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Fusarium Species in Agriculture Industry and Control of Them



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Abstract

One of the serious problems in the agriculture industry is contamination of agricultural plants and their products with fungi. *Fusarium* spp. are known as very important fungi that not only invade agricultural plants in both pre- and post-harvesting steps, but also disperse through the world. There are different methods to control disease caused by *Fusarium* spp., but they are associated with some limitations. Among these methods, bio control takes considerable attentions of researchers. Here, we briefly consider problems caused by *Fusarium* in agriculture industry and take a short look on methods to manage the fungi.

Keywords: *Fusarium*; Agriculture, Mycotoxins, Control, Biocontrol

Introduction

A critical problem in agriculture industry is outbreaks caused by pathogenic fungi. Pathogenic fungi are able to contaminate not only agricultural plants, but also their products. In addition to direct effects of the pathogens on their host such as necrosis, wilt, decrease of growth and death of the host, they contaminate their substrates with biosynthesized secondary metabolites, known as mycotoxins, as well. Most important fungi involving in contamination of agricultural plants during pre-harvesting processes are from genera *Botrytis cinerea*, *Puccinia*, *Fusarium*, *Colletotrichum*, and *Ustilago*. In post-harvesting steps such as stored crops or food products *Aspergillus*, *Penicillium* and *Fusarium* are considered as the most important fungi [1]. *Fusarium* spp. are classified as very important fungal pathogens due to their association with extremely important crops in almost all steps of the agriculture industry, both pre- and post-harvesting, throughout the world. Some members of *Fusarium* produce various types of mycotoxins including fumonisins, zearalenone, trichothecenes, moniliformin, beauvericin, and enniatins [1]. Some of these compounds, for instance fumonisins are known to be carcinogen [2]. *Fusarium* as important pathogens in agriculture industry.

Fusarium is belong to the Ascomycota and its species can be supposed as fungi with high impact on life and health of human, directly or indirectly. The direct impacts are the result

of the destructive effects of the fungi on crops and products which imposes massive economic losses, and indirect impacts are due to contamination of the products by mycotoxins secreted by the fungi. *Fusarium* spp. possesses different styles of life from saprophyte to pathogens, and moreover, some species are endophyte of plants [3-6]. Distribution of species belong to *Fusarium* through different climates is very high and it is estimated that almost all plant species are associated with at least one species of *Fusarium* during one stage of the life. Not only plants, but also animals and human can be infected by *Fusarium* spp. [7,8]. Accordingly, because of this diversity and impact on life, genus *Fusarium* has always been at the center of attention of mycologist and many studies have been done on that. Most Pathogenic fungi in agricultural plants are belong to species complexes of *F. oxysporum*, *F. solani*, *F. graminearum* [9-11]. *Fusarium* head blight caused by members of *F. graminearum* species complex; root rot, stem canker and sudden death by members of *F. solani* species complex; and wilt disease by members of *F. oxysporum* complex the main diseases threaten agriculture industry, which influence a considerable amount of lands under cultivation worldwide.

Contamination of stored yields, such as grains, chaff, straw, fruits, and nuts by *Fusarium* spp. Its a serious problems in process of storing agricultural products [12-14]. These

products can be contaminated by *Fusarium spp.* produced hazardous mycotoxins. The point that should not be neglected is the involvement of other fungal species in contamination of the stored products. Plus to *Fusarium*, species of the genera *Aspergillus*, *Penicillium* are the most predominant fungi causing the contamination and the frequency of their presence depends on the substrate they growth on. Mycotoxins biosynthesized by these groups of fungi are known as extremely toxic compounds on stored agricultural products [15]. Control and reducing the contamination with these fungi is a critical step through storing process of agricultural products.

Control of Fusarium

Managing of *Fusarium* outbreaks is an important issue in agriculture. Depends on the step and involved species, there are different ways to fight against *Fusarium spp.* Control of *Fusarium spp.* in field and in stored products can be completely different. In the field conditions, control of *Fusarium* pathogens is not an easy process. *Fusarium spp.* can form chlamyospores and survive for many years under different environmental conditions. On the other hand, species that invade the roots of plants are able to colonize roots of various plants, either associated with symptom of disease or not. Therefore, it is not easy to suppress the disease with crop rotation. Different methods have been used to control disease caused by *Fusarium spp.* including applying various chemicals to pretreatment the soil, breeding resistant cultivars, soil solarization and biocontrol [16-18].

As a matter of fact, these methods are not perfect and often are in company with some problems. Using huge amount of the chemical agents results in hazardous effects on the environment. Local climate constraints can limit soil solarization. Biocontrol of *Fusarium* outbreaks is an interesting method to fight against these fungi, but similar to other methods, biocontrol is imposed by biotic and abiotic factors [19].

In stored products, growth of *Fusarium spp.* leads to destruction and/or mycotoxins contamination. Species from *Fusarium* are predominant fungi of temperate and tropical cereals and mostly contaminate their substrates by fumonisins and trichothecenes. Even low amount of the molds in the products result in mycotoxin contamination. In storage of products, different factors are involved in control of molds such as grain and contaminant mold respiration, temperature, water availability and intergranular gas composition, and preservatives compounds. The severity of detriment is various from 10 to 50 percent which depends on post-harvest processing and environmental conditions. Some methods have been developed to manage *Fusarium* contaminations through storage. Modulating atmosphere of storing site via changing the level of CO₂ showed a significant effect on growth and production of toxins by *Fusarium*. Applying preservative compounds such as sorbic and propionic acids is another way to control fungi, but many of *Fusarium spp.* can metabolize these compounds.

Alternatively, it has been shown that different plant-based products such as chitosan, essential oils, glucosinolates,

benzaldehyde, acetic acid, jasmonates and microbial antagonists can be applied against *Fusarium* [20,21]. Because of environmentally-friendly and biodegradability, utilizing biocontrol methods for managing of fungal pathogens, particularly in the case of stored products, recently takes considerable attention of many researchers [20,22]. Almost, all of these compounds are obtained from nature. Moreover, a group of soil-borne bacteria, known as plant growth promoting bacteria, possess antifungal activity. This ability turned them into candidates that can be applied as biocontrol agents to control *Fusarium spp.* pathogens in field conditions [23].

Conclusion

To sum up, *Fusarium* species are major causing of diseases in important agricultural plants that make massive economic losses by affecting on plants in the fields and different kinds of stored products. Knowing these fungi in order to choose proper managing process against them, and also developing contamination managing methods which are more efficient and environmentally-friendly are inevitable duties must be attended.

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