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CAUSES OF WHEAT STEM RUST DISEASE AND A GENERAL OVERVIEW OF FUNGICIDES

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Abstract

Stem rust of wheat is one of the most dangerous fungal diseases that significantly reduces crop productivity and grain quality in many wheat-growing regions of the world. The disease is mainly caused by the fungus Puccinia graminis f. sp. tritici and develops rapidly under favorable environmental conditions such as high humidity and moderate temperatures. The appearance and spread of stem rust are influenced by several factors including susceptible wheat varieties, climatic conditions, presence of alternative host plants, and insufficient plant protection measures. If not controlled in time, the disease can lead to severe yield losses. Modern plant protection strategies focus on the integrated management of stem rust, where fungicides play an important role in preventing and reducing disease development. Fungicides help protect wheat plants from infection, slow down the spread of the pathogen, and maintain stable yields. This article provides a general overview of the causes of wheat stem rust occurrence, the biological characteristics of the pathogen, and the role of fungicides in controlling the disease.

Keywords

wheat, stem rust, fungal diseases, Puccinia graminis, plant protection, fungicides, disease control, crop yield, plant pathology

INTRODUCTION

Wheat is one of the most important agricultural crops in the world and plays a crucial role in ensuring global food security. However, the productivity and quality of wheat are often negatively affected by various biotic and abiotic factors. Among these factors, fungal diseases are considered one of the main causes of yield losses in wheat production. One of the most destructive fungal diseases affecting wheat is stem rust, which has been widely reported in many wheat-growing regions and poses a serious threat to sustainable crop production. Wheat stem rust is primarily caused by the fungal pathogen *Puccinia graminis* f. sp. *tritici*. This disease is characterized by the formation of reddish-brown pustules on the stems, leaf sheaths, and sometimes on other aerial parts of the plant. Under favorable environmental conditions, particularly high humidity and moderate temperatures, the pathogen spreads rapidly and can lead to severe damage to wheat crops. The occurrence and spread of stem rust are influenced by several factors, including susceptible wheat varieties, suitable climatic conditions, the presence of alternative host plants, and inadequate plant protection measures.

In recent years, climate change, the expansion of susceptible wheat cultivars, and insufficient implementation of preventive agricultural practices have contributed to the increased occurrence and spread of stem rust in many regions. Therefore, studying the causes of this disease and identifying effective control measures remain important issues in modern plant protection and crop management. Various strategies are used to control wheat stem rust, including agronomic, biological, and chemical methods. Among these approaches, fungicides

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play a significant role in protecting wheat plants from fungal infection and reducing the spread of the pathogen. The proper application of fungicides can effectively suppress the development of the disease, protect plant health, and help maintain stable crop yields. The purpose of this study is to analyze the main causes of wheat stem rust occurrence and to provide a general overview of the role and importance of fungicides in controlling this disease.

LITERATURE REVIEW AND METHODS

Stem rust of wheat is recognized as one of the most destructive fungal diseases affecting wheat production worldwide. The disease has been studied extensively by plant pathologists due to its ability to cause severe epidemics and significant yield losses. According to many scientific studies, the pathogen responsible for this disease, *Puccinia graminis* f. sp. *tritici*, has a complex life cycle and can spread rapidly under favorable environmental conditions such as moderate temperatures and high humidity. Researchers have noted that the pathogen infects different parts of the wheat plant, including stems, leaves, and leaf sheaths. The symptoms are usually visible in the form of reddish-brown pustules that rupture the epidermis of the plant tissue. As the disease progresses, the affected tissues weaken, which can lead to lodging and reduced grain filling[1]. Previous studies have also highlighted the role of environmental and agronomic factors in the spread of wheat stem rust. For example, susceptible wheat varieties, dense planting, and the presence of alternate host plants such as barberry (*Berberis* spp.) can significantly increase the risk of infection[2]. In addition, climatic conditions play an important role in disease development, as warm temperatures and moisture create favorable conditions for spore germination and infection. Various disease management strategies have been proposed to control wheat stem rust. These include crop rotation, the use of resistant varieties, removal of alternate hosts, and chemical control through fungicides. Among these methods, fungicide application is considered one of the most effective tools for preventing severe outbreaks, particularly in regions where resistant varieties are not widely available. The present study is based on the analysis of scientific literature related to wheat stem rust and fungicide use in plant protection. The research method includes the review and comparative analysis of scientific publications, textbooks, and research articles on plant pathology. The collected information was analyzed to determine the main causes of the disease and the role of fungicides in controlling its spread.

RESULTS AND DISCUSSION

The analysis of scientific literature indicates that wheat stem rust remains a serious threat to wheat production in many regions of the world. The disease develops when the fungal spores infect wheat plants and penetrate plant tissues. Once inside the plant, the pathogen grows rapidly and produces spores that spread through wind and rain to infect nearby plants. One of the main causes of stem rust outbreaks is the cultivation of susceptible wheat varieties. Many traditional varieties lack sufficient genetic resistance to the pathogen, making them highly vulnerable to infection. As a result, the disease can spread quickly in large wheat-growing areas[3]. Environmental factors also play a significant role in the development of wheat stem rust.

[1] Agrios, G. N. Plant Pathology. 5th ed. Burlington: Elsevier Academic Press, 2005, pp. 635–640.

[2] Roelfs, A. P., Singh, R. P., Saari, E. E. Rust Diseases of Wheat: Concepts and Methods of Disease Management. Mexico: CIMMYT, 1992, pp. 78–85.

[3] Zadoks, J. C., Schein, R. D. Epidemiology and Plant Disease Management. Oxford: Oxford University Press, 1979, pp. 210–215.

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Optimal temperatures between 18°C and 30°C combined with high humidity favor the germination of fungal spores and infection of plant tissues. Under such conditions, the disease can spread rapidly across wheat fields and cause serious economic damage. Another important factor contributing to the spread of the disease is the presence of alternate host plants, particularly species of the genus *Berberis*. These plants serve as intermediate hosts in the life cycle of the pathogen and contribute to the genetic diversity and spread of the fungus.

The use of fungicides is an effective method for controlling stem rust in wheat crops. Modern fungicides work by inhibiting the growth and reproduction of fungal pathogens. They can be applied either as preventive treatments before infection occurs or as curative treatments after the appearance of disease symptoms. Studies show that fungicides belonging to the triazole and strobilurin groups are particularly effective against rust diseases. These chemicals protect plant tissues, reduce pathogen activity, and prevent further spread of the infection[4]. However, excessive or improper use of fungicides may lead to the development of pathogen resistance, which emphasizes the need for integrated disease management strategies. Therefore, combining fungicide application with other control methods such as resistant varieties and proper agronomic practices is considered the most effective approach for managing wheat stem rust.

CONCLUSION

Wheat stem rust is one of the most harmful fungal diseases affecting wheat production worldwide. The disease is caused by the pathogen *Puccinia graminis* f. sp. *tritici* and can lead to significant yield losses if not properly controlled. The spread of the disease is influenced by several factors, including susceptible wheat varieties, favorable environmental conditions, and the presence of alternate host plants. The analysis conducted in this study shows that fungicides play an important role in protecting wheat crops from stem rust infection. Proper use of fungicides can significantly reduce disease severity and help maintain stable crop yields. However, chemical control should not be used as the only management strategy. Effective management of wheat stem rust requires an integrated approach that combines resistant varieties, appropriate agronomic practices, and rational fungicide use. Such strategies can help reduce the impact of the disease and ensure sustainable wheat production in the future.

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