EVALUATION OF CASSAVA GENOTYPES FOR VEGETABLE YIELD AT DIFFERENT HARVESTING PERIODS

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ABSTRACT

Fresh cassava leaves and tender shoots have shown to be a nutritious vegetable when pounded, boiled, cooked and consumed as a side dish. The leaves are rich in minerals, proteins and vitamins. Cassava fresh leaf production has not been fully exploited as an alternative source of income by many smallholder farmers. The production of cassava leaves as a vegetable could be cost effective as it does not demand high inputs and hence potentially profitable as a cash crop. This study aims at determining cassava vegetable yields in eleven genotypes at different harvesting periods. Eleven cassava genotypes namely, Chila, Nalumino, Tanganyika, Bangweulu, Kariba, Kampolombo, Nakamoya, Manyopola, Bwelelako, Mweru and Kapumba were planted at a spacing of 1m x 1m without any fertilizer added, set up in a randomized complete block design and replicated three times during the 2020/2021 rainy season. Days to 50% sprouting were recorded for each genotype from the entire plot area. The fresh cassava leaves and tender shoots were harvested at 109, 251 and 360 DAP from the middle rows, and weighed. Results suggest that vegetatively propagated cassava genotypes planted in the rainy season do not vary in the time to 50% sprouting ($P>0.05$) but vary in leafy vegetable yields at 109DAP ($P<0.01$) and at 360 DAP ($P<0.05$) but not at 251 DAP ($P>0.05$). Nakamoya which is a sweet genotype has shown potential for further development as it does not significantly differ in fresh leaf yields from Nalumino, a released bitter variety.

Key Words: Cassava, genotypes, vegetables, DAP.

INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is a crop of economic importance to Zambia. It is the second main staple food crop after Maize. In Zambia, there are only seven released varieties (Table 1), namely; Chila, Tanganyika, Bangweulu, Kampolombo, kapumba, Nalumino and

Mweru (Khonje *et al.*, 2015). Some other genotypes with potential include Manyopola (sweet), Bwelelako (sweet) and Nakamoya (sweet).

Table 1: Characteristics of Released Cassava Varieties

S/ No.	**Varieties**	**Attributes for major improved cassava varieties**				
		IITA Material	**Year of Release**	**Yield (Mt/ha)**	**Maturity (months)**	**Taste**
1.	Bangweulu	None	1993	31	12 to 16	Bitter
2.	Nalumino	None	1993	29	16 to 24	Bitter
3.	Mweru	IITA x Nalumino	2000	41	16	Sweet
4.	Chila	IITA x Nalumino	2000	35	16	Bitter
5.	Tanganyika	IITA x Nalumino	2000	36	16	Sweet
6.	Kampolombo	IITA x Nalumino	2000	39	16	Sweet
7.	Kapumba	None	1993	22	16 to 24	Sweet

Note: Adopted from Khonje et al. (2015)

Research findings have shown that cassava is highly resilient to future climatic changes (Jarvis *et al.*, 2012) and may therefore be the future source of carbohydrates in many African diets. Cassava is a low input crop that thrives even under low fertile soils as compared to most crops including the hybrid maize crops that demand for more input to have substantial crop yields (El-Sharkawy, 2004; Utsumi *et al*., 2019). The physiological makeup of the cassava crop supports its tolerance to drought. Cassava has the ability to absorb moisture from the deeper soils (Attarod *et al*., 2009) and cause its stomata to close on minimum soil moisture stress (Odubanjo, Olufayo and Oguntunde, 2011) during the dry season until such a time as favorable conditions prevail, when normal active growth resumes. It has the ability to survive as a perennial crop while harvesting continues year after year.

Young cassava leaves and tender shoots have shown to be a nutritious vegetable when pounded, boiled, cooked and eaten as a side dish. According to Wargiono, Richana and Hidajat (2002), consumption of cassava leaves as a vegetable helps to moderate the occurrence of anemia and protein deficiency. The young leaves and tender shoots are rich in Iron, protein, vitamin A and C, as compared to most exotic vegetables such as spinach (Wargiono, Richana and Hidajat, 2002). Other scientific tests have indicated that cassava leaves are rich in vitamins (B1, B2, and carotenoids) and minerals (Calcium, magnesium and potassium) (Dada and Oworu, 2010).

Despite the disadvantage of the cassava leaves being toxic due to cyanide levels, research has proved that the traditional methods of pounding and boiling them before consumption is sufficient enough to detoxify and make them edible by human beings (Achidi *et al.*, 2008). Cyanide consumption between 50–100 mg has been reported to cause critical poisoning in adults and if consumed in low amounts for a long period leads to severe health problems for example tropical glucose intolerance and neuro- pathy (Adugna, 2019). Fortification of cassava leaves with soya or groundnuts significantly reduce cyanide levels consumed (Alamu *et al.*, 2021). Cassava leaves are commonly consumed in some parts of Africa. A major part of the population in Zambia, Tanzania, Malawi and Mozambique as well as over 60% of the population in the Democratic Republic of the Congo, the Central African Republic, Sierra Leone, Liberia and Angola consume cassava leaves (Achidi *et al.*, 2005).

Production of cassava fresh leaves as a vegetable is cost effective as it does not demand high cost inputs and hence profitable as a cash crop. Cassava fresh leaf production has not been fully exploited as an alternative source of income by many smallholder farmers. The demand for cassava fresh leaves over the years has been growing and hence the need to understand the potential of different cassava genotypes as alternative sources of income and nutrition.

OBJECTIVE OF STUDY

The Objective of this study is to determine the cassava leaf vegetable yields at different harvesting periods in 11 genotypes namely; Chila, Nalumino, Tanganyika, Bangweulu, Kariba, Kampolombo, Nakamoya, Manyopola, Bwelelako, Mweru and Kapumba.

MATERIALS AND METHODS

The experiment was set up at Golden Valley Agricultural Research Trust during the 2020/2021 farming season. 11 genotypes namely; Chila, Nalumino, Tanganyika, Bangweulu, Kariba, Kampolombo, Nakamoya, Manyopola, Bwelelako, Mweru and Kapumba were planted during the rainy season in February in a randomized complete block design with 3 replications. A spacing of 100cm x 100cm was used on a plot size of $5m^2$ giving 5 rows per variety. The crop was planted in basins without any fertilizers added.

Fresh cassava vegetable yields were collected within the three net plots at 109 days after planting (DAP) (about 3 months), 251 DAP (approximately 8 months), 360 DAP (approximately 12 months) and 554 (approximately 18 months). Days to 50% sprouting were recorded for each genotype from the entire plot area. The fresh cassava leaves and tender shoots were harvested at 109, 251 and 360 DAP from the middle rows, and weighed

Genstat statistical package was used to analyze the data and the means were separated using Tukeys at 0.05 level of significance.

RESULTS AND DISCUSSION

a) Comparison of days to sprouting among vegetatively propagated cassava genotypes

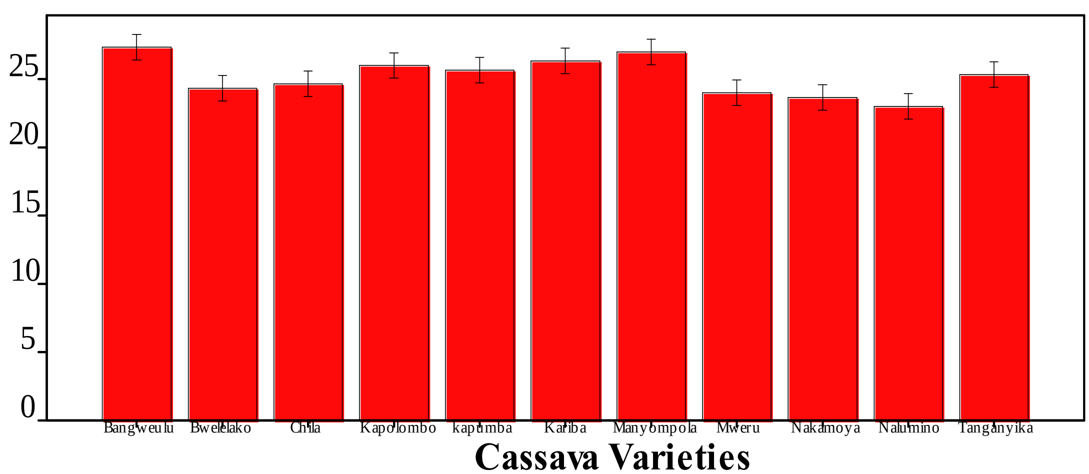

Figure 1: Number of Days to Sprouting of Various Cassava Genotypes

The results showed that there are no significant differences (P>0.05) in the number of days it takes for different varieties of cassava that are vegetatively propagated to sprout. Therefore, whichever cassava genotype (whether Chila, Nalumino, Tanganyika, Bangweulu, Kariba, Kampolombo, Nakamoya, Manyopola, Bwelelako, Mweru and Kapumba) that a farmer wishes to plant for leafy vegetables, there will be no significant differences in the days to sprouting during the rainy season. The findings are in agreement with the findings of Oka, Limsila and Sarakarn (1987) who indicated that there was no significant difference in the survival rate between Rayong l and Rayong 3 in the rainy season. Sprouting may be dependent upon the weather conditions and the ability of a variety or genotype to tolerate as clearly shown by Oka, Limsila and Sarakarn (1987) who showed that the two varieties were not significantly different in the rainy season but were significantly different in the dry season.

b) Comparison of leaves harvested for human consumption at different times among the 11 cassava genotypes

Table 2 below shows fresh leaves yield in metric tonnes per hectare harvested at three different growth stages of the eleven genotypes of cassava and the expected total yields.

Table 2: Fresh Leaf yield in Mt/ Ha harvested at 3 different periods (109, 251 and 360 DAP) and cumulatively during the growth of different cassava genotypes

Cassava Genotype	109 DAP Cassava Fresh Vegetable Leaves Yield (Mt/ Ha)	251 DAP Cassava Fresh Vegetable Leaves Yield (Mt/ Ha)	360 DAP Cassava Fresh Vegetable Leaves Yield (Mt/ Ha)	Total Cassava Fresh Vegetable Leaves Yield (Mt/ Ha)
Tanganyika	0.5333 a	3.627 a	3.851 a	7.673 a
Kapumba	0.7900 ab	3.003 a	5.317 ab	8.574 a
Manyompola	0.8667 ab	2.823 a	5.142 ab	8.316 a
Bwelelako	0.9100 ab	2.667 a	4.136 ab	7.096 a
Mweru	0.9133 ab	2.597 a	3.858 a	6.765 a
Bangweulu	0.9167 ab	2.820 a	5.196 ab	8.314 a
Nakamoya	0.9233 ab	2.630 a	7.515 b	10.48 a
Nalumino	1.0800 b	3.840 a	6.052 ab	10.259 a
Chila	1.1667 b	3.047 a	5.824 ab	9.27 a
Kariba	1.2067 b	3.060 a	5.241 ab	8.676 a
Kampolombo	1.2100 b	3.100 a	4.726 ab	8.233 a
CV	**5.3%**		**12.8%**	**11.0%**
P-Value	**0.004**	**0.290**	**0.048**	**0.230**

Values with a subscript of the same letter, means no significance difference at 0.05 level of significance.

Results revealed that there are significant differences when leaves are harvested at 109 DAP ($P<0.01$) and at 360 DAP ($P<0.05$) and not at 251 DAP (Table 2). Leaves harvested at different times differ in fresh yield among different genotypes and showed a linear trend across all genotypes as the cassava plants grow. Cumulatively, there was no significant difference ($P>0.05$) among the different cassava genotypes.

Generally, all the 11 cassava genotypes increase in leaf yield as the plant grows. Some genotypes such as Tanganyika and Mweru have shown that the biggest difference in yield is from 109 DAP to 251 DAP and very minimal differences from 251 to 360 DAP. This implies that a farmer is better off harvesting at either 251 or 360 DAP in order to save on labour for these particular genotypes.

On the other hand, Nakamoya, Nalumino, Chila, Kariba, Kampolombo, Bangweuru, Bwelelako, Manyopola and Kapumba have shown potential to be harvested at the 3 stages of cassava growth with quite substantial leaf yield increase as the plant grows. These genotypes seem to be better at partitioning DM to the above ground as compared to the aforementioned genotypes. Studies have also shown that the first seven months are the best periods to harvest fresh vegetables because during this period, dry matter accumulation is primarily for growth of leaves and stems, thereafter it is for root development (Lian and Cook, 1979; Wargiono and Tuherkih, 1982; Hozyo, Megawati and Wargiono, 1984). Wargiono, Richana and Hidajat (2002) indicated that harvesting selected young leaves weekly had no effect on the cassava root yield. On the contrary, Ariyo *et al.* (2003) discouraged the harvesting of tender apical leaves and shoots of cassava as vegetables alluding to the fact that such an action increases the severity of CMD infection in the regenerating shoots of cassava with associated storage root yield reduction. This may be dependent on variety and location.

Among the 11 cassava genotypes, Nalumino and Nakamoya stand out to be the best yielders of fresh leafy vegetables at both 109 DAP (1.08 Mt/ Ha and 0.92 Mt/ Ha respectively) and 360 DAP (6.05 Mt/ Ha and 7.52 Mt/ Ha). Wargiono, Richana and Hidajat (2002) indicated that weekly yields harvested before seven months in Indonesia are 4.45 to 5.67 million tonnes for intercropping and monoculture cassava respectively. The yields reported are way lower than those indicated in Indonesia probably due to differences in variety, climate and fertilizer use. The findings above seem to be in agreement with Sagrilo *et al.* (2001) who indicated that approximate yields of 2.25 Mt/ha of cassava leaf flour are possible based on the capacity of leaves produced per plant per hectare. Nalumino which is a bitter variety as compared to Nakamoya (sweet) may not be a better option in view of the conclusion by Alamu *et al.* (2021), who encouraged the utilization of sweet cassava varieties due to their nutritional benefits.

CONCLUSION

Vegetatively propagated cassava genotypes namely; Chila, Nalumino, Tanganyika, Bangweulu, Kariba, Kampolombo, Nakamoya, Manyopola, Bwelelako, Mweru and Kapumba do not vary in sprouting but vary in yields when grown for leafy vegetables at 109 and 360 DAP. Nakamoya which is a sweet genotype has shown potential for further development as it does not significantly differ in fresh leaf yields from Nalumino, a released bitter variety.

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