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Fungi Associated with Storage Rots of Onion Bulbs in Sokoto. Nigeria

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Abstract A survey of fungi associated with postharvest deterioration of onion bulbs was conducted in Sokoto, north-western Nigeria in 2010. Rotten onion bulbs sold at five different markets: Sokoto central markets, Kasuwa daji, Gawon nama, Arkilla and Mabera were infected with eight species of fungi: *Aspergillus niger, A. flavus, A. fumigatus, Alternaria porri, Rhizopus stolonifer, Fusarium oxysporum,* and *Penicillium citrinum.* Of these, *A.niger, A.flavus* and *A.porri* were the most frequently isolated fungi. *Penicillium citrinum* was the least encountered fungus. Pathogenicity tests revealed that all the isolated fungi were pathogenic on onion bulbs however; *A. porri, R. stolonifer* and *P. citrinum* were the most pathogenic leading to rapid disintegration of the infected bulbs within 21 days of inoculation. While A. *niger* was the least pathogenic. The implications of the findings in relation to post harvest handling of onion bulbs and mycotoxin production were discussed.

Keywords Onion Bulbs, Fungi, Storage Rots, Markets

1. Introduction

The onion (*Allium cepa* L.) is an important vegetable crop in Nigeria based on consumption and economic value to farmers. The crop is grown for its bulbs which are used daily in every home for seasoning and flavouring of foods. Onion is a valuable ingredient in the diet due to its content of sugars, vitamins and minerals (Ole *et al*., 2004). The crop is grown mainly in the north, during the dry season (October to April). The onion farmers in Nigeria almost always store, their onions after harvest for one to five months to ensure a continual supply through seasons when fresh produce was unavailable. Bulb rots are a common cause of onion loss during storage. Fungi, especially moulds are important pathogens of fruits and a vegetables particularly under tropical and sub-tropical conditions (Adebayo and Diyaolu, 2003).The importance of storage rots includes reduction in the quantity and quality of onion which affects the market value (Dogondaji *et al*., 2005). Other important consequence often overlooked, is mycotoxin contamination of the affected material (Muhammad *et al*., 2004).

2. Objectives

Fungal contamination of onion bulbs constitutes menace in the production and storage of onion particularly in the tropics. Apart from toxins production. Pressence of fungi on the onion bulbs eventually leads to disease development in the field when the infected bulbs are planted in the preceding cropping season.

The objective of this paper was to isolate and identify pathogenic fungi associated with postharvest deterioration of onion bulbs in Sokoto, north – western Nigeria.

3. Material and Methods

3.1. The Study Area

The study was conducted during the months of May to August, 2010 in the Department of Biological Sciences, Usmanu Danfodiyo University Sokoto. Sokoto State is one of the northern states where a large proportion of onion production and storage take place annually. The area is located in the north – western Nigeria (Longitude 3 – 9° East; latitude 10 – 14° North). It is characterized by long dry season (October to April) and a short rainy season (May to September). Average monthly temperature ranges from 21 to 35℃ and is lowest in December and January. Heat is more severe in March and April.

3.2. Collection of Samples

Onion bulbs showing symptoms of rotting and discolouration were randomly selected from five different markets: Sokoto central markets, Kasuwa daji, Gawon nama, Arkilla and Mabera located in Sokoto metropolis, for microbial analysis.

3.3. Isolation and Identification of Rot Inducing Fungi

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To isolate the pathogens responsible for the rots on the affected onion bulbs, the bulbs were stripped of their outer dry scales and surface sterilized in 1% Sodium hypochlorite solution for 60 sec.(Dimka and Onuegbu, 2010) These were then rinsed in three successive changes of sterile distilled water and blotted dry with sterile filter paper. Small segments of tissues ($3mm^3$) from the margins of rotted lesions were cut out with a sterile scalpel and plated on potato dextrose agar in 90mm Petri – dishes. The plates were incubated at room temperature (28 ± 3°C) for 7 days. Developing fungal colonies were sub – cultured continuously on fresh PDA plates to obtain pure cultures of the isolates. Fungal isolates were identified based on cultural and morphological characteristics (Barnett and Hunter, 1998).

3.4. Pathogenicity Test

Pathogenicity of the isolated fungi was established by testing for their ability to induce rot in healthy onion bulbs. The bulbs were stripped of their outer scales. The inner tissue was swabbed with cotton wool soaked in 1% Mercuric chloride and then washed twice in running tap water. Holes were dug in the bulbs by using 5mm diameter cork- borer and the plug was pulled and exchanged with 3mm diameter mycelial disc of each of the isolated fungi by placing it at the bottom of the hole to compensate for the thickness of the mycelial disc introduced into the hole. The plug was carefully placed and the wounded area sealed with Vaseline to prevent extraneous infection. Inoculated bulbs were incubated for 4 weeks at 30°C. Three replications were prepared for each treatment. Control consisted of sterilized 3mm PDA disc placed in the holes of the healthy bulbs. Inoculated Onion bulbs were subsequently observed for rot develovement. The degree of Pathogenicity of each fungus was determined by measuring the extent of rot (mm) on the infected bulbs.

4. Results and Discussion

The results on investigation of mycoflora associated with deterioration of onion bulbs are shown in Tables 1 and 2. A total of seven fungal species which include *Aspergillus niger*, A. *flavus* A. *fumigatus, Alternaria porri, Fusarium oxysporum*, *Rhizopus stolonifer* and *Penicellium citrinum* were isolated from rotten onion bulbs obtained in Sokoto, Nigeria (Table 1). Of these, A. *nige*r had the highest frequency of occurrence (30%) followed by A. *flavus (*18%) with P. *citrinum* as the least encounterd fungus (5%).

All the isolated fungi were found to be pathogenic to the onion bulbs, however A. *porri,* R. *stolonifer* and P. *citrinum* were, in general, considerably more pathogenic than the other fungi (Table 2) leading to rapid disintegration of the infected bulbs within 21 days of inoculation. While A. *niger* was the least pathogenic as measured in terms of the size of rot lesions on the affected bulbs. The finding from the present investigation indicates that the aforementioned fungi were associated with deterioration of onion bulbs. This agrees with the reports of other researchers (Muhammad *et al*., 2004; Dimka and Onuegbu, 2010) that fungi constitute a menace in the storage of many agricultural commodities including fruits, vegetables and nuts.

The action of A. *porri*, R. *stolonifer* and P. *citrinum* in causing onion bulb rot was shown to be much faster than that of other associated fungi demonstrated above. Under conditions of rapid movement of bulbs from field to market, it is likely that the effects of the other fungi may be negligible. However, onions are frequently stored for 1-5 months after harvest in Nigeria. Then the losses from the major pathogens may be greater in number but less in monetary value than that for example A. *niger* and A. *fumigatus* considering the fact that the bulbs are usually sorted before being transported to markets and severely rotted ones are discarded. Any rots that cannot be detected are passed by the farmers and moved to the markets. As a result, the slower type of rots characteristic of A. *niger* and A. *fumigatus* infection may be more costly because transport expenses are added. A certain level of postharvest rots of onion bulbs is inevitable, because their perishable nature, but this should be kept to a minimum.

Latent infection of onion bulbs may be the main factor contributing to postharvest deterioration during storage. Microbial infection of bulbs is often the result of poor preharvest management practices. Healthy, undamaged onion bulbs which have been dried in the field should be stored in dry well ventilated stores. This will reduce growth and develovement of fungal pathogens and minimize storage rots.

Table 1. Fungi isolated from rotten onion bulbs

Fungi	Frequency of occurrence (%)
Aspergillus niger	30
Flavus	18
Fumigatus	10
Alternaria porri	15
Fusarium oxysporum	13
Rhizopus stolonifer	9
Penicilliu citrinum	5

Table 2. Pathogenicity of the isolated fungi on onion bulbs

Fungi	Diameter of rot (mm)
Aspergillus niger	12
A. flavus	20
A. fumigatus	15
Alternaria porri	45
Fusarium oxysporum	22
Rhizopus stolonifer	37
Penicillium citrinum	30

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