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Biodiversity Study of *Fusarium* spp. on Stored Cereal Grains in Karnataka State, India

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Abstract: A study was undertaken to find the biodiversity of *Fusarium* spp. on stored cereal grains (maize, sorghum and paddy) collected from different places of Karnataka State, India by testing seed health. Altogether ten *Fusarium* species were found to be associated with different cereals such as, *F. moniliforme* (25.35%), *F. graminearum* (15.5%), *F. proliferatum* (14%), *F. oxysporum* (12.68%), *F. avenaceum* (9.86%), *F. subglutinans* (8.45%), *F. semitectum* (5.63%), *F. poae* (4.22%), *F. sporotrichiodes* (2.81%) and *F. anthophilum* (1.40%). The occurrence of *Fusarium* species were higher in maize 43.66%, followed by sorghum 38.02% and very low in paddy 18.31%. Among them *F. moniliforme*, *F. avenaceum*, *F. subglutinans*, *F. semitectum*, *F. graminearum* and *F. oxysporum* were common on all the three cereal grains.

Key words: Biodiversity, *Fusarium* spp., stored cereal grains, maize, sorghum and paddy

Introduction

Biodiversity is a unique characteristic of living organisms. One of the most fascinating and attractive aspects of the microbial world is its extraordinary diversity (Prescott *et al.*, 1996). Molds are ubiquitous in nature and domestic environments (Langseth *et al.*, 1993). As a result fungi can easily contaminate raw food materials both during their growing period and after harvest.

Food is the first and foremost source of nutrition. Cereals and millets form the staple food of the human race. More than 70% of the total food is served by the plant and plant products-cereals and millets (Pitt *et al.*, 1985). These include rice, maize, wheat, barley, oats, rye, sorghum, pearl millets, ragi and many other types of millet. The role of fungi (molds) in the loss of stored products (cereals & millets) can not be ignored. Besides *Aspergillus, Penicillum* and *Alternaria*; *Fusarium* also attacks the stored cereal grains. Members of the genus *Fusarium* are among the most widespread and important plant pathogens in the world. Most of the crops are invaded by one or more species of *Fusarium*. Members of this group of fungi are known for producing mycotoxins in cereal grains (Bacon *et al.*, 1992 and Marin *et al.*, 1998).

However, studies on biodiversity of *Fusarium* Liseola species on maize grain are very limited (Marin *et al.*, 1998). Not much work has been done to know the biodiversity of *Fusarium* spp. in cereal grains at Karnataka State, India. Hence the present piece of work was undertaken to identify the associated species of *Fusarium* and their occurrence in different stored cereal grains.

Materials and Methods

The experiment was conducted at the Laboratory of Department of Studies in Microbiology, Mysore University, India during the period from August 2000 to June 2001.

Collection of sample: Freshly harvested seed sample of maize, sorghum and paddy comprising of about 250 grams were collected from different places of Karnataka State, India. Then the seeds were kept in brown paper bag and stored at normal room temperature in the laboratory of Department of Studies in Microbiology, Mysore University, India over a period of 3 months.

Seed health test: Three replicated samples of maize, sorghum and paddy comprising 200 seeds were drawn randomly for seed health analysis following blotter method (ISTA, 1996).

Identification of *Fusarium* spp.: All the seed samples were assayed for the presence of fungal pathogen using stereo-binocular microscope. Identified *Fusarium* spp. under stereo-microscope were transferred to Potato Dextrose Agar (PDA) medium and then incubated for 4-7 days at 28 °C ±3. After incubation, temporary slides were mounted and examined under compound microscope with the help of relevant taxonomic books identified till species level according to the methods of Gilman (1956), Booth (1971) and Nelson *et al.* (1983).

Results and Discussion

The findings on this investigation for the occurrence of biodiversity of *Fusarium* spp. on stored cereal grains are in Table 1 & 2 and Fig. 1 & 2. Ten *Fusarium* spp. such as *F. moniliforme*, *F. proliferatum*, *F. subglutinans*, *F. avenaceum*, *F. semitectum*, *F. oxysporum*, *F. graminearum*, *F. anthophilum*, *F. poae* and *F. sporotrichiodes* were detected. The occurrence of these *Fusarium* spp. varied significantly depending on the type of cereals. Percent yielding *Fusarium* species were higher in maize followed by sorghum and very low in paddy. Distinguishable characteristics of *Fusarium* spp. obtained from the stored cereal grains are presented in Table 2.

Table 1: Occurrence of *Fusarium* spp. on stored cereal grains in Karnataka State, India

Species	Occurrence of *Fusarium* spp. (%)		
	Maize	Sorghum	Paddy
F. moniliforme	61.11	27.78	11.11
F. proliferatum	70.0	30.00	0.00
F .subglutinans	50.0	33.33	16.67
F. avenaceum	14.29	28.57	57.14
F. semitectum	25.0	25.00	50.00
F. oxysporum	22.22	44.44	33.33
F. graminearum	36.36	54.55	9.09
F. anthophilum	100.00	0.00	0.00
F. poae	33.33	66.67	0.00
F. sporotrichiodes	0.00	100.00	0.00

Occurrence of *Fusarium* spp. on stored cereal grains: The occurrence of *Fusarium* species was higher in maize 43.66%, followed by sorghum 38.02% and very low in paddy 18.31% (Fig. 1). Bacon *et al.* (1992) found similar results as he observed mean level of infection by *Fusarium* of 8.4% to 36.2% in maize, which was the highest among other grains, including wheat, rice, barley and oats. *Fusarium* is a contaminant of 88 - 100% of the corn-based products for animal consumption as whole corn kernels, screening, and feeds (Marin *et al.*, 1998). An extensive study by Sala (1993) on Spanish feed samples revealed that *Fusarium* species contaminated 14 of 15 samples of maize, 3 of 8 of wheat, 7 of 17 of barley, and 14 of 17 sorghum. The occurrence of *F. moniliforme* was the highest (25.35%) in

Table 2: Distinguishable characteristics of *Fusarium* spp. obtained from the stored cereal grains in Karnataka State, India

Species	Distinguishable characteristics
F. moniliforme	Microconidia formed in chains on monophialides and the absence of chlamydospores.
F. proliferatum	Microconidia formed in chains in the shape of 'V' on polyphialides and the absence of chlamydospores.
F. subglutinans	Microconidia formed on polyphialides in false heads and never in chains. Chlamydospores are absent.
F. avenaceum	Conidia are long, awl- or threadlike, ellipsoidally curved or both ends especially at the tip somewhat more strong bent than The middle. Conidia are seldom scattered.
F. semitectum	Conidia scattered in The aerial mycelium, sickle-shaped, strongly curved, tapering at both ends, tip more or less constricted, basal cell round. Chlamydospores intercalary. Sporodochia lacking.
F. oxysporum	Microconidia numerous in aerial mycelium, scattered, typical. Chlamydospores terminal and intercalary, globose or oval.
F. graminearum	Conidia spindle-sickle-shaped, strongly curved, tapering at both ends. Chlamydospores lacking.
F. anthophilum	Microconidia of oval, globose or pear-shaped formed on polyphialides, and not formed in chains. Absence of chlamydospores.
F. poae	Hyphae and conidiophores are richly branched. Microconidia lemon-shaped, or pear-shaped one or two celled. Macroconidia long spindle shaped, ellipsoid to sickle shaped. Chlamydospores mostly intercalary, in chains and knots.
F. sporotrichiodes	Conidia at the tips of the conidiophores which branch irregularly or dichotomously. Conidia in sporodochia. Chlamydospores intercalary, singly occurring.

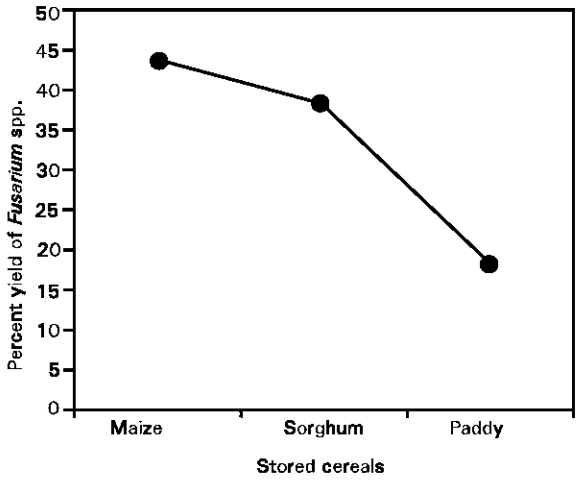

Fig. 1: Percent yielding *Fusarium* spp. obtained from different stored cereals in Karnataka, India

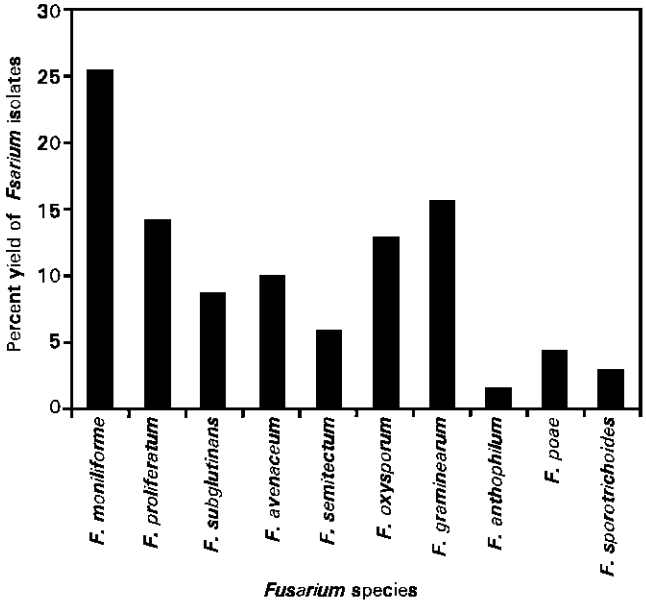

Fig. 2: Different isolates of *Fusarium* spp. obtained from stored cereals in Karnataka, India

stored cereal grains followed by *F. graminearum* (15.5%), *F. proliferatum* (14%), *F. oxysporum* (12.68%), *F. avenaceum* (9.86%), *F. subglutinans* (8.45%), *F. semitectum* (5.63%), *F. poae* (4.22%), *F. sporotrichiodes* (2.81%) and significantly lowest *F. anthophilum* (1.40%) (Fig. 2). Study of Sala (1993) revealed that almost 100% of the *Fusarium* strains from maize, wheat and other feed samples were of *F. moniliforme* and *F. proliferatum*, while in barley the percentage was 60%. *F. moniliforme* strains that occur on cereals and especially as a major fungal contaminant on maize (Castella *et al.*, 1999).

Maize sample was found to be infected by *F. moniliforme* (61.11%), *F. proliferatum* (70.0%), *F. subglutinans* (50.0%), *F. avenaceum* (14.29%), *F. semitectum* (25.0%), *F. oxysporum* (22.22%), *F. graminearum* (36.36%), *F. anthophilum* (100%), *F. poae* (33.33 %) and there was no infection of *F. sporotrichiodes*. Sorghum sample was found to be infected by *F. moniliforme* , *F. proliferatum*, *F. subglutinans*, *F. avenaceum*, *F. semitectum*, *F. oxysporum*, *F. graminearum*, *F. anthophilum*, *F. poae* and *F. sporotrichiodes*, 27.78, 30.0, 33.33, 28.57, 25.0, 44.44, 54.55, 0, 66.67 and 100% respectively (Table 1). However, in sorghum *F. sporotrichiodes* was found the most prevalent (100%) but *F. anthophilum* was absent.

Paddy sample was found to be infected by *F. moniliforme* , *F. subglutinans*, *F. avenaceum*, *F. semitectum*, *F. oxysporum* and *F. graminearum* with 11.11, 16.67, 57.14, 50, 33.33 and 9.09%, respectively (Table 1). In paddy, *F. avenaceum* was found highest (57.14%) followed by *F. semitectum* (50%) while *F. proliferatum*, *F. anthophilum*, *F. poae* and *F. sporotrichiodes* were absent.

The predominant species isolated from samples of maize, sorghum and paddy was *F. moniliforme*. These results are very much similar to those of previous investigations of Castella *et al.* (1999) and Marin *et al.* (1999).

F. moniliforme, *F. proliferatum* and *F. subglutinans* were the most commonly associated fungi with maize production in North America and many other temperate regions of the world (Munkvold *et al.*, 1997). Species of *F. moniliforme* and *F. proliferatum* have been frequently (8 to 36%) isolated from maize (Marin *et al.*, 1999). Again *Fusarium* spp. are capable of causing seedling diseases, root rots, stalk rots, and ear rots of maize, as well as damaging stored grains by producing mycotoxins (Cotton *et al.*, 1998 and Munkvold *et al.*, 1997). In addition to corn, *F. moniliforme* has been isolated from grains, including wheat, rice and oats (Marin *et al.*, 1999).

Identified characteristics of *Fusarium* spp.: The identified characteristics of different *Fusarium* spp. are presented in Table 2 based on the manual of Gilman (1956) and Nelson *et al.* (1983). However, biodiversity is very important to know the nature of the organisms associated with the cereal grains which could pave the urgency of molecular studies of the organisms.

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