Effect of Harvest On Pathogenic and Non-Pathogenic Losses of Onion and Pepper Grown in Yobe State

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Abstract

Onion (Allium cepa) and pepper (Capsicum annum) are widely consumed vegetables that contribute significantly to food supply worldwide. Despite their importance, these crops are highly perishable due to their soft tissues and high moisture content, making them prone to fungal attack, which leads to considerable post-harvest losses (PHL). Globally, these losses have been estimated at about 42% of annual harvest. This study focused on isolating and identifying both pathogenic and non-pathogenic causes of post-harvest deterioration of onion and pepper in Fune, Yunusari, and Bade Local Government Areas of Yobe State. Information on handling practices was also obtained from farmers and traders through structured questionnaires. A total of 273 fungal colonies were isolated, with species such as Aspergillus niger, Aspergillus flavus, Penicillium spp., and Saccharomyces cerevisiae being identified. The study also found that poor handling during harvesting, packaging, and transportation contributed to non-pathogenic losses, with Yunusari and Bade showing higher incidences compared to Fune. (Alshehri & Palanisamy, 2020; Al-Najada & Gherbawy, 2015)

Introduction

Vegetables are vital food components, often consisting of leaves, roots, bulbs, flowers, seeds, and stems, and are essential in daily diets. They are valuable for their nutrient content, particularly vitamins and minerals, which help maintain health and prevent diseases. Evidence links higher fruit and vegetable intake to a reduced risk of several chronic diseases. However, microbial contamination is a significant issue, often introduced through soil, water, air, or poor post-harvest handling. Fungi such as Aspergillus, Penicillium, and Fusarium can grow on vegetables and may produce harmful mycotoxins that cause allergic reactions, immune suppression, and even cancer. Minimally processed vegetables, frequently consumed raw, pose risks since conventional sanitizers cannot always eliminate pathogens due to the protective structures on vegetable surfaces. In Nigeria, consumption of onion and pepper has risen, but post-harvest spoilage remains a problem. An estimated 20% of vegetables intended for human consumption are lost to microbial spoilage. The contamination may occur at different stages, from seed to distribution. This study was therefore carried out to isolate and identify fungi responsible for spoilage of onion and pepper, and to examine the socio-economic impact of these losses. (Agrios, 2004)

Materials and Methods

Study Area
The research was conducted in Fune, Yunusari, and Bade Local Government Areas of Yobe State, Nigeria. The region is characterized by Sudan Savanna vegetation, with parts of Sahel Savanna found in the far north.

Sample Size
Sixty (60) samples of onion and pepper were collected across the three LGAs.

Sample Collection and Storage
Fresh produce was obtained from local markets in Yunusari, Fune, and Bade. Samples were collected in sterile polythene bags and transported under hygienic conditions to the laboratory.

Isolation and Identification of Microorganisms
Samples were surface-sterilized, cut, homogenized, and subjected to serial dilutions. The dilutions were plated on Potato Dextrose Agar (PDA) and incubated at 25°C for 8–10 days. Emerging colonies were sub-cultured to obtain pure isolates. (American Type Culture Collection [ATCC], 2011)

Microscopic Identification
Isolates were identified using wet mount and slide culture methods with lactophenol cotton blue staining. Observations were made under ×10, ×40, and ×100 magnifications. Morphological features such as hyphae structure and colony appearance were compared with standard references.

Pathogenicity Test
Koch's postulates were applied. Healthy samples were inoculated with fungal mycelia and monitored for disease development. (Agrios, 2004)

Molecular Identification
DNA was extracted using the phenol/chloroform method. ITS gene amplification was done using universal

primers ITS1 and ITS4, and PCR products were analyzed on 1% agarose gel. (Al-Shuhaib et al., 2018)

Results

Out of 60 samples cultured, Aspergillus niger accounted for 43% of isolates, Aspergillus flavus 23%, Saccharomyces cerevisiae 17%, and Penicillium spp. 15%. Molecular analysis confirmed the identity of these fungi. Pathogenicity tests revealed that Aspergillus spp. caused the highest level of rot within two days, while S. cerevisiae showed less virulence.

Table 1: Cultural Identification of Fungi Isolated from Fune, Yunusari and Bade.

S/N	VEGETABLE	LOCATION	FUNGAL ISOLATE
1	**Onion/papper**	Fune	*Aspergillums niger, penicillium, S. cerevisiae*
2	**Onion/ pepper**	**Yunusari**	*Aspergillus niger, Aspergillus flavus penicillium*
3	**Onion/ pepper**	**Bade**	*S. cerevisiae, Aspergillus niger, Aspergillus flavus, Penicillium*

Table 2: Total Fungal Count (Cfu/G) Of samples Sample Obtained from Fune, Yunusari and Bade Local government Area's Markets**.**

S/N	SAMPLE	LOCATION	ORGANISM	(CFU/G)
1.	Pepper/onion	Fune	*Aspergillus niger* *penicillium* S *cerevisiae*	17 7 13
2.	Pepper/onion	Yunusari	*Aspergillus niger Aspergillus flavus* *penicillium*	9 11 9
3.	Pepper/onion	Bade	*S cerevisiae* *Aspergillus niger* *Aspergillus flavus* *Penicillium*	11 15 21 17

Table 3: Percentage of Occurrence of Fungal Isolates from the Sample Sourced from Fune, Yunusari and Bade Local Government Area's Markets.

organism	**Location** Fun	Yun	bad	**Total**	**percentage Occurrence (%)**
Aspergillus niger	+	+	+	3	100%
Aspergillus flavus	_	+	+	2	75.33%
Penicillium	+	+	+	3	100%
S. cerevisiae	+	-	+	2	75.33%

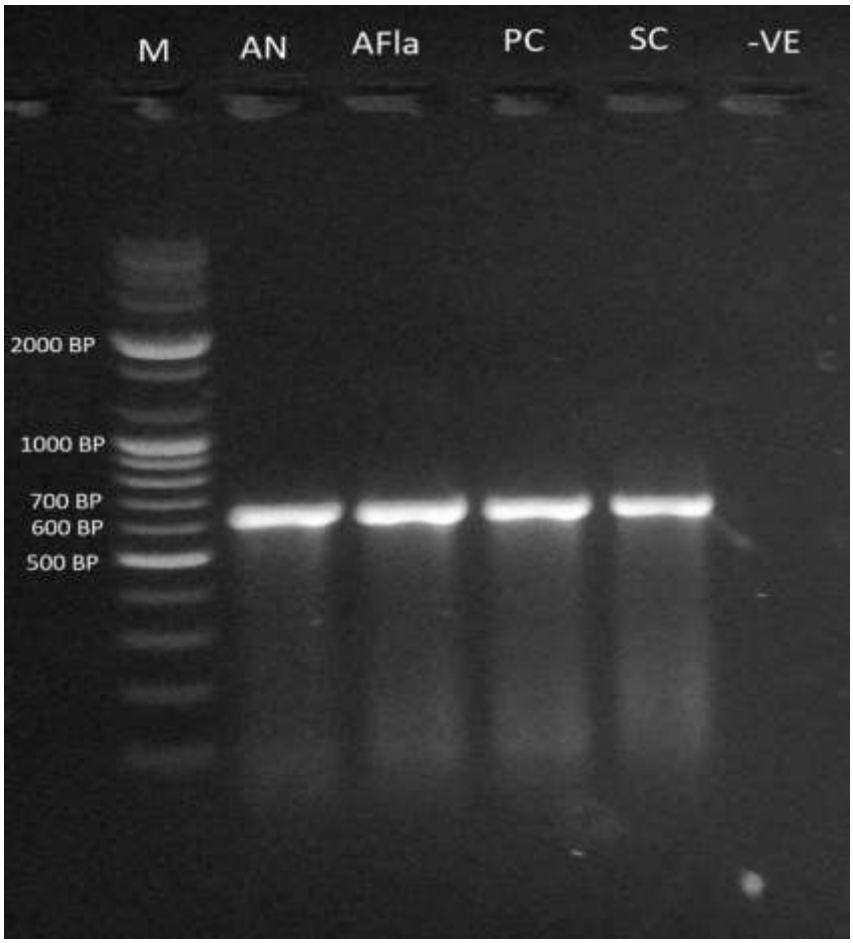


Plate 1: Gel picture of PCR product: The ITS gene amplicons of *Aspergillus niger*, *Aspergillus flavus*, *penicillium*, and *Saccharomyces cerevisiae* isolates shown on GelDoc.
Key: Lane 1= DNA Ladder (M); Lane 2= *Aspergillus niger* (AN); Lane 3= *Aspergillus flavus* (AFLA); Lane 4= *penicillium* (PC); Lane 5= *Saccharomyces cerevisiae* (SC); Lane 6= Negative control.

Table 4: Sequence homology of Fungal Isolates from Fune, Yunusari and Bade Local Government Area's

Test Organism	Request ID	Sequence Identity
Aspergillus niger	3SW46KCJ014	94.46%
Aspergillus flavus	3SWSOA3G016	96.96%
Penicillium	3SX2HCDN013	97.15%
Saccharomyces cerevisiae	3SX72CZU013	96.43%

Table 5: Pathogenecity Test result on fresh/appearing healthy fruit

Fungal Isolate	**Fune**	**Yunusari**	**Bade**
Aspergillus niger	+	+	+
Aspergillus flavus	-	+	+
Penicillium	+	+	+
S. Cerevisiae	+	+	+

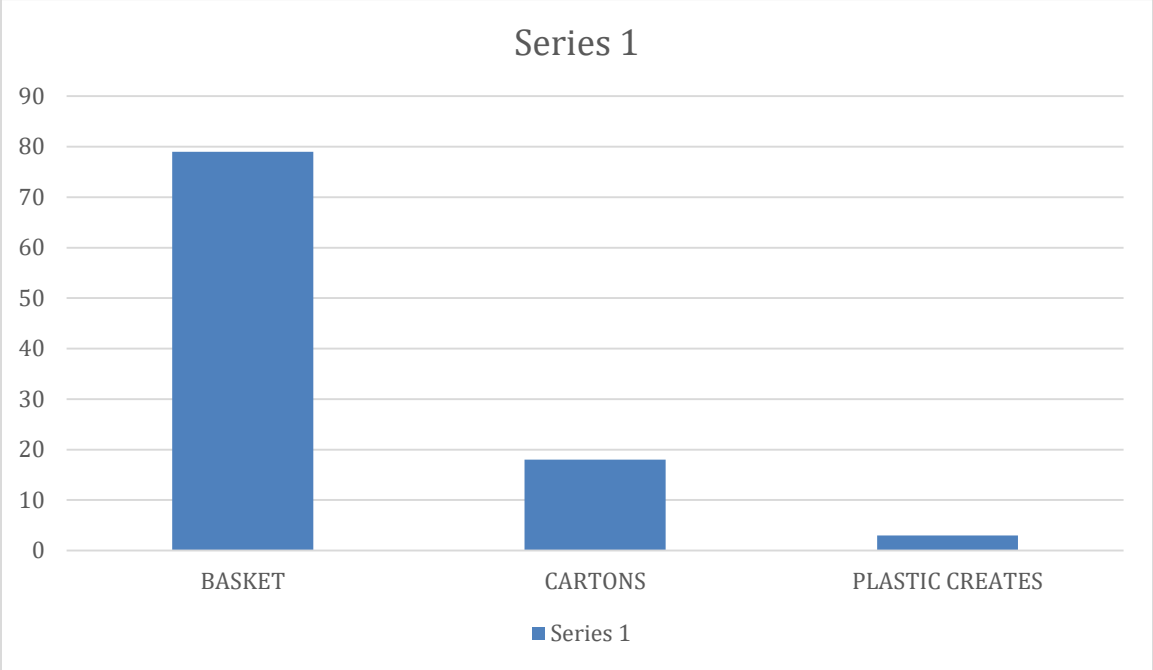
Keys: +, -

Non- Pathogenic Loss of Onion/pepper in Fune, Yunusari and Bade

.Non-pathogenic factors were also significant. From 123 respondents, 78% harvested early in the morning, while 22% harvested later in the day. About 88% of farmers did not treat their produce post-harvest, while 12% applied sodium hypochlorite. Regarding packaging, 79% used baskets, 18% used cartons, and 3% used plastic crates. Transportation methods varied: 57% used pickup trucks, 29% lorries, 10% motorcycles, and 4% bicycles. Commonly reported post-harvest diseases included bacterial soft rot (50%), fusarium rot (45%), and phoma rot (5%). Most farmers (75%) reported higher losses during the rainy season. (Alshehri & Palanisamy, 2020; Al-Najada & Gherbawy, 2015)

Packing materials of pepper/ onion in Fune, Yunusari and Bade Local Government Area's Markets

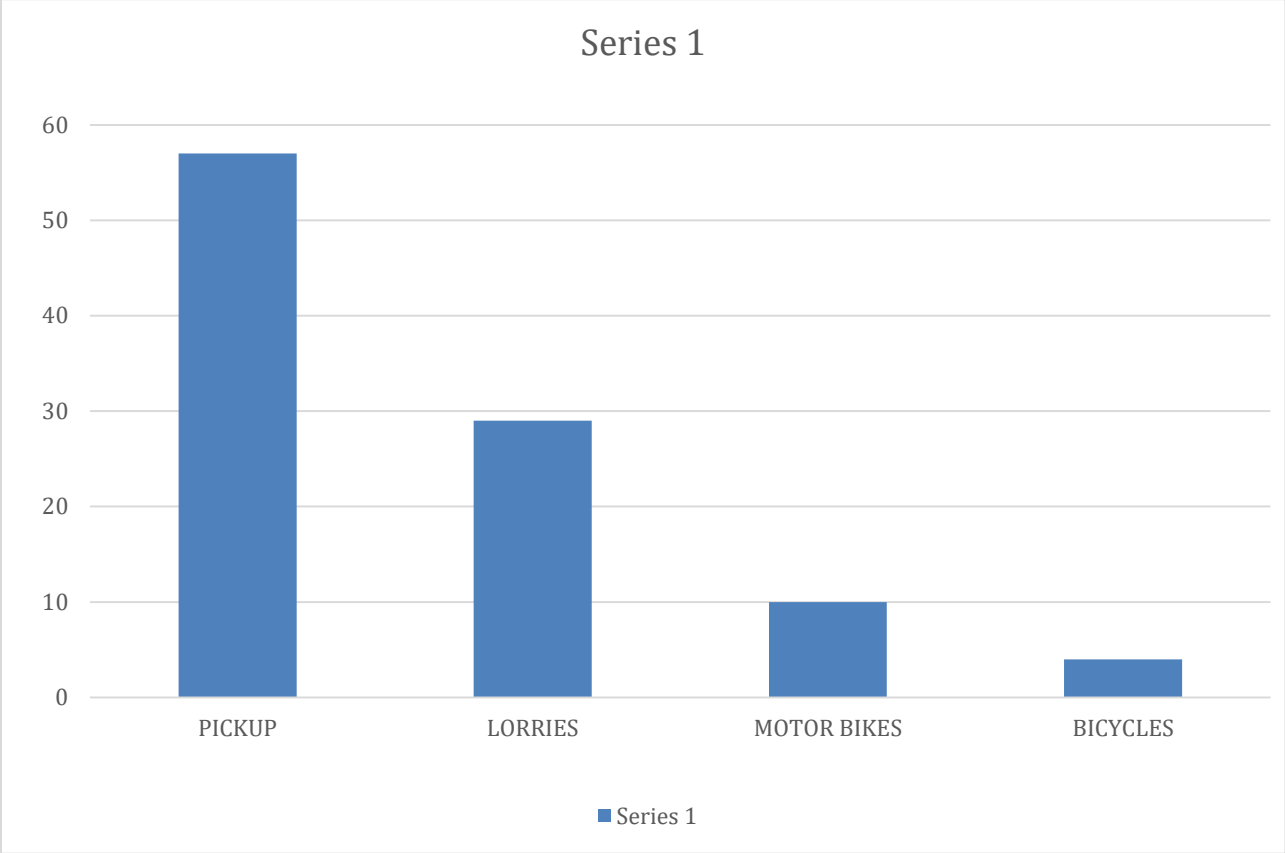
The packing material used by the farmers varied percentage % most of the respondents (79%) packed their fruits on busked and few in cartons (18%). The rest of the respondents (3%) used plastic creates for transportation of tomatoes.



Graph.1: Chart illustrating packing materials of pepper/ onion in Fune, Yunusari and Bade Local Government Area's Markets

Means of Transporting pepper/ onion to Fune, Yunusari and Bade Local Government Area's Markets

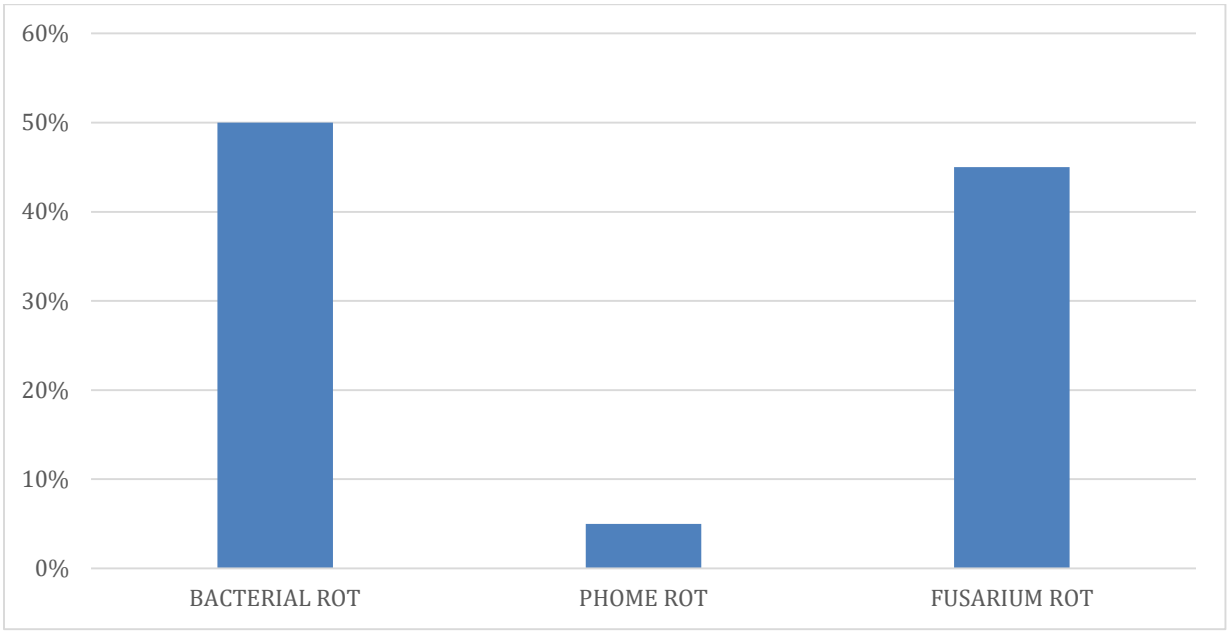
Pepper and onion sold to brokers were transported to the market be use to pickups (57%) and lurries (29%) those who sold in the neighboring markets transported their products by motorbikes (10%) and bicycles (4%) some responded used more than one means of transport depending on availability the means of transport varied significant %.



Graph 2: Chart illustrating means of Transporting pepper/ onion to Fune, Yunusari and Bade Local Government Area's Markets.

Common pepper and onion Post Harvest Diseases affecting farmers

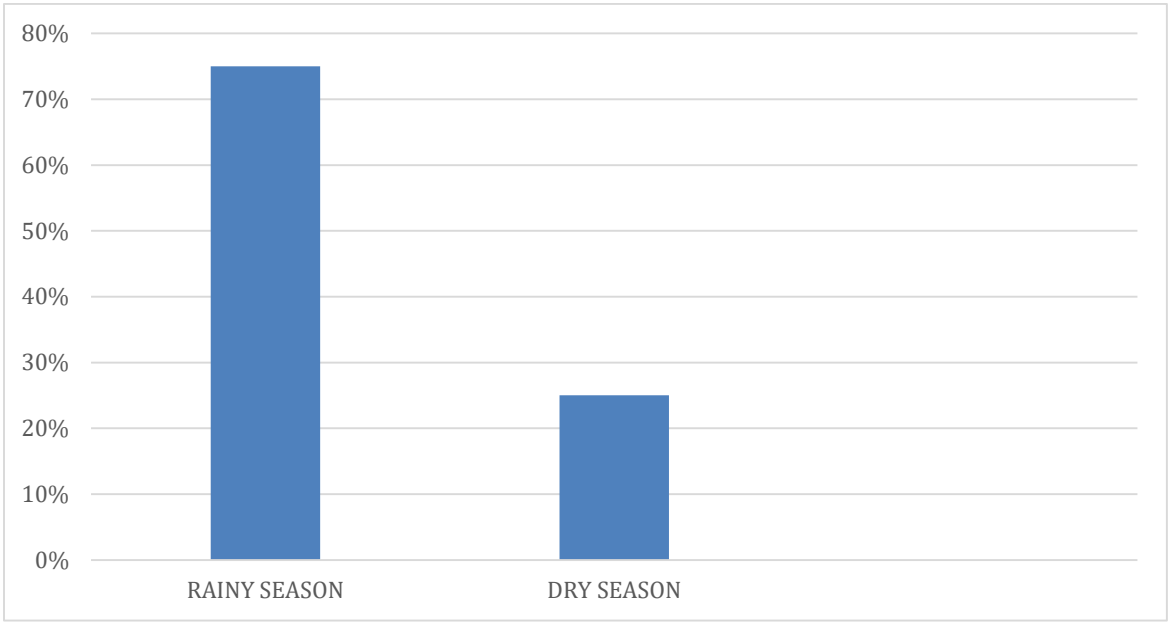
Diseases affecting fruit the respondents (45%) identified fusarium rot and bacterial soft rot 50% as the most damaging diseases. However, 5% of the respondents indicated phoma rot as another disease that affected their fruits.



Graph .3: Chart illustrating Common pepper/onion Post Harvest Diseases affecting Farmers

Season Experiences More Loss

The study revealed 75% of the respondents experiences more losses during rainy season while 25% of the respondents experiences more losses during dry season.



Graph .4: Charts illustrating Season Experiences More Loss

DISCUSSION

Findings confirmed the prevalence of Aspergillus niger, Aspergillus flavus, Penicillium spp., and Saccharomyces cerevisiae in spoiled onions and peppers across the study areas. Similar studies have also identified Aspergillus spp. as the most frequent post-harvest pathogens. Aspergillus niger emerged as the most destructive, in line with earlier reports. Molecular sequencing results further confirmed close genetic similarity with reference strains deposited in GenBank. Non-pathogenic causes, such as poor harvesting practices, use of baskets, improper treatment, and exposure during transportation, also significantly increased spoilage. Losses were particularly high during the rainy season due to increased humidity, which favors fungal growth. These findings highlight the need for better post-harvest handling, improved storage, and education of farmers on effective preservation techniques.

Conclusion.

This study demonstrated that fungal pathogens, particularly Aspergillus niger, Aspergillus flavus, Penicillium spp., and Saccharomyces cerevisiae, are key contributors to onion and pepper spoilage in Yobe State. Aspergillus species were the most virulent, causing rapid deterioration. Non-pathogenic factors such as poor handling, inadequate packaging, and transportation methods also exacerbated losses. Farmers reported higher losses in the rainy season compared to the dry season. Improved post-harvest management practices, including treatment with safe sanitizers, use of improved packaging materials, and better transportation, are essential to reducing these losses. Molecular techniques proved effective in accurately identifying fungal isolates, complementing traditional methods. (Alshehri & Palanisamy, 2020; Al-Najada & Gherbawy, 2015)

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