

Incidence of Pathogenic Fungal Species Associated with Sweet Potato Tubers (*Ipomoea batatas* Lam) in Gwandu Local Government

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Abstract

Sweet potatoes have become an increasing popular food source in Kebbi State due to its nutritional benefits, medicinal value, and economic importance. Fungal species plays a pivotal role in declineit production and promoting food insecurity of this tuber crop. This research is aimed for isolating and identifying fungi associated with sweet potato tubers (*Ipomoea batatas* Lam) using needle mount method. The pathogenicity studies revealed the incidence of three fungal species: *Rhizopus oryzae*, which produced the highest virulence zone (73 mm), while *Aspergillus niger* and *Alternaria* spp. each produced 13.5 mm virulence zones. The rotten tissues yielded an identical fungus with the original fungus inoculated. Isolated fungal species causes significant losses of sweet potato tubers both before and after harvest. Hence, there is a need to develop alternative disease control methods using plants that may be effective against the isolated species.

Keywords: Fungi, incidence, pathogenic, and sweet potato.

1.0 Introduction

Sweet potato (*Ipomoea batatas* Lam) is a root crop with various sizes and colors, cultivated in many countries, including Nigeria, where it is called “*Dankali*” in Hausa, and it belongs to the family Convolvulaceae. It is cultivated in over 100 countries with over 98% of the production being consumed in developing countries[1]. In Nigeria, it is the fourth most important root crop after cereal grains and the seventh most important food crop globally. It possesses numerous positive attributes, including the ability to be cultivated three times a year, high yield potential, use as food for both humans and animals, rich nutritional value, resistance to production stresses, environmental friendliness, as well as economic and industrial applications [2, 3, 4]. According to [1] more than two billion people in Asia, Africa and Latin America depended on this crop for food, animals’ feed and income. Under a controlled environment, sweet potato roots tubers can be stored for several months. Curing potato for 8 days at 15°C and 95% relative humidity allow extended storage of up to 5 months[5].

The production of sweet potato in Nigeria is constrained by several factors such as physiological, physical and microbes which resulted in significant loss in the storage rot caused by fungal infection[6]. Fungal infections, often resulting from mechanical damage to tuber crops, play a major role in causing economic losses for sweet potato farmers and contributing to food insecurity. Currently, around 80% of plants diseases are linked to fungal pathogens, particularly in African countries where poor postharvest handling, unsuitable storage conditions, and the absence of effective disease management systems remain significant challenges[7]. The control strategies of fungal pathogens focuses on preventing mechanical injuries to sweet potatoes during harvesting, which increase fungal exposure routes and ensuring proper curing of the roots before storage, play a pivotal role in prevent pathogens infection. Moreover, African countries such as Nigeria and Uganda account for 50% yield loss [8]. Fungal species such as; *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Fusarium* spp., *Penicillium* spp., *Rhizopus* spp., *Mucor* spp., and *Saccharomyces* spp. are the species infesting sweet

potato tubers in some state of Nigeria [9, 10]. In Kebbi State, fungal diseases are considered the leading cause of deterioration in sweet potato and cocoyam [11, 12]. These fungi caused localized discoloration and damage to the surrounding tissues of infected tubers [13, 14]. Post-harvest losses of root and tuber crops pose a serious challenge for farmers in the state, with more than 40% harvests lost due to fungal decay. Some species also produce mycotoxins (including fumonisins, zearalenones, and trichothecenes), which contaminated the seeds and enter the food chain, posing risks to human and animal health, and making them hazardous to agricultural products, livestock, wild life, and humans [15, 16]. Soft rot caused by *Rhizopus* species is likely widespread wherever sweet potatoes are cultivated, though it appears to cause greater damage in temperate area. This study was aimed to isolate fungi associated with the sweet potato tubers and evaluate their pathogenicity.

2.0 Materials and Methods

2.1 Study Area

Gwandu local government area is approximately located between latitudes 12° 17'N and 12° 39'N and longitudes 4° 28'E and 4° 54'E. It is bounded by Argungu local government in the north, Sokoto state in the east and Aliero and Birnin Kebbi local government at the west [17]. The mean annual temperature is 21°C – 38°C, though it sometimes fluctuates with the mean annual rainfall of about 500mm.

2.1 Collection of Samples

Four (4) white varieties of sweet potato tubers showing symptoms of infection such as sunken lesion, deformed or cracked of the tubers, stunted growth, discoloration and three (3) symptomless were collected from Bada village in two different farms within the study area. All the samples collected were packed in sterile polythene bags, well labeled and brought to the Laboratory of the Department of Plant Science and Biotechnology, Abdullahi Fodio University of Science and Technology, Aliero for identification and fungal analysis. Voucher no. was assigned by the Taxonomist professional as (AFUSTA/PLSB/093).

2.2 Sample Preparation

All the samples collected were washed under running tap water, allowed to strain and then surface sterilized using a 70% ethanol, followed by immersion for 3 minutes in dilute (0.5%) Sodium hypochlorite and a sterile distilled water rinse.

2.3 Preparation of Potato Dextrose Agar (PDA)

The medium (PDA) used to carry out the study were prepared according to the manufacturer's recommendations and specified instruction. Chloramphenicol was used as the antibiotic to prevent bacteria growth.

2.4 Culturing

Two (2) mm pieces of the surface-sterilized tuber samples were singly placed on Potato Dextrose Agar (PDA) antibiotics incorporated medium in petri dishes in accordance with [18, 19]. The plates were incubated at room temperature (28±2°C) for 7 days and observed daily [19]. Colonies selected on the different Petri dishes were sub-cultured on new prepared PDA chloramphenicol medium and incubated at 37°C for 24 hours. These young colonies were used for identification.

2.5 Identification of Fungal Isolates

The fungal cultures were observed for 5-10 days and the colony characteristics noted. Slides of fungal mycelia in the reproductive stage were prepared using lactophenol and cotton blue and observed under the microscope using different magnifications (x10, x40 and x100) for the detailed morphological features of the fungi such as hyphae, sporangia and conidia, in chain or single and type of spores [19].

2.6 Pathogenicity Test

Pathogenicity test was performed using the methods described by [19] with a slightly modification using fresh healthy tubers. The selected tubers were washed under running tap water and then surface sterilized with seventy percent (70%) ethanol for 2mins. Cylindrical cores were removed from the tubers with the help of five millimetre (5 mm) cork borer. Four millimetres (4 mm) Potato Dextrose Agar (PDA) medium discs containing seven (7) days old cultures of the isolates were inoculated into the holes and sealed with the sterile Vaseline. The controls were set up as in accordance with the

methods [19] described except that the inocula consist of uninoculated PDA discs. All the treated tubers were put singly into sterile polythene bags and incubated at 28 ± 2 °C for ten (10) days. The tubers were cut through and examined for the extent of rotting at the end of the incubation period. Using a sterile knife, the tubers were cut longitudinally to revealed infected tissue, allowing the extent of disease spread measured in diameter (mm). The degree of rot or infection as then determined using the formula provided below;

$$\text{Virulence score} = \frac{\text{Lesion area (mm)}}{\text{Tubercle size}}$$

3.0 Results

The results reveals that *Alternaria alternata*, *Aspergillus niger* and *Rhizopus oryzae* were isolated and found to be associated with the damages caused fungal species of sweet potato tuber in Bada villages farms. The most prevalent fungal pathogen within Bada village farms was *A. Niger* 73mm virulence zone, while *A. alternata* and

Rhizopus oryzae each with 13.5mm virulence zone (Table 1).

Table 1: Incidence of Pathogenic Fungal species on Sweet Potato tubers (*I. batatas* Lam)

Fungi Isolates	Virulence Zone (mm)
<i>Rhizopus oryzae</i>	73
<i>Aspergillus niger</i>	13.5
<i>Alternaria alternata</i>	13.5

Results of pathogenicity studies showed that *Rhizopus oryzae* was the most virulent with a virulence zone of 73 mm of the rotten tissues of sweet potato tuber caused by the inoculant in a hole after 10 days incubation period was recorded. *A. alternata* and *A. niger* each with recorded 13.5mm virulence zones. All the fungal isolates were pathogenic on the healthy sweet potato tubers. Upon re-isolation, the rotten tissues yielded a fungus which was identical with the original fungus inoculated. No disease or fungal growth was observed on the controls which were not inoculated with the fungi.



Plate 1. A healthy tuber infected with *Rhizopus oryzae* after 10 days incubation period



Plate 2. A dissected tuber showing the rotten tissues caused *Rhizopus oryzae* after 10 days incubation period



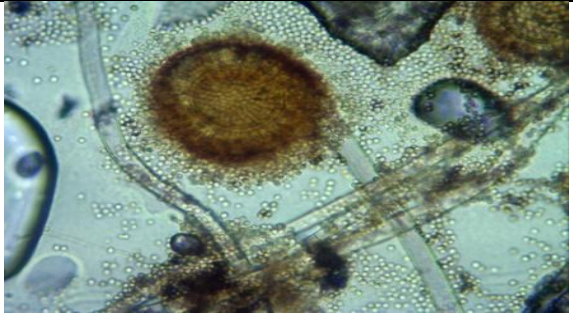
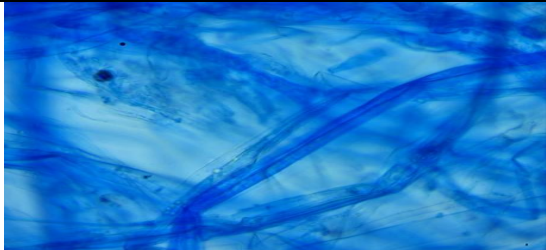
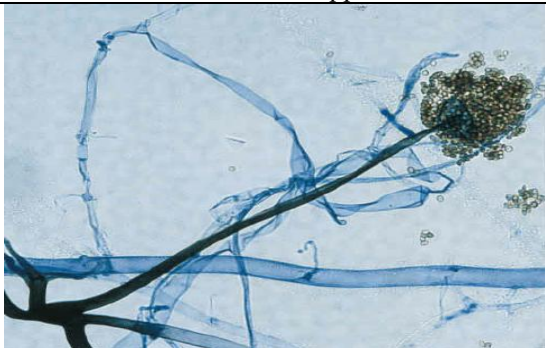
Plate 3. A dissected tuber showing the rotten tissues caused *Aspergillusflavus* after 10days incubation period



Plate 4. Control without inoculum showing no rotten tissues

Plate 1-3 Pathogenicity Test: Appearance of Disease Symptom on Sweet Potato with the Control (**Plate 4**)

Table 2: Identification of the Isolated Species

Cultural characteristics	Microscopic characteristics	Identified Fungal Species
White then green, green-gray then dark green to blackish-gray	Thick septate hyphae with conidia borne in chains from the sterigmata.	 <i>Aspergillus niger</i>
Flat white cottony growth on plate	Erect conidiophores, septate hyphae with cylindrical conidia.	 <i>Alternaria spp</i>
Creamy white in appearance	The hyphae are septate and hyaline. Conidiophores may be either simple or branched. Phialides are arranged in brush-like clusters (penicilli) at the tips of the conidiophores. The conidia are unicellular, spherical or ovoid, either hyaline or pigmented, and may have rough or smooth walls, occurring in chains.	 <i>Rhizopus oryzae</i>

4.0 Discussion

Incidence of fungi associated with deterioration of sweet potato tubers such as *A. alternata*, *A. niger* and *R. oryzae* recorded in this study had also been reported by many researchers in different places except *A. alternata* [20, 21]. The present findings justified that, the three fungi inciting rotten of sweet potato tubers with two species *Aspergillus niger* and *A. alternata* having the same virulence zone value (Table 1) fungal species during the investigated. This work is in line with the findings of [13, 14] whom reported *A. niger* as the specie responsible for post-harvest rot of sweet potato tubers in Wada Market, Zamfara State and Ipodo Market, Lagos State. According to [22], the *A. niger* infection on sweet potato tuber started around a wound as small water soaked dull area with white mycelial growth, followed by black sporulation of the fungus. Rosemary *et al.* (2024) reported that fungal species creates local discolouration and offensive odors of the surrounding tissues of infected tubers between 12 – 14 days of infection. These harmony with what observed in the study in which sweet potato tubers incited with *A. niger* infection characterized by softening of internal tissue, development of black spore mass over the infected area. Studies of [23, 24, 19] support our present findings. The isolation of *R. oryzae* in this investigation agrees with the findings of [25, 19]. Similarly, *R. oryzae* infection was characterized by the development of cottony with white coloured mycelial growth over the wounded area. In addition, the occurrence of *A. alternata* on sweet potato tubers in the study area could represent the first documented case, as no prior records were encountered during the investigation. However, this species has been reported on sweet potato leaf and stem blight in many producing countries, including Nigeria [26]. All the isolates identified are predominant in tropical and subtropical regions. Storage roots are quickly destroyed by a soft, watery rot that consumes the entire tuber, often without significant change in skin color. A distinct sweet, alcohol-like odor develops during infection. The fungus is highly specific about the type of wound it infects, requiring surrounding tissue death before colonization. Harvested roots are affected, with tubers becoming more susceptible after direct sunlight exposure. A heavy presence of fruit flies in storage often signals the disease. Prevention can be achieved through careful handling and prompt curing at optimal temperature and humidity, while fungicide treatment may also aid in control. The

most effective pre-packing strategies involve minimizing mechanical injuries after harvest, ensuring adequate curing and storage [27].

5.0 Conclusion

The study revealed that *A. alternata*, *A. niger*, and *R. oryzae* were found to be the most common fungal tuber pathogens of sweet potato in Bada villages farms, Gwandu. The most virulent fungal pathogen within the study area is *Rhizopus oryzae* (73mm). All the fungal species isolates are contribute to enormous loss of sweet potato tubers both before and after harvest, despite its economic and nutritive value in the studied area. Therefore, there is need for the development of alternative disease control using plants that might be effective in controlling the isolated species.

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