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A RE- EXAMINATION OF THE EFFECTS OF LENGTH OF STEM CUTTINGS ON THE GROWTH AND YIELD OF CASSAVA (*Manihot esculenta* CRANTZ)

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ABSTRACT

Paucity of cassava propagules and transportation costs during the peak planting season is a major constraint to its production in Nigeria. Field experiments were carried out at the Teaching and Research Farm of the Ambrose Alli University, Ekpoma during the 2009 and 2010 planting seasons to re-examine the length of cutting materials used for planting cassava in view of the increase in demand for planting materials. Two experiments were carried out in polyethylene bags and in the field. In the polybag trial, five cutting lengths (10, 15, 20, 25, and 30cm) of variety 92/0326 were planted on 5 September 2009 in a randomized complete block design with four replicates. The Field experiment was planted on 27 April 2010 using the same length of cuttings and experimental design. The results showed that in the polyethylene bag experiment, sprouting and early vegetative growth were not significantly different between 20, 25 and 30cm cuttings. In the field, vegetative traits were significantly ($P<0.5$) reduced when stem cuttings of 10cm were used. There was no difference in vegetative growth between stem cuttings of 15, 20 and 25cm. Number and weight of tubers per plant and tuber yield were highest in plots planted with 30cm cuttings but were not significantly different from 20 and 25cm cuttings. The result clearly showed that the length of cuttings can be reduced from 25cm already in use to 20 or even 15cm, especially when planting materials are scarce.

Key words: Cassava, planting materials, length of stem cuttings, vegetative traits, tuber yield.

INTRODUCTION

Cassava is essentially a lowland tropical crop and has indeed become a very important staple crop in sub-Saharan Africa (Remison, 2012). The International Institute of Tropical Agriculture (IITA), Ibadan and the National Root Crops Research Institute (NRCRI), Umudike have collaborated closely to develop some improved cassava varieties capable of adapting to a wide range of ecological conditions and farming systems in Nigeria. The improved cultivars developed by IITA are designated as 'TMS' and those developed by NRCRI as 'NR' series (Remison, 2012). Many of the improved varieties are early maturing, high yielding and disease resistant but materials available for planting are scarce. One way of making sufficient improved materials available for planting is to embark on large scale field multiplication and possibly reduce the length of cuttings.

A lot of work has been done on the agronomic aspect of cassava improvement (e.g. Njoku, 1987; Dixon *et al.*, 1992; Hahn *et al.*, 1993; Nwagbo and Obeta, 1994; Remison, *et al.*, 2002 Ogedegbe and Remison, 2013) but the issue of meeting with the increasing demand of

improved varieties has not been vigorously addressed.

Ene (1978a and 1978b) noted that simple rapid propagation methods can be adopted to quickly multiply selected cassava varieties for distribution. He found that propagules so produced were as good as plants from 20cm woody cuttings. Propagation by means of tissue culture has also been tried. The procedure for raising plantlets using the tissue culture technique has been well outlined by IITA (Anon, 1990). In the production of plantlets, meristem or shoot tip culture was reported to be the most effective method for virus elimination (Anon 1990). However, Nwachukwu and Novak (1991) examined the performance of five varieties *in-vitro* using bud and nodal explants and noted that nodal cultures performed better than bud cultures in the production of plantlets. The fact that cassava has a low multiplication ratio was considered in the development of the rapid multiplication technique (Anon, 1990). In this technique, cassava stem is cut into several small pieces (ministem cuttings) and planted out in nursery beds or in black polyethylene bags. After 4-6 weeks, the ministem cuttings

Table 1. Effect of length of stem cutting on number of branches and leaves of cassava, Expt. 1.

Length of Stem cuttings(cm)		Weeks after planning			
		5	7	9	11
Number of branches/ plant	10	1.3	1.3	1.3	1.3
	15	2.0	1.8	1.8	1.5
	20	1.5	1.5	2.0	1.0
	25	1.5	1.5	1.5	1.8
	30	1.5	1.5	1.0	1.8
	Mean	1.6	1.5	1.5	1.5
	LSD(0.05)	1.01	0.091	1.13	0.121
Number of leaves/ plant	10	15.3	16.8	14.3	16.3
	15	19.0	18.8	20.5	21.8
	20	16.0	21.3	20.0	20.8
	25	21.3	24.0	25.8	31.0
	30	16.0	17.8	19.3	20.3
	Mean	17.5	19.7	20.0	22.0
	LSD (0.05)	0.151	0.921	1.03	1.01

are transplanted into the field. This procedure seems laborious and expensive for the ordinary farmer. The planting of cuttings directly in the field will always be more attractive to the farmer.

As a result of increase in the demand for cassava and a corresponding demand for planting materials, it has become important to re-examine the length of cuttings used. Hence, the objective of this study was to evaluate the effect of different sizes of stem cuttings on the performance of cassava.

MATERIALS AND METHODS

The first experiment was carried out outdoors at the Faculty of Agriculture, Ambrose Alli University, Ekpoma in black polyethylene bags of 35cm x 40cm size and 500cm gauge perforated at the bottom to allow for water to drain. The area from which the soil was collected had been left fallow for three years. The surface turf of the soil was removed and soil was collected from 5 - 10cm below the surface. The soil was sieved to remove stones and plant materials. Each polyethylene bag was filled with 13kg of soil. The experiment was begun on 28 September 2009 using cassava variety 92/0326 and stem cuttings of 10, 15, 20, 25 and 30cm. The cuttings were planted in a slanting position at the rate of one cutting per polyethylene bag. The layout was a randomized complete block design with four replicates. Replacement of dead cuttings was made after two weeks of planting. The plants were watered twice weekly and weeds were removed by hand fortnightly. Records were taken fortnightly from 5 weeks after planting for number of branches, number of leaves, dry weight of leaves, stem

and roots.

The second experiment was conducted at the Teaching and Research Farm of Ambrose Alli University, Ekpoma (Lat. 6° 4' North and Long 6° 48' East). The site had been left fallow for about three years. The variety, 92/0326 was used and cuttings of 10, 15, 20, 25 and 30cm were planted at 1 x 1m on the flat on 27 April 2010. The layout was a randomized complete block design with three replicates. Each plot size was 4 x 4m and the plots were separated by a spacing of 1m. Weeding was done manually thrice at 3, 6 and 9 weeks after planting.

Vegetative traits recorded were plant height, number of leaves and leaf area. Leaf area was computed by using the equation $Y = 6.11 \times L$, where Y = leaf area and L = the length of the mid-rib of the central lobe (Hammer, 1980; Litaladio, 1986). Yield traits recorded at six months were number and weight of tubers.

RESULTS

In the polybag experiment, the length of stem cuttings had no effect on the number of branches produced (Table 1). The numbers of branches produced were few even at 11 weeks after planting. There were significant differences ($P < 0.05$) in leaf production especially after 7 weeks of planting (Table 1). Reducing the length of cutting below 15cm reduced the number of leaves. For instance, decreasing cutting length from 15 to 10cm, reduced the leaf number by 12%, 43% and 34% at 7, 9 and 11 weeks respectively. The differences in leaf production between other stem lengths were small.

Data of dry weight production from 5 WAP showed that there was more partition of dry matter to the leaves than

Table 2. Effect of length of stem cuttings on dry weight (g/plant) of leaves, stem and roots of cassava, Expt. 1.

Length of Stem cuttings(cm)		Weeks after planning			
		5	7	9	11
Leaves	10	3.5	4.5	4.3	2.0
	15	4.0	5.5	5.6	4.6
	20	5.2	9.5	6.0	9.0
	25	6.9	8.2	8.2	18.7
	30	5.0	5.1	3.7	10.2
	Mean	4.9	5.8	5.6	8.9
	LSD (0.05)	0.330	0.401	0.512	0.411
Stem	10	1.0	2.4	2.3	1.2
	15	1.0	1.7	2.4	5.2
	20	1.4	2.4	2.4	3.8
	25	2.0	2.7	4.4	11.6
	30	1.4	2.6	2.4	6.2
	Mean	1.4	2.4	2.8	5.6
	LSD (0.05)	0.101	0.140	0.131	0.282
Roots	10	0.5	0.9	0.9	0.7
	15	0.4	1.2	1.5	2.4
	20	0.7	1.0	2.2	2.7
	25	1.4	1.8	2.3	4.2
	30	0.5	1.2	1.4	4.9
	Mean	0.7	1.2	1.7	3.0
	LSD (0.05)	0.050	0.111	0.131	0.121

to the stem and roots (Table 2). Increasing size of cutting from 10 to 15cm resulted in increase in leaf dry weight by 14%, 22%, 30% and 130% at 5, 7, 9 and 11 weeks respectively. The size of stem cuttings had no significant effect on dry matter partition to the stem except at 11WAP when there was increase in weight by 333% with increase in length from 10 to 15cm. Dry matter partition to the stem with cuttings of 20cm and above did not follow any particular pattern.

Dry matter partition to the roots was also not affected by size of stem cuttings at the early stages of growth (Table 2). However, at 9 and 11WAP, increase in stem length from 10 to 15cm increased weight of roots by 66% and 243% respectively.

In the field experiment, vegetative traits were monitored for a longer period (16 weeks). The size of cuttings had no effect on plant height but the numbers of leaves produced were significantly affected at 8 and 16 weeks after planting (Table 3). Cuttings of 30cm length produced the highest number of leaves but these were only significantly ($P<0.05$) higher than those of 10cm length. Leaf area measurements were taken only at 8, 12 and 16 WAP and the highest values were obtained with 30cm cuttings (Table 4). These values were significantly higher ($P<0.05$) than those of 10cm cuttings by 60, 36, and 42% at 8, 12 and 16 WAP respectively.

Interestingly, the size of cutting had no effect on yield and yield components except number of tubers, which were highest with 30cm cuttings (Table 5). Even cuttings of 10cm length gave reasonable tuber yield of over 16 t/ha. The highest yield was from cuttings of 30cm and this was 38% higher than the yield from 10cm cutting. There was no difference in yield between plots planted with 20, 25 and 30cm cuttings.

DISCUSSION

Sprouting and early vegetative growth increased with increase in length of stem cutting in this study. Sprouting was about 85% in 10cm cuttings, 95% in 15cm cuttings and 97% in 20, 25 and 30cm cuttings. The rate of germination seemed to be related to the number of nodes on the cuttings, which were about 3, 5, 7, 8 and 11 for 10cm, 15cm, 25cm and 30cm respectively. The node is of course the source of development of the fibrous roots and emergence of shoot which later develop leaves (Anon, 1990). Therefore, the number of nodes is certainly an important factor in determining sprouting and subsequent performance of crop.

Most of the vegetative traits recorded increased significantly ($P<0.05$) with increase in length of cutting

Table 3. Effect of length of stem cuttings on plant height and number of leaves of cassava, Expt. 2.

Length of Stem cuttings(cm)		Weeks after planning				
		8	10	12	14	16
Plant height (cm)	10	30.5	42.8	59.8	73.0	91.9
	15	30.7	59.9	64.6	85.1	103.5
	20	34.6	65.6	72.2	90.2	104.4
	25	36.4	71.7	74.3	85.6	110.1
	30	44.3	73.4	88.6	110.3	124.1
	Mean	35.3	62.7	71.9	88.8	106.8
	LSD (0.05)	3.43	5.56	5.70	10.59	9.43
Number of leaves/ plant	10	14.5	19.9	21.9	26.8	31.4
	15	15.5	22.2	23.1	34.1	37.4
	20	15.6	19.2	24.3	29.0	36.7
	25	15.4	20.7	24.4	30.1	35.3
	30	18.4	24.8	26.7	35.5	39.5
	Mean	15.9	21.4	24.1	31.1	36.1
	LSD (0.05)	0.140	5.59	2.02	2.95	2.93

Table 4. Effect of length of stem cuttings on leaf area (cm²/plant) of cassava. Expt.2.

Length of Stem cuttings(cm)	Weeks after planning		
	8	12	16
10	1082.7	2224.5	3293.7
15	1272.1	2343.6	3973.5
20	1200.1	2631.7	4075.6
25	1200.5	2938.1	4083.6
30	1737.7	3028.9	4670.8
Mean	1298.6	2633.4	4019.4
LSD (0.05)	113.35	396.77	383.64

Table 5. Effect of length of stem cuttings on yield and yield components of cassava at 6 months after planting Expt. 2.

Length of Stem cuttings(cm)	Number of tubers/plant	Weight of tubers (kg)/plant	Tuber size(kg)	Yield (t/ha)
10	9.2	1.83	0.21	16.1
15	9.3	1.83	0.20	18.3
20	10.3	2.07	0.20	20.7
25	10.5	2.21	0.21	22.1
30	11.2	2.22	0.19	22.2
Mean	10.1	2.03	0.20	19.9
LSD(0.05)	0.341	0.131	0.022	1.24

from 10 to 15cm. There were generally no significant differences between the other cutting lengths. It seems that long cuttings of 30cm or more for propagation would be wasteful and those shorter than 15cm may give poor sprouting because of insufficient nodes. Short cuttings of

15cm may give poor sprouting because of insufficient nodes. Short cuttings with few nodes are also likely to dry out faster than longer cuttings with more nodes.

Plants cultivated with stem cuttings of 15, 20, 25 and 30cm did not show any marked differences in dry matter

accumulation, vegetative and yield traits in both the polyethylene bag and field experiments carried out in this study. While exploring possibilities of increasing planting materials through various methods, namely, simple rapid multiplication to produce propagules (Ene, 1978a), the tissue culture technique (Anon, 1990), ministem cuttings that would be passed through a nursery stage before field planting, seedling production from seeds sometimes used in plant breeding, etc., the most feasible method for the ordinary farmer should always be considered. Reduction of stem cuttings for direct planting in the field seems to be the clear answer to solving the unavailability of planting materials. One of the reasons why planting materials lose viability is because they have to be transported over long distances or left after cutting unplanted for days.

The results showed that the length of cuttings can be reduced from 25cm already in use to 20cm or even 15cm, especially when planting materials are scarce. In other words, cuttings of 15-20cm can be conveniently used especially if the materials are freshly harvested

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