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Use of Bulking Rate as a Selection Index for Early Maturity in Sweet Potato Genotypes Grown in South-East Nigeria

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Abstract
Seven sweet potatoes (Ipomoea batatas (L) Lam) genotypes were evaluated for early bulking rate in a field experiment conducted at the National Root Crop Research Institute, Umudike. The sweet potato genotypes (Centennial, Umuspo 3 (Mother's Delight), TIS 8164, Ex-Igbariam, TIS 87/0087, Umuspo 1 (King J) and Solomon 2 were arranged in a randomized complete block design (RCBD) with four replications. Data was collected to assess the bulking rate at 4, 6, 8, 10, and 12 WAP weeks after planting (WAP), total number of tubers per plot, and fresh root tuber yield. The results showed significant ($P<0.05$) variations among the seven sweet potato genotypes at 4, 6, 8, 10, and 12 WAP. The final harvest of the tuber was done at 16WAP. Umuspo 1 (King J) exhibited the highest bulking rate in both cropping seasons. The total number of tubers per plot was highest for Umuspo 1 (King J) at 72.8 kg/ha and 57.8 kg/ha, followed by TIS 87/0087 at 41.2 kg/ha and 41.5 kg/ha in 2014 and 2015, respectively. In terms of fresh root tuber yield, Umuspo 1 (King J) also showed the highest significance ($P<0.05$) with 31.2 t/ha in 2014 and 28.73 t/ha in 2015, closely followed by TIS 87/0087. Centennial had the lowest tuber yield at 2.10 t/ha in 2014 and 3.55 t/ha in 2015 cropping seasons, indicating a lower yield compared to Umuspo 1 (King J) by 93.26% and 92.33% in 2014 and 2015, respectively. Based on the results, Umuspo 1 (King J) and TIS 87/0087 demonstrated early bulking rates and could be used in developing early maturing varieties of sweet potato, enabling more than two plantings in a year.
Keywords: Sweetpotato, bulking rate, total number of tubers, and fresh root tuber yield

Introduction

Sweetpotato [Ipomoea batatas (L.) Lam] is an important food security crop that feeds millions worldwide. Sweet potato is a perennial plant but normally grown as an annual (Woolfe, 1992). According to Ambe and Lyonga (1987), the growth cycle of sweet potato varies from 3 to 7 months, depending on cultivars and environment. In Nigeria, sweet potatoes rank fourth among major root and tuber crops produced (Tewe *et al*., 2003), after cassava (Manihot esculenta), yams (Dioscorea spp.), or taro (Colocasia spp).

The sweet potato varieties varied in the number of branches / plant, internode length, number of leaves per plant, vine girth and length, root diameter, number and weight produced (Egbe *et al*., 2012). Sweet potato cultivars differ from one another in the color of tuber skin, the color of tuber flesh, the shape of the tuber, the shape of the leaves, rooting depth, time of maturity, resistance to disease, and other vegetative characteristics (Onwueme, 1978). The yellow-to-orange-fleshed cultivar contains a particularly high level of carotenoids and is equaled only by carrot as a source of pro-vitamin A (Woolfe, 1992). The white-fleshed sweet potato cultivars contain a smaller amount of β-carotene (Tumwegamire *et al*., 2004). There are two main varieties of sweet potato in Nigeria; purple and yellow-skinned types. The yellow-skinned variety is rich in Beta-carotene as compared to the purple-skinned variety. Beta-carotene is known to play a big role in reducing cancer risk (Islam, 2006).

The bulking rate (BR) of root and tuber crops varies, and thus, exerts a strong influence on the time of root maturity and yield. More so, it depends on the cultivar, environmental factors, and crop management (NRCRI, 2007). The increasing potential of the crop in poverty alleviation and food security due to its high productivity per unit area and time makes it a candidate crop for the survival of the resource-poor farmers in Nigeria (NRCRI, 2003). To select cultivars for various uses, information on the growth characteristics such as bulking rate as a measure of early maturity, high tuber yields, and productivity per unit of time are necessary to make decisions useful for advising farmers. Different

varieties of sweet potatoes that mature early should be introduced to farmers. The broad objective of the study is to evaluate the bulking rate of different varieties to select the early-maturing ones that could be planted more than twice a year.

Materials and Methods

Experimental Material: Seven sweetpotato genotypes from National Root Crop Research Institute Umudike, namely Centennial, Umuspo 3 (Mother's Delight), TIS 8164, Ex-Igbariam, TIS 87/0087, Umuspo 1(King J), Solomon 2 were used for this study.

Experimental Site: The study was conducted at the National Root Crop Research Institute Umudike (NRCRI). The location is characterized by a bi-modal distribution pattern of rainfall, which peaks in July and September, with a short dry spell in August between the peak periods. In the cropping seasons, annual mean rainfall, maximum temperature, and relative humidity (0900 hours) were 209.2 mm, 31.0 ºC, and 80.6 %, respectively and 206.2 mm, 30.5 ºC and 78.6 %, respectively (2015).

Field Preparation: The experimental site was cleared, plowed, and harrowed, and one-meter ridges were made. The dimension of the entire experimental area was 50 m × 25 m (1,250 m²). The plot size was 6 m × 5 m.

Experimental Design: The Experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications

Planting and Field Maintenance: Planting was at the spacing of 100cm × 30cm on the crest of the ridges, given a total plant population of 33,333 plants per hectare (Collins, 1995). Planting was done during the mid-cropping season. Sweet potato cuttings measuring 20 cm in length were planted on the crest of the ridges on 6th June 2014 in the first year and 15th June 2015 in the second year. Establishment count and supply of vacant stands was done 2 WAP.

Field Maintenance: Weeding was done manually using a hoe, at 4 and 8 weeks after planting (WAP) and NPK 15:15:15 at 400 kg/ha was applied immediately after the second wedding (8 WAP).

Harvesting: Harvesting of fresh root tubers was done at 16 WAP from the net plots. In the first year harvesting was done on 12th September 2014 and in the second year on 5th October 2015.

Results and Discussion

The analysis of the figure depicting the bulking rates of seven sweet potato varieties across different weeks after planting (WAP) reveals significant variations (Fig. 1). Notably, Umuspo 1(King J) exhibited the highest bulking rate among the varieties, indicating its superior growth potential. In contrast, Centennial demonstrated the lowest bulking rate, despite initiating bulking earlier than other varieties. This observation underscores the impact of bulking tubers in accelerating the growth phase from planting to harvesting, as highlighted by Nweke *et al*. (1994).

Complementing the bulking rate data, the results presented in Table 1 shed light on the fresh root tuber yield and total number of tubers per plot for the seven sweet potato varieties across the 2014 and 2015 cropping seasons. Umuspo 1(King J) consistently emerged as the top performer, delivering significantly high fresh root tuber yields of 31.1 (t/ha) and 28.73 (t/ha) in the respective years, along with the highest total number of tubers per plot. In contrast, Centennial and Umuspo 3 (Mother's Delight) displayed the lowest yields in 2014 and 2015, respectively.

The data further indicate that Umuspo 1(King J) outperformed other varieties in terms of both fresh root tuber yield and total number of tubers per plot, with Solomon 2 and TIS87/0087 following closely behind in the 2014 and 2015 cropping seasons. Notably, Centennial recorded the lowest yields of 2.15 (t/ha) and 3.55 (t/ha) across both years, reflecting its comparatively lower productivity.

These findings is in agreement with earlier research by Ndaeyo and Ndon (2001), who attributed varietal yield differences to factors such as leaf number, vine length, and yield parameters. Similarly, studies by Okorie and Okpala (2000) and Wariboko (2014) corroborated the superior root yield performance of TIS87/0087. Collectively, the data underscore the significance of varietal characteristics in influencing sweet potato yield outcomes and emphasize the potential of specific varieties, such as Umuspo 1(King J), in optimizing production efficiency and overall crop productivity.

Conclusion

Since high yield potential and early maturity are important characteristics in sweet potato production, Umuspo 1(King J) and TIS 87/0087, which were high yielding and matured early (bulks early) can be used to enhance productivity as well as can be planted two or three times within a cropping season, thereby improving food security. Furthermore, Centennial could be classified as a long-duration variety that bulks late and should be allowed to stay at least three months in the field before assessing its fresh tuber root yield.

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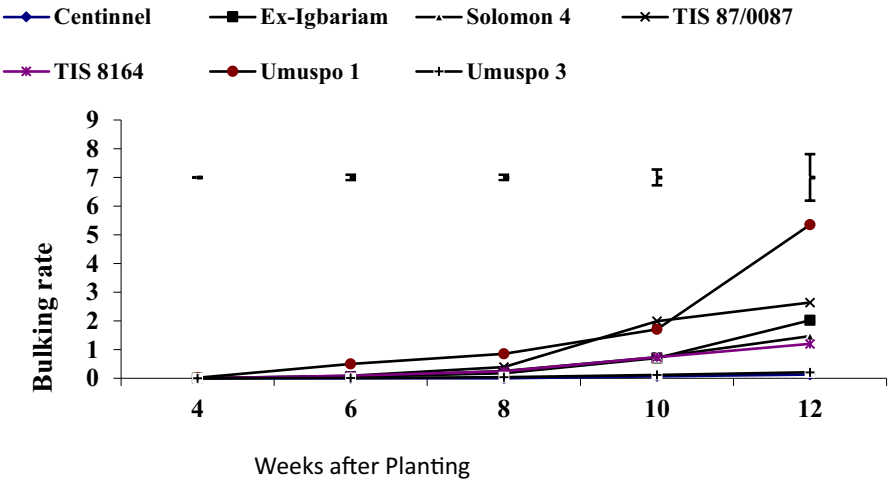

Fig. 1: Bulking rate of the seven sweet potato varieties

Table 2: Total Number of tubers/plot and yield (t/ha) of seven sweetpotato genotypes grown under degraded ultisol in 2014 and 2015 cropping seasons

Genotype	2014		2015	
	Total No. of tubers/plot	Fresh root tuber yield (t/ha)	Total No. of tubers/plot	Fresh root tuber yield (t/ha)
Centennial	29.0	2.15	42.8	3.55
Ex-Igbariam	39.2	10.25	28.8	9.45
Solomon 2	49.0	18.57	40.8	15.52
TIS 8164	32.2	16.46	31.0	16.13
TIS 87/0087	41.2	27.45	41.5	25.01
***Umuspo* 1(King J)**	72.8	31.1	57.8	28.73
***Umuspo*3(Mother's Delight)**	30.8	5.14	28.0	5.94
LSD(0.05)	20.16	7.92	20.16	7.63