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Evaluation of improved white fleshed sweet potato varieties at Gamo zone, Southern Ethiopia

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Abstract

Six white fleshed sweet potato varieties were tested in Gamo zone of southern region, Ethiopia in 2019 and 2020 to evaluate their total root yield potential and demonstrate best performing varieties. The experiment was laid out as a Randomized Complete Block Design with four replications. The combined analysis of variance showed highly significant differences among genotypes on growth, root yield and its components. The maximum number of marketable roots per plot was recorded on variety Hawassa -09 (70.25) whereas minimum number of roots per plot was recorded on ADU (11.00). The highest root yield per hectare was obtained from variety Hawassa -09 (62.16 ton ha-1) followed by Tola and Berkume (53.99 and 52.85 ton ha-1), respectively. The lowest root yield per hectare was recorded from variety ADU (5.21 ton ha-1). Based on the result of this study from six evaluated white fleshed sweet potato varieties Hawassa -09 was recommended for pre extension demonstration at the area and similar agro ecological locations.

Keywords: Sweet Potato; White Fleshed; Root Yield; Yield Related Traits

1. Introduction

Sweet potato (Ipomoea batatas L.) is one of the globally important crops ranking seventh and fifth in production in the world and in Africa, respectively [1]. It is mainly grown for human food and animal feed. It produces storage roots which are rich in carbohydrate, vitamins such as A, B complex, C, E and minerals such as potassium, calcium and iron. Central America is considered as the primary center of diversity of sweet potato based on molecular markers study and most likely the center of origin since the highest diversity was found in this region [2, 3].

Globally China is the leading sweet potato producing country with production of 70,963,630 metric tons (MT), followed by Nigeria (3,478,270 MT), Tanzania (3,345,170 MT) and Ethiopia (2,701,599 MT). China contributes annually more than half of the world's total sweet potato production [4].

In Ethiopia, sweet potato is widely grown in south, southwestern and eastern parts by small-scale farmers with limited land, labor and capital. Ethiopia is one of the largest sweet potato producing countries in the world. Sweet potato occupied about 53,499 hectares of land with a total annual production of 1.85 million tons during the main growing season only [5]. However, the productivity of the crop remained low (8 t ha-1) for a long time and the production of the crop is also declining due to many factors including recurrent drought, lack of planting materials, shortage of farmer

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preferred varieties, poor extension system that doesn't encourage production of root crops, market and postharvest related problems.

Sweet potato viruses, sweet potato weevil and sweet potato butterfly are the major sweet potato production constraints in Ethiopia. Low root dry matter content and lack of knowledge on postharvest storage and processing are also some of the prevailing constraints of the crop [6].

The farmers in the study areas still use old released white fleshed sweet potato varieties that are susceptible to disease. Nowadays many improved sweet potato varieties have been released by research centers and universities for production. These improved sweet potato varieties together with improved management proved to give three to four fold yield advantage and nutrient composition as compared to old released white fleshed sweet potato varieties together with traditional production and management practices. Therefore, this study was proposed to evaluate and select the best high yielding, disease and insect pest resistant sweet potato varieties and to demonstrate the best adaptable sweet potato varieties in Gamo Zone, SNNPRS.

2. Material and methods

2.1. Description of the Study Areas

The experiment was conducted at Arba minch Zuria district of Gamo zone, SNNPRS during 2019 and 2020 growing seasons. The site is located at 37°35'51''E longitude, 6°6'55''N latitude and altitude of 1220 m.a.s.l. The mean annual rainfall is 1050 mm and the soil textural class of the experimental site is clay loam.

2.2. Experimental Materials and Design

For this study, six white fleshed sweet potato varieties were used. The name of the varieties, source and year of released presented in Table 1.

The experiment was laid out as a RCBD with four replications. Each plot was 3 m x 2.4 m = 7.2 m^2 wide consisting of four rows, which accommodated 10plants per row and thus 40 plants per plot. The spacing between plots and block were 1m and 1.5m, respectively. Health and young sweet potato vines were planted at a spacing of 60 cm between rows and 30 cm between plants. Cultural practices such as weeding, cultivation and ridging were practiced as per the recommendation. To reduce border effect, data were recorded from the two central rows of each plot.

Table 1 Sweet potato varieties used for the study

No	Varieties	Source1	Year of release
1	Beletech (192026 II)	AwARC/ SARI	2004
2	ADU (Cuba-2)	HU	2007
3	Berkume (TIS 8250-2)	HU	2007
4	Tola (TIS 844-40)	BARC	2012
5	Hawassa – 09 (TIS-8250-1)	AwARC/ SARI	2017
6	Awassa – 83 (Standard check)	AwARC/SARI	1997/98

1HU = Haromaya University, AwARC/SARI = Awassa Agricultural Research Center / Southern Agricultural Research Institute, WARC/EIAR = Werer Agricultural Research Center / Ethiopian Institute of Agricultural Research and BARC= Bako Agricultural Research Center

2.3. Data Collected

The following data were collected from the two central rows and used for analysis.

Stand count at harvest, Yield of top green parts per plot (fresh weight in kg), Vein & inter nod length at maturity (cm), Number of marketable roots per plot, Weight of marketable roots per plot (kg), Average marketable root length (cm), Average marketable root girth (cm), Number of unmarketable roots per plot, Weight of unmarketable roots per plot (kg), Number of marketable roots per hectare, Weight of marketable roots per hectare (t/ha), Number of unmarketable roots per hectare, Weight of unmarketable roots per hectare (t/ha), Total number of roots per hectare, Total weight of roots per hectare (t/ha) were collected and analyzed.

2.4. Statistical Analysis

Analysis of variance for each year was done for tuber yield and other traits using the SAS software version 9.0 [7]. For factors showing significant effects, mean comparisons were made using the least significant difference (LSD) at 5% level of significance.

3. Results and discussion

The result of combined ANOVA showed that there is highly significant variation ($P < 0.01$) between varieties for yield and yield related parameters except stand count at harvest (Table 2).

Maximum number of roots per plot was recorded on varieties Hawassa – 09 (70.25) whereas minimum number of roots per plot was recorded on variety ADU (11.00). The highest root yield per hectare was obtained from variety Hawassa -09 (62.16 ton ha^{-1}) followed by Tola and Berkume (53.99 and 52.85 ton ha^{-1}), respectively. The lowest root yield per hectare was recorded from variety ADU (5.21 ton ha^{-1}) (Table 3). The result of this study was in line with Mohammed A. [8] and Tesfaye *et al*. [9] who reported the presence of significant variation between sweet potato varieties for yield and yield related parameters.

Variety ADU had the highest yield of top green parts per plot (21.25 kg) and the lowest number (11) and weight (1.18 kg) of marketable roots per plot (Table 3). This indicates that this variety can be produced for feed rather than food.

Table 2 Combined ANOVA for mean squares of growth, yield and yield related parameters for six white fleshed sweet potato genotypes grown at A/Minch zuria district in Southern Ethiopia during 2019 and 2020

Source of variation	DF	SCAH	YTGPPP (kg)	VINLAM (cm)	NMRPP	WMRPP	AMRL (cm)	AMRG (cm)	NUMRPP
Yr	1	12.00^{ns}	78.21**	3996.75**	7178.52**	606.34**	22.55*	35.11*	2268.75**
Yr(Rep)	6	4.21^{ns}	11.76^{ns}	111.94^{ns}	27.74^{ns}	2.97^{ns}	3.05^{ns}	9.67^{ns}	86.88*
Trt	5	8.63^{ns}	182.39**	4051.30**	3482.92**	357.27**	53.45**	283.34**	1035.13**
Yr*Trt	5	6.65^{ns}	22.06*	343.78^{ns}	368.02**	27.17**	3.08^{ns}	18.02*	1347.85**
Error	30	4.61	5.97	140.12	34.96	4.83	4.44	5.93	35.66
Mean		14.71	12.43	155.43	51.10	13.05	19.57	23.63	38.17
CV (%)		14.60	19.66	7.62	11.57	16.84	10.77	10.30	15.65
Source of variation	**DF**	**WUMRPP(kg)**	**NMRPH**	**WMRPH (t ha^{-1})**	**NUM RPH**	**WUMRPH (t ha^{-1})**	**TNRPH**	**TWRPH (t ha^{-1})**	
Yr	1	55.86**	55389820867**	4678.58**	17505788310**	430.92**	148766081536**	7949.28**	
Yr(Rep)	6	0.15*	214066786.61^{ns}	22.95^{ns}	670331834*	1.15*	1435507203.20^{ns}	19.71^{ns}	
Trt	5	5.26**	26874389764**	2756.56**	7987139983**	40.61**	63566229016**	3354.75**	
Yr*Trt	5	3.369**	2839667020.3**	209.63**	10400077381**	25.98**	14416151448**	313.83**	
Error	30	0.06	269750953.38	37.27	275141468.42	0.43	694894419.50	39.64	
Mean		2.19	141956	36.25	106018.5	6.07	245370.4	42.33	
CV (%)		10.83	11.57	16.84	15.65	10.81	10.74	14.88	

DF = Degree of freedom, SCAH = Stand count at harvest, YTGPPP= Yield of top green parts per plot (fresh weight in kg), VINLAM= Vein & inter nod length at maturity (cm), NMRPP =Number of marketable roots per plot, WMRPP= Weight of marketable roots per plot (kg), AMRL =Average marketable Root length (cm), AMRG =Average marketable Root girth (cm), NUMRPP= Number of unmarketable roots per plot, WUMRPP =Weight of unmarketable roots per plot (kg), NMRPH = Number of marketable roots per hectare, WMRPH = Weight of marketable roots per hectare (t/ha), NUMRPH = Number of unmarketable roots per hectare, WUMRPH = Weight of unmarketable roots per hectare (t/ha), TNRPH = Total number of roots per hectare, TWR = Total weight of roots per hectare (t/ha).

Table 3 Mean values of growth, yield and yield related traits of six white fleshed sweet potato genotypes grown at A/Minch zuria district in Southern Ethiopia during 2019 and 2020

Genotypes	SCAH	YTGPPP(kg)	VINLAM (cm)	NMRPP	WMRPP (kg)	AMRL (cm)	AMRG (cm)	NUMRPP	WUMRP (kg)	NMR /ha	WMR(t/ha)	NUMR/ ha	WU MR (t/ha)	TNR/ha	TWR (t/ha)
ADU	16.50a	21.25a	162.45b	11.00d	1.18e	17.76c	12.16c	25.38d	0.70e	30556d	3.28e	70486d	1.93e	85417d	5.21e
Awassa -83	15.38ab	9.71cd	124.38d	64.13b	14.48c	19.53bc	23.58b	35.38c	1.96d	178125b	40.21c	98264c	5.44d	276389b	45.64c
Berkume	13.88b	10.94c	164.43b	51.00c	16.63bc	22.43a	28.58a	28.50d	2.40c	141667c	46.18bc	79167d	6.67c	220833c	52.85b
Beletech	14.00b	14.06b	190.08a	55.25c	9.62d	15.50d	23.75b	45.88b	2.66b	153472c	26.72d	127431b	7.38b	280903b	34.10d
Hawassa -09	14.50 ab	10.81c	150.33c	70.25a	19.34a	21.73a	26.68a	56.13a	3.03a	195139a	53.75a	155903a	8.41a	351042a	62.16a
Tola	14.00b	7.81d	140.90c	55.00c	17.06b	20.45ab	27.05a	37.75c	2.38c	152778c	47.40b	104861c	6.60c	257639b	53.99b
mean	14.71	12.43	155.43	51.10	13.05	19.57	23.63	38.17	2.19	141956	36.25	106018.5	6.07	245370.4	42.33
LSD	2.19	2.495	12.09	6.04	2.24	2.15	2.49	6.10	0.24	16771	6.23	16938	0.67	26918	6.43

Means in the same column followed by the same letters are not significantly different at 5% level of significance. SCAH = Stand count at harvest, YTGPPP= Yield of top green parts per plot (fresh weight in kg), VINLAM= Vein & inter nod length at maturity (cm), NMRPP =Number of marketable roots per plot, WMRPP= Weight of marketable roots per plot (kg), AMRL =Average marketable Root length (cm), AMRG =Average marketable Root girth (cm), NUMRPP= Number of unmarketable roots per plot, WUMRPP =Weight of unmarketable roots per plot (kg), NMR = Number of marketable roots per hectare, WMR = Weight of marketable roots per hectare (t/ha), NUMR = Number of unmarketable roots per hectare, WUMR = Weight of unmarketable roots per hectare (t/ha), TNR = Total number of roots per hectare, TWR = Total weight of roots per hectare (t/ha)

4. Conclusion

From evaluated six white fleshed sweet potato genotypes Hawassa -09, Tolla, and Berkume gave the better yield than locally well-known and largely cultivated standard check variety (Awassa -83). Therefore, these varieties are recommended for pre extension demonstration at the area and similar agro ecological locations.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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