BERKELEY PUBLICATION AND RESEARCH INTERNATIONAL
09.30.2019
Journal of African Sustainable Development Vol. 10 No.2

EFFECT OF STORAGE METHODS ON CASSAVA (*MANIHOT ESCULENTA* CRANTZ) STAKES IN THE DRY SAVANNAH

OLADEJO A.O.
Pest Management Technology, Federal College of Forestry, Jos Nigeria.

ABSTRACT

Storage of cassava planting materials is necessary when harvest and subsequent planting are separated in time due to long drought. Stakes harvested during this drought period, either dry-out or become infested with micro-organisms or pests. As a result of these problems, procurement of cassava stakes for planting in the planting season become difficult. To avoid these problems different methods of storage of cassava stake were designed to find effective methods of storing cassava stakes in the dry season (i.e. between October 2017 – February 2018). The treatments include (i) Black polythene bag (ii) White-thick polythene bag (iii) White-light polythene bag (iv)Pit storage and (v) Local method of storage (control). 12 stakes were kept in each of the treatment and was replicated 4 times. All treatments were done under tree shade for the period of 137 days. The fresh stakes were separated from the dried ones and the fresh stakes were expressed as percentage of total stakes in each treatment. Then the fresh ones were planted in green house to assess their viability. All these were subjected to analysis of variance. Parameters showing significant difference were further separated using Duncan Multiple Rang Test

Introduction:

Cassava (*Manihot utilisima* and *Manihot esculenta* Crantz) are members of the family Euphorbiaceae and are short perennial shrubs. In some cultivars, the tubers are ready for harvest about one year after planting, but in most, they take 18 months or two years to mature(Cock, 2011). Cassava is playing a major role in efforts to alleviate the African food crisis (IITA, 1989). In West Africa, cassava appears to be the most economical, lowest risk subsistence crop for the small farmers. In coastal or humid tropical areas of Nigeria, roots and tuber account for over 50% of the food energy intake. Among the root crops produced in Nigeria, Cassava ranks as one of the most important staple food item (Nwankiti *et al.,* 1981).

Cassava is majorly

(DMRT). The result shows significant difference among the treatments with pit-storage treatment had the least moisture loss (45.7%) followed by White-thick polythene (52.5%), while Black polythene had the highest (82.8%). There were no significant differences in weight loss among the treatments, however, white-thick polythene had the least percentage weight loss (47.5%) followed by white-light polythene (49.0%) while black polythene had the highest percentage loss (56.3%). Statistical analysis also shows no significant differences among the treatments with respect to percentage viability after the storage period. However, white-thick polythene and pit storage treatments showed the highest percentage viability (50.0%). Storage with white-thick polythene has the highest Percentage germination while pit and local storage methods had 15.0% each and black polythene had the least (7.5%). White-thick polythene bag storage is therefore recommended for storage of stake in dry savannah.

Key words: *Storage, Cassava stake, Dry savannah, Polythene bag*

Propagated using vegetative part called stem cutting or stake. This propagule is highly perishable as they dry up within a few days after harvest. Use of fresh stakes is normally preferable to stored planting material because, cassava plant requires good planting materials free from pests and diseases for good stand establishment, growth and subsequent root yield (Mdenye *et al.,* 2018). Cassava are usually harvested in dormant period in between two rain seasons when the root reach better commercial quality with maximum production and starch content of roots (Leihner,1980). So, when stakes are harvested at this season they need to be stored for next planting season. Problem of stem storage arises when harvest and subsequent plantings are separated by time for several months due to drought, low temperature or floods (Leihner, 1982; Mdenye *et al*., 2016). Moisture loss of cuttings during storage has proven to have strong influence on stake viability and vigour it may also have influence on some biochemical properties of cuttings that control sprouting and nutrition of stored cuttings (Leihner, 1983)

The planting stakes of cassava are said to be good if they are of right stem age which is between 8 – 18 months, right stem diameter meaning the diameter of pith is equal to or less than 50% of the total diameter of the cutting (CIAT, 1987; FAO, 2013), adequate number of nodes meaning cuttings of 20-25 cm should have 5-7 number of nodes (Penh, 2015). Good stem cuttings come from plants grown from well nourished soil, and this provide enough food for new sprout hence vigour and high yield (Leihner, 1983; Penh, 2015). The problem of low yield/diseases attack is aggravated by the fact that subsistence farmers lack technical advice, absence or shortage of clean planting materials; continue planting infected stakes has been known to be an important means of dissemination of pathogens (Maraite and Meyer, 1975). In view of scarce information on improved stake conservation methods, this study therefore aim to investigate variety of stake storage methods and their effects on the moisture and weight losses, germination and stake viability.

MATERIALS AND METHOD

Study Location

The Experiment was conducted between October 2017 and February 2018 at Experimental Farm, Federal University of Agriculture Makurdi, Benue state, Nigeria. Makurdi is located between latitude 7.41^0N and longitude 8.37^0E at an altitude of 97m above sea level. This falls within the Southern Guinea Savannah Ecological Zone of Nigeria.

Experimental Design and Storage Preparation.

The study was conducted using cassava variety TMS 8303, obtain from the University experimental farm. The cassava stakes were cut to a length of 70cm each. All cuttings were made at the same time and those in polythene bags were treated with 2000ppm Benlate before storage while those in pits were not treated. The storage methods used were (a) Black thick-polythene bags (b) White-thick polythene bags (c) White-light polythene bags (d) Pit storage and (e) Local method of storage (in which stakes were placed vertically with about ¼ of the length in the ground under the shade of tree covered with grasses) as control. All polythene bags were of 75cm by 45cm in dimensions each while pit storage has a dimension of (90 x 60 x 45) cm^3 each laid with cross sticks which was covered with neem (*Azadirachta indica*) leaves and grasses to prevent direct contact with the soil water, soil was later used to fill up the pit. The essence of neem leaves was because of its pesticidal properties that may help in controlling soil pest. All the treatment contains 10 stakes each, which were randomly selected. Each treatment was replicated 4 times given a total of 20 plots. Those treatments in the polythene bags were also placed under tree shade for a period of 137 days.

Data collection

Each bundle of 10 stakes was weighed before the storage and at the end of the storage period to determine the weight loss. Also at the end of the storage period the fresh stakes were separated from the dried ones and the fresh stakes were expressed as percentage of total stakes in each bundle. Then the fresh ones were planted in a green house at inclined position of about 45^0 with about $^1/_5{}^{th}$ of the material submerged to assess their viability.

Germination counts were taken every one week after planting and continued till 3 weeks when no further sprout or germination was observed. Total germination counts were expressed as the percentage stand population per plot. Numbers of established sprouts per stake were recorded at the end of each week for 3 weeks after planting. These were expressed as the mean number of established sprouts per plot.

Data Analysis

All the data collected were subjected to analysis of variance. Parameter showing significance differences among the means were further separated using Duncan Multiple Rang Test (DMRT).

RESULTS AND DISCUSSIONS

The results shown in table 1 present the percentages of moisture loss, weight loss and viable stakes.

Table 1: Means for Percentage Cassava Moisture loss, weight loss and Percentage Viable stakes after 137 Days for each Method of storage of cassava stakes.

Treatments	% Moisture loss	% Weight loss	%Viable stakes
Black Polythene bag	82.80^{a}	56.30^{a}	32.50^{a}
White-thick Polythene	52.50^{bc}	47.50^{a}	50.00^{a}
White-light Polythene	53.60^{bc}	49.00^{a}	27.50^{a}
Pit Storage	45.70^{c}	51.50^{a}	50.00^{a}
Local storage (control)	60.30^{b}	53.40^{a}	32.50^{a}

Means along the column followed by the same alphabets are not significantly different at 1% level of probability.

Table 2: Mean Square Estimate of Parameters under Study.

Source of variation	df	%moisture loss	%weight loss	% viable stakes
Treatment	4	817.50**	49.30^{NS}	457.50^{NS}
Error	15	68.10	80.80	388.30
Total	19			

NS – Indicate that mean Square values are not significantly different
*** -- Indicate highly significant mean square.*

Moisture loss:

Stakes stored in black polythene bag storage showed the highest percentage moisture loss of 82.80%, followed by local storage method with 60.30%, while Pit storage had the least percentage loss of 45.70% (table 1). Analysis of variance shows that the percentage moisture loss in black polythene bag was significantly different from all other storage methods at one percent level of probability. This could probably due to the fact that black bodies absorb more radiant heat more than polished or transparent ones (Alan, 1984). However, local storage method was not significantly different from white-thick (52.50%) and white-light (53.60%) polythene bags but significantly different from pit storage method of 45.70% moisture loss (table 2). Greater percentage moisture loss was also observed in the control (60.3%), this could be attributed to nature of the soil of experimental site which is sandy- loam and this dry out easily during the dry season than sandy-clay or silty soils. The preliminary water budget for hydro-geological year 2017/2018 for Markurdi (table 3) also provided some possible reasons for this. In the budget, the soil was a bit wet at the beginning of the storage, but dried out quikly around the second and third months of storage to the extent that underground water was being used completely to balance up the deficit caused by the evapo-transpiration. Because of this fact, much moisture was lost from the stakes through direct evapo-transpiration and soil absorption from the stakes.

Table 3. Preliminary Water Budget for Hydrological Year 2017/2018 for Makurdi, Benue State.

Months/ Parametas	M	A	M	J	J	A	S	O	N	D	J	F
Temp	39.6	36.0	33.3	29.8	30.0	29.8	30.5	31.9	33.3	34.1	35.0	38.0
R/Fall	--	109.9	79.7	142.3	158.3	219.5	310.8	81.2	--	--	--	--
Heat index	22.29	19.3	17.2	14.6	14.7	14.6	15.1	16.1	17.2	17.8	18.5	21.0
Evapotran-Spiration	187.5	130.2	96.6	63.1	64.8	63.1	69.0	81.9	96.6	105.8	116.9	160.1
Insoil Reserve	0	0	0	79.2	100	100	100	99.3	2.7	0	0	0

____________ Storage period.

Weight loss:

The weight loss in different storage methods seem to followed the same pattern as percentage moisture loss. However, the pit storage tends to deviate from the normal (table 1). This could be attributed to the effect of termite attack, which apart from moisture loss contributed to the weight loss. This is in agreement with work done in CIAT (1977) that termite feed on propagating material, growing plants and roots. The principal damage thereof appears to be loss of cutting which invariably lead to loss in total weight. The biology of cassava stem is bond to lose weight when is not in contact with wet soil (Cock, 2011). Stakes in the black polythene bag storage had the highest percentage weight loss of 56.30%, followed by the local storage method (53.40%), while stakes in white-thick polythene bag had the least weight loss of 47 .50% (table 1). However, analysis of variance shows no significant difference in weight loss among the different methods (table 2).

Percentage Viable Stakes:
As a result of the excessive dehydrations and weight losses, the percentage fresh stakes for all the treatments were very low, except white-thick polythene bag and Pit storage treatments that had highest percentage viable stakes of 50.00% each (table 1). This was followed by Black polythene bag and local storage treatments with 32.50%, while White-light polythene bag treatment had the least percentage viability of 27.50% (table 1). This could be as result of longer storage duration. This is line with the work of Boonma *et al*., (2007) and Promkhambut *et al.,* (2016) that attested to the negative effects of duration on cassava viability. Despite the differences in percentage viability, statistical analysis showed no significant differences among the treatments after 137 days of storage (table 2).

Table 4: Mean Germination Percentage of Stakes for the various Storage after 137 Days of Storage.

Treatments	1st WAP	2nd WAP	3rd WAP
Black polythene bag	5.00	7.50	7.50
White-thick Polythene bag	17.50	17.50	27.50
White-light Polythene bag	15.00	15.00	17.50
Pit Storage	12.50	12.50	15.00
Local Storage (control)	10.00	15.00	15.00

WAP = Weeks After Planting.

Table 5: Average number of established Sprout per Stake for each treatment after 137 days of storage.

Treatment	1st WAP	2nd WAP	3rd WAP
Black polythene bag	1.00	1.25	3.50
White-thick polythene bag	3.75	3.75	7.75
White-light polythene bag	3.75	4.25	9.50
Pit Storage	2.50	2.50	4.00

Local Storage (control)	1.25	2.50	4.50

WAP = *Weeks After Planting*

Germination Percentage and established sprout

The totality of moisture and viability losses of stored stakes resulted in poor germination in all the treatments after 137 days (table 4). The stake stored in white-thick polythene bag that showed the highest percentage germination had only 27.50%. This was followed by white-light polythene bag with 17.50% germination; pit and local storage methods had 15.00% germination each while storage with black polythene bag had the least percentage germination of 7.50% (table 4). This could be adduced to the longer duration of the storage (4 months and 15 days) and probably the in conducive conditions of storage which exposed stored stakes to too much environmental stress (CIAT, 1979; Boonma *et al*., 2007 and Promkhambut *et al.,* 2016).

Although there were no significant differences in average number of established sprout per stake after 137 days of storage (table 5). Still, highest number of established sprout of 9.50 sprouts per stake was obtained from stakes stored with white-light polythene bag. Followed closely by white-thick polythene bag, having 7.75 sprouts per stake. Pit and local storage methods had 4.50 and 4.00 sprout per stake respectively and storage with black polythene bag had the least number of 3.5 sprouts per stake (table 5). The reason for this could be adduced to the excessive loss of moisture from the stakes and pests attack which may have rendered the buds of the stakes non viable. While stakes in white-thick and white-light polythene bags gave a promising results.

CONCLUTION AND RECOMMENDATIONS

Based on this work, it could be concluded that there was a general reduction in germinations and sprouting per stakes after 137 days of storage. This could be adduced to the excessive dehydration and insect attack. However, storage with white-thick polythene bag had less percentage moisture loss, less percentage weight loss and had the highest percentage stake germination after 137 days of storage. It is therefore recommended that subsistence farmers in Makurdi locality use white-thick polythene bag for save stake storage.

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