

Communication

Isolation of Fungal Pathogens of Stored Maize, *Zea mays* L., in Seka Chokersa District of Jimma Zone, Ethiopia

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Abstract: Maize, the most common staple food in Africa, is attacked by different pests during its production and post-harvest. Fungi are usually responsible for the deterioration of maize seedlings and grains right in the field or in storage. Storage fungi usually invade grain or seed during storage and are generally not present in large quantities before harvest in the field. They cause quality loss through their production of toxic byproducts which has high risk for human and animal health. The most common storage fungi are species of *Aspergillus* and *Penicillium*. This short study was conducted with an objective of isolating and identifying the major fungi genera associated with stored maize grain in Seka Chokersa district of Jimma Zone in 2017. Samples were taken from farmers traditional storage containers. For isolation, the fungi were grown on PDA medium and identified morphologically using a dissecting microscope. Accordingly, common stored cereal grain fungi genera *Aspergillus*, *Fusarium* and *Penicillium* were morphologically identified off the samples collected to their genus level. Among these fungi, *Aspergillus* spp. was identified with high frequency (86.6%) followed by *Fusarium* spp. (53.3%) and *Penicillium* spp. (40%). *Aspergillus*, *Fusarium* and *Penicillium* are among the top fungi genera deteriorating stored cereal grain which have high health risk for both human and animal.

Keywords: Stored Cereal Grain, Fungal Pathogen, Fungi Genera, Aflatoxin

1. Introduction

Maize (*Zea mays* L.) is among the top cereal crop which has food and feed importance, raw materials for industrial processing [1]. It is one of the staple food crops largely produced in Ethiopia [2]. Losses up to 50-80% can be occurred in stored maize due to storage fungi provided favorable conditions existed for fungi development during the storage period [3].

In Ethiopia, maize grain storage structures are usually open-air storage structures which expose to moisture and related pest activities resulting in damage to stored grain. According to Demissie et al. [4], 100% loss of stored maize can occur due to maize weevils' damage and subsequent mold development at storage level. Fungi are important postharvest pests causing deterioration and loss of stored maize grain next to insects [5]. They are among the principal causes of deterioration and yield loss on farmers' maize during the storage period. Several fungi species are attributed to maize

seeds causing deterioration during storage period. The conditions at which the maize grains arrive at the store determine the fungi that predominate and the subsequent infection by the storage fungi. Fungi such as *rhizopus*, *mucor*, *rhizoctonia*, *cladosporium*, *trichothecium*, *fusarium* and *altenaria* are common on grains harvested immaturely. Fungi that develop on grains during storage usually survive at low moisture contents, the typical examples are *Aspergillus*, *Penicillium* and *Fusarium* are the major fungi genera typically found in stored grains, several of which are capable of producing toxins [6, 7]. *Aspergillus flavus* systematically produces Aflatoxin in seedling of maize and damage stored maize which has high risk to human health. *Fusarium* principally invades more than 50% pre-harvest maize grain and produces mycotoxin [5, 8]. Several internal and external factors can affect the development of these fungi, some of which are the moisture content of the product, temperature, storage time, and degree of fungal contamination prior to storage, insects and mite activity that facilitates fungi dissemination [9].

Sode et al. [10] reported that poor post-harvest practices

aggravate post-harvest pests' development which in some cases results in losses exceeding 50% of stored product. And, the greatest yield loss is from mould developed on poorly handled stored products [11]. Yield losses due to physical and mechanical damage during harvesting are considerable on which pests such as insects and rodents are common [12].

Human and animal health, and seed quality reduction in storage are concerned because of the seriousness of mycotoxins in grains and other staple foods and feed stuffs. In spite of the importance of these postharvest pathogens, there is a limited information on the occurrence and prevalence of these fungi among many farmers in Ethiopia particularly in Jimma zone where maize is the top staple food. This mini study was conducted with the objective of identifying fungi pathogens of stored maize grain in Seka Chokersa district of Jimma Zone, Ethiopia.

2. Materials and Methods

2.1. Study Area and Sample Collection

The study was conducted in Seka Chokersa district of Jimma Zone, Ethiopia in 2017. The district is situated at 7°29' 59.99"N and 36 ° 04' 60.00"E with an elevation range of 1580 to 2560 m.a.s.l. Samples were collected from stored maize grains; three months later to storage time with the expectation of high infestation level during this time. The study district was selected

based on its maize production potential. Twenty farmer stores were sampled from the district at random. Samples were carefully diagnosed for the occurrence any genus of fungus.

2.2. Laboratory Study

The collected grains were surface disinfected with NaOCl. Five seeds were plated on petri-dish of 9 cm diameter poured with PDA medium. The seeds were incubated for pathogens on the seeds to grow. Identification of each fungus was done to genus level based on its morphological characteristics (Figures 1 to 3). For each fungus genus identified, percent of isolation frequency (IF) was done using the formula used Marasas et al. [13].

$$IF (\%) = \frac{\text{number of samples of occurrence of fungi species}}{\text{total number of samples}} * 100$$

3. Results and Discussion

In this study, three most important stored grain fungi, *Aspergillus*, *Fusarium* and *Penicillium* were isolated, characterized and identified microscopically to their genus level (Figures 1 to 3). Of the fungi identified, *Aspergillus* spp. was the most frequently occurred (86.6%) storage fungus followed by *Fusarium* spp. (53.3%) and *Penicillium* spp. (40%) (Table 1).

Table 1. Frequency of occurrence and percent isolation frequency of the fungal genera identified.

Number of isolates with fungus	Fungal genera identified	Frequency of occurrence of each fungus genus	Percent isolation Frequency, IF (%)
15	<i>Aspergillus</i> spp.	13	86.6%
	<i>Fusarium</i> spp.	8	53.3%
	<i>Penicillium</i> spp.	6	40%

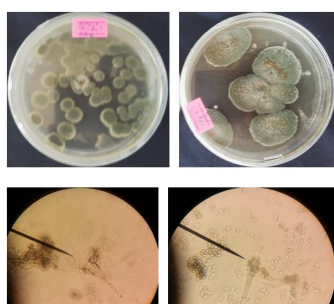


Figure 1. *Penicillium* spp.

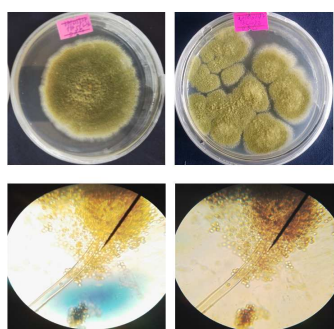


Figure 2. *Aspergillus* spp.

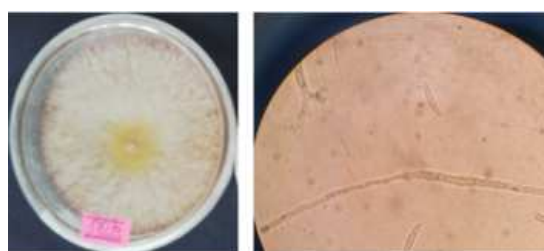


Figure 3. *Fusarium* spp.

The results agree with the findings of different researches on mycoflora of stored maize grain in which these storage fungi are common [14, 15]. Many studies report that *Aspergillus* spp. is the most important and frequently isolated storage fungus of the common stored grain fungi genera which this study also confirmed [1, 16, 17]. Some findings also report that the fungi genera identified in this study were common in traditional storage containers of the study area [16]. Similar findings in Adetunji et al. [18], Negasa et al. [19], Aminu and Keta [20] and Sharma and Sharma [21] also indicate that these fungi are common in traditional storage structures of farmers with their respective mycotoxins being a serious concern in all reports.

4. Conclusion

Maize is affected by several fungi genera before harvest and during post-harvest. Contamination of seed and grain with fungal organisms may result in poor germination, seedling vigor or grain quality. Contamination occurs through small quantities of spores contaminating the grain as it is going into storage from the harvest, in handling and storage equipment or from spores already in the storage structures. Under high temperatures and moisture, this small amount of inoculum can increase rapidly. Fungi cause two distinct problems in storage grains: spoilage from fungal growth or molds and the production of poisonous mycotoxins. Mycotoxins are fungi byproducts, poisonous chemical compounds produced by certain fungal species that infect crops.

The current results revealed that during storage period, a series of storage fungi can be developed in stored maize among which potentially toxigenic species of fungi genera such as *Aspergillus* spp. are significant in traditional maize storage. The study also indicated that *Aspergillus* spp., *Fusarium* spp. and *Penicillium* spp. were the major stored maize fungi genera in the study area. These fungi genera produce byproducts which are risky to human and animal health.

Conflict of Interest

No conflict of interest is concerned on the manuscript.

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