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].
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 grow on. Mycotoxins biosynthesized by these groups of fungi are known as extremely toxicous 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 chlamydospores 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 pretreatement 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, benzoaldehyde, 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.

**References**

1. Marin S, Ramos AG, Cano SG, Sanchis V (2013) Mycotoxins: Occurrence, toxicity, and exposure assessment. Food Chem Toxicol 60: 218-237.
2. Ruyck KD, Boevre MD, Huybrechts I, Saeger SD (2015) Dietary mycotoxins, co-exposure, and carcinogenesis in humans: Short review. Mutat Res Rev Mutat Res 766: 32-41.
3. Karim NFA, Mohd M, Nor NMIM, Zakaria L (2016) Saprophytic and potentially pathogenic Fusarium species from peat soil in Penak and Pahang. Trop Life Sci Res 27(1): 1-20.
4. Demers JE, Gugino BR, Jimenez GM (2015) Highly diverse endophytic and soil *Fusarium* oxysporum populations associated with field-grown tomato plants. Appl Environ Microbiol 81(1): 81-90.
5. Chehri K (2016) Genetic diversity of pathogenic *Fusarium* semitectum isolates from potato tubers, using PCR-IGS-RFLP markers. Potato Research 59(4): 393-406.
6. Aoki T, O’Donnell K, Geiser DM (2014) Systematics of key phytopathogenic Fusarium species: Current status and future challenges. Journal of General Plant Pathology 80(3): 189-201.
7. Nucci M, Anaisie E (2007) Fusarium infections in immunocompromised patients. Clin Microbiol Rev 20(4): 695-704.
8. Chehri K, Rastegar PN, Sayyadi F (2015) Dermatitis in the Fringe-Toed Lizard, *Acanthodactylus nelsoni* Rastegar-Pouyani, 1998 (Sauria: Lacertidae) associated with *Fusarium* proliferatum. Curr Microbiol 71(5): 607-612.
9. Zhang N, O’Donnell K, Sutton DA, Naim FA, Summerbell RC, et al. (2006) Members of the *Fusarium* solani species complex that cause infections in both humans and plants are common in the environment. J Clin Microbiol 44(6): 2186-2190.
10. O’Donnell K, Guédan C, Sink S, Johnston PR, Crous PW, et al. (2009) A two-locus DNA sequence database for typing plant and human pathogens within the *Fusarium* oxysporum species complex. Fungal Genet Biol 46(12): 936-948.
11. Goswami RS, Kistler HC (2005) Pathogenicity and in plant a mycotoxin accumulation among members of the *Fusarium* graminearum species complex on wheat and rice. Phytopathology 95(12): 1397-1404.
12. Ji F, Wu J, Zhao H, Xu J, Shi J (2015) Relationship of deoxynivalenol content in grain, chaff, and straw with *fusarium* head blight severity in
wheat varieties with various levels of resistance. Toxins (Basel) 7(3): 728-742.

13. Chehri K (2016) Molecular identification of pathogenic Fusarium species, the causal agents of tomato wilt in western Iran. Journal of Plant Protection Research 56(2): 143-148.

14. da Rocha MEB, Freire FDCO, Maia FEF, Guedes MIF, Rondina D (2014) Mycotoxins and their effects on human and animal health. Food Control 36: 159-165.

15. Tournas VH, Niazi NS, Kohn JS (2015) Fungal presence in selected tree nuts and dried fruits. Microbiol Insights 8: 1-6.

16. Tamietti G, Valentino D (2006) Soil solarization as an ecological method for the control of Fusarium wilt of melon in Italy. Crop Protection 25: 389-397.

17. Omar I, O’Neill TM, Rossall S (2006) Biological control of fusarium crown and root rot of tomato with antagonistic bacteria and integrated control when combined with the fungicide carbenazim. Plant Pathology 55: 92-99.

18. Luo J, Ran W, Hu J, Yang X, Xu Y, et al. (2010) Application of bio-organic fertilizer significantly affected fungal diversity of soils. Soil Science Society of America Journal 74: 2039-2048.

19. Jimenez DRM, Olivares GC, Landa BB, Jimenez GM, Navas CJA (2011) Region-wide analysis of genetic diversity in Verticillium dahliae populations infecting olive in southern Spain and agricultural factors influencing the distribution and prevalence of vegeative compatibility groups and pathotypes. Phytopathology 101(3): 304-315.

20. Tripathi P, Dubey NK (2004) Exploitation of natural products as an alternative strategy to control postharvest fungal rotting of fruit and vegetables. Postharvest biology and Technology 32: 235-245.

21. Magan N, Aldred D (2007) Post-harvest control strategies: minimizing mycotoxins in the food chain. Int J Food Microbiol 119(1-2): 131-139.

22. Lecomte C, Alabouvette C, Edel HV, Robert F, Steinberg C (2016) Biological control of ornamental plant diseases caused by Fusarium oxysporum: A review. Biological Control 110: 17-30.

23. Compant S, Duffy B, Nowak J, Clement C, Barka EA (2005) Use of plant growth-promoting bacteria for biocontrol of plant diseases: principles, mechanisms of action, and future prospects. Appl Environ Microbiol 71(19): 4951-4959.