

**Post-harvest rot diseases of fruits of *Asmina triloba* (*carica papaya*) in some parts of Imo and Abia States of Nigeria**

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**ABSTRACT:**In a survey of post harvest rots of papaw (*Asmina triloba*) fruits carried out in some parts of Imo (Okigwe, Owerri, Orlu and Umuagwo) and Abia States (Aba and Umuahia) of Nigeria, *Botyodiplodia theobrome Pat*, *Rhizopus oryzae* Went Prinsen Georlings; *Aspergillus niger Tieghem* and *Aspergillus flavus* Link ex. Fr. were constantly associated with infected (rotted fruits of pawpaw). These isolates were confirmed in pathogenicity studies to be responsible for fruit rots of pawpaw. The incidence of rots was high (30 - 78.2%) in all the areas studied, with *B. theobromae* being most prevalent. The optimum temperature for rot development was 30°C but it was observed that lower temperatures between 5 - 10°C discouraged rot incidence and development. Some control measures like careful handling, orchard sprays and hot water dips were recommended.

**KEYWORDS:** Post-harvest, rot, diseases, fruits, *Asmina triloba*, Imo and Abia State

**INTRODUCTION**

Pawpaw (*Asmina triloba*) is a prominent fruit crop in Nigeria whose products are a rich source of vitamin C. The fruits of pawpaw mature during the months between September and December but are highly perishable and cannot be stored for more than one week after harvest. They are usually very susceptible to spoilage particularly under hot and humid conditions.

One of the most important biochemical changes which occur in the pawpaw fruit during ripening is an increase in the quality of sugars present (Orr *et. al.* 1953). The fruits are bulky and because of their easy deteriorating nature, must be harvested green for long distant transportation (Naceeb and Broughton, 1978). During collection, storage and transportation, the fruits are exposed to various macro and micro environments where they respond to changes in temperature and relative humidity conditions (Awada, 1958; Ezeibekwe, 1992).

Serious disease problems have been encountered at temperatures of 30°C or above under high relative humidity (Ezeibekwe, 1992). Considering the importance of pawpaw in the nutritional health of Nigerians, the present paper was aimed at evaluating the post harvest damage of pawpaw and the associated pathogens.

**MATERIALS AND METHOD**

**Disease Survey**

The incidence and severity of rots on pawpaw fruits at different stages of maturity and ripening were recorded in the following areas of Abia State, Aba and Umuahia while the areas of Imo State are, Okigwe, Orlu and Umuagwo.

Losses produced as a result of each type of rot and deterioration problem was assessed as a percentage of the total fruits assessed. One hundred fruits were randomly screened for the presence of rot and the percentage incidence of rot is expressed as;

$$\frac{\text{Total no of diseased fruits}}{\text{Total of fruits observed}} \times \frac{100}{1}$$

The severity of rot infection was assessed by using the following scale.

- 0% of fruit body covered with rot no infection.
- 1- 20% (1) of fruit body covered with rot slight infection
- 21- 40% (2) of fruit body covered with rot moderate infection
- 41- 60% (3) of fruit body covered with rot extensive infection
- 61 - 80% (4) of fruit body covered with rot very extensive infection
- 81 - 100% (5) of fruit body covered with rot completely rotted

A percentage rot score per sample of 100 fruits was derived from the total rot scores as follows:

$$\text{Severity} = \frac{\text{sum of numerical ratings}}{\text{Total no of observed fruits}} \times \frac{100}{\text{max. disease class (5)}}$$

**Isolation and Identification of Associated Organisms**

Some rot specimens were collected from the diseased pawpaw fruits collected from the six locations in Abia and Imo States of Nigeria. The rot specimens were inoculated on a Potato Dextrose Agar (PDA) in twenty-five (25) Petri dishes, and incubated for five days at 25°C.

Fungi associated with rots were isolated and sub-cultured for identification on separate Petri-dishes containing Potato Dextrose Agar. The isolated fungi were tested for pathogenicity by inoculations into healthy fruits according to the method described by Gollifer and Booth (1973) as follows:-

Ten (10) matured healthy fruits from each of the six locations were surface sterilized by thoroughly scrubbing their surface with cotton wool soaked with Calcium hypochloride, rinsed in sterile distilled water and allowed to dry naturally in a sterilized environment of a glass container. Cylindrical discs (1 cm deep) were removed from the fruits with a 10mm sterile cork borer.

10mm discs of five day old actively growing fungal cultures were introduced aseptically into the holes made in the fruits. Sterile paraffin was applied at the point of inoculation to exclude extraneous pathogens.

Discs of non-inoculated (Sterile) PDA were used as control experiments. The inoculated fruits were each enclosed in a sterile polythene bag and incubated for seven days at 25°C. A micro-humidity environment was achieved by enclosing a sterile water-soaked aseptic cotton wool in each set up.

Re-isolation of the pathogen was carried out using a sterilized and flamed-knife. Small pieces of tissues about 3mm from the advancing edge of the rot were removed from the inoculated fruits, placed on PDA and incubated at room temperature for five days and re-isolations made.

### IDENTIFICATION OF ISOLATED FUNGI

Fungi isolated were identified and characterized by using Barnett and Hunter (1987), and pictures of the cultures (macro and microscopic) were taken from culture plates and from prepared slides. Percentage occurrence of the fungi species diseased fruits were recorded.

### EXPERIMENTAL DESIGN

The experimental design used were Randomized Complete Block Design (RCBD) and Analysis of Variance (ANOVA) used to separate the means using Least Significant Differences (LSD) to determine levels of significance. Daily readings were taken for 5 days measuring the diameter of growth on the plates.

### RESULTS

#### Disease Survey

A high incidence of fruit rot ranging from 30.6 78.2% was recorded in the areas studied and the diseases observed included *Anthraxnose* rot, Chocolate spot, stem end rot, stem-end *Rhizopus* rot, Blue mold rot and bacterial rots (Table 1).

The percentage incidence of disease reported in the six localities was also high ranging from 30.6 78.2% (Table 1).

The percentage severity of diseases was high in all the areas ranging from 28.3 56.2% (Table 2).

The Percentage incidence of lesions associated with presence of specific pathogens isolated from pawpaw fruits from the six locations were fairly high, ranging from 45.2 70.1% (Table 3).

The severity of lesions associated with the presence of specific pathogens on pawpaw fruits from the six locations ranged from 18.6 48.5% (Table 4).

The percentage occurrence of each pathogen in each of the studied locations is appreciably high (Table 5). The mean diameter (cm) of rots recorded from inoculated pawpaw fruits incubated at different temperatures is presented in Table 6. The percentage incidence of diseases in all location is presented in Table 7.

#### Pathogenicity Tests

Results of the pathogenicity tests confirmed that *B. theobromae* Pat, *Rhizopus oryzae* Went and Prinsen

Georlings, *Aspergillus niger* Tiegbem, and *Aspergillus flavus* Link ex. Fr. were implicated in rotting of the pawpaw fruits, Plates 1,2,3 and 4 represented the various pathogens as were isolated from the rotted pawpaw fruits.

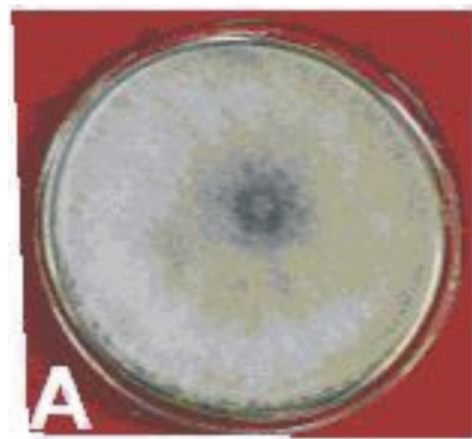


Plate 1: Culture (A) Hyphae, Conidium, and (B) Chlamydospores of *B. theobromae*

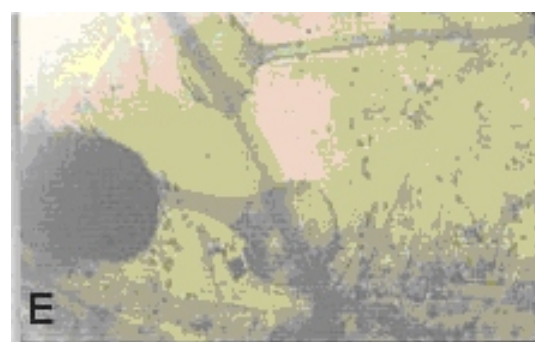
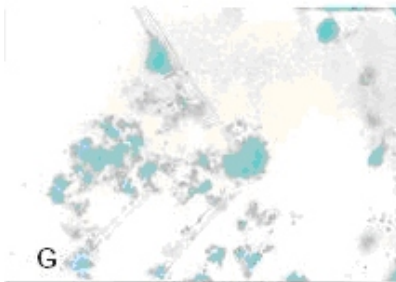
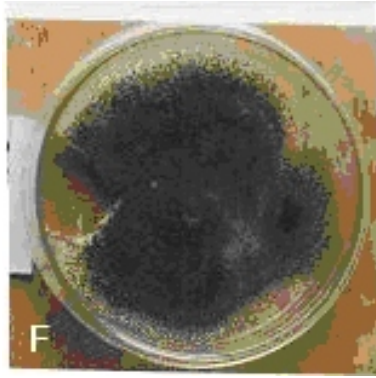
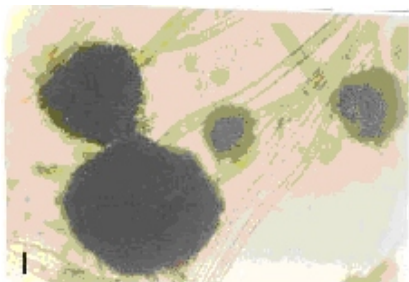
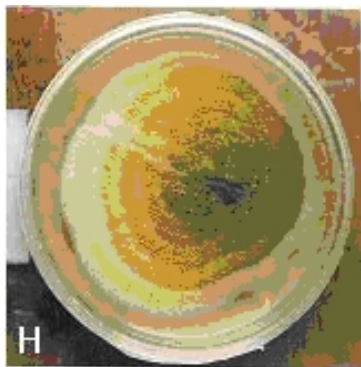


Plate 2: Culture (C) Mycelium and Sporangium (D) Columella, and (E) Sporangioophores with Sporangia of *Rhizopus oryzae*



**Plate 3:** Culture (F), Conidiophores and (G) Conidia of *A. Niger*



**Plate 4:** Culture (H) Conidiophores and (I) Conidia of *A. Flavus*

*B. theobromae* was most frequently associated with infected pawpaw fruits in all the locations as shown in the Table 5 and 6. All the pathogens as shown were pathologically significant at 0.05 and 0.01 levels. The incidence of rot disease was high in all the areas, but Umuagwo had the highest incidence of 82% followed by Owerri 80% and Aba 70% (Table 7).

### Symptoms

- (i) *Botryodiplodia theobromae* produced a spongy soft rot characterized by water-soaked lesions which spread gradually. Lesions were circular and grayish, affected parts became leathery, turning from white to dirty white and black with age.
- (ii) *R. oryzae* produced soft rot on pawpaw fruits characterized by water-soaked lesions. The rot spread fast and the fruit got completely rotted in four days of incubation. The rotted portion was discoloured dirty white or cream colour producing pungent odour.
- (iii) *Aspergillus niger* produced a purple brown discolouration which spread slowly producing a wet rot confined as small circular lesions.
- (iv) *Aspergillus flavus* produced dry rot as light coloured circular lesion. The lesions progressed very slowly bearing patches of white mycelia with yellowish green powder spore masses.

### DISCUSSION

The assessment of post harvest rot disease of pawpaw fruits in the six locations of Imo and Abia States of Nigeria showed a high incidence of rot disease resulting in high post harvest losses of the fruits.

Anthraco disease was considered the most important post harvest disease in the six locations studied. This finding agrees with that of Dickman and Alvarez (1983) who reported that Anthracnose of pawpaw was caused by the fungus *Colletotrichum gloeosporioides* in Hawaii and in many other tropical regions where pawpaw is grown.

Pawpaw fruits show very little evidence of infection when picked at the major green stage and symptoms develop during the post climacteric phase of maturation which is the ripening phases. Thus, infection appears to take place near maturity and during the post harvest handling. This again agrees with the findings of Dickman and Alvarez (1983) who worked on latent infection of pawpaw in Hawaii. According to them, most post harvest diseases of pawpaw were initiated in the field; and that Anthracnose was present before harvest at latent infection.

The frequency of occurrence of the isolates varied within the locations. However *B. theobromae* was most frequently associated with infected pawpaw fruit deterioration, and predisposes the fruits to other pathogenic attack and enhancing the dissemination of other diseases.

It was observed that methods of harvesting, handling and transportation of the fruits predisposed them to mechanical injury through which most of the pathogens attack them.

The prevalent environmental conditions of temperature and relative humidity affect rot development. Most of the pathogens caused lots of decay of the fruits at temperature range of 25°C 30°C which fall within ambient temperature. Rot development is favoured by high relative humidities. This is in line with Nwufor (1980) who reported that at Umudike the high incidence of storage rots on cocoyam may be contributed by the mean relative humidity of 85% recorded during the survey.

**Table 1: The Percentage Incidence of Disease in Abia and Imo States of Nigeria**

Towns	Aba	Umuahia	Okigwe	Orlu	Owerri	Umuagwo
Anthracnose	78	65	65	60	64.1	66.5
Anthracnose (Chocolate Spot)	40.5	46.6	46.6	33.5	40.1	35.8
Stem-end Rot	30.1	24.6	15.5	18.1	25.1	18.4
Rhizopus rot	15.0	9.5	8.5	10.1	12.5	8.8
Blue mold Rot	8.0	6.6	7.0	8.6	8.2	5.2
Bacterial Rot	4.0	3.5	4.6	5.0	3.5	2.8
% Disease Incidence	78.2	56.1	52.6	34.6	60.2	30.6
$\bar{X} \pm S$	<b>27.73±25.48</b>	<b>25.76±22.75</b>	<b>21.31±19.70</b>	<b>23.47±19.7</b>	<b>26.29±21.12</b>	<b>22.84±22.49</b>

Data are means of five determinations from field and market surveys in each location.

**Table 2: The Percentage Severity of Disease Reported in Pawpaw Fruits in the Six Areas of Imo and Abia States**

Towns	Aba	Umuahia	Okigwe	Orlu	Owerri	Umuagwo
Anthracnose	50.1	54.2	3.56	40.1	45.0	42.5
Anthracnose (Chocolate Spot)	33.5	40	29.6	32.4	44	30.
Stem-end Rot	20.1	18.2	10.6	15.1	22.1	16.4
Rhizopus rot	10.0	8.6	6.2	8.2	10.1	7.5
Blue mold Rot	5.5	4.5	4.2	5.6	6.2	3.8
Bacterial Rot	4.0	2.5	3.0	3.5	2.1	1.0
% Disease Incidence	15.1	45.2	36.5	30.3	42.6	28.3
$\bar{X} \pm S$	<b>19.7±16.81</b>	<b>15.3±13.81</b>	<b>14.74±12.8</b>	<b>13.4±10.53</b>	<b>19.57±15.49</b>	<b>16.4±15.00</b>

Data are means of five determinations from field and market surveys in each location.

**Table 3: Percentage Incidence of Lesions and the associated Pathogens on Pawpaw Fruit at the Six Locations**

Towns	Aba	Umuahia	Okigwe	Orlu	Owerri	Umuagwo
<i>B. theobromae</i>	50.1	42.5	23.8	18.1	28.1	36.2
<i>R. oryzae</i>	7.1	8.3	5.0	4.2	6.8	7.1
<i>A. niger</i>	11.0	1.3	8.1	10.0	15.2	7.1
<i>A. flavus</i>	8.2	6.5	8.3	9.1	11.2	12.1
% Disease Incidence	66.4	56.1	52.6	34.6	60.2	30.6
$\bar{X} \pm S$	<b>19.1±20.7</b>	<b>17.6±8.84</b>	<b>11.41±8.88</b>	<b>10.4±9.13</b>	<b>15.3±9.18</b>	<b>18.4±12.71</b>

Data are means of five determinations from field and storage places/market in each locations.

**Table 4: Percentage Severity of Lesions with the associated Pathogens on Pawpaw Fruit at the Six Locations**

Towns	Aba	Umuahia	Okigwe	Orlu	Owerri	Umuagwo
<i>B. theobromae</i>	32.2	38.2	26.6	12.8	10.6	30.4
<i>R. oryzae</i>	3.5	2.8	2.4	1.8	2.2	3.2
<i>A. niger</i>	4.1	5.5	3.8	6.2	4.5	2.3
<i>A. flavus</i>	1.5	2.0	3.0	1.5	1.2	1.0
% Disease Incidence	41.2	48.5	25.5	18.6	21.1	40.2
$\bar{X} \pm S$	<b>10.3±14.6</b>	<b>0.5±15.54</b>	<b>8.93±11.73</b>	<b>5.58±5.3</b>	<b>4.6±4.21</b>	<b>9.2±14.15</b>

Data are means of five determinations from field and storage places/market in each locations.

**Table 5: Percentage Occurrence of each Pathogen in each location**

Location	PATHOGENS			
	<i>R. oryzae</i>	<i>B. theobromae</i>	<i>A. niger</i>	<i>A. flavus</i>
Aba	7.5%	17.5%	10.0%	9.0%
Umuahia	5.0%	12.5%	7.5%	5.5%
Okigwe	2.5%	7.5%	4.0%	4.5%
Orlu	5.0%	19.0%	9.0%	7.0%
Owerri	4.0%	7.5%	5.5%	4.5%
Umuagwo	3.0%	9.0%	4.5%	4.5%

Note:- % of rot is expressed as % of total rots.

**Table 6: Mean diameter (cm) of rots Recorded from Inoculated Pawpaw Fruits Incubated at Different temperatures**

Incubated Temperatures	<i>R. oryzae</i>	<i>B. theobromae</i>	<i>A. niger</i>	<i>A. flavus</i>
5	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
15	3.28±1.268	4.17±1.656	2.32±0.506	1.64±0.044
20	4.66±2.648	4.58±2.056	2.68±866	2.88±1.284
25	4.75±2.738	4.70±2.176	3.54±1.726	3.34±1.744
30	5.04±3.028	5.52±2.996	3.96±2.146	3.22±1.624
35	0.038±1.632	3.30±0.776	2.75±0.936	2.22±0.624

**Table 7: Percentage disease Incidence (All types of Diseases Included in the Field)**

Location	Percentage Incidence/SD	
Aba	79±4.67%	b
Umuahia	72±2.33%	c
Okigwe	68±6.33%	d
Orlu	65±9.33%	e
Owerri	80±5.67%	ab
Umuagwo	82±7.67%	a

L.S.D

0.05 = 2.81

\* Values having the same letter(s) are not significantly different at 0.05.

### CONCLUSION

Wounds inflicted on pawpaw fruits during harvesting, transportation, and storage form the entry sites of pathogens and if avoided could reduce the incidence of disease in the fruits and may render them less predisposed to fungal attack.

Orchard Sprays have been found to be essential in the control of post harvest disease and also for post harvest treatment. According to Alvarez and Nelson (1982), carefully controlled hot water dips of fruits produced fairly good results of disease control. Pawpaw fruits should be harvested mature green especially as they are climacteric fruits.

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