suspension of disease development. However, in 2023, the disease developed weaker compared to 2022 because of the cool, prolonged spring and the dry, hot summer, which unfavorably affected the development of infection.

During the visual inspection of trees, it was observed that the initial signs of walnut blight caused by the bacterium *Pantoea agglomerans* start from inflorescences and gradually spread to shoots and branches. The affected shoots turn brown, and the leaves develop necrotic spots in different shapes.

The symptoms characteristic of walnut blight caused by *Pantoea agglomerans* include small dark spots on leaves, young shoots, inflorescences, and fruits. Figure 1 swows images of necrotic spots, 1-2 mm in diameter, scattered around the periphery of the leaf (Figure 1a). Necrotic spots can also be found on young shoots (Figure 1b, c) and fruits (Figure 1d).



a b c d

Figure 1 - Symptoms of walnut affected by walnut blight disease in the farms of Turkestan region and Almaty region

The prevalence, degree of development, and resistance of different introduced walnut varieties to disease on the studied farms are presented in Table 3.

Table 3 - Infestation of introduced varieties and forms of walnut by walnut blight (*Pantoea agglomerans*), 2022 - 2023.

Sort	Prevalence of the disease (P, %)		Development of disease (R, %)		Defeat points		Average lesion score
	2022	2023	2022	2023	2022	2023	
Chernovitski	48,75	29,75	20,47	9,3	3	2	2,5
Miroslava	30,0	18,25	6,8	3,65	2	1	1,5
Ovidiu	32,0	19,0	9,9	4,2	2	1	1,5
Velnitsa	50,5	30,25	20,3	9,15	3	2	2,5
Germisara	33,25	18,75	6,6	3,75	2	1	1,5
Yarivski	25,25	28,0	8,6	9,45	2	2	2
Peshanski	33,25	28,5	9,8	9,7	2	2	2
Kogylnichanu	26,75	32,0	8,5	9,9	2	2	2
Xin xin 2	47,25	30,75	19,25	9,4	3	2	2,5
185	31,0	32	9,65	10,0	2	2	2
Jin Long 2	51,75	31,75	22,35	9,5	3	2	2,5
Lipin 2	31,75	31,75	9,95	9,8	2	2	2
Liaohe (Turgen)	30,75	32,0	9,75	9,9	2	2	2
Milotai 10	49,25	32,75	19,9	10,05	3	3	3
CITH - W2	51,0	33,25	20,5	9,8	3	2	2,5
Fernor	30,5	32,0	9,75	9,9	2	2	2
Lara	46,0	30,25	20,05	9,45	3	2	2,5
Lateral lui Trifan	51,0	33,25	21,5	9,8	3	2	2,5
Brichanski	42,0	31,25	15,35	10,05	3	3	3
Plin	32,0	19,0	9	4,85	2	1	1,5
Codrene	49,75	29,5	20,3	8,5	3	2	2,5
Kazaku	7,25	9,0	1,45	1,8	1	1	1
Kishinevski	27,5	32,0	9,85	9,9	2	2	2
Liaohe (Esik)	49,2	38,1	25,1	20,71	3	3	3
Saryagash forms	48,47	45,5	26,2	24,3	3,4	3,4	3,4

The prevalence of walnut blight at the farm LLP "Integration - Turgen" in 2022 ranged from 7.25% to 51.75% by variety, and in 2023 from 9.0% to 33.25%, with corresponding degrees of disease development of 1.45-29.65% and 1.8-10.05%. The disease was identified on the leaves of 150 trees, representing 53% of the infestation.

Based on immunological evaluation, the Kazaku variety was found to be highly resistant, with an average lesion score of 1. Other varieties and forms of walnut with scores ranging from 1.1 to 2, and with a percentage of lesions on leaves of 5-10%, were classified as resistant to the disease. They are Miroslava, Ovidiu, Germisara, Yarivski, Peshanski, Kogylnichanu, 185, Lipin 2, Liaohe, Fernor, Plin, and Kishinevski.

Medium-resistant varieties were found to have scores ranging from 2.1 to 3 on the scale of damage assessment, and with the percentage of lesions on leaves ranging from 10-25%. They are Chernovitski, Velnitsa, Xin xin 2, Jin Long 2, Milotai, CITH - W2, Lara, Lateral lui Trifan, Brichanski, and Codrene.

Lastly, the local Saryagash forms of walnut from LLP "Saryagash zher syyy" were found to be severely affected, with an average walnut blight damage score of 3.4.

Overall, the introduced varieties and forms of walnut in the southern zone of fruit-growing in Kazakhstan are mainly resistant and medium-resistant, with the Moldavian variety Kazaku being immune or highly resistant. This makes it of considerable interest for production and breeding.

It is important to note that the infestation of walnut varieties differ from year to year and depends on the climatic conditions of that year. In 2023, a year unfavorable for the development of walnut blight, many resistant varieties demonstrated immunity. For example, in 2022, varieties like Miroslava, Ovidiu, Germisara, and Plin can be classified as resistant, but in 2023, they showed themselves as immune.

Furthermore, the susceptibility of the same variety also varies greatly and largely depends on the growing conditions. For instance, the variety Liaohe in the State Enterprise "Issyk State Dendrological Park" had an average score of 3 points for walnut blight and was moderately resistant, while in LLP "Integration-Turgen", located in the foothill zone, it was resistant. This indicates that the resistance of the variety largely depends on the growing conditions. More reliable assessment can be made by having long-term data of natural infectivity of varieties or by conducting an assessment on a rigid artificial infectious background.

Conclusions

The study has revealed that walnut blight, caused by the pathogenic bacterium *Pantoea agglomerans* in conjunction with fungal pathogens, causes damage to walnut plants every year. The degree of damage depends on the prevailing weather and climatic conditions. A comparative analysis of the degree of walnut lesion over the years 2022-2023 showed that the walnut blight caused by *Pantoea agglomerans* was weaker in 2023 due to the cool prolonged spring and dry hot summer compared to 2022.

In southeastern Kazakhstan, a variety of Moldovan selection Kazaku was found to be immune to walnut blight among the introduced varieties and forms. Other resistant varieties include Miroslava, Ovidiu, Germisara, Yarivski, Peshanski, Kogylnichanu, 185, Lipin 2, Liaohe, Fernor, Plin, and Kishinevski, which are suitable for production and breeding use. The medium-resistant varieties are Chernovitski, Velnitsa, Xin Xin 2, Jin Long 2, Milotai 10, CITH - W2, Lara, Lateral lui Trifan, Brichanski, and Codrene. The local forms of Saryagash are classified as severely affected. The resistance of the variety to the disease largely depends on the growing conditions.

Gratitude: This research was funded by the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan under grant number AP19677936, which aimed to investigate the main walnut diseases and the molecular genetic basis of the resistance of promising varieties to economically important pathogens.

References

1. Richter, A.A.; Yadrov, A.A. Walnut. *Moscow: Agropromizdat.* 1985, *215.* (in Russian).

2. Oleichenko, S.N. Bookmark walnut plantations in the South of Kazakhstan. Collection of materials of the international scientific and practical seminar "Providing the nut growing industry of Kazakhstan with high-quality planting material of promising forms varieties". 2018, *10-13.* (in Russian).

3. Nussipzhanov, N.S.; Oleichenko, S.N.; Shoibekova, A.Zh. Improvement of methods for increasing the germination capacity of walnut seeds (*Juglans regia*). *Izdenister, natijeler - Research and results.* 2020, *N3(87), ISSN 2304-3334.* (in Russian).

4. Zubkov, A.V.; Antonenko, V.V.; Thiessen, M.V.; Indolov, V.M. Infestation of species of the genus *Juglans L.* in the conditions of the Non-Black Earth Region of the middle zone of Russia. *Vestnik agrarnoi nauki.* 2021, *1(88), 3-8.* (in Russian).

5. Dutkiewicz, J.; Mackiewicz, B.; Lemieszek, M.K.; Golec, M.; Milanowski, J. *Pantoea agglomerans:* a mysterious bacterium of evil and good. Part IV. Beneficial effects. *Ann. Agric. Environ. Med.* 2016, *23, 206–222*. DOI: 10.5604/12321966.1203879.

6. Xiao, J.; Liu, Z.; Sun, S.; Fan, C.; Wang, D.; Zhang, D. Complete Genome Sequence of *Pantoea agglomerans* CHTF15, a Walnut Pathogen. *Mol Plant Microbe Interact.* 2023, *36(2), 134-137.* https://doi.org/10.1094/MPMI-10-22-0216-A.

7. Gutiérrez-Barranquero, J.A.; Cazorla, F.M.; Torés, J.A.; Vicente, A. *Pantoea agglomerans* as a new etiological agent of a bacterial necrotic disease of mango trees. *Phytopathology.* 2019, *109:17-26.* DOI:10.1094/PHYTO-06-18-0186-R

8. An, X.H; Wang, N.; Wang, H.; Li, Y.; Si, X.Y.; Zhao, S.; Tian, Y. Physiological and transcriptomic analyses of response of walnuts *(Juglans regia)* to *Pantoea agglomerans* infection. *Front Plant Sci.* 2023. *5; 14:1294643.* DOI: 10.3389/fpls.2023.1294643.

9. Yang, K.Q.; Qu, W.W.; Liu , X.; Liu , H.X.; Hou, L.Q. First report of *Pantoea agglomerans* causing brown apical necrosis of walnut in China. *Plant Dis.* 2011, *95(6):773.* DOI: 10.1094/PDIS-01-11-0060.

10. Shamrai, S.N.; Glushchenko, V.I. Fundamentals of field research in phytopathology and phytoimmunology: textbook. *Kharkiv: KhNU named after V.N. Karazin*. 2006, *64.* (in Russian).

11. Programme and methodology of varietal studies of fruit, berry and nut crops. Under the general editorship of E. N. Sedov and T. P. Ogoltsova. *Orel: VNIISPK Publishing House.* 1999, *102-111.* (in Russian).

12. Meteorological and hydrological databases of the National Hydrometeorological Service of Kazakhstan (2022 and 2023). Available on: https://www.kazhydromet.kz/ru/about/o-nacionalnoy-gidrometeorologicheskoy-sluzhbe-kazahstana.

Г.Н. Каирова[1]*, Э.С. Исмагулова[1], С.Н.Олейченко [1], Г.А. Сулейманова [1], Н. Basim [2], М.Ж. Саршаева [3]

[1] НАО «Казахский национальный аграрный исследовательский университет»
г.Алматы, Республика Казахстан, gulshariya.kairova@kaznaru.edu.kz;
elya_ismagulova@mail.ru; oleichenko@mail.ru; gulnur.suleimanova@kaznaru.edu.kz
[2]«Университет Акдениз», г.Анталья, Турция, hbasim@akdeniz.edu.tr
[3]ТОО «Казахский научно-исследовательский институт плодоовощеводства»
г. Алматы, Республика Казахстан, moka-1993@mail.ru

УСТОЙЧИВОСТЬ СОРТОВ ГРЕЦКОГО ОРЕХА К БАКТЕРИОЗУ, ВЫЗВАННОМУ *PANTOEA AGGLOMERANS* В ЮЖНОЙ ЗОНЕ ПЛОДОВОДСТВА КАЗАХСТАНА

Аннотация

Бактериоз грецкого ореха – вредоносное заболевание, поражающее орехоплодные культуры. Вызывается бактерией *Pantoea agglomerans* и в последние годы получил широкое распространение, представляя серьезную угрозу для ореховых плантаций. Болезнь не только уничтожает более половины урожая, но и вызывает растрескивание коры и медленное усыхание кроны, что может привести к дальнейшему заражению. Одним из важнейших требований к современным сортам сельскохозяйственных растений, в том числе орехоплодных, является повышенный уровень устойчивости к болезням.

В Казахстане в настоящее время нет данных о распространении болезней орехоплодных культур и устойчивости сортов к вредным заболеваниям. Это затрудняет рекомендации подходящего сорта для промышленных и частных ореховых садов. Для улучшения селекционного процесса и повышения продуктивности орехоплодных плантаций чрезвычайно актуальна оценка устойчивости сортов к наиболее опасным возбудителям болезней.

Впервые в Казахстане проведено двухлетнее мониторинговое исследование по оценке устойчивости перспективных сортов и форм грецкого ореха к возбудителю бактериоза грецкого ореха *(Pantoea agglomerans),* с учетом сложившихся погодно-климатических

условий. Исследование проведено по 23 сортам и формам в основных плодовых регионах страны.

Установлено, что бактериоз грецкого ореха, вызываемый бактерией *Pantoea agglomerans*, ежегодно повреждает растения грецкого ореха, причем степень поражения болезнью зависит от преобладающих погодно-климатических условий.

Результаты исследований показали, что молдавский сорт Kazaku показал высокую устойчивость к бактериозу грецкого ореха. У сортов Miroslava, Ovidiu, Germisara, Yarivski, Peshanski, Kogylnichanu, 185, Lipin 2, Liaohe, Fernor, Plin, Kishinevski за годы наблюдения наблюдалась минимальная поврежденность, не превышающая 2 баллов. Эти сорта рекомендуются как пригодные сорта для повышения продуктивности промышленных и частных ореховых садов и улучшения селекционного процесса.

Ключевые слова: *орех грецкий, сорт, бактериоз грецкого ореха, Pantoea agglomerans, устойчивость сортов, развитие болезни, распространенность болезни.*

Г.Н. Кайрова[1]*, Э.С. Исмагулова[1], С.Н. Олейченко [1], Г.А. Сулейманова [1], Н. Basim [2], М.Ж. Саршаева[3]

[1]«Қазақ ұлттық аграрлық зерттеу университеті», Алматы қаласы, Қазақстан Республикасы, gulshariya.kairova@kaznaru.edu.kz; elya_ismagulova@mail.ru; oleichenko@mail.ru; gulnur.suleimanova@kaznaru.edu.kz

[2]«Акдениз университеті», Анталья қаласы, Түркия мемлекеті, hbasim@akdeniz.edu.tr

[3]«Қазақ жеміс-көкөніс шаруашылығы ғылыми-зерттеу институты» ЖШС, Алматы қаласы, Қазақстан Республикасы, moka-1993@mail.ru

ҚАЗАҚСТАННЫҢ ОҢТҮСТІК ЖЕМІС ӨНДІРУ АЙМАҒЫНДАҒЫ *PANTOEA AGGLOMERANS* ҚОЗДЫРҒЫШЫ ТУДЫРҒАН БАКТЕРИОЗҒА ГРЕК ЖАҢҒАҒЫ СОРТТАРЫНЫҢ ТӨЗІМДІЛІГІ

Аңдатпа

Грек жаңғағының бактериозы жаңғақ дақылдарының зиянды ауруларының бірі болып табылады. Бұл ауру *Pantoea agglomerans* бактериясынан туындаған және соңғы жылдары жаңғақ екпелеріне елеулі қауіп төндіріп, кеңінен таралды. Ауру өнімнің жартысынан көбін жойып қана қоймайды, сонымен қатар ағаштың қабықтараның жарылуына және бөрікбасының біртіндеп құрғауына әкеліп соғады және инфекция көзі болып қала береді. Ауылшаруашылық өсімдіктерінің заманауи сортына, соның ішінде жаңғақ дақылдарына қойылатын маңызды талаптардың бірі - ауруларға төзімділігін арттыруы болып табылады.

Бүгінгі таңда Қазақстанда жаңғақ дақылдары ауруларының таралуы және сорттардың зиянды ауруларға төзімділігі туралы деректер жоқ. Бұл өнеркәсіптік және жеке жаңғақ бақтары үшін қолайлы сортты ұсынуға мүмкіндік бермейді. Селекциялық процесті жетілдіру және жаңғақ ағаштарының өнімділігін арттыру үшін сорттардың ең қауіпті патогендерге төзімділігін бағалау өте өзекті мәселе болып табылады.

Екі жылдық мониторингтік зерттеулер барысында Қазақстанда тұңғыш рет негізгі жеміс өңірлеріндегі грек жаңғағының перспективалы 23 сорт пен түрлерінің бактериялық дақ қоздырғышына *(Pantoea agglomerans)* төзімділігіне баға берілді.

Pantoea agglomerans бактериясынан туындаған грек жаңғағының бактериозы жыл сайын өсімдіктерге зиян келтіреді, сонымен қатар аурудың зақымдану дәрежесі қалыптасқан ауа-райы мен климаттық жағдайларға байланысты екендігі анықталды.

Жүргізілген зерттеулердің нәтижелері грек жаңғағының Молдова селекциясының Kazaku сорты бактериозға жоғары төзімділікке ие екенін көрсетті. Зертеу жүргізген жылдар бойы грек жаңғағының Miroslava, Ovidiu, Germisara, Yarivski, Peshanski, Kogylnichanu, 185, Lipin 2, Liaohe, Fernor, Plin, Kishinevski сорттарында аурумен зақымдалуы төмен болдып, 2 баллдан аспағаны байқалды. Бұл сорттар өнеркәсіптік және жеке жаңғақ бақтарының өнімділігін арттыру және селекциялық процесті жақсарту үшін қолайлы сорт ретінде пайдалануға ұсынылады.

Кілт сөздер: *грек жаңғағы, сорт, грек жаңғағының бактериозы, Pantoea agglomerans, сорттардың ауруға төзімділігі, аурудың дамуы, аурудың таралуы*

МРНТИ 68.37.29 **DOI** https://doi.org/10.37884/2-2024/24

Нелис Т. Б., Давыдова В. Н., Кочоров А. С., Базарбаев Б. Б., Утельбаев Е. А., Исмаилова А. А., Погосян А. С.

ТОО «Научно-производственный центр зернового хозяйства им. А.И. Бараева», Акмолинская область, Шортандинский район, Казахстан
tnelis570@gmail.com, vera751575@mail.ru, kochorov@mail.ru, utelbaev_erlan@mail.ru, bazarbayev_berik@list.ru, aigul_kok@mail.ru, araik.pogosyan.98@inbox.ru

ДИНАМИКА ЧИСЛЕННОСТИ КАПУСТНОЙ МОЛИ В ПОСЕВАХ ЯРОВОГО РАПСА НА ФОНЕ ПРИМЕНЕНИЯ ИНСЕКТИЦИДОВ

Аннотация

В связи с расширением посевных площадей под рапсом и нарушением технологии его производства происходит ухудшение фитосанитарного состояния посевов, обостряются проблемы с выращиванием капустных культур из-за постоянного роста заселения растений этого вида вредителями – капустной молью. В настоящее время радикальным и эффективным методом защиты рапса ярового от вредителей является химический, который включает в себя обработку вегетирующих растений. Для выявления наиболее эффективных инсектицидов в борьбе с капустной молью было испытано четыре препарата из различных химических классов, разрешенных к применению в Республике Казахстан. Биологическая эффективность препарата системного действия Димиприд, 70% в.д.г. составила от 88,1 до 93,5% по дням учета, контактно-кишечного действия Децис Эксперт, к.э. – 96,6–86,1%, фосфорорганический препарат контактного действия Данадим Эксперт, к.э. – 93,7–84,0% и системно-контактного действия Борей Нео, с.к. показал эффективность на уровне 96,6–88,1% по сравнению с контролем и положительно сказалась на количестве сохраненного урожая.

Была изучена скорость прохождения фаз развития капустной моли во многом определяется температурным режимом, складывающимся в мае-августе. Установлена определенная закономерность в сопряженности развития вредителя и кормового растения. Данные фенологических наблюдений свидетельствуют о том, что критическим периодом в развитии кормового растения и фитофага является фаза от формирующейся розетки до бутонизации, так как именно в это время гусеницы наиболее вредоносны.

Ключевые слова: рапс яровой, капустная моль, фенологические наблюдения, инсектициды, биологическая эффективность, урожайность.

Введение

Рапс – ценная масличная и кормовая культура. Ценность и универсальность ярового рапса определяется его биологическими потенциальными возможностями, которые позволяют возделывать эту культуру в регионе Северного Казахстана и Западной Сибири с её специфическими почвенно-климатическими особенностями. Она является реальным резервом увеличения производства растительного масла и кормового белка, удачно сочетая в себе высокую потенциальную продуктивность семян (2,0-4,0 т/га) с высоким содержанием