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Journal of Horticulture

Research Article

Evaluation and Demonstration of Cassava Varieties and its Product *via* Promotional Workshop under Irrigated Condition of Middle Awash, Afar, Ethiopia

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ABSTRACT

Cassava production is popular in Africa due to its low water requirement, which is recently adapted in Afar region that characterized by low availability of moisture. Demonstration was not done to familiarize the crop with agro pastorals in the area. Therefore, the experiment was carried out at WARC, Bedulale and Kedigadora kebeles in 2014 cropping season using two released cassava varieties namely Qulle and kelo planted on double observational plots that arranged as RCBD with two replications at each location. Practical training on product development and end product test were accomplished for selected agro pastorals of Amibara districts through promotional workshop. Storage root yield results of the experiment showed that there was highly significant difference ($P<0.01$) between the two cassava varieties as, Variety Kello gave significantly higher average storage root diameter (2.25 cm) and average root length (16.65 cm), average root number (43.36%), unmarketable root yield (24.67%), marketable root number (71.03%), total root number (43.09%) and total root yield (18.43%) than variety Qulle. Combined analysis of variance for each location also showed the same result. Varieties were non-significant at the specified level of significance for total root yield at Werer agricultural research center and Kadigadora but they were found to be significant at Wedulale. Similarly, the varieties were non-significant at the specified level of significance for average root diameter and number, unmarketable and total root number at WARC and Wedulale but, they were found to be significant at Kadigadora. Agro pastorals were provided and consumed eight different kinds of cassava based meals namely: 1) Cassava bread, 2) Cassava chechebsa, 3) Cassava cookies, 4) Cassava cheeps and biscuits, 5) Wet from Cassava leaves, 6) Cassava enjera 7) Boiled cassava root, 8) Cassava potage. After testing food, discussion with Agro pastorals about the crop, its production and food test was done. They became interested to grow cassava and happy with the demonstration and call it "Me'e" meaning best in Afar language. Thus it, cassava production and utilization are suggested to be increased all over the tested locations and areas with similar agro ecologies in the region.

Keywords: Cassava dishes; *Manihot esculenta* crantz; Participatory; Injera

INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is one of the most consumed root crops in the world and second important staple food for energy in sub-Saharan Africa providing up to 285 calories per person/day [1]. It's grown in the area between the latitudes 30° N and 30° S [2]. Cassava tolerates hot climate, but a critical point exist between a daily average temperature of 18 and 20°C, below which the plants don't grow normally and the yield decrease rapidly. It grows exclusively as food in 39 African countries, stretching through a wide belt from Madagascar in the south-east to Senegal in the Northwest [3]. It is a staple food for more than a tenth of the world's populations, and in tropical countries it is the third source of calories after maize and rice [4]. Cassava supplies energy for over 500 million people in tropical Africa [5]. It is also used as a livestock feed substitute for grain

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Received: 30-Mar-2022, Manuscript No. HORTICULTURE-22-16507; **Editor assigned:** 01-Apr-2022, PreQC No. HORTICULTURE-22-16507 (QC); **Reviewed:** 15-Apr-2022, HORTICULTURE-22-16507; **Revised:** 30-May-2022, Manuscript No. HORTICULTURE-22-16507 (R); **Published:** 06-June-2022, DOI: 10.35248/2376-0354.9.312.

Citation: Kuma Y (2022) Evaluation and Demonstration of Cassava Varieties and its Product *via* Promotional Workshop under Irrigated Condition of Middle Awash, Afar, Ethiopia. J Hortic. 9:312

[6]. Cassava possesses unique attributes, notably the ability to make returns of root yield even at extreme stress conditions [7].

Africa currently accounts for more than 50% of the world's annual output of 184 million tonnes of cassava with Nigeria being the leading producer in the world, followed by Brazil, Thailand, Indonesia, Democratic Republic of Congo, Ghana, Tanzania, Mozambique, Madagascar and Uganda [8] in that order. Cassava ranks after yam in terms of production among the root and tuber crops of economic value [9], and fourth in the tropical world after cereal (rice, wheat and maize) [10]. The main value of this crop is in its storage roots where the dry matter contains more than 80% starch. The areal parts, mainly the leaves are also widely consumed as vegetables, supplying protein, vitamins and essential minerals [11,12]. As the root crop has gained industrial importance with uses in ethanol production, high quality cassava flour in bread production, and glucose syrup production.

It was not known when cassava was introduced to Ethiopia, but it is popular in Southern regions of the country since very long time. Currently, it is expanding all over Ethiopia due to its drought tolerant and higher yield as a result two cassava varieties were released namely Qulle and kelo both are late maturing (12-18 months). The crop was recently introduced to Afar region and two cassava varieties were adapted for their yield and yield components to drought and heat stress condition of Amibara districts. Following variety adaption agro-pastoral participatory cassava product development and promotion is needed. Therefore, this paper was aimed to poster activities carried out in the selected locations of the region and results obtained through demonstration of cassava based products.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted on horticulture experimental site of Werer research center and on agro-pastorals farm of Bedulale and Kedigadora kebeles in 2014 cropping season. The area is located in the Afar Regional State, Zone-3, Amibara district, which is 280 km in the north east of Addis Ababa. It is located at 9° 60' N latitude and 40° 9' E longitude with an altitude of 740 meter above sea level (m.a.s.l.). The mean annual temperature of the area was 34°C, while the mean annual rainfall and evapo-transpiration are 560 and 2600 mm, respectively. The area has very long hot and dry seasons with erratic rainfall.

Field experiment

The field experiment was laid out in Randomized Complete Block Design (RCBD) with two replications in three locations namely werer research center and on agro-pastorals farm of Bedulale and Kedigadora kebeles in 2014 cropping season. Two released Cassava varieties Kelo (44/72 red) and Qulle (104/72 Nigeria red) were evaluated. Each cassava variety was planted on 100 m2 area in double observational plots as replications. One by one between row spacing and within row spacing were used weed control was done manually by hand and hoe specially during early establishment. Irrigation was applied by furrow irrigation. Yield and all necessary data were collected from the central eight rows. Samples of cassava storage roots were collected from all location and delivered to Ethiopian health and nutrition research Institute for hydrogen cyanide test.

Statistical analysis

Analysis of variance test was carried out by using SAS software, version 9.0 (SAS Institute Inc., 2002). Mean separations were analyzed using the Least Significant Differences (LSD) test at 5%and 1% level of probability.

Cassava product development and demonstration: A total of twenty four participants, twenty two agro-pastorals and two development agents were selected and attended the workshop on cassava product development and demonstration which was held at Were agricultural research center. Prior to cassava plant exposure detail theoretical training was given on cassava production technique, protection, cassava flour preparation and product development. Lastly the participants were practically visited cassava fields, cassava flour preparation and test foods prepared from cassava root.

Recipes preparation

Two cassava varieties; Storage roots from Kello and Qulle cassava varieties were dug out and processed to flour based on the following steps:

1. Peeling and washing cassava roots
2. Split cassava roots into two and remove the central
3. Cut into small pieces and soak in the water for an hour
4. Sieving wet cassava pieces and drying in an open air
5. Mash in to flour
6. Mix with teff and wheat flour in ratio of 70:30 (Cassava: Teff/Wheat) to make different products based on recipe preparation manual prepared by Hawassa agriculture research center.

RESULTS AND DISCUSSION

Performance of varieties for yield and quality parameters

The result of analysis of variance indicated that effects of variety averaged over replication and location were highly significantly differ for all parameters except average root yield, marketable root yield and unmarketable root number between tested varieties (Tables 1 and 2).

The analysis of variance indicated that there was highly significant difference ($P<0.01$). Between the two cassava varieties. Variety Kello produced significantly more average root diameter (2.25 cm) and average root length (16.65 cm) than variety Qulle. The result obtained in this experiment is supported by the findings of [13] who reported that the cassava variety Kello gave the highest storage length followed by the clone AWC-5 and

AWC-2; 40.67, 38.25 and 37.77 cm, respectively at Amaro, Hawassa, Jimma and Sekota. Similarly, variety Kello produced significantly more average root number (43.36%), unmarketable root yield (24.67%), marketable root number (71.03%), total root number (43.09%) and total root yield (18.43%) than variety Qulle. This finding is in agreement with the result of [14] who reported that Genotype 96/1708 had the highest storage root yield (19.25 t ha^{-1}) under irrigation, whilst CTSIA 48 had the lowest (7.0 t ha^{-1}). Under no irrigation, root yield ranged between 7.5 and 17.0 t ha^{-1} for Biabasse and 96/1708, respectively in the Guinea Savannah agro-ecological zone of Ghana. On the contrast, variety Qulle produced 18.11% higher hydrogen cyanide content than variety Kello indicating HCN content varies with variety. The result obtained in this experiment is supported by the findings of who reported that the cassava variety KU50 (184) gave the highest storage root hydrogen cyanide contents (mg.kg^{-1}) than variety HNT (46).

Table 1: Combined analysis of variance for yield and yield components of cassava variety under three locations.

Parameters	Source of Variation				
	Rep	variety	Variety*Rep	Location	Variety*Location
DF	1	1	1	2	2
ARD	0.03	15.14**	0.29	2.03*	0.09
ARL	18.98	831.50**	1.53	2.72	59.93
ARN	0.32	2.86**	0.66*	1.49**	0.06
ARY	0.06	0.1	0.01	32.76**	0.83
MRY	20.51	2269.03	0.36	14882.74**	1470.9
UMRY	1.15	634.23**	14	8247.10**	163.04*
MRN	35490481	300570270.80**	31050484	6036154	2941391
UMRN	82668	209616.3	6523925	157970127.00**	658766.3
TRN	32147407	2849048220.10**	66039900	149586402.10**	6383105
TRY	11.94	5302.51*	9.85	37053.28**	672.07
HCN	0.27	2.59**	0.06	0.11	0.27

ARD=average root diameter, ARL=average root length, ARN=average root number, MRY=marketable root yield, UMRY=unmarketable root yield, MRN=marketable root number, UMRN=unmarketable root number, TRN=total root number, TRY=total root yield, HCN=hydrogen cyanide.

Table 2: Yield, yield related and quality traits of two cassava varieties at WARC, Bedulale and Kadigadora.

parameters	Source of Variation					
	variety		over all mean	LSD	CV	R-2
	Qulle	Kello				
ARD	4.85[b]	7.10[a]	5.97	0.84**	8.78	0.95
ARL	40.80[b]	57.45[a]	49.12	7.99**	10.14	0.91
ARN	2.26[b]	3.24[a]	2.75	0.45**	10.17	0.96
ARY	3.28	3.46	3.37	NS	14.22	0.99
MRY	169.13	196.64	182.88	NS	9.39	0.97

UMRY	58.94[b]	73.48[a]	66.21	5.69**	5.36	1
MRN	14092.00[b]	24102.00[a]	19096.92	5345.9**	17.46	0.9
UMRN	8526	8261	8393.5	NS	12.21	0.99
TRN	22618.00[b]	32363.00[a]	27490.42	4467.3**	10.14	0.96
TRY	228.07 [b]	270.11[a]	249.09	26.20**	6.56	0.99
HCN	6.13[a]	5.19[b]	5.66	0.35**	4.47	0.94

ARD=average root diameter, ARL=average root length, ARN=average root number, MRY=marketable root yield, UMRY=unmarketable root yield, MRN=marketable root number, UMRN=unmarketable root number, TRN=total root number, TRY=total root yield, HCN=hydrogen cyanide.

Combined analysis of variance for yield and yield components of cassava variety

Combined analysis of variance for each location showed that the varieties were significantly different at (P<0.01) for all characters except average root length, marketable root number, and hydrogen cyanide content (Table 1). Varieties were non-significant at the specified level of significance for total root yield at WARC and Kadigadora but they were found to be significant at Wedulale (Figure 1). Contrarily, varieties were non-significant at the specified level of significance for average root diameter, average root number, unmarketable root number and total root number at WARC and Wedulale but they were found to be significant at Kadigadora. The combined analysis of variance across the three locations revealed that varieties were non-significant for most of the characters except unmarketable root yield.

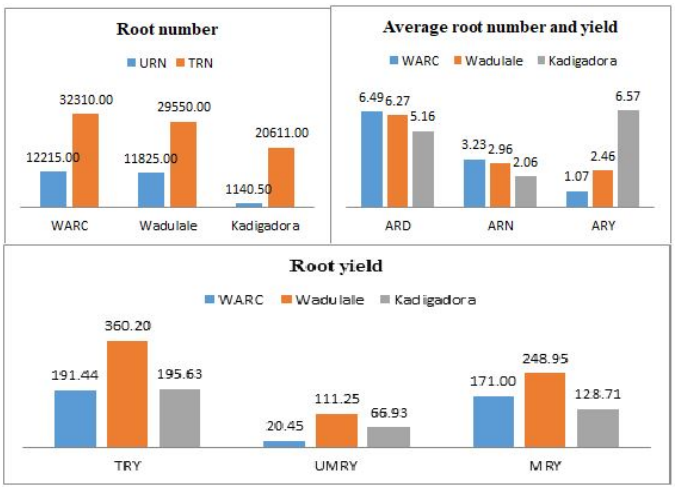

Figure 1: Location difference on cassava yield and yield related traits.

Variety Kello produced significantly more total root yield (270.11 q ha^{-1}) than variety Qulle (228.07 q ha^{-1}) which was a bit lower than the yield at western and southern parts of the country, 281 and 272 q ha^{-1}, respectively. The HCN content of both varieties grown in all locations were highly lower than the value obtained at different parts of the country which indicates that that the crop can be used for food without any health frustrations in middle Awash under irrigated condition. This might be due to furrow irrigation applied during the production season of the crop. This result is in line with the result reported by that stated, irrigating with 60 mm and harvesting at 9 MAP produced the lowest cyanogen content and highest starch percentage in cassava roots and suggest that administering an ample supply of water, particularly during the dry season, should mitigate the cyanogenic potential of cassava roots. The cyanogenic glycosides content in the root was higher under the drought-stressed condition than under the well irrigated condition as in a previous report.

Cassava products preparation and demonstration

Cassava is recently introduced to afar regional state through adaptation trials by Horticultural research case team of were agricultural research center. Cassava production theoretical and practical trainings were given in the hall and field (Figure 2) and cassava food preparation (Figure 3) and consumption (Figure 4) were demonstrated to agro pastorals of Amibara districts. Cassava based common dishes were prepared through mixing 70% of cassava flour with 30% wheat and Teff flour. The dishes were 1. Cassava bread, 2. Cassava "chechebsa", 3. Cassava cookies, 4. Cassava cheeps and biscuits, 5. "Wet" from Cassava leaves, 6. Cassava "enjera" 7. Boiled cassava root and 8. Cassava potage. Flour prepared from both Cassava varieties separately was mixed with Teff for preparation of cassava "Injera" (Ethiopian flatbread with a slightly spongy texture) and the remaining were mixed with wheat flour for other food types (Figure 5).

Figure 2: Cassava training and field visit.

Figure 3: Demonstration of Cassava flour preparation.

Figure 4: Cassava made foods (a. Cassava bread b. cassava 'chechebsa' c. cassava cookies d. cassava cheeps and biscuits e. 'Wet' from Cassava leaves f. cassava 'enjera'g. boiled cassava root h. Cassava potage).

Figure 5: Tasting on cassava foods and closing remarks.

CONCLUSION

Cassava (*Manihot esculenta Crantz*) is one of the most consumed root crops in the world and second important staple food for energy in sub-Saharan Africa providing up to 285 calories per person/day. This valuable crop is drought tolerant and higher yielder in small plot of land which is the behavior that most crops do not show. The character is confirmed by the storage root produced by both varieties which yielded more than 20 t ha^{-1}. The varieties were characterized by; lower content of the deadly chemical called HCN.

In addition, the crop is adaptable to the agro climatic condition of the tested and areas with similar conditions. Moreover, cassava based food products were prepared by the pastoral and agro-pastoral communities of the region. Thus wider production and consumption of the crop is recommended for the tested and areas with similar agro ecologies.

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