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A COMPARATIVE ANALYSIS OF BARN AND PLATFORM AS STORAGE STRUCTURES FOR YAM TUBER IN IBADAN, NIGERIA

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Abstract : An experimental study was undertaken to evaluate and compare the performances of a local barn and a platform, as storage structures for yam tubers (Dioscorea rotundata poir.) The criteria used for evaluation and comparison were the degree of weight loss during storage, tuber sprouting and rotting of yam tubers during a 17 week storage duration between March and June 2008. Measurements of temperatures and relative humidity in the storage environment were taken thrice daily during the period. Weight loss in each tuber was measured weekly while sprouts were removed from tubers fortnightly. Results show that the average temperature and relative humidity on the platform were 30.4°C and 57.3% respectively while for the barn, they were 26.5°C and 55.5% respectively. The average weight loss in tubers in the barn during the duration was 32.8% while for tubers on the platform, it was 30.3%. Yam tubers on the platform recorded 5.4% sprouting while those in the barn had 4.9% sprouting. Palm leaves cover for yam tubers on the platform protected the tubers from excessive heat and moisture loss. Rotting was observed in 10% of the tubers stored in the barn but was completely absent from those stored on the platform.

Introduction

Yam belongs to the genus Dioscorea which has 600 species but only about six of which are cultivated for human consumption while a few non-edible ones are cultivated for industrial raw materials. Yam plays a prominent role in a variety of human food diets and livestock feed in many of the areas where it is cultivated. ((Lancaster and Coursey, 1984; Opara, 1999; IITA, 2008). Yam has socio-economic and cultural values in many parts of the world, these being manifested in the celebration of traditional ceremonies to usher in the new yam season (opara, 1999). In some parts of Nigeria, it is customary for the parents of a bride to offer her yams for planting as a resource to assist them in raising a family. The meals offered to gods and ancestors by some traditionalists consist principally of mashed yam. A well-built and well stocked yam barn is one the major factors through which a man gains prestige in some communities (Lancaster and Coursey 1984; Opara, 1999).

Keywords : Barn, platform, sprouting, weight loss, yam tuber

Although yam can be cultivated in many environments with a temperature of between 25 and 30°C; an annual rainfall of about 1,000 – 1,500 mm distributed evenly over the vegetative period of five to six months and deep, fertile, friable and well drained soils, majority of the world's yams are cultivated in sub-Saharan Africa. The 2005 world yam production records show that, of the annual production of 48.7 million tonnes from about 47 countries of the tropical and sub-tropical regions, 97% was produced in sub-Saharan Africa with Nigeria alone accounting for about 70% Ghana is the world's largest exporter of yam with an annual export of about 12,000 tonnes (IITA, 2008).

Most edible yams species reach maturity in 8-11 months after planting. As a seasonal crop, harvested yam tubers are stored to meet the demand during the offseason period. Adequate aeration, reduction of temperature, protection from direct sunlight and flood; and regular inspection of produce are the basic requirements for successful and long term storage of yam tubers (Wilson, 1980; Lancaster and Coursey, 1984, Orhevba and Osunde, 2006). Ventilation prevents moisture condensation on the tuber surface and assists in removing the heat of respiration. Low temperature is necessary to reduce losses from respiration, sprouting and rotting; while regular inspection is important to remove sprouts, rotted tubers, and to monitor the presence of rodents and pests. Dormancy in stored yam tubers, is the period after harvest during which sprouting is inhibited. It is influenced by the yam species, temperature and relative humidity of the storage environment. At lower temperatures, the rate of respiration is reduced, the formation of germ is delayed and the onset of sprouting can be prolonged leading to longer storage periods. (Orraca-Tetteh, 1978; Knoth, 1993, Shiwachi et. al., 2002).

The structures used for the storage of yam tubers are numerous. Some of the storage structures include trench or clamp silos, underground pits; barns of various designs; shelves in specially constructed or improvised sheds; raised huts, and assorted platforms. The popularity of these structures varies from one region to another, and the choice made depends on the volume to be stored and what the farmer can afford.

Oyo State lies between latitude 7°03' and 9°23' N and between longitude 2°47' and 4°35'E, with an annual rainfall of about 1,300mm distributed over 8–month period. Yam is one of the most popular crops cultivated by the farmers, which after harvest is stored either as chips or tubers. The barn and platform are among the most popular structures used for the storage of the tubers. The work reported here was undertaken to evaluate and compare the performances of these two structures for the storage of the yam tuber.

Materials and methods

(a) Experimental site

A hilltop under a tree shade within the premises of the Department of Agricultural and Environmental Engineering, University of Ibadan was selected to simulate the traditional practice whereby farmers prefer elevated sites under shades with adequate drainage and unobstructed ventilation for the storage of yam tubers.

(b) Storage structures :

The storage structures used for this study were a barn and platform.

The barn was constructed of main vertical poles from Gliricidia sepium species. Holes of 30cm depth and spaced 30cm apart were dug along the perimeter of the 2.7m by 1.7m barn for the support of the main vertical members. Poles of average diameter of 5cm were used as main vertical members. The main members were held together by smaller diameter poles pleed horizontally and tied using cordage. The exterior of the barn was covered with palm leaves tied to the poles. The palm leaves were also used as roofing material for the barn which was 1.9m above the floor. A small entrance was created for the purpose of inspection. The yam tubers were placed horizontally along the height of the main members, one above the other and tied using cordage (Plate 1).

For the construction of the platform, four holes to a depth of 30cm were dug at the corners of a 0.9m × 0.9m square. Four 1.2 m high Y-fork columns of diameter 8cm were inserted in the holes and compacted. Metal sheets were cut, shaped and wound round the columns to serve as rodent guards. Split bambusa vulgaris were laid horizontally on top of the columns to form the platform. The yam tubers were then heaped on the platform and covered with palm leaves (Plate 2).

Plate-1 : An interior section of the yam barn.

Plate-2 : A platform with yam in stotage.

(c) Sourcing of yam tubers.

The yam tubers used for this study were white yam (D. rotundata Poir.) which is the most commonly cultivated species among the farmers in the area of study. The tubers used were harvested from a farm at Igboho, a popular yam growing community in Oyo state. The authors undertook the harvestng in order to ensure that there was no mix up of species. The harvesting was carefully done to ensure that no mechanical damages were inflicted on the tubers. The tubers were cleaned by trimming off roots attachment.

(d) Experimentation

The experimentation consisted of monitoring the temperature and relative humidity of the storage environments, the weight in the tubers and the rate of sprouting in the tubers.

Temperatures and relative humidity were monitored using wet and dry bulb thermometers and hygrometers. Three readings; at 8.00 am; 12.00 noon and 6.00 pm were taken daily and averaged on weekly basis.

The tubers were labeled for ease of identification and weighed before the commencement of the experiment. The weights of the tubers were taken every week and the difference between subsequent weights represented the weekly loss. Weights were measured with Digital AND SK 2000 Weighing Balance sensitive to 1g and 2kg capacity. The sprouts were removed fortnightly and weighed.

During the weekly weighing periods, the tubers were also observed for physical defects such as rotting and insect attack.

The experiment was carried out for a period of 17 weeks between March and June 2008.

Results and discussion

(a) Storage Environment

The platform and barn temperatures are presented in Fig-1. While the temperatures in the platform varied from 23.1°C to 32°C with an average value of 30.4°C, those within the barn varied from 23.0°C to 31.7°C with an average value of 26.5°C. The temperatures within the barn were generally lower than those recorded in the platform for all periods throughout the experimentation period.

The relative humidity ranged from 44 – 78.3% with an average value of 55.5% for the barn while for the platform, the range was from 47 – 80% with an average of 57.3%. Although there were a few overlaps, the relative humidity within the barn was generally lower than for the platform (Fig.-2).

The variation in the environmental conditions within the two structures is attributed to the mulching effect of the palm leaves used on the platform. There is more ventilation within the barn which favours the release of heat and moisture from the enclosure unlike the platform in which the palm leaves acted as a barrier and inhibited the escape of heat and moisture.

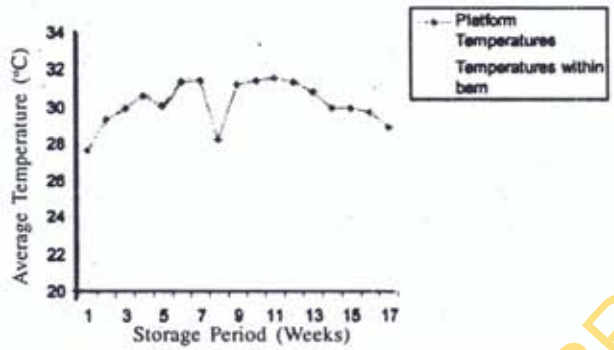

Figure-1 : Temperature Fluctuations with Storage Period

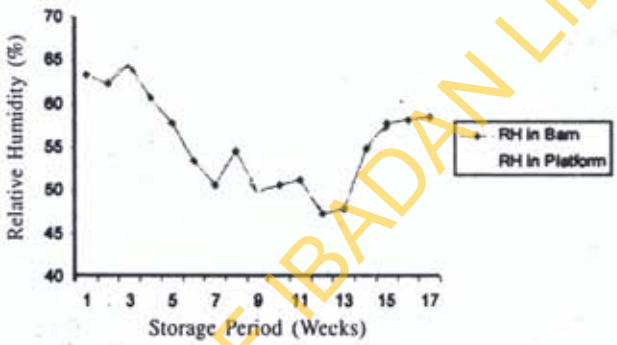

Figure-2 : Relative Humidity Versus Storage Period

(b) Weight Loss

The weekly rate and cumulative weight losses observed in the stored yam tubers are presented in Figs-3 and 4 while the summary of the statistical analysis is presented in table-1. The values of the weekly weight losses were higher in the barn than the platform except for the 2nd, 4th and 11th weeks when the rate was observed to be higher on the platform than the barn. Although there was no significant difference ($p > 0.05$) between the rates of weight losses in the barn and the platform, the mean value for the barn (1.93) was higher than platform (1.78). Weight loss in stored yam tubers is attributed to three factors. These are moisture loss through transpiration, respiration and sprouting which exhaust the food stored in the yam. Of the three factors, moisture loss is reported to contribute the highest percentage to the weight loss even though such loss may not be in terms of the edible portion of the tuber (Orraca-Tetteh, 1978; Wilson, 1980).

The observed difference in weight loss between the yam tubers stored in the two structures can be attributed to the amount of moisture loss. The palm leaves used for covering acted as mulch which restricted the rate of moisture loss from the tubers unlike the tubers in the barn which were not as protected.

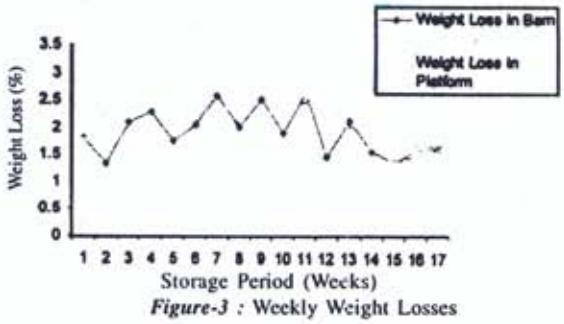

Figure-3 : Weekly Weight Losses

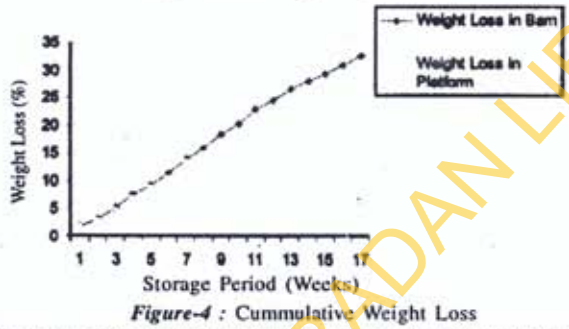

Figure-4 : Cummulative Weight Loss

Table-1 : t-test for weight loss in tubers stored in barn and platform

Group	N	x	SD	df	t	Sig. t
Barn	17	1.93	0.42	32	0.96*	0.86
Platform	17	1.78	0.49			

*Not sig. at $p > 0.05$

(c) Sprouting

The weekly and cumulative data of sprouts in the yam tubers stored in the two structures are presented in Figs.-5 and 6 while the summary of the statistical analysis is presented in table-2. Although there was no significant difference ($p > 0.05$) between the sprouting in barn and the platform, the mean value for the barn (0.62) was lower than the platform (0.68). Sprouting is promoted by humid environment and high temperatures. The higher relative humidity and temperatures within the yam tubers stored on the platform are the major factors responsible for the higher sprouting in the platform than the barn

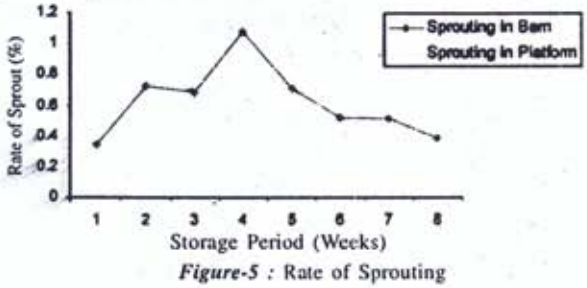

Figure-5 : Rate of Sprouting

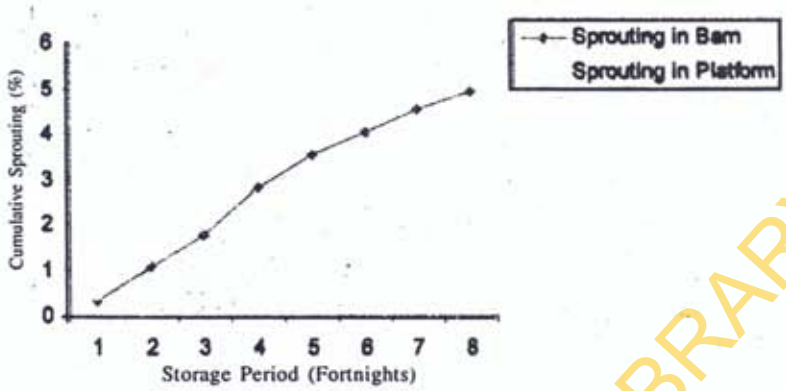

Figure-6 : Cumulative Sprouting

Table-2 : t-test for sprouting in tubers stored in barn and platform

Group	N	x	SD	df	t	Sig. t
Barn	8	0.62	0.23	14	0.46*	0.21
Platform	8	0.86	0.29			

*Not sig. at $p > 0.05$

(d) Physical Observation

Rotting of yam tubers was one of the physical parmeters considered in this study. At the 5th week of storage, rotting was initiated in three tubers within the barn and by the end of the 14th week, a tuber had completely rotted. There was however no incidence of rotting among the yam tubers stored on the platform throughout the period of experiment.

Conclusions and recommendations

Yam tubers were stored in barn and platform over a period of 17 weeks. While the barn maintained an environment of 26.5°C and 55.5% relative humidity, the platform environment was 30.4°C and 57.3% relative humidity. The yam tubers stored on the platform were found to have sprouted more (5.42%) than those in the barn (4.93%) but the overall weight loss in the yam tubers was more in the barn (32.8%) than on the platform (30.3%). The mulching effect of the palm leaves cover for the yam tubers stored on the platform was considered a possible factor. There was no rotting observed among the tubers stored on the platform as against the barn where rotting was observed in about 10% of the yam tubers. The platform is able to reduce weight loss which is to the advantage of the farmer as yams are priced on weight basis and it may therefore be preferred. Further work which should involve longer storage periods and determination of the qualities of the stored yam tubers is recommended.

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