

# DETERMINATION OF THE APPROPRIATE DURATION OF SWEET POTATO VARIETIES TO MATURE

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## ABSTRACT

The study was conducted to assess the appropriate duration of sweet potato varieties in terms of yield performance and quality attributes. Seven sweet potato varieties were tested following a split plot in a randomised complete block design with three replications. Significant differences ( $P = < 0,001$ ) were observed in the percentage of large storage-roots, marketable root yield and dry matter percentage. The highest yield (49,5 t/ha) and dry matter percentage (41,6 %) was obtained at Mannheim Research Station. Severe yield lost (above 60 %) due to weevil infestation, was observed at Omahenene Research Station, with the result that no significant difference ( $P = 0,559$ ) was recorded there. At Mannheim and Bagani Research Stations, however, a significant difference of yield lost was recorded due to weevil infestation. The highest percentage yield lost recorded here was when the sweet potato crop was harvested 150 days after planting (DAP). To avoid yield loss and reduce the cost of production, it is therefore recommended to harvest a sweet potato crop within 120 days after planting.

## INTRODUCTION

Sweet potato (*Ipomoea batata* L.) belongs to the family *Convolvulaceae*. It originated in the northern parts of South America and the southern parts of Central America (Onwene & Charles, 1994), and is now grown in tropical, subtropical and temperate regions. In Namibia the production of sweet potato is small. It ranges from a bucket full to a few bags, and is grown mainly at homesteads as a garden crop (Lenhardt & Rusch, 1999). Regions like Oshikoto, Omusati, Kavango and Caprivi, however, have the potential to increase sweet potato production due to good water sources such as the Olushandja dam in the Omusati region and perennial rivers in the Kavango and Caprivi regions. Soil characteristics of these regions are sandy to loamy, which is suitable for sweet potato production.

Sweet potato is ready to harvest when the bulk of the storage-roots have reached a marketable size. The development cycle of sweet potato from crop planting to harvesting of storage-roots vary depending on the variety, soil type, and moisture and temperature conditions. Bertelson *et al.* (1994) reported the duration ranges from 70 to 150 days, while Ehisiannya *et al.* (2011) reported that sweet potato reaches maturity at three to eight months after planting. The time taken to harvest sweet potato is essential in order for farmers to make a well-informed plan and make a good choice between the varieties. Knowing when to harvest will enable the farmers

to avoid keeping the crop in the field for an unnecessary time, which will also increase the production cost and reduce yield lost due to pests and diseases, and other factors that affect the storage-roots.

In Namibia sweet potato is harvested as a piece meal and the crop is not uprooted for many years. The aim of this study was therefore to assess the maturity duration of sweet potato varieties and thus categorise them accordingly. This is very important in order to advise farmers on selecting the desired varieties and also to match production with the peak in the market. Another objective was to assess the effect of prolonged harvest on yield and quality attributes, and to determine the dry matter content at different stages of production.

## MATERIAL AND METHODS

### Site selection

The site was selected based on the regions where sweet potato is being produced. The following three research stations were therefore used: Mannheim Research Station (representing Oshikoto region), Bagani Research Station (representing Kavango and Caprivi regions), and Omahenene Research Station (representing Omusati region). The annual rainfall recorded during the cropping seasons of 2009/10 and 2010/11 was 505,9 mm and 873,4 mm at Mannheim, 510,4 mm and 776,6 mm at Omahenene, and 648,5 mm and 707,4 mm at Bagani Research Stations respectively.

### Trial design and management

The trial followed a split plot in a randomised complete block design with three replications. Seven pre-released varieties were tested. Tip cuttings of 30 cm long were used as planting material. Each treatment consisted of two rows, 4,5 m long with an intra spacing of 0,30 m. The space between the ridges was 1 m. The fertiliser NPK 2:3:2 (37), plus 5 % zinc at the rate of 300 kg/ha was broadcasted evenly above the ridges and well incorporated into the soil. In addition, a side dressing of potassium nitrate (13:0:46) was added at the rate of 200 kg/ha. (This was split twice.) The trial was planted during the rainy season, but irrigation was also applied during dry spells. Weeding was done by hand three weeks after planting and also during the course of the growing period as the weeds appeared.

### Harvesting and data collection

Harvesting was done as per treatment at 90 days, 120 days and 150 days after planting. The data that was recorded was

the number of storage-roots per plant, and the weight of storage-roots. The storage-roots were sorted as marketable and unmarketable storage-roots. The marketable storage-roots were those that were more than 3 cm in diameter and free from any defects. Unmarketable storage-roots included small roots less than 3 cm in diameter, weevil infected roots, cracked, rotten and rat damaged roots. The diameter of the storage-roots was measured with a veneer calliper.

A sample of storage roots was peeled and sliced, and 300 g of the slices was placed in an oven at 60 °C. The dry weight of the slices was recorded after 48 hours and then every 24 hours until a constant dry weight was reached.

### Data processing and analysis

Data from all 30 plants per plot was used in calculating the marketable yield (t/ha), number of large storage-roots and total yield. The data was analysed using Sigma Stat, and statistically significant differences at 5 % were compared using the All Pairwise Multiple Comparison procedure (student Newman-Keuls method).

## RESULTS AND DISCUSSION

The maturity of sweet potato was indicated by a higher percentage of large storage-roots as opposed to a small storage-roots percentage. Large storage-roots are those greater than 3 cm in diameter. At Mannheim Research Station (during 2009/10) the percentage of large storage-roots was significantly lower ( $P = < 0,001$ ) when the crop was harvested 90 days after planting. While at Bagani Research Station the percentage of large storage roots obtained when the crop was harvested 150 days after planting, was much higher (63,4 %) than when the crop was harvested 90 and 120 days after planting. The highest percentage (80,7 %) was obtained at harvest time 150 days after planting (Table 1). The value with a similar exponent indicates no significant difference between those values.

Table 1. The percentage large storage-roots of sweet potato harvested different days after planting during 2009/10 and 2010/11 cropping season (%)

	Mannheim		Bagani		Oma- henene
	2009/10	2010/11	2009/10	2010/11	2010/11
90 days	28,7	64,4	47,6	42,2a	55,8
120 days	75,4a	71,7	43,8	50,5a	64,0
150 days	79,8a	80,7	49,9	63,4	68,4
Mean	61,3	72,3	47,1	52,0	62,7
<i>P</i>	< 0,001*	0,130	0,304	< 0,001*	0,229

Marketable root yield is the weight of large storage-roots that are free from any defect. It indicates the marketing value of the sweet potato. The marketable yields of sweet potato harvested different days after planting are presented in Table 2. The results indicate significant differences between the marketable yield at different days after planting at Mannheim Research Station during both cropping seasons, and also at Bagani Research Station in 2010/11. The marketable root yield did not, however, differ significantly at Bagani Research

Station during 2009/10, and also not at Omahenene in 2010/11. The results agreed with what has been reported by Jahan *et al.* (2009) who reported that harvest time had a significant effect on the weight of a tuber, with the maximum weight obtained at 150 days after planting. Late harvested crops have more time to deposit metabolites from leaves to roots, which resulted in increased root size and weight.

Table 2. Average marketable root yield of sweet potato harvested at different days after planting during 2009/10 and 2010/11 cropping seasons

	Mannheim		Bagani		Oma- henene
	2009/10	2010/11	2009/10	2010/11	2010/11
90 days	3,5	16,3	10,4	102	1,9
120 days	27,2*	37,7*	8,1	18,5	2,0
150 days	27,6*	49,5*	13,4	12,7	4,9
<i>P</i>	< 0,001	< 0,001	0,223	< 0,001	0,067

The yield of sweet potato was reduced by various factors, weevils being the main contributing factor, followed by cracking of the storage-roots (as presented in Table 3). Severe yield lost (above 60 %) was recorded at Omahenene Research Station, but there was no significant difference between the levels of harvesting. Except for in the case of Omahenene Research Station, yield lost due to weevils were significant ( $P = < 0,001$ ) at Mannheim and Bagani Research Stations. The higher value (21,8 %) was recorded when the sweet potato was harvested 150 days after planting. These results concur with the results reported by Ehisianya *et al.* (2011), who reported that weevil damage increases with the increase of harvest time. Prolonged harvesting allows weevils to access the roots for oviposition. Similarly, Villanueva, (1996) also reported that the intensity of weevil infestation on the storage-roots increases significantly as the days of harvest was delayed from 90 days to 150 days after planting.

In addition, the percentage of yield lost, due to cracking of the storage-roots, were more at Bagani Research Station. When sweet potato was harvested 120 days after planting, 19,9 % of the storage roots were cracked, although there was no significant difference between the levels of harvesting. Prolonged harvesting may result in cracks of the storage-roots, which reduces market value and increases the risk of disease infection.

Dry matter refers to what is left after a sweet potato is dried in an oven to remove the moisture. Generally it indicates the starch content of the storage-roots. Laurie (2010) reported that starch content and dry matter are correlated. The results (presented in Table 4) indicated that the percentage dry matter of sweet potato harvested at different days after planting differ significantly ( $P = < 0,001$ ). A higher dry matter percentage was obtained at 150 days after planting (41,6 % and 23,4 %) at Mannheim Research Station during 2009/10 and 2010/11 respectively. This was higher than the dry matter recorded at 90 days after planting, but not at 120 days after planting. This implies that when sweet potato is harvested 150 days after planting, it received maximum vegetative growth, as well as development of storage-roots which aided maximum

Table 3. Percentage yield lost due to weevil infestation and cracking of storage-roots during the 2009/10 and 2010/11 cropping season

	Mannheim				Bagani				Omahenene	
	Weevils		Cracks		Weevils		Cracks		Weevils	Cracks
	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11
90 days	2,3b	2,7	5,1	4,3	6,2	5,4	1,5	7,2	60,3	4,9
120 days	0,05b	4,6	1,3	4,2	12,9	3,3	7,9	19,9	71,84	2,5
150 days	14,4a	14,4	2,9	11,3	21,8	19,8	5,0	14,9	58,3	1,8
Mean	5,6	7,3	3,1	6,6	13,6	9,5	4,8	14,0	62,1	3,1
<i>P</i>	< 0,001	< 0,001	0,532	0,156	< 0,001	< 0,001	0,005	0,130	0,559	0,365

photosynthesis and hence the accumulation of dry matter in the storage-roots. The results agree with what was found by Monamodi *et al.* (2003) who reported that the dry weight of sweet potato increases linearly during the crop development stage. Jahan *et al.* (2009) also came to the conclusion that there is a significant effect of harvest time on the dry matter content of storage-roots.

Table 4. Percentage dry matter of sweet potato harvested different days after planting

	Mannheim		Omahenene
	2009/10	2010/11	2010/11
90 days	23,7	13,9	25,6
120 days	37,9	22,0	26,4
150 days	41,6	23,4	27,5
<i>P</i>	< 0,001	< 0,001	0,251

## CONCLUSION AND RECOMMENDATION

The present experiment was conducted to assess the maturity duration of sweet potato varieties based on yield performance and quality attributes. The sweet potato varieties and harvest time under study exhibited remarkable variations regarding average storage-roots per plant, and percentage of large marketable storage roots and dry matter.

Higher yields and dry matter content was obtained when sweet potato was harvested 150 days after planting. This, however, was accompanied by severe loss of yield due to weevil infestation and cracks, which reduced the market value. It is therefore important to harvest sweet potato at 120 days after planting to reduce these effects and so also the cost of production.

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