Novelty Journals

ISSN 2394-9716

International Journal of Novel Research in Interdisciplinary Studies
Vol. 9, Issue 2, pp: (1-6), Month: March – April 2022, Available at: www.noveltyjournals.com

Evaluation of White fleshed Sweet Potato (*Ipomoea batatas* L.) Varieties for Maximum Root Yield and Quality Traits at Wondo Genet and Koka

[1]Damtew Abewoy, [2]Habtamu Gudisa Megersa, [3]Dadi Tolessa Lemma
[4]Dejene Tadesse Banjaw

Ethiopian Institute of Agricultural Research, Wondo genet Agricultural Research Center

Corresponding Author: Email: damtewabewoy@gmail.com. Tel.: +251 92 158 2397

Abstract: **The experiment was conducted during 2020 and 2021 growing seasons at Wondogenet and koka to evaluate the performance of white fleshed potato varieties with respect to their root yield and qualities. Six improved white fleshed sweet potato varieties were tested using randomized complete block design with three replications. All necessarily data were collected and analyzed using SAS software. The combined analysis of variance showed a highly significant differences ($p \leq 0.05$) among tested varieties for plant height, root number per plant, root diameter, root weight per plant, root yield per hectare and root dry matter content. As a result, Hawassa-09 variety gave the highest tuber yield per hectare (40.76 t ha^{-1}) which was statistically similar with Berkume variety (37.81 t ha^{-1}) while the lowest (17.23 t ha^{-1}) from Adu variety. The highest root dry matter content (27.29) was obtained from Hawassa-83 variety which was followed by Hawassa-09 (26.09) variety while the lowest (20.01) from variety Adu. Therefore, among the tested sweet potato varieties, Hawassa-09 and Hawassa-83 were recommended for their better root yield and quality traits for the study areas and similar agroecology.**

Keywords: **Environment, Genetic variation, Root dry matter content, Root yield, White fleshed.**

1. INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is a dicotyledonous plant belonging to the family Convolvulaceae (Tortoe *et al*., 2010). Globally, sweet potato is the seventh most important food crop after wheat, rice, maize, potato, barley, and cassava (FAO, 2014). More than 140 million tons had been produced globally per year. The world average storage root yield had been estimated to be 14.8t ha^{-1} (FAO, 2014). Asia is the world's largest producing continent (129 M tons per annum) and China is the leading country (121 M tons per annum) which is 86% of world production. In Asia, it is primarily used for human consumption and animal feed. In Africa, sweet potato is the second most important root crop after cassava and its production is concentrated in the East African and African great lake region countries (Ndole *et al.*, 2001; Dantata *et al.*, 2010). It is one of the most important sources of carbohydrates for smallholder farmers in Ethiopia (Amare *et al*., 2014) and the third root and tuber crop after Irish potato and cassava in the quantity of consumption in tropical Africa (Laban *et al*., 2015). Sweet potato yields are high per unit area (Nwankwo *et al*., 2012) per unit of time (Nedunchezhiyan *et al*., 2012). Due to its higher productivity and drought tolerance, the crop can play a vital role in achieving food self-sufficiency in the region (Amare *et al*., 2014). This makes it an ideal sustainable crop for production in developing countries, where population growth has decreased the amount of arable land per person and increased the use of marginal land for food production (Woolfe, 1992). Sweet potato provides household food security because the crop can be harvested within 3-6 months (Anyaegbunam *et al*., 2008) and also can remain in the ground for "piece meal" harvesting, a common sweet potato "storage" practice in the tropics (Laban *et al*., 2015).

In Ethiopia, sweet potato ranks first in total production (36.78 t ha^{-1}) and third in area coverage next to Irish potato and taro from root and tuber crops cultivated in the country (CSA, 2019). Its root is used as food usually consumed in a boiled form which is one of the cheapest sources of vitamin A and its leaf and vine are used as feed for livestock. The sweet potato is tolerant to adverse conditions like drought. It is drought-resistant, hardy, and can grow in marginal areas, thus contributing to improved food security. Hence, it is considered an attractive food crop among farmers growers because it requires less care and input (CIP, 1995). It is a widely produced and popular food in many parts of Eastern Africa countries. Even if different sweet potato varieties are grown in different potential areas of Ethiopia, the orange-fleshed type of sweet potato has not been widely grown and popular in the study areas. It also contains soluble fiber which helps in reducing cholesterol concentration and anti-oxidant nutrients which can inhibit the development of coronary heart disease (Kays and Kays, 1998). As a result, it is better to evaluate the improved varieties by involving farmers in their field by their selection criteria. When the farmers select the variety by their selection criteria the newly generated technology is familiar to their farming activity and increases technology utilization. Hence, evaluation of sweet potato varieties is needed in this research to identify the best adapted and performed varieties and assimilate into the production system in the study areas.

In many parts of Ethiopia particularly at Wondo Genet, Sidama region, and Koka, Oromia region, white-fleshed sweet potato varieties have not yet reached to farmers to grow, which resulted in farmers for highly demanding of better yielding, and disease resistant varieties of sweet potato. Therefore, evaluation of sweet potato varieties was done as a solution to evaluate and select the best adaptable, high yielder and disease resistant varieties of white fleshed sweet potato and to diversify and popularize this economically important crop in the study areas.

2. MATERIALS AND METHODS

2.1. Description of Experimental Site

The experiment was conducted at Wondo Genet, sidama region and Koka, Oromia region. All experimental sites were described in the following Table

Table 1: Description of the study areas.

Locations	Soil type	Temperature (^{0}c)		Soil pH	Annual RF	Altitude (m.a.s.l.)	Latitude	Longitude
		Min	Max					
Wondo Genet	Sandy clay loam	12.02	26.72	6.4	1000	1876	7°19' N 38°38' E	7°19' N 38°38' E
Koka	Loam	13.68	28.30	8.01	830.9	1604	8°26' N	39°1' E

2.2. Experimental Design and Field Management

The experiment consisted of six white fleshed sweet potato varieties (**Hawassa-09, Berkume, Tolla, Hawassa-83, Mae and Adu**), which were released by Southern Agricultural Research Institute (SARI), Hawassa Agricultural research center. The trial was arranged in randomized complete block design (RCBD) with three replications. Thus, there was six treatments in triplicates. The treatments were randomly allotted to each plot. The treatments were randomly allotted to each plot. The experimental plot had an area of 9 m^2 (3 m length x 3 m width). The space between replications and plots was1.5 m and 1 m, respectively. The space between rows and plants was 60cm and 30cm respectively. Plants in the three middle rows out of the five rows per plot constituted the net plot used as the sampling unit. Ten plants from the middle rows were taken for sampling and for growth parameters and the yield was obtained from the harvestable area of the middle three rows and converted to hectare.

2.3. Data Collection and Analysis

Data on plant height, root number/plant, root length, root diameter, root weight/plant, root yield/ha and tuber dry matter content were collected. Collected data were subjected to analysis of variance using SAS package (SAS 9.4). Least significance differences (LSD) were made to compare the treatments following the procedures of Gomez and Gomez (1984).

3. RESULT AND DISCUSSIONS

The combined analysis of variance showed that there was a highly significant ($p < 0.001$) difference among tested sweet potato varieties for all traits except root length. the result also showed a significant variation among testing locations for plant height, root diameter, root weight per plant and root yield per hectare. As a result, the highest plant height (109.09 cm) was recorded from Berkume variety which was statistically in par with Hawassa-09 9 (101.03 cm) variety and followed by variety Tolla (97.77 cm) but the shortest was Mae (72.80 cm) variety. With respect to location, the tallest plant height was recorded from wondo Genet (120.6cm) and shortest (89.44 cm) was from koka site. This indicated that there might be variability among tested varieties and environments. This result is in agreement with similar findings in sweet potato varieties tested in different areas (Mekonnen, 2021) and potatoes (Zewdu *et al*., 2017). The maximum root number (4.05) was recorded from variety Hawassa-09 which was statistically similar with variety Berkume (3.48) and the lowest (1.5) was observed from Adu variety. Maximum root diameter (6.85 cm) was recorded from Hawassa 09 variety, statistically similar with Tolla (6.79 cm) and Bekume (5.96 cm) varieties, but the lowest was obtained from Adu (3.91 cm) variety. The differences in plant height, root number, and root diameter among the studied sweet potato varieties might be due to the inherent characters of the varieties and the differences in the environment between the study areas. The present study results are in agreement with the result obtained by Mekonnen (2021). Mohammed (2018) also reported significant variation between sweet potato varieties in yield and other desirable traits. Moreover, Gezahegn *et al* (2020) and Merga *et al*. (2018) reported that significant differences have been observed among sweet potato varieties for growth parameters like plant height, root number and root diameter.

Table 2: Combined mean values for different traits of tested White fleshed sweet potato varieties at Wondo Genet and Koka sites in 2020/21 main cropping season.

Varieties	Plant height (cm)	Root number	Root length (cm)	Root diameter (cm)
Hawassa-09	101.03^{ab}	4.05^{a}	7.27	6.85^{a}
Berkume	109.09^{a}	3.48^{ab}	7.45	5.96^{ab}
Tolla	97.77^{ab}	3.02^{b}	10.58	6.79^{a}
Hawassa-83	94.60^{b}	2.83^{b}	6.77	5.09^{b}
Mae	72.80^{c}	1.9^{bc}	7.12	5.35^{bc}
Adu	84.79^{b}	1.5^{c}	8.22	3.91^{c}
LSD	12.39	1.02	NS	1.02
Locations				
Wondo Genet	120.66^{a}	2.66	15.42	7.44^{a}
Koka	89.44^{b}	2.43	15.31	5.03^{b}
LSD (0.05)	10.99	NS	NS	0.82
CV (%)	8.69	13.63	13.28	7.06

Maximum root weight per plant was harvested from Hawassa-09 (0.75kg) variety which was statistically similar with Berkume (0.69 kg) and Tolla (0.67 kg) varieties but Adu variety gave the lowest (0.30 kg). As far as location is concerned, the highest root weight per plant was harvested from koka site (0.74 kg) over wondo genet (0.53 kg) site. Hawassa-09 variety gave the highest root yield per hectare (40.76 t ha^{-1}) which had no statistically difference with the yield obtained from Berkume (37.81 t ha^{-1}) variety while the lowest (10.28 t ha^{-1}) was recorded from Adu variety. Koka (41.22 t ha^{-1}) site gave statistically higher root yield per hectare than wondo genet (33.47 t ha^{-1}). The variability of locations in terms of altitude, soil types, rainfall amount, temperature, humidity etc, resulted in the varieties responded to

differently due to their difference in their genetic makeup. The presence of highly significant differences among sweet potato varieties might be due to the presence of genetic differences used in the development of these varieties and the varieties responded differently to different environments. Makonnen (2021) also reported that tested sweet potato varieties had a significance difference with respect to root and related traits. Similar findings were reported by different authors, who found that sweet potato genotypes had significant differences with their yield traits and responded differently to different environments (Moussa *et al*., 2011; Osiru *et al*., 2009; Fekadu and Shiferaw, 2019). Similarly, Habtamu *et al*. (2016) also reported a similar result in which significance differences among potato varieties was found probably due to genetic variability presented. Merga *et al*. (2018) also found that sweet potato varieties had a significant difference with respect to agronomic and yield traits. Variety Hawassa-83 gave the highest root dry matter content (27.29 %) which followed by variety Hawassa-09 (26.09 %) and the lowest (20.01 %) was from variety Adu. The differences in root dry matter content might be due to genetic variations among tested varieties.

Table 3: Combined mean values for different traits of tested White fleshed sweet potato varieties at Wondo Genet and Koka sites in 2020/21 main cropping season.

Varieties	Root weight per plant (kg)	Root yield per hectare (t ha^{-1})	Root dry matter content (%)
Hawassa-09	0.75^{a}	40.76^{a}	26.09^{b}
Berkume	0.69^{ab}	37.81^{ab}	24.30^{bc}
Tolla	0.67^{ab}	33.15^{bc}	23.68^{c}
Hawassa-83	0.51^{c}	34.14^{b}	27.29^{a}
Mae	0.55^{bc}	29.61^{c}	22.50^{d}
Adu	0.30^{d}	17.23^{d}	20.01^{e}
LSD	0.15	4.72	1.13
	Locations		
Wondo Genet	0.53^{b}	33.47^{b}	39.9
Koka	0.74^{a}	41.22^{a}	39.35
CV (%)	13.18	14.91	2.93
LSD (0.05)	0.072	4.99	NS

4. SUMMARY AND CONCLUSIONS

There is an increasing demand by farmers for production and consumption of improved sweet potato varieties in the country particularly in the study areas. In order to increase the production of this crop, high yielder and quality sweet potato varieties should be provided for the farmers. Thus, this research was conducted with the objective of selecting superior white fleshed sweet potato varieties with high root yield and dry matter content. The combined analysis of variance showed a highly significant differences ($p \leq 0.05$) among tested varieties for plant height, root number per plant, root diameter, root weight per plant, root yield per hectare and root dry matter content. As a result, Hawassa-09 variety gave the highest tuber yield per hectare (40.76 t ha^{-1}) which was statistically similar with Berkume variety (37.81 t ha^{-1}) while the lowest (17.23 t ha^{-1}) from Adu variety. The highest root dry matter content (27.29) was obtained from Hawassa-83 variety which was followed by Hawassa-09 (26.09) variety while the lowest (20.01) from variety Adu. Therefore, among the tested potato varieties, Hawassa-09 and Hawassa-83 were recommended for their better root yield and quality traits for the study areas and similar agroecology. Finally, the selected varieties should be promoted to farmers of the study areas and its agronomic management packages, quality and nutritional trials should be done further for better use of the crop.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

ACKNOWLEDGMENT

We would like to thank the Ethiopian Institute of Agricultural Research (EIAR), Root crops research program through for financing this research and Wondo genet Agricultural Research Centre (WGARC) for facilities provided during the activities we did. It is also our pleasure to thank Hawassa Agricultural Research Center for provision of white fleshed sweet potato varieties. Moreover, field assistants like Teka Gebisso and Melese Mendida are highly acknowledged for their efforts in field management from beginning to end.

REFERENCES

[1] Amare, B., F. Abay and Y. Tsehaye, 2014. Evaluation of sweet potato (*Ipomea batata* L.) varieties for total storage root yield in south and south east zones of Tigray, Ethiopia. Am. J. Trade Policy, 1: 74-78.

[2] Anyaegbunam, H.N., G.N. Asumugha, E.O. Mbanasor, T.O. Ezulike and K.I. Nwosu, 2008. Guide to improved sweet potato production in Nigeria. National Root Crops Research Institute, Umudike, pp: 1-9.

[3] Belay, G., Tefera, H., Tadesse, B., Metaferia, G., Jarra, D. and Tadesse, T., 2006. Participatory variety selection in the Ethiopian cereal tef (*Eragrostis tef*). *Experimental Agriculture*, 42(01),pp.91101.Availableathttp://journals. cambridge.org/abstract_S0014479705003108 [Accessed December 03, 2018].

[4] Bellon, M.R. 2001. Participatory Research Methods for Technology Evaluation. A Manual for Scientist Working with Farmers. Mexico, D. F. CIMMYT, pp. 93.

[5] CIP, 2007. Sweet potato facts sheet. Lima, Peru p. 2

[6] CSA, 2019. Crop and livestock product utilization. Agricultural sample survey (private peasant holdings, meher season). The federal democratic republic of Ethiopia

[7] Dantata, I.J., Babatunde, F.E., Mustapha, S. and Fagam, A.S., 2010. Influence of variety and plant spacing on tuber size, tuber shape and fresh marketable yield of Sweetpotato in Bauchi Nigeria. *Biological and Environmental Science Journal for the Tropics*, 7: 140-144. *Science Journal*, 9(1):41-48.

[8] Fekadu, G. and Shiferaw, M., 2019. Evaluation of root yield performance of newly bred orange-fleshed sweet potato genotypes in Ethiopia. J. Agric. Crop Res, 7, pp.9-17.

[9] Gezahegn, A, Sintayehu, G. and Dereje, D., 2020. Evaluation of Orange Flesh Sweet Potato Varieties (Ipomoea batatas L.) in West Hararghe Zone of Oromia Region, Eastern Ethiopia. *Biochemistry and Molecular Biology*, *5*(3), p.37.

[10] Kays, S.J. and Kays, S.E., 1998. Sweetpotato chemistry in relation to health. *Proceedings of the Sweet Potato Production System Towards the 21st Century*, pp.231-272.

[11] Laban, T.F., K. Peace, M. Robert, K. Maggiore, M. Hellen and J. Muhumuza, 2015. Participatory agronomic performance and sensory evaluation of selected orange-fleshed sweet potato varieties in south western Uganda. Global J. Sci. Frontier Res., 15: 25-30.

[12] Laban, T.F., K. Peace, M. Robert, K. Maggiore, M. Hellen and J. Muhumuza, 2015. Participatory agronomic performance and sensory evaluation of selected orange-fleshed sweet potato varieties in south western Uganda. Global J. Sci. Frontier Res., 15: 25-30.

[13] Low, J.W., Mwanga, R.O., Andrade, M., Carey, E. and Ball, A.M., 2017. Tackling vitamin A deficiency with biofortified sweetpotato in sub-Saharan Africa. *Global food security*, *14*, pp.23-30.

[14] Mekonnen, B., 2021. Participatory variety selection of improved orangefleshed sweet potato varieties at Gedeb district of Gedeo zone, Southern Ethiopia. Journal of Agricultural Science and Practice **130-135**. https://doi.org/10. 31248/JASP2020.281

[15] Merga,. B, Habtam S, Jemal I . Performance Evaluation of Sweet Potato Varieties (Ipomoea Batatas (L) Lam) at Kamashi area, 140 Western Ethiopia. Mod Concep Dev Agrono.2(3). MCDA.000536. 2018. DOI: 10.31031/MCDA. 2018.02.000536

[16] Mohammed A., 2018. Evaluating the Performance of Improved Sweet Potato (Ipomoea Batatas) Varieties at Shishir, Southern Ethiopia. International Journal of Research in Agriculture and Forestry Volume 5, Issue 6, 2018, PP 33-36 ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

[17] Moussa, S.A.M., El-Aal, H.A.A. and El-Fadl, N.A., 2011. Stability study of sweet potato yield and its component characters under different environments by joint regression analysis. *Journal of Horticultural Sciences and Ornamental Plants*, *3*, pp.43-54.

[18] Ndolo, P.J., Mcharo, T., Carey, E.E., Gichuki, S.T., Ndinya, C. and Maling‟a, J., 2001. Participatory on-farm selection of Sweetpotato varieties in western Kenya. *African Crop*

[19] Nedunchezhiyan, M., G. Byji and S.K. Jata, 2012. Sweet potato agronomy. Fruit Vegetable Cereal Sci. Biotechnol., 6: 1-10.

[20] Nwankwo, I.I.M., E.E. Bassey, S.O. Afuape, J. Njoku, D.S. Korieocha, G. Nwaigwe and T.N.C. Echendu, 2012. Morpho-agronomic characterization and evaluation of in-country sweet potato accessions in southeastern Nigeria. J. Agric. Sci., 4: 281-288.

[21] Osiru, M.O., Olanya, O.M., Adipala, E., Kapinga, R.E.G.I.N.A. and Lemaga, B.E.R.G.A., 2009. Yield Stability Analysis of'Ipomoea batatus' L. Cultivars in Diverse Environments. *Australian Journal of Crop Science*, *3*(4), pp.213-220.

[22] Tortoe, C., M. Obodai and W. Amoa-Awua, 2010. Microbial deterioration of white variety sweet potato (*Ipomoea batatas*) under different storage structures. Int. J. Plant Biol., 1: 10-15.

[23] Woolf, J.A. 1992. Sweet potato: An untapped food resource. Cambridge university, Great bretain.

[24] Zewdu, A., Aseffa, G., Girma, S. and Benga, C., 2017. Participatory Evaluation and Selection of Improved Irish Potato Varieties at Daro Lebu and Oda Bultum Districts of Western Hararghe Zone, Oromia Regional State, Ethiopia. *Bioinformatics*, *5*(6), pp.82-89.