TITLE PAGE

'URE AND MOISTURE VARIATION IN YAM STORAGE BARN.

BY

NDANUSA ABDULLAHI

PGD/AGRIC/98/99/37

AS A PARTIAL FULFILLMENT FOR THE AWARD OF POST GRADUATE DIPLOMA (PDA) IN SOIL AND WATER ENGINEERING DEPARTMENT OF AGRICULTURAL ENGINEERING SCHOOL OF ENGINEERING FEDERAL UNIVERSITY OF TECHNOLOGY MINNA NIGER STATE.

AUGUST, 2000

APPROVAL PAGE

This project tittle soil temperature and moisture variation in yam storage barn meet the regulation governing the award of PGD soil and water engineering with Federal University of Technology Minna S.E.E.T.

PROJECT SUPERVISOR

Mrs. Z.D Osunde

HEAD OF DEPARTMENT

Engr. (Dr.) M.G Yisa

DEDICATION

This work is dedicated to my parents Alh. Ndanusa (Ndamarakin Nupe) and Hadisatu Ndanusa. It is also dedicated to my wife and children, whose encouragement, patience and tolerance during the period of my study and enables me to complete this project.

DECLARATION PAGE

This is to certify that this work was carried out by Ndanusa Abdulaahi at Federal University of Technology Minna under my supervisor.

TABLE OF CONTENT

ABSTRACT

Yams are stored principally to provide seeds for the next planting season and to make them available for human consumption during the period between planting and harvest despite its importance the post harvest storage of yams has received very little attention. This project is therefore to assess soil temperature time and moisture variation in different storage structures (pit, improved and local barn) its effect on weight loss and sprouting of yam tubers were considered. The result of the experiment reveal that for the structures, weight loss and sprouting rate of yam tubers increases with the storage period of the three structures local barn exhibit lower weight loss and sprouting rate in a storage period with a minimum of 25g.km and maximum of 20g &3.4cm for weight loss and rate respectively. The improved barn ranked second and lasting the pit barn with a maximum of 22g, 4.9cm and 22.5g, 5.5cm respectively for both improved and pit barns. From the use as storage structures for such purpose.

CHAPTER ONE

1.0 INTRODUCTION

Yams are stored principally to provide for the next planting season and to make them available for human consumption during the period between planting and harvest. Even of agronomic innovations and advances in yam breeding research make it possible to grow yams seeds as well as shorten the rather long growing season of the crop there will still be need of store whole yam tubers for food purposes.

It has been argued however that mass processing of freshly harvested tubers into various food products would eventually provide an indirect solution to the intractable problem of yam tuber storage.

Unfortunately, this type of argument ignores the ethno and socio – cultural significance of yams and the fact that millions of yams consumers would still prefer to prepare their yam needs from whole tubers. Besides it is doubtful that the original yam flours would still be preserved after extensive processing and storage. Because of the fastidious nature of the crop coupled with its long growing season. Yam can be grown once a year in most parts of the producing states of Nigeria except perhaps in a few riverine areas where the crop is known to thrive. These realities in the foreseeable future, will create an obligatory need for the continued storage of whole yam tubers for at least 5 – 6 months if they are to be available for food at all times of the year.

Despite its importance the post harvest – storage of yams has received very little attention. Consequently only sporadic information on the storage behaviours of yams is available in print (UGOCHKWU et al 1977, IKEDIOBI AND OTI, 1983)

Much of the earlier work on am tuber storage was concerned with identification agents of yam spoilage (BOOTH 1974 PASSAM, 1978 ADESIYAN et al 1975, 1976 NOON 1978) and with quantitative assessment of yams losses in storage (PASSAM). Only very few studies have dealt directly with the post harvest biochemistry and physiology of the yam tuber and yet the later are so vital to any research effort aimed at developing an appropriate storage method for yams. It is probably true to conclude that the absence of an economical, relatively cost free long farm storage method for yams has contributed significantly to the delay in the large scale commercialization of yam production and processing in much of the yam growing world.

1.1 HISTORICAL DEVELOPMENT OF YAM STORAGE

The types of yam storage structures are influenced by various factors. These include climate, purposes of the yam tubers in storage and socio – cultural aspects of storage (symbols of prosperity, use for cult purpose). However, the yam storage structures are also influenced by the type of building material available and the resources of the farms, in particular, the availability of labour and capital (FAO,1990). Many determinants and interactions concerning these systems have to be considered unknown (CHINSMAN AND FIAGAN, 1987). All systems are in need of further analyses to define the feature relevant to storage.

1.2 AIMS OF THE PROJECT

The main aim of this project is to assess soil temperature and moisture variation in different yam storage structures its effect in weight loss of the tubers and sprouting.

JUSTIFICATION

The environmental and climatic conditions have a great effect on stability of stored products. Yam in Niger State is by heaping the tuber on the ground inside a barn. The yam is heaped on the soil. There is no doubt the temperature and moisture content of the soil has an effect on the tuber. This study assesses the variation in soil temperature and the moisture content of soil in different barn and compared it with the soil temperature and soil moisture content of the outside

CHAPTER TWO

2.0 LITERATURE REVIEW

It is estimated that in the tropics each year between 25 and 40% at stored agricultural products is lost because of inadequate farm and village level storage (Hayma 1995). In the field and during storage the products are threatened by insect rodents, birds and fungi and the pests. Moreover, the product may be spoiled by infection from fungi yeasty or bacteria. In addition, for sowing seed it is important that the viability (its capacity to germinate is maintained.

In order to minimize the losses during storage it is important to know the optimum environmental conditions for storage at the product as well as the conditions under which its attackers flourish. The storage as well as the organisms attacking stored products are living things they breath. During respiration oxygen is need up and carbon dioxide water and heat are produced. The rate of respiration and thus the amount of carbon dioxide, water and heat that are produced is strongly dependent on the temperature and the moisture content of the product.

The rate of respiration is reduced approximately by one half for each 10^0c reduction in temperature (Hayma 1995).

Losses which can occur during the storage of fresh yams have very varying cause some of the losses are endogenous, i.e. physiological.

These includes transpiration and germination. Other losses are caused by exogenous factors like insect pests nematodes, rodents, rot bacteria and fungi on the stored produced (Knoth 1993).

Dormancy occurs shortly after physiological maturity of the tubers (Wilting Point).

Dormancy unidentified serves to facilitate the tuber, as an organ of vegetative propagation to overcome an unfavorable climatic period. Consequently, varieties of yam native to requan with marked aril reason have a longer period of dormancy than those native to region with shorter dry season. According to (Knoth 1993) the duration of natural dormancy fluctuates according to the variety of yam between 4 and 18 weeks.

In recent years, other approaches for yam storage have been attempted such as ionizing radiation (7.5 k rad), treatment with sprout suppressants and controlled gas atmosphere.

Although some success have been obtained, however their practical application is doubtful. Cold storage above 12^0c has been the most successful in extending tuber shelf life and reducing storage losses but its application in developing countries is highly questionable (Villamabu 1979).

2.1 LEVEL OF TUBER MATURITY

The yam tubers are ripe for harvesting when the foliage has died without having to fear any great loss in yield, the harvest can then take place some time afterwards and the tubers can simply be left in the ridges. The duration of this type of storage depends on the particular variety of yam and can extend over 1 to 4 months (Coursey 1983).

2.2 PRE – STORAGE REQUIREMENT OF YAM TUBER

Tubers are usually cared before storage spreading them out evenly in the shade 2 or 3 days after harvest. This prevent wound to heal toughens the peel and slightly reduces moisture content thus improving storability and prolonging shelf life. Other pre storage treatments such as pesticidal dips organism's wratnants such as radiation also prolong storage life Coursey 1972 Lawton and Lawton 1969) experience at I.I.T.A. and else where (Wickham et al 1984).

2.2.1 CURING

Curing ideally, before your tubers are stored by whatever method it adopted they should be properly curved. The term lowering as applied to root and tuber crops is used to indicate their controlled exposure to relatively high temperatures and humidities for short periods about 24 hours after harvest with the intention of improving their subsequent storage life. In the curing processes involves exposure of the freshly harvested to temperature of 29 – 40^0c and relative hudimidie of 90 – 95^0c for 5 – 7 days. (adesuyi 1973) has however found that temperature of 25^0c and relatives humdicidi of 55 = -62% for 5 days were also suitable for curing yams.

2.3 YAM STORAGE STRUCTURES

Yam storage structures are inflaming by various factors. These include climate, purpose of the yam tubers in storage and socio cultural aspects of storage (symbols of prosperity use for cult purpose).

However, the storage structures are also influence by the type of building materials available and the resources of the farm in particular the availability of labour and capital FAO 1990.

The storage systems existing in west Africa have only, been mentioned rudimentary in literature so far. Many determinants and interaction concerning these systems have been considered unknown (Chrisman and Fiagan, 1987).

2.3.1 YAM BARN

The construction of the barn under a conical protective roots made of guinea corn or millet stalks to provide shade and coolness during the storage period. The tubers lie on top of each other under this protection.

2.3.2 IMPROVED VENTILATED YAM BARN

Yams are usual stored in well-ventilated barn. The upright of the barn may be constructed from live stems cassava stem are particular suitable yam should inspect the yams once a week to remove rotten tubers and to pick out any shoots which being to spirant. It is important to keep the yams dry and warm (at a temperature above 15^0c) yams can spoilt if the temperature is too low.

2.3.3 PLAT FORM

Yams are sometimes stored on raised platforms constructed in the field. This is a common mode of storage in the South pacific the tubers may be placed vertically or horizontally this type of platform storage is often crested under or shady evergreen. It consists of a conical protective roof, which can also be lengthened as protection (NKEPENU and TOUGNON 1991).

2.3.4 UNDERGROUND PIT

The storage of yams in underground pit is also practiced. The pit is dug the tubers are put in, and then covered with shading materials.

Verification is adequate, and constant instruction of the yam tuber is done.

2.4 YAM STORAGE PROBLEMS

Yam storage problems are of two kinds. The first involves the direct effects of pest disease, nematodes and mechanical damage that leads to rotting and losses in quality and marketability. The second involves sprouting of the tubers. Under normal situations, tubers remain dormant for 10 to 15 weeks and then start sprouting leading to loss in food reserves, which reduces both the weight and quality of the tubers. Effective storage systems are needed to ensure minimum post harvest from both causes.

Storage system varies considerably depending on the environment. The most important traditional system is used of shaded barns where tubers are tied up on racks or poles (Wilson, 1980) but the care needed to tie the tubers on the poles makes the system tedious and laborious. IITA recently developed a modified system using simple openwork shelf inside a barn. Its advantage is that placing tubers on the shelves requires less time and labour and damage tubers can easily be removed.

Whatever the storage system however, there are three essential requirements for a barn. The first is adequate ventilation the barn must be located in an open position to allow for easy airflow. The second is adequate shade (usually of live trees) ensuring that only diffused light reaches the tubers. The third is providing protection from direct rain to avoid spread of bacterial infection and discourage easy sprouting.

CHAPTER THREE

The storage structure used in this experiment is the yam barn, the pit improved and Local Yam barn. Three different storage structures were built in the Federal University of Technology Minna Campus. All the structure was made from local available materials. Two replication of each structure was made for this experiment. The yam barn is 2m high, 3m weights and 2m length and it is similar as the barn the farmers use in the villages. It is made from guinea corn stalk, to use for making wall and roof, stick and rope are used to tie the barn.

The Pit:- 1 meter deep pit was dug into the ground and 1 meter high structure made from stick and guinea corn structure was built above the ground. The roof was made of guinea corn stalk and also the wall was made of stick and ropes are used to tie them together.

The improved yam barn is also made from sticks as frame and guinea corn sticks as wall and roof. In addition, the barn was lined from inside with rice straw which increase the thickness of the wall.

Yam tubers was purchased directly from the local farmers and stored for five months (February to June) in the barn. Two types of yams were purchased, these were Giwa (white yam and Asuba. A total of 105 tubers of yam were stored in each structure.

The yams were stored in different size category and heaped at different positions in the barn.

3.1 DATA MEASUREMENT

The soil temperature was measured three times a week namely, Monday, Wednesday and Friday and four times a day i.e. 8 am, 12 noon, 4pm and 7pm. The measurement was taken in the soil temperature was measure using all the barns and outside. Soil sample for moisture determination was collected once each month from the six-storage structure and the outside. Soil moisture was determined used oven method. Be weighing the container and oven drying for 105^0C for 24 hours, and then collect dry sample.

The moisture content of a product is expressed as a percentage of the wet weight, which is as follows.

$$M.C.\ \% = \frac{\text{Weight of water = the moist product}}{\text{Weight of the moist product}} = 100$$

3.2 **WEIGHT LOSS DETERMINATION**

Twenty tubers in each barn were numbers from one to twenty and weighed by weekly and data recorded weight weekly. The average weight loss was determined for each month and the average sprout growth was determined for each for each month.

CHAPTER FOUR

RESULTS AND DISCUSSION

Maximum and minimum values observe in the result obtained shows the maximum and minimum temperatures. The results that the pit storage structure has the lower temperature compare to improved barn and local barn structure, the soil temperature was higher in April and lower in June, the average daily in soil temperature variation is 4% for the pit is 4°c which is minimum while average temperature for improved barn 4.5°c and that of local barn is 4.8°c. This shows that the higher temperature variation in the local barn compared to the pit table 1,2, to 6. Table 8 shows the soil.

The graph fig. I the reading of the pit graph coincide with that of local barn graph at 6pm. It shows that under this study, the temperature of the two reading become equal at 6pm at 32°c the two graphs met at 1pm indicating equal reading of temperature of 36°c.

Both the improved barn graph and outside graph have no contact with any graph. The outside graph showed higher temperature reading than that of local and pit barn.

The outside graph maintains its highest temperature of 46°c at 12.00 noon. It is because that is the peak period of heat during the dry season when these observations were much; the soil moisture variation was very low throughout the storage period. The soil moisture increase by 80% in June and storage period in fig2 shows the sprouting in these storage structure the rate and growth of sprout is minimum in improved barn, there could be due to low intensity of light caused by the raise in improved barn. The highest sprouting rate was observed in the pit storage structure.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Sprouting of yam is necessary to ensure a confirmed supply of good quality crop all year. Long – term storage help fight storage.

Yam storage structures, apart from been influenced by a member of factors including climate, and also influenced by the type of building materials used. The local yam barn gave better results in terms of weight loss and sprouting rate of yam tubers. Under normal situation, tubers remains dormant for 10 – 15 weeks and then start sprouting leading to loss in food reserves which reduces both the weight and quantity of the tubers. The local barn was observed to have provided a better storage system that would ensure a minimum post harvest losses.

5.2 RECOMMENDATION

Based on the results of this study, the following recommendations are made: -

1. Yam should be stored in well-ventilated barn, with tubers being inspected once a week to remove rotten ones and to pick out any shoot which beginning to sprout.
2. To minimize the losses during storage of tubers, it is important to keep yams dry and warm (at a temperature of not lee than 15°c). Yams can be spoilt if the temperature is too low.
3. Curing should be done before tubers are stored. In curing, Adesayi (1973) recommended the exposure of freshly harvested tubers to temperatures of 29 – 40°c and relative humidity of 90 – 95% for 5 – 7 days.
4. From the results, it is recommended that the local barn be adopted for the storage of yam tubers as its ranked higher in terms of sprouting rate and weight loss.

TABLE 1

BY WEEKLY AVERAGE TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	25.3	29.7	31.5	-
	27.8	32.2	32.8	32.3
MONTH	27.7	30.5	31.6	31.6
	28.1	32.7	43.3	33.4
	28.5	33.2	35.2	33.5
	28.3	33.8	34.7	43.8
APRIL	30.7	33.3	34.7	34.8
	30.4	34.3	34.0	-
	31.1	35.0	35.6	34.0
	32.3	35.2	36.7	35.3
MAY	30.1	32.8	34.3	33.7
	31.2	34.0	35.6	34.3
	30.9	35.7	34.5	33.6
	26.5	27.5	29.5	29.1
JUNE	25.5	26.3	28.1	28.0

Table 2
BARN 2

BY WEEKLY AVERAGE SOIL TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	24.7	30.2	31.0	-
	27.9	30.7	33.5	31.7
MARCH	28.3	32.8	34.5	33.1
	28.8	32.5	34.7	33.4
	28.8	33.2	34.9	32.9
	31.3	33.7	35.2	35.1
APRIL	30.7	33.5	35.0	-
	30.3	35.3	33.5	29.5
	30.2	33.9	34.6	33.6
	31.8	34.1	35.5	34.4
MAY	30.0	32.7	33.9	33.5
	30.8	33.4	34.3	33.7
	29.9	31.5	33.2	33.3
	26.5	27.3	29.3	28.2
JUNE	25.4	24.5	26.2	26.5

Table 3
BARN 3

BY WEEKLY AVERAGE SOIL TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	24.8	29.4	31.3	-
	26.3	30.8	32.3	30.7
MARCH	27.0	30.1	31.5	30.5
	28.2	32.7	33.3	32.3
	28.1	32.8	32.9	32.4
	28.9	32.0	32.4	32.7
	30.5	33.6	34.2	33.3
APRIL	29.9	31.8	32.5	29.5
	29.3	33.3	32.5	29.4
	30.3	33.2	34.1	33.8
	31.5	33.8	34.7	34.8
MAY	29.9	31.8	33.5	32.7
	30.8	33.1	34.6	33.5
	29.3	30.7	32.6	32.1
	27.0	27.4	28.6	28.0
JUNE	25.0	24.6	27.6	26.0

Table 4
BARN 4

BY WEEKLY AVERAGE SOIL TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	23.2	33.2	34.2	26.0
	27.7	35.0	37.3	32.7
MARCH	25.5	30.5	34.0	30.0
	28.1	32.2	33.8	32.7
	28.7	32.5	33.8	32.7
	29.5	32.9	34.1	33.3
	31.4	33.9	34.8	34.3
APRIL	30.8	33.3	34.3	-
	29.7	34.2	33.6	25.5
	30.5	33.5	34.6	33.3
	31.7	34.6	35.9	34.9
MAY	30.1	32.9	33.9	33.3
	31.1	34.3	34.8	34.8
	30.1	31.7	33.5	33.1
	26.7	24.7	29.1	28.2
JUNE	25.5	25.9	26.3	27.5

Table 5
BARN 5

BY WEEKLY AVERAGE SOIL TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	24.1	27.8	28.9	-
	27.3	29.5	32.0	32.0
MARCH	26.9	28.3	33.0	29.0
	27.6	31.7	33.0	32.3
	28.2	32.0	31.8	32.2
	28.4	31.8	33.0	32.4
	30.5	32.7	33.8	33.1
APRIL	30.1	31.0	33.9	34.1
	29.2	83.9	32.3	28.5
	30.1	33.3	34.5	32.9
	31.2	33.8	33.4	34.5
MAY	29.6	31.8	33.5	32.9
	30.8	33.3	34.5	33.0
	29.3	30.8	33.0	32.4
	26.4	27.5	28.8	28.3
JUNE	25.2	24.4	27.1	26.0

Table 6

BARN 6

BY WEEKLY AVERAGE SOIL TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	25.6	30.2	32.2	31.2
	28.5	32.3	34.0	32.9
MARCH	27.0	32.1	32.0	-
	28.2	33.2	35.3	33.0
	28.6	33.1	34.4	32.6
	28.8	33.1	35.3	33.7
	30.7	34.2	35.7	34.6
APRIL	30.4	33.5	34.9	30.1
	30.3	34.1	33.9	30.0
	30.3	33.8	34.2	34.1
	31.4	34.5	35.3	34.7
MAY	29.8	32.5	34.1	33.3
	31.0	33.6	35.1	34.3
	29.2	35.0	32.8	32.9
	26.3	26.8	28.5	28.0
JUNE	25.0	24.8	27.6	26.8

Table 7
OUTSIDE

BY WEEKLY AVERAGE SOIL TEMPERATURE

MONTH	8am	12noon	4pm	8pm
FEBRUARY	25.5	38.0	38.0	31.5
	28.7	42.2	45.1	35.0
MARCH	27.6	40.5	42.5	34.5
	30.2	43.7	43.0	34.3
	28.5	41.2	43.2	35.5
	29.7	41.8	42.2	35.7
	32.9	48.4	42.2	37.0
APRIL	32.9	39.3	43.0	33.7
	32.8	40.0	39.3	25.5
	31.2	45.9	44.5	37.2
	35.1	42.8	44.9	37.0
MAY	31.9	39.8	39.9	35.0
	33.4	44.1	44.5	37.9
	31.6	37.6	41.9	35.6
	28.6	28.6	33.0	30.7
JUNE	25.8	27.3	29.9	26.5

TABLE 8

MONTHLY SOIL MOISTURE VARIATION

	BARN 1	BARN 2	BARN 3	BARN 4	BARN 5	BARN 6	OUTSIDE
11/2/2000	0.80	1.2	0.66	0.40	0.82	0.62	0.26
12/3/2000	0.11	0.06	0.05	0.19	0.10	0.12	0.00
13/4/2000	1.59	0.04	0.13	0.13	0.28	0.79	0.36
15/5/2000	0.09	0.08	0.06	0.08	0.08	0.08	0.17
16/6/2000	2.5	2.6	1.9	2.4	1.8	2.5	2.8

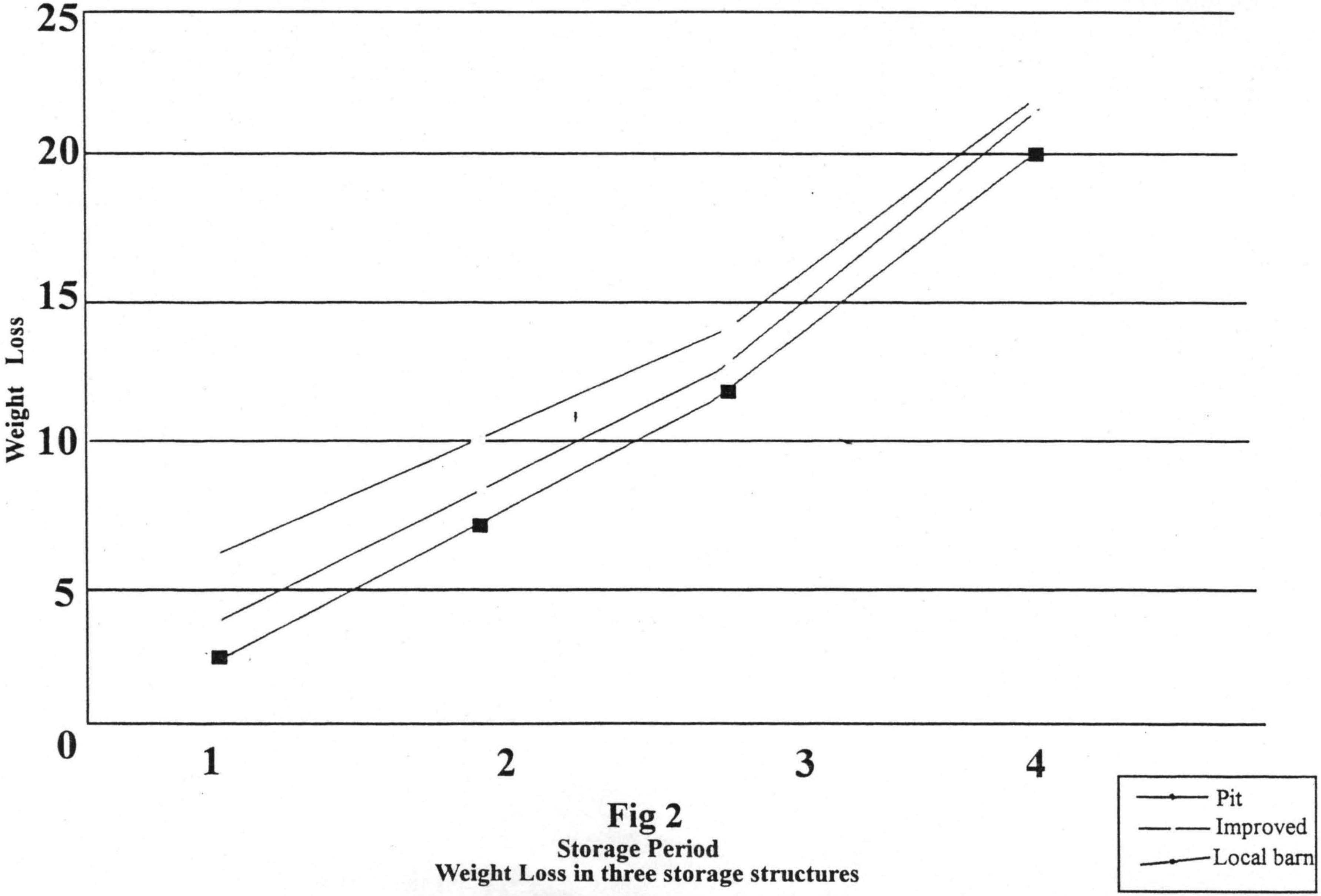


Fig 2
Storage Period
Weight Loss in three storage structures

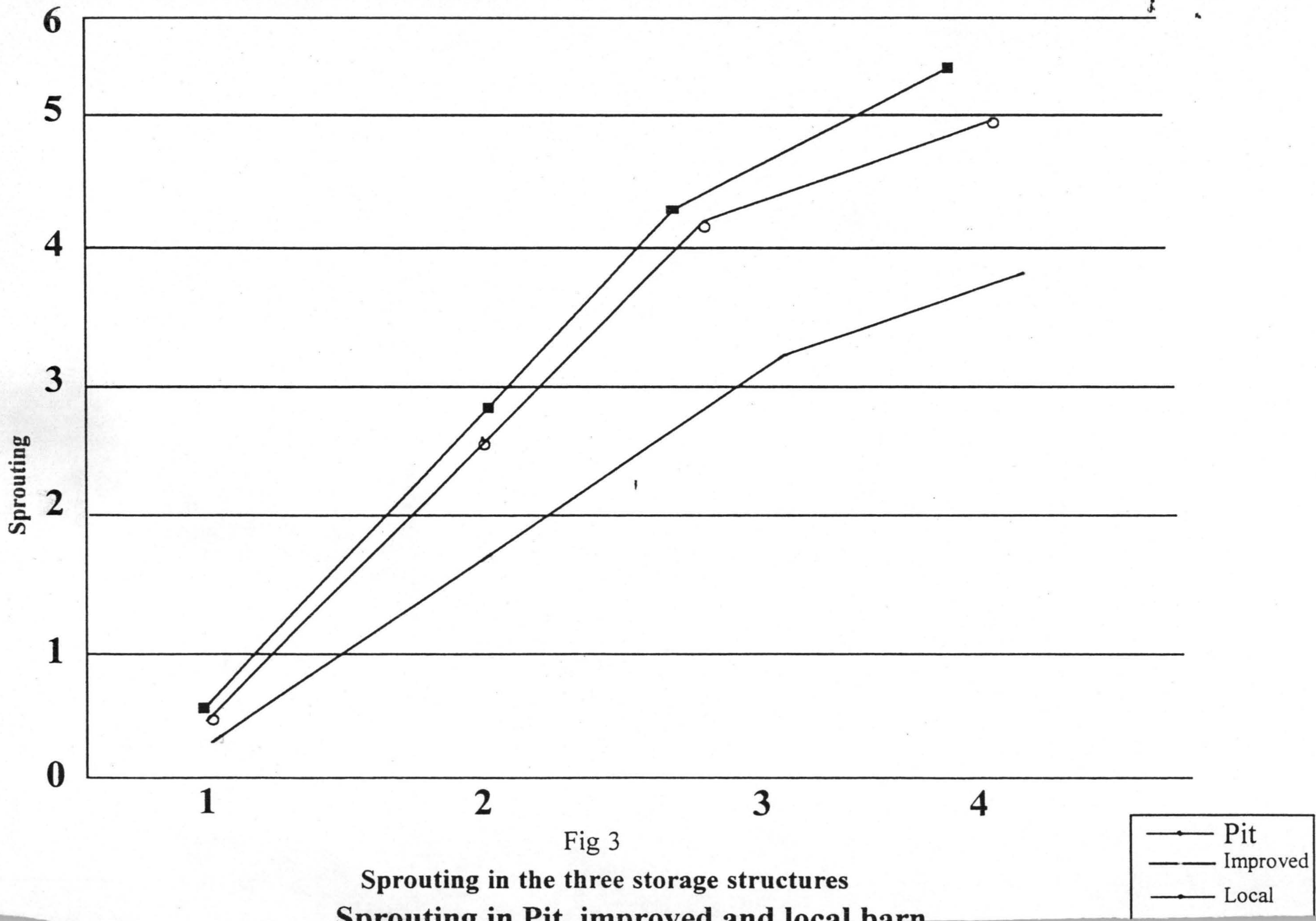
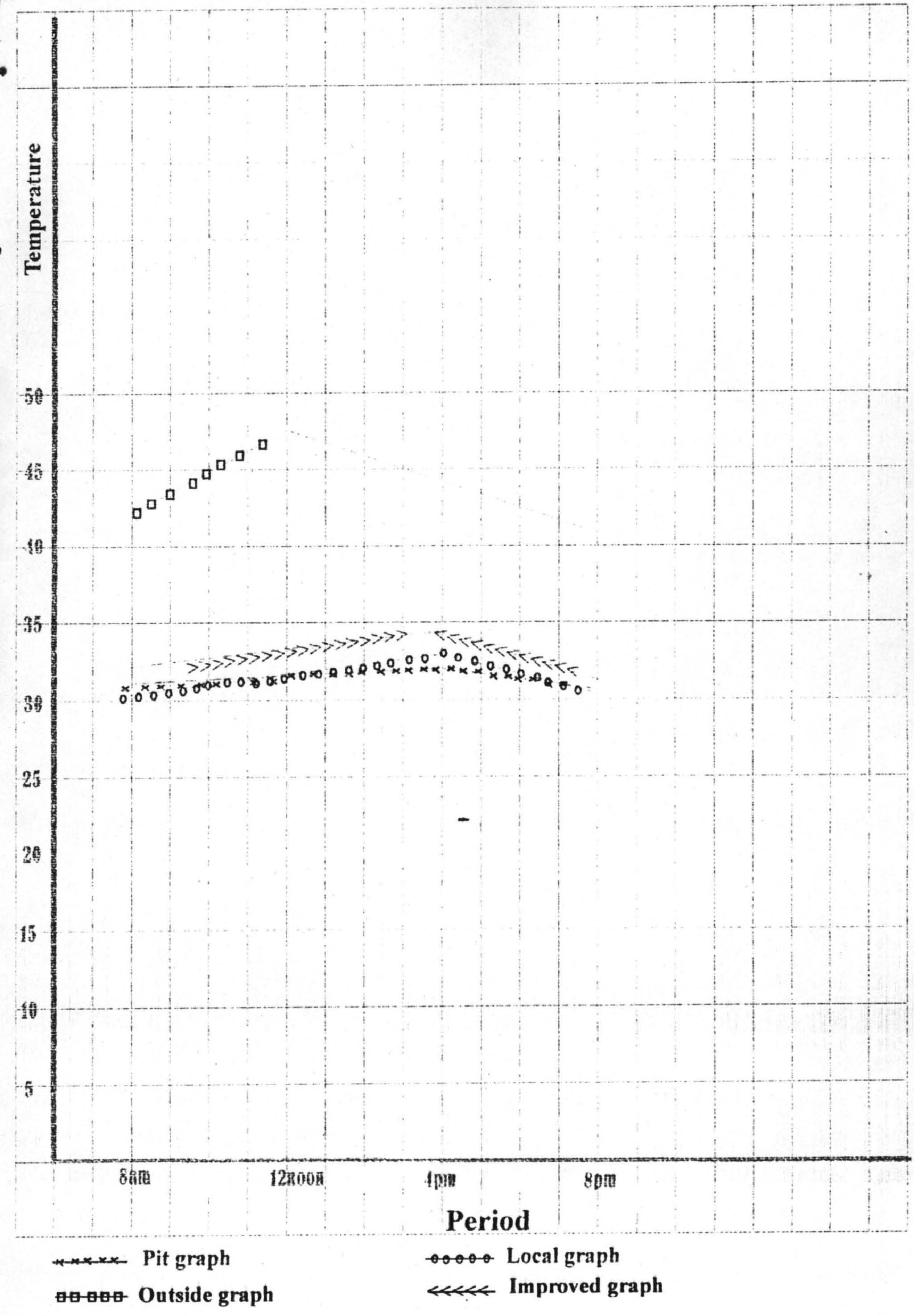


Fig 3

Sprouting in the three storage structures

Sprouting in Pit, improved and local barn



Temperature
50
45
40
35
30
25
20
15
10
5
8am
12noon
4pm
8pm
Period
Pit graph
Local graph
Outside graph
Improved graph

REFERENCES:

ADESUYI, S.A, (1973).
Curing technique for reducing the incidence of root in yams. Technical report No 9 Nigeria stored products Research institute pp57 – 63.

ADESIYAN, S.O. (1975).
Economic losses coursed by the yam nematode in Nigeria

BOOTH, R.H. (1974.
Post harvest deterioration of tropical crops, losses and their control.

COURSE Y, D.C (1983).
Yams in CHAN, H.T (jr) edi. 1983, Hand book of Tropical foods. New York.

CHINSMAN and FIAGAN, (1987).
Traditional storage of yams and cassava and its improvement pp – 19

COURSEY, D.C (1972)
Production of yams: Present role and future prospective. By S.K. HAHN, D.S.O. OSIRU.

F. A. O, (1990).
Action programme for the prevention of food losses, improving post harvest handling storage and processing of root and tuber crops.

HAYMA, J. (1995).
The storage of tropical agricultural products Agrodoc – services No 31 Agromasa, wagening in the Netherlands.

LOWTON, (1969).
Production of yams: Present role and future prospects. BY SK HANN, D.S O or OSIRU.

NKPENU and TOUGNOW (1991)
Traditional storage of yams and cassava and its improvement. pp – 22

PASSAM, H.C. (1978).
Dormancy in yams in relation to storage.
In IFS provisional report.

UGOCHUKWU, E. N. (1977)
Changes in enzyme activity of white yam tubers after prolonged storage.

VILAMEVA, M. R. (1979).
Processing and stored of yam F. A. O. plant production and protection paper 87.

WILKHAM, L. D. (1984).
Tuber development storage and Germination in yams in Response to Pre-Harvest Application of plant growth Regulators, in Journal of Agricultural services.