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RESEARCH ARTICLE

Adaptation of orange fleshed sweet potato varieties in the Siltie and Guraghe zones of the SNNPR, Ethiopia

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Background: Sweet potato plants are important food security crops for millions of people in Africa.

Objective: The present study was conducted to select orange-fleshed sweet potato varieties based on their growth parameters and adaptability.

Material and Method: Adaptability evaluation was conducted in Sankura district (in the Siltie Zone) and Meskan District (in the Guraghe Zone). The experiment was conducted using four orange-fleshed sweet potato varieties laid out in the RCBD and three replications were performed. The following data were collected: number of branches per plant, number of leaves per plant, vine length, fresh weight and dry matter content.

Results: Analysis of variance (ANOVA) revealed that there was a highly significant difference ($P \leq 0.01$) in the fresh weight yield per hectare and a significant difference ($P \leq 0.05$) in the dry matter per plant (g) among the tested varieties and varieties*across environments, while there were nonsignificant differences among the tested varieties for the remaining parameters. Based on the mean values, the Kulfo variety was the first followed by the Kabode variety according to the fresh weight yield, whereas the least common variety was Alamura. Again, the Kulfo variety had the highest amount of root dry matter per plant, followed by the Kabode variety, while the Alamura variety had the lowest amount of root dry matter per plant.

Conclusion: Therefore, in the future, it is essential to demonstrate the selected varieties to farmers for production in the study area through preextension and demonstrations.

Keywords: Sweet potato, Adaptability, Growth, Demonstrations, Participatory.

Introduction

The dicotyledonous plant known as sweet potato (*Ipomoea batatas* L.) is a member of the Convolvulaceae family. This crop, which is mostly grown in East Africa as a staple for rural populations, is one of the root and tuber crops and is the third most important crop in the world after cassava and potatoes. According to Amare, B., et al., 2014, carbohydrates are among the most significant sources of carbohydrates for Ethiopia's smallholder farmers. Globally, it is cultivated in various settings, frequently by small-scale farmers on marginal soils with minimal inputs (Amare B., et al., 2014). Taro and sweet potatoes are staple foods in some of the world's poorest countries (Dagne, Y., et al., 2014). In Ethiopia, small-scale farmers with limited resources-land, labor and capital-growing sweet potatoes are common in the country's southern, southwestern and eastern regions. According to the Central Statistical Authority (Cochrane, L., et al., 2018), sweet potato plants are cultivated on approximately 53,499 hectares of land and 1.85 million tons of potato are produced annually during the primary growing season alone.

Nevertheless, crop productivity has remained low (8 t ha^{-1}) for a considerable amount of time and crop production is currently declining as a result of a number of issues, such as ongoing droughts, a lack of planting supplies, a lack of farmer-preferred varieties, an inadequate extension system that discourages the production of root crops, issues with the market and postharvest issues (Fekadu, Y., et al., 2015).

While sweet potato plants have many potential uses and benefits, their yield in many areas of Ethiopia is less than the potential yield of 30-73 t•ha^{-1} due to abiotic, biotic and socioeconomic constraints before and after harvest. Over the years, several white-fleshed sweet potato varieties have been evaluated and released by national and regional agricultural research centres; however, farmers have not grown improved white-fleshed sweet potato varieties that are high-yielding, disease-resistant and pest-resistant since there has not been an adaptability study in the considered area. Therefore, research strategies such as adaptability studies should involve the selection of best-performing, high-yielding and disease-resistant white-fleshed sweet potato varieties that will be ideal and important for addressing the gap in the Siltie and Guraghe zones. The objective of the present study was to select orange-fleshed sweet potato varieties in terms of yield and yield-related parameters for the study area.

Materials and Methods

Site description

The present study was conducted in the Siltie (Sankura district) and Guraghe (Meskan district) zones in 2022. It was done with recommended agronomic practices like fertilizer application NPS 100 kg/ha, UREA 100 kg/ha, weeding, cultivation and earth up was done.

Experimental treatments

Four orange-fleshed varieties of sweet potato, namely, Dilla, Allamura, Kabode and Kulfo, were used. The varieties were collected from the Hawassa Agricultural Research Center.

Experimental design

Three replications of the RCBD were used in the Meskan and Sankura districts. The plot size was 2.4 m × 3 m and the spacing was 60 cm, with 30 cm between rows of plants.

Data collection and statistical analysis

Data were collected on the basis of the number of branches per plant, the number of leaves per plant, vine length, fresh root weight and root dry matter content. The collected data were analysed by using SAS software, version 9.3 and the means were compared with LSD values of 1% and 5%.

Analysis of variance

Analysis of variance (ANOVA) revealed that there was a highly significant difference ($P \leq 0.01$) in the fresh weight yield per hectare and a significant difference ($P \leq 0.05$) in the dry matter per plant (g) among the tested varieties and between the varieties*across environments, while there were nonsignificant differences among the tested varieties for the remaining parameters (Table 1). These findings implied that there was variation among the tested varieties in yield and other desirable traits in terms of their adaptation performance. The observed yield variation between varieties may be due to meteorological or climatic factors and the genetic potential of the varieties grown under Sankura and Meskan conditions. The results of the combined ANOVA showed that there was significant variation in yield and yield between Orange-Fleshed Sweet Potato (OFSPs) varieties and these parameters support the present findings (Ejigu, F., et al., 2022). This variation was generated due to environmental effects and genetic variability among the varieties. These findings are supported by the findings of Mekonnen, B., et al., (2015), who indicated that various factors significantly influence the marketable tuberous root yield and total tuberous root yield of sweet potato plants. Similarly, Kathabwalika, DM., et al., (2013) also reported significant differences in total tuberous root yield among sweet potato varieties. Therefore, based on this combined analysis of variance, the varieties that had better yield performance in different agroecosystems across the studied locations were selected for production.

Table 1. Mean square values for yield and other agronomic traits of the tested varieties combined by location.

Source of Variance	DF	Mean Squares					
		NBPP	NLPP	VLPP	RFWPP	RDMPP	RFWY
Location	1	1.76	234.37	219.01	100.45	114402.04	326.19**
Replication	2	0.14	436.17	490.54	9.10	30119.29	3.87
Varieties	3	8.23	641.26	1445.43	4.92	107705.49*	11.69**
Loc*Var	3	10.09	600.48	205.79	5.79	16136.49	21.24**
Error	14	6.66	2148.93	1028.41	4.73	31871.67	1.79
Mean	-	10.52	31.33	82.89	4.28	305.45	7.63
CV(%)	-	24.52	147.96	38.68	50.81	58.44	17.56

N.B **= Highly significant at $p \leq 0.01$, *= Significant at $p \leq 0.05$, NBPP=Number of Branches Per Plant, NLPP= Number of Leaves Per Plant, VLPP= Vine Length Per Plant, RFWPP= Root Fresh Weight Per Plant (g), RDMPP= Root Dry Matter Per Plant (g) and RFWY = Root Fresh Weight Yield per hectare tone/hectare)

Mean performance of growth parameters

According to the mean values of the tested varieties, significant differences in the root fresh weight per plant (g), root dry matter per plant (g) and root fresh weight yield per hectare (tone/hectare) were recorded, as indicated in Table 2. Kulfo (29.59a) t/ha was the first variety identified according to the mean yield, followed by Kabode (27.57b) t/ha according to the fresh weight of the roots, whereas the least common yielder was Alamura (16.37b) t/ha. Again, the Kulfo (500.8a) variety had the highest amount of root dry matter per plant, followed by the Kabode (264.7b) variety, while the Alamura (196.0b) variety had the lowest amount of root dry matter per plant. This difference might be due to the different varieties responding differently to different environments. Similar findings were reported by different authors, who reported that sweet potato genotypes exhibit significant differences in yield traits and respond differently to different environments (Moussa SAM., et al., 2009; Osiru MO., et al., 2009; Gurmu, F., et al. 2019).

Table 2. Average values for yield-related traits and tuber yield per hectare for four orange-fleshed sweet potato varieties evaluated in two districts, the Sankura and Meskan districts, in the SNNPRS

Treatment	NBPP	NLPP	VLPP	RFWPP	RDMPP	RFWY
Dilla	10.25	151.17	102.17	3.28	260.3^{b}	16.98^{c}
Alamura	9	139	79.33	3.95	196.0^{b}	16.37^{c}
Cabode	11.17	140.5	64.67	4.45	264.7^{b}	27.57^{b}
Kulfo	11.67	161.17	85.42	5.43	500.8^{a}	29.59^{a}
Grand Mean	10.52	147.96	82.89	4.28	305.46	27.63
LSD 5%	2.25	40.59	28.08	1.9	156.32	1.17

Results and Discussion

In this study, four sweet potato varieties were evaluated across two locations over one year based on their yield performance and test preference. The findings of this study clearly showed significant differences in yield and yield-contributing parameters among the studied orange-fleshed sweet potato varieties (Table 1). The significant differences among the evaluated varieties for yield and yield-related traits were generated due to environmental effects and genetic variability among the varieties. These findings are supported by the findings of Mekonnen, B., et al., (2015) and Ejigu, F., et al. (2022), who indicated that various factors significantly

influence the total tuberous root yield of sweet potato plants. The G-X E interaction is an important technique for identifying and selecting promising varieties that perform better in terms of yield potential in specific environmental situations or under different agroecological conditions. Significant differences in terms of root yield were detected between the varieties, environment and their interaction (Table 1). The presence of a highly significant difference between the two test locations for all traits indicated that the genotypes performed differently across the test environments. The significant genotype-by-environment interaction showed that the genotypes performed differently across the different environments, revealing the complication of selecting a single genotype for all environments. Being a high yielder is not the only trait that needs to be addressed in variety evaluation trials of any crop since it should include the farmer preference to expand the preferred variety. Therefore, participatory evaluation is needed in the future to determine the preferred variety through pre-extension demonstrations in the studied area for better enhancement of food security and livelihood income.

Conclusion

Analysis of variance (ANOVA) revealed that there was a significant difference ($P \leq 0.05$) in the number of leaves per plant among the tested varieties and varieties*across environments and a highly significant difference ($P \leq 0.01$) in fresh root weight yield, while there was a nonsignificant difference among the tested varieties for the remaining parameters. In this study, highly significant variation in adaptability was investigated among white-fleshed sweet potato varieties. The study revealed that the presence of potential orange-fleshed sweet potato varieties should be expanded for farmers in the study area. The two orange-fleshed sweet potato varieties Kulfo and Kabode were selected because they have better fresh root weights and are recommended for use by farmers in the study area in the future.

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Conflict of Interest

The authors declare no conflict of interest.

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