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EFFECT OF TIME OF VINE HARVESTING ON GROWTH AND ROOT YIELD ATTRIBUTES OF THREE SWEETPOTATO (*IPOMOEA BATATAS* (L) LAM.) VARIETIES

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ABSTRACT

One of the major constraints to sweetpotato cultivation in Nigeria is the insufficient planting materials at the onset of the growing season. This study was conducted to evaluate the effect of time of vine harvesting on vine re-growth and root yield of three sweetpotato varieties and the performance of harvested vine in an on-farm trial. The experiment was laid in randomized complete block design with three replicates. Treatments comprised all combinations of three sweetpotato varieties (Mother's Delight, King J and Ex-Igbariam) and four cutting regimes 0, 6, 8 and10 weeks after planting (WAP). Data on morphological growth (vine length, number of branches, number of leaves per plant at 4, 6, 8, 10 and 12 WAP) and root yield were estimated at harvest. Data collected were subjected to two-factor analyses of variance (ANOVA) at 5% of probability. The results showed that, variety Mother's Delight had relatively high average root yield of 24.34-27.65t/ha.Vine harvesting regimes significantly influenced the regeneration ability of sweetpotato, and harvesting of vines within 6-8WAP significantly influenced vine length, leaf formation and root yield. It is therefore recommended that farmers that are interested in producing both roots and vines to maximize profit should consider planting Mother's Delight and vine harvesting should be done within 6 and 8 WAP to ensure sustainable supply of planting materials to other farmers and not compromising root yield of sweet potato.

Keywords: Vine length, vine cutting, regrowth, root yield, sweet potato

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam) is a root crop with immense ability to grow in marginal fields. In Nigeria, it is traditionally cultivated for food, while the top is also used as valuable forage livestock (Giang and Ogle, 2004). Its readiness to enter into the food chain immediately after harvest with minimal processing, and the availability when other root and tuber crops are still growing on the field have made it an important food security crop in Nigeria (Afuape, 2014). Nigeria is ranked the 2nd largest producer after China with the annual root production of 3.478 million tonnes in 2014 (FAO, 2015). Increasing recognition of the great potential of the sweetpotato as a nutritious food for humans and animals has resulted in intensified research efforts to enhance its production and consumption in recent decades. One of the constraints to the production of this crop is the unavailability of planting materials during the dry season. Different techniques of conserving and multiplying vines during the dry season for planting when the rains have stabilized have been introduced to farmers (Egbe, 2012). The most common farmers' practice is their reliance on vine re-growths that sprout from their previous fields. The vines from this practice are often inadequate to meet farmers vine needs due to the effects of global warming that bring prolonged drought and extremely hot dry season which kill most roots buried beneath the soil, preventing their re-growths after the rains have stabilized. The menace of nomadic herdsmen who graze their animals on re-growths at the on-set of rains also makes vine unavailability at the critical planting period As a result, most farmers usually have very small quantity of vine to start the season with. Farmers

have been encouraged to rapidly multiply this small quantity using the "Rapid Vine Multiplication Technique" (Abidin et al., 2017). This technique intensively multiplies vines using small vine length of 2-nodes and smaller spacing in a net-tunnel. However, farmers have largely refused to adopt this technique because it gives only vines and near zero roots in return. Their preferred system is one that allows them to concurrently produce both roots and vines on their farms. The vines are pruned for sale or replanted immediately after they begin to spread. However, Mohammed et al. (2012) have reported that vine harvesting of sweetpotato reduces the yield of tuberous roots. An et al. (2003) also concluded from their studies that age of vine when pruned is an important management factor that affects sweetpotato fodder and tuberous root yield as well as quality. This study therefore, was designed to evaluate the effect of time of vine harvesting on vine re-growth and root yield of sweetpotato varieties.

MATERIALS AND METHODS

The study was conducted at the Research Field of National Root Crops Research Institute, Iresi out-station, Osun State(longitude 7.10^{0}N and latitude 3.26^{0}E) south-west in the rain-forest ecology of Nigeria during 2016 and 2017 cropping seasons and on farmer's fields in 2016 cropping season.

Twelve treatment combinations comprising three sweetpotato varieties (Mother's Delight, King J and Ex-Igbariam) and four vine cutting regimes (0, 6, 8 and10 weeks after planting (WAP)) were laid out in a randomized complete block design with three replications. The plots size was 4 m x 3 m (12 m^2) with 1m alley. The field was cleared, ploughed, harrowed and ridged at 1m crest to crest. The vines were planted in May, 2016 and 2017 growing seasons at a plant spacing of 1m by 0.3m. The long vines were cut into 25 – 30 cm with 4 - 6 nodes on it, two nodes were buried leaving two to four nodes above the ground to encourage the sprouting process and maintain a population of 33,333 plants/ha. N.P.K fertilizer (400 kg/ha) was applied at 4WAP using band method (Asumugha, *et al*; 2008). Hand weeding was done at 3 and 6 WAP while Cypermethrin was applied at 3L/ha to control insect pests. The sweetpotato vines were cut at the appropriate period leaving 40cm length to the base to ease regeneration or regrowth. Harvesting was done at 4 months after planting using a garden fork when the leaves have showed senescence and cracking of the soil were obvious. Data collected on morphological growth parameters included vine length, number of branches, number of leaves per plant at 4, 6, 8,10 and 12 weeks after planting. Root yield was estimated at harvest in both years. All the data collected were subjected to two-factor analyses of variance (ANOVA) using the generalised linear model procedure of the System Analyses Software (SAS, 9.2 version) at 5% of probability . The treatment means were separated using Fisher's $LSD_{0.05}$. Sweetpotato vines from each variety harvested at 6 and 8 WAP were used for on-farm evaluation trial with vines from farmers' fields used as control. One hundred cuttings each having at least four nodes were given to each of three farmers selected from three farming communities: Egbeda (Lat.7.617 and Long.4.467); Igbajo (Lat.7.540 and Long.4.490) and Ajaba (Lat.8.670 and Long.3.390) in Osun State, south-west Nigeria. The trials were established using randomized complete block design with three replications. The plots size was 9m^2 comprising 30 cuttings per treatment per replication. Field maintenance and harvesting were done according to the farmers' practices.

RESULTS AND DISCUSSION

The vine harvesting regime significantly influenced the regeneration ability except at 6 and 12WAP during the 2016 season (Table 1). The control plots showed that vine length of sweetpotato increased rapidly throughout the growing season in 2016 while in 2017, the rapid increase in vine length was within 4 and 8WAP. Uncut vines of Ex-Igbariam had the longest vine of 283.04 cm in 2016 while unpruned Mother's Delight vines exhibited the longest vines (273.25 cm) in 2017. However, among the cut treatments, King J cut at 6 WAP had the longest vines with 203.95 cm in 2016, while Mother's Delight also cut at 6 WAP had the longest vines (231.48 cm) in 2017. Generally, across varieties, vines cut early at 6 weeks seem to have longer vines than those cut at later periods. Afuape (2014) described Mother's Delight and Ex-Igbariam as spreading varieties due to their long vine length while King J which exhibits shorter vine length as an erect variety. The finding of An et al. (2003) that age of vine is an important factor for its ability to regrow explains the observed higher regenerative ability of vines pruned at 6 WAP over those pruned at later age. For number of leaves, sweetpotato vine harvesting influenced the number of leaves. The control plots across varieties, had more average leaves than the cut treatments in both years except for for Mother's Delight cut at 8 WAP in 2016 (Table 2). Harvesting vines at 8WAP in all three varieties had relatively high number of leaves per plant when observed at 12 WAP except in Mother's Delight in 2017 where vines cut at 6WAP had highest number of leaves. Number of sweetpotato branches follow similar trend as highlighted in Table 3. The number of branches, as observed in number of leaves, seemes to be favoured by early vine harvesting (6-8 WAP) than later pruning .This could be so as early vine harvesting gives the plant longer time to recover, regrow and accumulate more photo-assimilates.

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Table 1: Response of sweetpotato vine length to the interaction effect of variety x harvesting regime in 2016 and 2017 seasons

Treatment combinations	Sweetpotato Vine Length (cm)									
	2016 Growing Season					2017 Growing Season				
	4WAP	6WAP	8WAP	10WAP	12WAP	4WAP	6WAP	8WAP	10WAP	12WAP
King J x Cut @ 0WAP	40.42	111.01	191.94	232.91	269.19	43.34	64.45	103.45	124.24	124.34
King J x Cut @ 6WAP	42.53	112.32	149.52	197.48	203.95	40.25	71.64	68.44	103.45	108.97
King J x Cut @ 8WAP	41.22	125.33	134.88	125.28	144.75	47.57	85.62	122.72	79.26	99.96
King J x Cut @ 10WAP	38.91	62.83	107.16	154.39	98.04	42.53	88.86	106.67	122.08	91.82
M. Delight x Cut@0WAP	70.04	101.15	105.17	113.74	166.33	125.36	237.37	252.16	272.13	273.25
M.Delight x Cut@ 6WAP	68.32	113.34	108.22	142.83	145.18	102.19	176.48	145.47	230.62	231.48
M.Delight x Cut@ 8WAP	74.86	92.87	155.25	117.93	136.01	117.32	197.42	272.38	134.06	162.79
M.Delight x Cut@ 10WAP	79.87	81.65	116.72	119.08	140.28	107.25	206.83	285.99	317.60	136.11
Ex-Igbariam x Cut@ 0WAP	64.72	161.22	209.73	263.90	283.04	76.64	110.16	159.60	194.21	194.80
Ex-Igbariam x Cut@ 6WAP	60.51	72.58	94.97	154.37	161.30	70.77	121.66	98.91	154.32	205.09
Ex-Igbariam x Cut@ 8WAP	68.03	85.31	113.35	144.33	148.06	78.84	132.14	173.12	110.96	146.87
Ex-Igbariam x Cut@ 10WAP	64.29	118.73	191.86	202.27	107.28	67.72	130.19	177.76	180.73	113.84
LSD (p<0.05)	25.03*	NS	51.08*	85.65*	NS	17.70**	47.02**	42.83**	51.00**	49.87**

WAP=weeks after planting, * P=0.05, **p=0.001

Table 2: Response of sweetpotato number of leaves to the interaction effect of variety x harvesting regime in 2016 and 2017 seasons.

Treatment combinations	Number of Sweetpotato Leaves per Plant									
	2016 Growing Season					2017 Growing Season				
	4WAP	6WAP	8WAP	10WAP	12WAP	4WAP	6WAP	8WAP	10WAP	12WAP
King J x Cut @ 0WAP	37	48	78	85	170	60	111	459	653	638
King J x Cut @ 6WAP	46	54	79	86	129	49	152	411	527	509
King J x Cut @ 8WAP	45	62	84	92	136	60	156	532	509	532
King J x Cut @ 10WAP	42	48	90	99	123	64	135	481	674	445
M. Delight x Cut@0WAP	23	37	78	85	130	57	82	271	281	304
M.Delight x Cut@ 6WAP	27	38	94	101	127	57	85	225	236	255
M.Delight x Cut@ 8WAP	33	47	69	76	156	62	100	261	212	244
M.Delight x Cut@ 10WAP	38	69	86	90	121	61	92	279	255	221
Ex-Igbariam x Cut@ 0WAP	29	40	78	84	133	57	87	264	364	267
Ex-Igbariam x Cut@ 6WAP	34	42	81	86	115	49	95	250	256	231
Ex-Igbariam x Cut@ 8WAP	37	51	86	92	121	59	105	299	342	254
Ex-Igbariam x Cut@ 10WAP	29	40	58	79	118	54	98	335	306	222
LSD (p≤0.05)	16.02*	20.50*	17.74*	25.16	43.16*	19.38	42.54*	149.6*	118.4**	105.2**

WAP=weeks after planting , * P=0.05, **p=0.001

Table 3 also presents the fresh root yields as influenced by the treatments. Vine pruning does not seem to have effect on root yield when vines were pruned early (6 – 8 WAP) as some vine harvest treatments either had higher or same yield level than the control (uncut vines) in both years. This might be due to the ability of the vines to quickly regenerate when cut early. Quick vine regeneration might lead to effective utilization of available nutrient and light, leading to increased vegetative growth and root volume. Plants' root volume decreases as the age of the planting material increases (Lencha et al.,2016). It is generally known that Variety Mother's Delight have higher root yield than others (Afuape, 2014), so it is not surprising to observe high mean root yield among its treatments compared to other varieties. However, it is evident that delaying vine pruning to 10 WAP will hurt root yield. This is probably so as 10 WAP is a critical period for rapid root bulking and photosynthate production and accumulation. An *et al.* (2003) already observed that defoliation or pruning of vines at 10WAP had a depressing influence on storage root yield production of sweetpotato, while Nwinyi (1992) also have reported that timing of vine harvesting is important and that pruning is detrimental to storage root production when done beyond two (2) months after planting because rapid root formation and development takes place at that time.

Table 4 shows the on-farm performance of the vines harvested at different regimes distributed to farmers. The root yield significantly differed across varieties and similar across vine sources except at Egbeda and Igbajo where root yield obtained from Mother's Delight and King J significantly differed across harvesting regimes. Generally, root yield obtained in plots where cutting at 6 WAP were planted had similar root yield with the control plots. Young vines are more vigorous when planted and have good root yield under enable environmental conditions (NRCRI,2014)

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Table 3: Response of sweetpotato number of branches per plant and root yield to the interaction effect of variety x harvesting regime in 2016 and 2017 seasons.

Treatment combinations	Number of Sweet potato Branches per Plant and Tuber Yield(TY)									
	2016 Growing Season					2017 Growing Season				
	6WAP	8WAP	10WAP	12WAP	TY(t/ha)	6WAP	8WAP	10WAP	12WAP	TY(t/ha)
King J x Cut @ 0WAP	7	14	19	35	25.56	14	56	58	82	12.83
King J x Cut @ 6WAP	8	12	19	23	20.53	20	48	59	61	10.16
King J x Cut @ 8WAP	8	12	22	30	22.97	24	55	50	82	12.89
King J x Cut @ 10WAP	7	13	20	22	16.78	24	47	49	55	10.55
M. Delight x Cut@0WAP	7	7	15	28	27.83	7	29	29	33	27.53
M.Delight x Cut@ 6WAP	7	11	15	28	29.84	7	22	27	30	27.95
M.Delight x Cut@ 8WAP	7	7	16	41	27.83	8	26	29	27	22.47
M.Delight x Cut@ 10WAP	8	12	15	23	25.64	8	27	29	24	19.39
Ex-Igbariam x Cut@ 0WAP	7	10	20	19	24.25	9	27	32	25	12.39
Ex-Igbariam x Cut@ 6WAP	6	8	14	23	24.39	8	25	32	23	10.86
Ex-Igbariam x Cut@ 8WAP	5	9	17	30	18.23	11	24	40	24	12.17
Ex-Igbariam x Cut@ 10WAP	6	7	12	23	16.29	9	25	34	19	10.65
LSD (p≤0.05)	3.207	3.927*	4.438*	12.64*	7.782*	8.022**	13.10**	12.20**	14.77**	4.579*

WAP=weeks after planting, * P=0.05, **p=0.001

Table 4: Performance of vines sources of vines on sweetpotato root yield (t/ha) in three farming communities in 2017

On-farm Communities	Varieties	Vine sources			
		Vines cut at 6WAP	Farmer's practice	Vines cut at 8WAP	LSD (0.05)
Egbeda (Farmer I)	Mother's Delight	23.45	25.64	20.88	1.47
	King J	18.39	19.06	16.86	NS
	Ex-Igbariam	19.92	23.46	19.22	NS
	LSD (0.05)	4.37	2.17	2.64	
Igbajo (Farmer II)	Mother's Delight	27.99	28.93	22.20	NS
	King J	22.40	17.44	18.80	1.58
	Ex-Igbariam	21.07	14.28	20.04	NS
	LSD (0.05)	3.85	2.04	1.97	
Ajaba(Farmer III)	Mother's Delight	26.95	26.37	22.46	NS
	King J	21.60	26.04	17.78	NS
	Ex-Igbariam	23.40	22.85	21.60	NS
	LSD (0.05)	1.49	4.83	3.81	

CONCLUSION

In this study, harvesting or cutting of sweetpotato vines within 6-8WAP did not compromise leaf formation, branching and root yield of sweetpotato. Planting spreading varieties like Mother's Delight and Ex-Igbariam influences rapid regeneration of vines after cutting. It is therefore recommended that farmers that wish to concurrently produce both vine and root should harvest vine from 6 to 8 WAP to ensure supply of planting materials without reduction in root yield of their sweetpotato crop.

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