Geographical distribution of wheat fusariosis in the central and south regions of Uzbekistan

Nodira Khaytbayeva[1,*] and *Qalandar* Bababekov[2]

[1]Tashkent State Agrarian University, Tashkent, 100140, Uzbekistan
[2]Scientific Research Institute of Quarantine and Plant Protection, Tashkent, 100003, Uzbekistan

Abstract. The article offers a comprehensive exploration of the geographical distribution of wheat fusarium, focusing on both central and select southern regions within Uzbekistan. The study delves into the symptoms of fusarium disease and elucidates the extent of its impact on crop productivity. Furthermore, it investigates the spread of this disease across diverse soil and climatic conditions within Uzbekistan, spanning the period from 2021 to 2023. The research outcomes underscore critical findings related to fusarium-infected plants. Notably, infected plants exhibit an absence of a budding phase, suggesting a disruption in their growth cycle. Experimental evidence confirms the formation of only one spike from a single plant, emphasizing the negative effects of the disease on plant reproductive structures. The article additionally examines the quantitative aspects of wheat production in relation to fusarium. Findings reveal that fields plagued by the prevalence of fusarium exhibit a lower spike formation rate, with approximately 250-300 spikes forming per square meter. This figure contrasts with healthier plants, which yield a more substantial output, exceeding 400 spikes per square meter. By offering insights into the geographical spread, symptomology, and productivity repercussions of wheat fusarium, this article advances our understanding of the disease's impact on agricultural systems. The presented results provide valuable information for practitioners seeking effective management strategies against fusarium, ultimately contributing to the maintenance of healthy wheat crops and sustained agricultural productivity.
Keywords. *Fusarium, F. gramenearum, F. culmorum, F. avenaceun, F. incartanum,* plant, wheat, spike.

1 Introduction

The main food products are made from wheat flour [1]. Therefore wheat is grown on large areas in almost all regions of our republic. In the conditions of Uzbekistan, mainly soft wheat is grown [2]. Depending on the soil and climate conditions of Uzbekistan in winter wheat is planted at different times. In order to obtain a high and quality harvest from wheat, the purity of seed grains, treatment with seeders during seed storage, and timely application of planting and agrotechnical measures in the specified periods of each region are important measures [3]. But when these measures are not used in time, there are cases of decreased productivity

* Corresponding author: khaytbayevanodira@mail.ru

due to diseases in plants. In recent years, the fusarium disease in wheat causes damage to the plant from germination to the end of the growing season, causing a sharp decrease in productivity [4]. The presence of 4 types of fungi belonging to the genus Fusarium that cause diseases in wheat was determined during the research [5].

The Fusarium disease encompasses various species, including *F. graminearum*, *F. culmorum*, *F. avenaceum*, and *F. incarnatum*. Within this context, optimal temperature and humidity levels play a pivotal role in the onset and progression of Fusarium-related plant diseases [6-8]. Notably, the interplay between these environmental factors significantly influences the development of the disease [9].

The research reveals that Fusarium disease tends to thrive under specific conditions. Notably, the disease becomes more pronounced when environmental conditions feature high humidity, typically around 70%, accompanied by temperatures ranging between 24 to 27 degrees Celsius [10]. This particular combination of temperature and humidity appears to foster the growth and proliferation of the Fusarium pathogen [11].

It is important to note that the extent of Fusarium disease impact is influenced by climatic factors, especially rainfall patterns. In years marked by lower rainfall, the disease's effects tend to be less noticeable [12]. This observation underscores the intricate relationship between environmental conditions and the prevalence of Fusarium disease [13].

These findings offer valuable insights into the environmental prerequisites for Fusarium disease development, enhancing our understanding of its epidemiology and aiding in the formulation of targeted disease management strategies.

2 Materials and methods

The correct application of special methods is important for the isolation of fungi from plant parts. To clean the seed from external mycoflora, it is possible to use sulema dissolved in a ratio of 1:1000, as well as formalin solution dissolved in a ratio of 1:300 (for 30 minutes), 1% bromine water (for a few seconds), 2% potassium solution with manganese (for 15 minutes). It is recommended to keep the seed in the prepared solution for the indicated period, and then rinse it several times in sterilized water. When cleaning the seed from external infection is not effective, we recommend to use the method of flaming the seed under investigation using dena turat or technical alcohol for sterilization. Antibiotics (streptomycin) were used to ensure that the isolated fungi were free of bacteria.

In order to isolate fungi, moist chambers prepared in Petri dishes were used. For this purpose, 1 circles made of filter paper are placed in sterilized Petri dishes at 121^0C under a pressure of 1 atm and soaked in sterilized water. The seed was placed in moistened chambers in Petri dishes and stored in desiccators. The temperature in the thermostat should not exceed $27\text{-}30^0$C, the humidity should be 70-80%. After 2-3 days, the growth and development of the fungi growing in it began to be observed under a small lens of a microscope. Some pieces of mycelia, conidia of emerging fungi are planted in the agar nutrient medium in a test tube using a microbiological hook.

The use of moist chambers is the most effective method for isolating fungi parasitizing inside plant seeds.

3 Results and discussion

In the researches, the spread of fusarium disease of wheat in different soil and climatic conditions of the republic and damage to productivity were studied. The experiment was conducted mainly in Tashkent, Syrdarya, Jizzakh, Samarkand, Bukhara and Kashkadarya

regions. During the research, the prevalence and damage of Fusarium disease in wheat was studied in the period from 2021 to 2023 (Table 1).

Table 1. Number of plants per 1 m^2 in fields infected with *Fusarium.*

Region	Districts	1 m^2 of healthy plants	1 m^2 plant infected with fusarium	Reduction in the number of plants due to fusarium wilt
Samarkand	Pastdarg‘om	430	323	107
	Oqdaryo	390	276	114
	Payariq	412	304	108
Jizzakh	Sharof Rashidov	398	301	97
	Paxtakor	395	289	97
	G‘allaorol	350	246	104
Syrdarya	Sardoba	387	283	89
	Guliston	385	275	110
Tashkent	Qibray	403	304	99
	Quyi Chirchiq	391	299	92
Kashkadarya	Yakkabog‘	361	244	117
	Kasbi	398	309	89
	SHahrisabz	329	218	111
	Kitob	401	306	95
Bukhara	Buxoro	298	201	97
	Jondor	323	243	120
	Romiton	306	205	101
	Peshku	367	273	94

We are in 6 regions and 18 districts in the central and some southern regions of the republic. We observed the wheat fields of 33 farms and studied the spread of the disease (2021-2023). The disease spread the most in dry wheat crops in Yakkabog and Shahrisabz of Kashkadarya region, Jondor district of Bukhara region, Gallaorol district of Jizzakh region. In the fields where fusarium disease did not occur, the number of spikes per 1 m^2 was the maximum of 430, while in the places where the disease was widespread, the number of spikes per 1 m^2 was 89. In the fields heavily affected by fusarium disease, the number of wheat stalks and the formation of spikes are sharply reduced, as a result of the rotting of the lateral roots of plants infected with fusarium, the plant does not germinate and only one spike is formed from one plant. Therefore, the productivity of plants infected with fusarium disease is sharply reduced (Figure 1).

In the research, the geographical spread of the fusarium disease of wheat in different soil and climatic conditions was studied. In the data in this diagram, in 2021-2023, the disease level of plants during the season of Fusarium disease was studied on a total area of 325 ha in Tashkent, Syrdarya, Jizzakh, Samarkand, Kashkadarya and Bukhara regions. The obtained results show that in 2023, compared to 2021 and 2022 years, the spread of fusarium disease was found in the spring season. Fusarium infection of this wheat is especially common in Kashkadarya and Bukhara regions. In these fields, during the vegetation period of early spring wheat, there are many cases of diseased plants not budding and plants turning yellow compared to healthy plants.

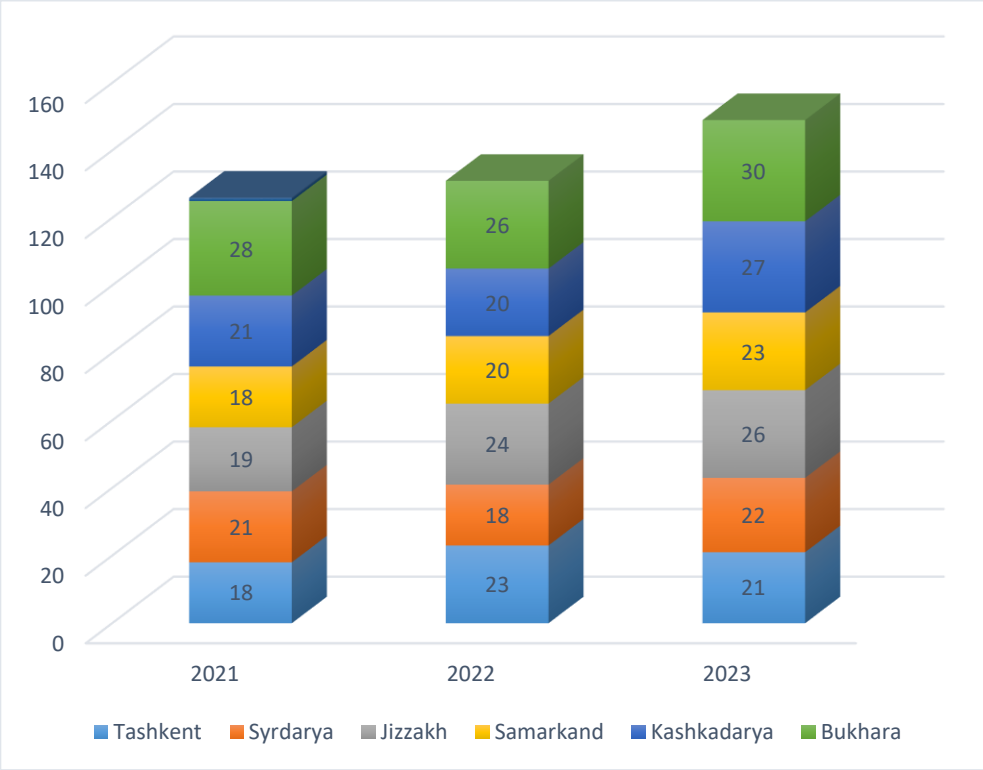

Figure 1. Geographic distribution of wheat fusarium disease in the conditions of Uzbekistan (2021 - 2023).

Wheat plants were brought from fields with disease symptoms and analyzed in the laboratory. In order to identify the pathogenic species of fusarium, which cause diseases in wheat, the roots, stems and leaves of the plant were planted in artificial nutrient media, and pure cultures of fungi belonging to the genus fusarium were isolated and identified.

These pictures show the condition of wheat infected with fusarium during the growing season in the central and southern regions of the Republic. Analysis of fusarium-infected plants in the laboratory conditions of plants affected by fusarium in wheat fields turning yellow and forming a foci, lack of a flowering phase, and plants drying before wheat ripens during the milk ripening period. we can see that the fungi belonging to the fusarium family have evolved (Figure 2).

Figure 2. Geographic distribution of wheat fusarium disease in the conditions of Uzbekistan (2021 - 2023).

4 Conclusions

In conclusion, the impact of fusarium disease on wheat cultivation is significant, potentially leading to a substantial yield reduction of up to 50%. To mitigate the detrimental effects of this disease, implementing proactive agrotechnical measures is imperative. This includes adhering to region-specific planting schedules to optimize crop health. Moreover, treating seeds with effective seeders before sowing is crucial to establish a strong foundation for disease resistance.

Furthermore, it is advised to maintain vigilance during the growing season, particularly when symptoms of fusarium disease become apparent. In such instances, timely intervention is key. One recommended approach involves the application of biostimulants to the affected plants. This strategic use of biostimulants can bolster plant health, enhancing their resilience against fusarium disease and potentially mitigating its impact.

By following these recommendations and adopting a comprehensive approach to disease management, farmers can proactively safeguard their wheat crops from the ravages of fusarium disease. Ultimately, the prudent implementation of these measures can contribute to maintaining healthy yields and sustaining the productivity of wheat cultivation in the face of this significant agricultural challenge.

Rerefences

1. Atabayeva H.N., Khudaikulov J.B. "Plantology". "Fan and Technologies" Publishing House, Tashkent: 2018.
2. Atabayeva H.N., Azizov B.M. "Wheat". Monograph, T. ToshdAU, 2008, P-10.5
3. Gagkayeva T.Y., Gavrilova O.P., Levitin M.M., Novozhilov K.V. Fusarium zernovix culture. Applied magazine "Zashita i karantin rastenii", 2011, No. 5, p-70-120.
4. Khaitbayeva N., Sheraliyev A. Fusarium diseases of wheat in saline soils of the Republic of Karakalpakstan and measures to combat them. Monograph ToshdAU, Tashkent, 2020, 130 pages
5. Leslie J.F., Summerell B.A. 2006. The *Fusarium* Laboratory Manual. Ames, Iowa, USA, Blackwell Publishing, 2006, xii + 388 pp.
6. Safarov A.A., Turdiyeva D.T., Hasanov B.A. Fusarium root rot of wheat. Agrochemical protection and plant quarantine, 2020, No. 5, pp. 95-100.
7. Khasanov B.A., Safarov A.A., Turdiyeva D.T. Fuzariozniye corneviye and biological journal, 2020, No. 5, p. 21-32.
8. N.S.Khaytboyeva. Q.B.Bobabekov, N.R.Tillyaxodjayeva, U/X.Raximov The Advantagesof Wheat's Biological Ways of Fighting against Endophit Fungus International Journal of Environmental and Agriculture Research. Volume-8, Issue-11, November 2022, pp 9-12.
9. Boboev, S., Makhkamov, T., Bussmann, R. W., Zafar, M., & Yuldashev, A. (2023). Anatomical and phytochemical studies and ethnomedicinal uses of Colchicum autumnale L. Ethnobotany Research and Applications, 25, 1-9. DOI:10.32859/era.25.6.1-9
10. TKh, M., Brundu, G., Jabborov, A. M., & Gaziev, A. D. (2023). Predicting the potential distribution of Ranunculus sardous (Ranunculaceae), a new alien species in the flora of Uzbekistan and Central Asia. BioInvasions Records, 12(1), 63-77. DOI:10.3391/bir.2023.12.1.05
11. Ameen, M., Zafar, M., Ahmad, M., Ramadan, M. F., Eid, H. F., Makhkamov, T., ... & Majeed, S. (2023). Assessing the Bioenergy Potential of Novel Non-Edible Biomass Resources via Ultrastructural Analysis of Seed Sculpturing Using Microscopic Imaging Visualization. Agronomy, 13(3), 735. DOI:10.3390/agronomy13030735

12. Noor, W., Zafar, M., Ahmad, M., Althobaiti, A. T., Ramadan, M. F., Makhkamov, T., ... & Khan, A. (2023). Petiole micromorphology in Brassicaceous taxa and its potential for accurate taxonomic identification. Flora, 303, 152280. DOI:10.1016/j.flora.2023.152280
13. Aziz, A., Ahmad, M., Zafar, M., Gaafar, A. R. Z., Hodhod, M. S., Sultana, S., ... & Chaudhay, B. (2023). Novel Copper Oxide Phyto-Nanocatalyst Utilized for the Synthesis of Sustainable Biodiesel from Citrullus colocynthis Seed Oil. Processes, 11(6), 1857. DOI:10.3390/pr11061857