

Performance of Cassava (*Manihot esculanta*. Crantz) Varieties at Different Areas of South Omo, Southern Ethiopia

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Abstract: A field experiment involving four improved cassava (*manihot esculanta*, crantz) varieties and one local check was carried out at four different locations of South Omo zone (Kurea, Jinka on station, Geza and Shepi Kebelles) during the 2018 to 2019 cropping seasons under rain fed conditions to identify the best performing variety/ies to the target areas of South Omo zone. The cassava varieties included in the field experiment were four improved (Kelo, Qulle, Hawassa-04, Chanco) and a local check. The experimental design was a randomized complete block design (RCBD) with three replications. Growth, yield and yield components were studied. The result showed that plant height was significantly affected by variety while number of primary and secondary branch was not significantly influenced by variety. Total root number per plant, tuber weight and total yield per hectare also showed a significance difference among varieties. The highest total root yield per hectare (24.77 t/ha) was recorded from Hawassa-04 where as Chanco, Kelo, Qule and local check show no significance difference among each other. Therefore, it can be concluded that use of the improved cassava varieties such as Hawassa-04 is advisable and could be appropriate for cassava production in the test area even though further testing is required to put the recommendation on a strong basis.

Keywords: Root Yield, Growth Parameters, Cassava Variety, Yield Components

1. Introduction

Cassava (*Manihot esculenta* Crantz) is an important staple crop recognized as a 21st century crop mostly for smallholder farmers [1, 2]. According to Food and Agriculture Organization of the United Nation (FAO), it is one of some 100 species of tree, shrub and herbs of the genus *Manihot* believed to have been introduced from northern Argentina to the United States of America [2]. Other studies opined that cassava has several centers of origin beginning from southern edge of the Brazilian Amazon [3, 4].

Cassava (*Manihot esculenta* Crantz) is cultivated throughout the lowland tropics, typically between 30°N and 30°S of the equator, in areas where the annual mean temperature is greater than 18°C [5]. Cassava is an important crop in Africa where it serves as a famine reserve crop, industrial raw material and livestock feed [6]. The crop stores

well in the soil, has high starch productivity and performs relatively well in low fertility soils and marginal areas [7]. The diverse uses of cassava largely explain its popularity in the tropics [7]. In Africa most cassava produced is used for food consumption, with 50% in processed form, and 38% in the fresh and/ or boil form; 12% is used for animal feed. Despite its enormous production potential, adaptation to a great diversity of environments, its recognized tolerance of biotic and abiotic constraints to production, and its diversity of uses, cassava has not yet been managed to fully develop its potential in tropical agriculture due to numerous factors. Among the factors that constrained the production of cassava is lack of early maturing, high yielding and low hydrogen cyanide containing varieties [8].

According to FAO estimates, 291,992,646 tons of cassava were produced worldwide in 2017. Africa accounted for 57%, Asia for 32%, and others 11% of the total world

production. In 2017, Nigeria produced 59.4 million tones making it the world's largest producer followed by Congo DR, Thailand, Indonesia and Brazil with 31.5, 30.9.19 and 18.8 million tons, respectively. In terms of area harvested, a total of 26,342,330 hectares was planted with cassava throughout the world in 2017; about 64% of this was in sub-Saharan Africa. The average yield in this year was 11.08 tons per hectare [9].

In Ethiopia, it is mainly cultivated by small resource poor farmers on smallholding plots of land. It is both a food security crop and a source of household income. It is increasingly becoming a source of industrial raw material for production of starch, ethanol, waxy starch, bio-plastics, glucose, bakery and confectionery products, glue, among others [10]. In Ethiopia, cassava generally is being grown in almost all parts of the country. But bulk of its production is situated in south, south western and western parts of the country.

The average total coverage and production of cassava per

annum in Southern region of Ethiopia is 195,055 hectares with the yield of 501,278.5 tones indicating the average productivity of cassava in the country is not more than 25 ton per hectare [11]. Which is by far lower than the yield obtained by other tropical countries such as Nigeria that recorded 35.00 tons per hectare per year [1].

In Ethiopia, most of the varieties produced were local farmers' varieties which are low yielding, late maturing, bitter type and containing high hydrogen cyanide [12]. To alleviate these problems, a number of research activities focusing on crop variety improvement were conducted in different agro-ecological locations. Hence evaluation of four improved cassava varieties and one local check were conducted at different locations of South Omo zone as a result, promising varieties with regard to storage root yield per a given period from a given area of land were obtained. Therefore, this paper aimed to show the performance of different improved cassava varieties under different agro ecological conditions of southern Ethiopia.

Table 1. World (regions) cassava production ('000 tonnes).

	2012	2013	2014	2015	2016	2017
World	277,683	278,454	292,054	295,244	296,043	291,993
Africa	158,033	159,836	169,595	173,343	177,736	177,948
America	30,487	30,519	32,338	32,436	30,267	28,038
Asia	88,953	87,849	89,867	89,122	87,798	85,763
Caribbean	957	1,134	1,256	1,528	1,481	1,378
Oceania	210	250	253	252	241	245

Source: FAOSTAT, 2019

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted on four different locations namely Jinka on station, Geza, Shepi and Kurea kebele of South Omo zone. The long term weather data for these area revealed that the maximum and minimum monthly average temperature of the center is 31.55°C and 19.55°C, respectively; whereas, the maximum and minimum monthly average temperature of the growing periods was 23.576°C and 10.622°C, respectively. The long term rainfall data for the area showed that the mean annual rainfall of the area is 1774.67 mm; while the mean monthly rainfall of the area for the growing seasons was 151.7188 mm. Rainfall pattern of the area over the years have been bi-modal with peaks around September and October and spans from February to November. The experiment was conducted during the 2018 to 2019 cropping seasons under rain fed conditions.

2.2. Treatments and Experimental Design

The experiment was executed by using four improved cassava varieties and one local check. The improved varieties were Awassa-04, Chanco, Qule and Kello. The field experiment was laid out in a randomized complete block design (RCBD) with three replications. The spacing was 1mX1m between plants and rows respectively. The gross plot area was 4m X 5m, 20m².

Storage root yield and other yield related data such as root length, root girth, number of roots per plants and growth rate were taken from the net plot at harvesting except the growth rate which was taken in three months interval from planting. Data on the root length, root girth, number of roots per plants and growth rate were taken from randomly selected five plants. Whereas, the storage root yield data was taken from each plot in kilogram and converted into yield per hectare in ton by using the following formula:

$$\text{Yield per hectare} = \frac{\text{yield per plot (kg)} \times 10000\text{m}^2}{20\text{m}^2 * 1000(\text{kg/t})}$$

Note that 1 ton(t) is equals to 1000 kg.

Storage root yield was clustered into marketable, unmarketable and total yield. Marketable storage roots yield was referred to the yield of those roots weighting 100-500 g, storage roots not infected by disease and not infested by insect pests, whereas unmarketable storage root yield was referred to those roots weighting more than 500 g and less than 100 g, storage roots infected by disease and infested by insect pests and miss shaped roots. Total storage root yield was the sum total of marketable and unmarketable root yields. The dry matter content of the varieties was taken after oven drying for 24 h at 110°C for consecutive dates until the weight was constant.

2.3. Statistical Analysis

Analysis of variance was performed using the GLM

procedure of SAS Statistical Software Version 9.0 [13]. Effects were considered significant in all statistical calculations if the P-values were <0.05 . Means were separated using Fisher's Least Significant Difference (LSD) test.

3. Result and Discussion

Significant differences ($P<0.05$) were observed on parameters of plant height, canopy diameter, number of buds, root diameter, number of roots per plant, number of

marketable roots, marketable yield, total yield and dry matter content (Table 2 and Table 3). The plant height ranged from 241.21 cm in Chanco variety to 243.50cm in local check. Hawassa-04 variety record maximum canopy diameter (281.67 cm) while Chanco variety recorded minimum (198.75cm). Maximum number of roots per plant (13.33) was recorded on variety Hawassa-04 with no significant difference over the variety Kelo (11.33) whereas minimum number of roots per plant was recorded on varieties Chanco (10.00), Qulle (9.00) and local check (8.33) with no significant difference among each other.

Table 2. Mean Square values for growth related parameters of four cassava varieties grown at South Omo, in 2018 to 2019.

Source	DF	PH	CD	NB	NPB	NSB	RL	RD
Treatment	5	2474.97*	3092.08*	189.44*	0.11ns	2.27ns	161.65ns	5.85
Block	2	635.26	70.31	90.32	1.12	11.85	71.93	0.24
Error	7	174.60	212.23	49.19	0.41	3.22	63.90	0.72

PH=plant height, CD=canopy diameter, NB=number of buds, NPB=number of primary branch, NSB= number of secondary branch, RL= root length, RD= root diameter *= significant ns=non significant

Table 3. Mean Square values for yield related parameters of five cassava varieties grown at South Omo, in 2018 to 2019.

Source	DF	NRPP	NMR	NUNMR	MY	UNMY	TY	DM
Treatment	5	11.90*	54.77*	17.23ns	125.93*	0.75ns	120.57*	23.02*
Block	2	1.25	6.07	0.20	5.26ns	0.04ns	4.97ns	1.52
Error	7	3.00	8.07	6.28	5.42	0.41	5.07	2.42

NRPP=number of roots per plot, NMR= number of marketable roots, NUNMR= number of unmarketable roots, MY= marketable yield, UNMY= unmarketable yield, TY= total yield, DM=dry matter

Table 4. Combined mean plant height, canopy diameter, number of buds, number of primary branch, number of secondary branch, root length and root diameter of five cassava varieties grown at south omo.

Variety	PH	CD	NB	NPB	NSB	RL	RD
Hawassa 04	221.25B	281.67A	40.00A	3.00	8.17	58.33	9.04A
chanco	195.65C	198.75D	32.67AB	2.83	7.17	38.47	6.72B
kelo	241.21AB	216.67CD	25.17BC	3.00	8.00	49.27	6.02B
qulle	207.80BC	250.83B	18.83C	2.67	7.00	50.53	5.73B
local	243.50A	228.33BC	28.67ABC	3.17	9.17	44.80	5.73B
Significance	*	*	*	ns	ns	ns	*
SE \pm	7.62	8.41	4.04	0.36	1.03	4.61	0.49
LSD (0.05)	21.87	27.43	13.20	1.20	3.38	15.05	1.60
CV (%)	5.68	6.19	24.13	21.78	22.73	16.56	12.80

PH=plant height, CD=canopy diameter, NB=number of buds, NPB=number of primary branch, NSB= number of secondary branch, RL= root length, RD= root diameter *= significant ns=non significant

Yield and yield related traits also showed a significant difference ($P<0.05$) across locations (Table 5). Highest tuber yield was recorded on the variety Hawassa-04 (24.77 t/ha) and showed a significant difference over the tested varieties. In case of root dry matter varieties Kelo and Chanco recorded maximum dry matter, of 49.83 and 49.33 respectively, which is significant difference over the other varieties.

Average storage yield obtained from East African countries such as Kenya, Uganda and Tanzania in 2013 was 15.89, 12.02, 7.50 tons per hectare, respectively. Differences in cassava tuber yield are determined by several factors, such as number of tubers, tuber length and tuber weight per plant. [14] concluded that storage root number, storage root size and storage root diameter were the main yield components contributing to yield enhancement in cassava. As far as yield related traits are concerned, the value obtained directly

concedes with the report of [15]. In his study, the highest storage root length obtained from the variety, Cuban White Stick was 40.46 cm. In the same way, the highest storage root number per plant was obtained from the variety John LaMotte (7.78) which is similar to the value recorded from the current study (8.52).

The parameters number of primary branch, secondary branch, root length, number of non-marketable roots per plot and unmarketable yield per hectare showed no significant difference ($P > 0.05$) among varieties (Table 2 and Table 3).

From this study variety Hawassa 04 which yields maximum yield as compared to the other varieties is recommended in terms of yield. In case of Dry matter content both varieties of Chanco and Kelo are recommended which were recorded maximum dry matter content with no significant difference among each other.

Table 5. Combined mean number of roots per plant, number of marketable roots, number of unmarketable roots, marketable yield, unmarketable yield, total yield and dry matter of five cassava varieties grown at south Omo.

Variety	NRPP	NMR	NUNMR	MY	UNMY	TY	DM
Hawassa 04	13.33A	21.33A	5.67	23.77A	1.00	24.77A	44.83B
Chancha	10.00B	15.00B	5.33	10.37B	0.97	11.27B	49.33A
Kelo	11.33AB	13.33B	9.00	11.00B	1.90	12.90B	49.83A
Qulle	9.00B	9.67B	8.67	7.50B	1.73	9.23B	44.17B
Local	8.33B	13.33B	3.33	9.47B	0.80	10.27B	44.67B
Significance	*	*	ns	*	ns	*	*
SE \pm	1.00	1.63	1.44	1.34	0.36	1.29	0.89
LSD (0.05)	3.26	5.34	4.71	4.38	1.20	4.23	2.92
CV (%)	16.65	19.54	39.17	18.74	49.85	16.44	3.33

4. Conclusion

In Ethiopia, most of the varieties produced were local farmers' varieties which are low yielding, late maturing, bitter type and containing high hydrogen cyanide.

Significant differences ($P < 0.05$) were observed on parameters of plant height, canopy diameter, number of buds, root diameter, number of roots per plant, number of marketable roots, marketable yield, total yield and dry matter content. The plant height ranged from 241.21 cm in Chancha variety to 243.50 cm in local check. Hawassa-04 variety record maximum canopy diameter (281.67 cm) while Chancha variety recorded minimum (198.75 cm). Maximum number of roots per plant (13.33) was recorded on variety Hawassa-04 with no significant difference over the variety Kelo (11.33) whereas minimum number of roots per plant was recorded on varieties Chancha (10.00), Qulle (9.00) and local check (8.33). storage root number, storage root size and storage root diameter were the main yield components contributing to yield enhancement in cassava.

Using improved varieties of cassava could make an important contribution to increase agricultural production and productivity in areas like South Omo where there is low practice of using improved technologies such as improved crop varieties. To this end, use of improved cassava technologies such as improved varieties could be one of the alternatives to improve productivity by small farmers. However, the use of improved Cassava varieties is not yet studied in the area. Thus, this research work is initiated to investigate the impact of including improved Cassava varieties on the existing production system is of paramount important.

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