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Research Article

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

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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 byHawassa-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

Introduction

Sweet potato (*Ipomoea batatas* L.) is a dicotyledonous plant belonging to the family Convolvulaceae (Tortoe et al. [1]. 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 perannum) 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. [2], Dantata et al. [3]. It is one of the most important sources of carbohydrates for smallholder farmers in Ethiopia Amare et al. [4]. and the third root and tuber crop after Irish potato and cassava in the quantity of consumption in tropical Africa Laban et al. [5]. Sweet potato yields are high per unit area Nwankwo et al. [6]. per unit of time Nedunchezhiyan et al. [7]. 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. [4]. 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 [8]. Sweet potato provides household food security because the crop can be harvested within 3-6 months Anyaegbunam et al. [9].and also can remain in the ground

for "piece meal" harvesting, a common sweet potato "storage" practice in the tropics Laban et al. [5].

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 [10]. 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 [11]. 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 antioxidant nutrients which can inhibit the development of coronary heart disease Kays and Kays [12]. 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.

Materials and Methods

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 1.

Table 1: Description of the study areas.

Locations	Soil Type	Temperature(°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	28.3	8.01	830.9	1604	8°26' N	39°1' E

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 (3m length x 3 m width). The space between replications and plots was1.5 m and 1 m, respectively. The space between rows and plants was60cm 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.

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).

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 varietywhich 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 [13] and potatoes Zewdu et al. [14].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 resultsare in agreement with the result obtained by Mekonnen [13] & Mohammed [15] also reported significantvariation between sweet potato varieties inyield and other desirable traits. Moreover, Gezahegn et al. [16] & Merga et al. [17] reported that significant differences have been observed among sweet potato varieties for growth parameters like plant height, root number and root diameter Table 2.

Table 2: Combined mean values for different traits of tested White fleshed sweet potato varieties at Wondo Genet and Kokasitesin 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 (40.76t ha^{-1}) which had no statistically difference with the yield obtained from Berkume (37.81t ha^{-1})variety while the lowest (10.28t ha^{-1}) was recorded from Adu variety. Koka (41.22t ha^{-1}) site gave statistically higher root yield per hectare than wondo genet (33.47t 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. Mekonnen [13] 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. [18]; Osiru et al. [19]; Fekadu and Shifera [20]. Similarly, Habtamu et al. [21].also reported a similar result in which significance differences among potato varieties was found probably due to genetic variability presented Merga et al. [21]. 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 [22-24] Table 3.

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

Varieties	Root weight Per Plant (kg)	Root Yield per Hectare (tha^{-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

Summary and Conclusion

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 varietiesshould 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 wasstatistically 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.

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Conflict of interest

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

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