Original Research Article

Popularization of Medium Maturing Orange Fleshed Sweet Potato (OFSP) Variety (Alamura) and On Farm Evaluation of its Root Yield Performance At Halaba Zone, Weira District, SNNPR, Ethiopia

Abstract: *Orange fleshed sweet potato is one of the important root crops with richness in β-carotene which protects against vitamin A deficiency. But in the most rural area of the country, there is a serious health problem related to vitamin A deficiency. The associated causes of inadequate intake and production of this crop are lower adoption,, weak extension support, and inaccessibility of improved variety. For that demonstrating the newly released variety of this crop is among the necessary measures. Hence it improves the adoption rate, creates awareness, and contributes to food and nutrition security. Accordingly, two farmers training centers and ten farmers were purposely selected to conduct the demonstration. The variety "Kulfo" was used for its comparison by using a 10mx20m plot size for each variety. Evaluations were conducted during the mid-maturity stage, through the field day, and field visits with concerned stakeholders, beneficiaries, and surrounding farmers. Based on the result, the new variety and standard check yields are 22.5 tons/ha and 10.5 tons/ha, respectively. This shows the new improved variety has a 114.3 percent yield advantage compared to the standard check. In addition, the result of cost-benefit analysis reveals that the new variety has 65250.1* Ethiopian Birr more return than standard check and ranked by farmers by its disease resistance, taste, and its productivity. Therefore, *the new variety was recommended to further scale up in the Halaba zone and other similar agro-ecologies and agricultural extension personnel will be encouraged to facilitate communication among farmers-researchers and vein multiply cooperatives.*

Keywords; Demonstration, Orange-fleshed sweet potato, Pre-extension, variety Alamura

Background and justification

Orange flesh sweet potato (OFSP) is a globally important staple crop. The health benefits of OFSP are substantial, especially for nutrition-endangered populations due to its rich source of nutrients and fiber. (Bowser. et al, 2017). Based on sound scientific evidence that has been established, this crop has a role in reducing VAD. Hence, promoting OFSP as a food-based approach to address VAD is effective in providing vitamin A to consumers (Hotz et al. 2012a; Hotz et al. 2012b; Konan Everard Brice Dibi et al. 2017). Consumption of OFSP among children aged below 5 years led to a 15% reduction in the prevalence of VAD. (Brice Dibi et al. 2017). In addition, OFSP is an excellent food security crop due to its characteristics of a good source of energy (293 to 460 kJ/100 g), easy to cultivate, vegetatively propagated, and fairly drought resistant, and high productivity, (Carey et al, 2007)

Sweet potato generally and OFSP especially has the potential to give 50-60tones/ha root yield in Ethiopia conditions, but the yield actual obtained from the farmer's field is under 10tons/ha. This big variation is attributed to biotic and abiotic stresses; lack of improved varieties, a weak attitude of people toward sweet potato, inefficient means of technology transfer, and inadequate set of package recommendations. (Daniel.2016).

However different research works have been conducted at national and regional agricultural research teams. Accordantly, Hawassa agricultural research center has long experience in sweet potato research either white-fleshed or orange-fleshed ones focusing on variety improvement. In fact, in 2020, three OFSP varieties were officially released and registered from Hawassa agricultural research center as a new variety due to its outstanding performance. The variety alamura is one of them. It is a best-adapted variety with medium-sized roots, good resistance to sweet potato virus disease, has a great potential to respond to vitamin A requirements for farming families due to its enrichment of beta carotene. But production of OFSP was not adopted at halaba zone generally and demonstration district specifically due to weak extension support, and inaccessibility of improved variety. Hence, this pre-extension demonstration was conducted to demonstrate and popularize the newly released OFSP variety (Alamura) for farmers, to collect farmers' preference analysis on the newly released OFSP variety (Alamura). Thereby ultimately to contribute improvement of food and nutritional security of farmers.

Materials and Methods

Description of the demonstration area

Halaba zone is found in the southern nation's nationalities and peoples' region of Ethiopia. It is named after the Halaba people and covers part of their homeland. Located in the great refit valley Halaba zone is bordered on the south by an exclusive of Hadiya zone, on the southwest by the kambata Tembaro zone, on the west and north by Hadiya Zone, on the northeast by Lake shala and the east by Oromiya region; the Bilate River, which is its major body of water, defines its western boundary. The administrative center is Halaba kulito, the elevation of this Zone ranges from 1700 to 2200 meters above sea level. The climate is characterized as temperate or locally called *woinadega*, the mean annual temperature is about 17.6 - 22.5 C and the mean annual rainfall falls between 601-1200mm. The economy is largely based on subsistence agriculture in the form of dryland farming and raising livestock, with some apiculture. The main cash crops include pepper, maize, sorghum, haricot bean, and wheat. The total population of the zone is a total population of 232,325, of whom 117,291 are men and 115,034 women. With an area of 994.66 square kilometers.

Site Selection procedures

Before the selection of demonstration sites (woreda and kebele) effective discussion regarding OFSP technologies, objectives, and expected output of demonstration was done at the zonal level. Then demonstrating district (Atoti ulo) was selected purposively by considering sweet potato production potential and accessibility (land and road). Also, at the district level, the further discussion had held on objectives, expected outputs, production potential, and expected share responsibility to conduct and supervise demonstration. Accordingly, demonstrating kebeles (Guba shiraro and Gurura) were selected purposively based on production potential, accessibility, and representativeness.

Beneficiary farmers Selection Procedures

Beneficiary farmers were selected by cooperating with kebele development agents' coordinators and crop experts, by considering representativeness (model role player to others), background experience of sweet potato production, willingness to participate in the demonstration, willingness to cooperate every means of data question, and willingness to share a lesson learned

and result obtained from demonstration to surrounding farmers. Finally, due consideration of the aforementioned issues 10 beneficiary farmers and 2FTC were selected from (Guba shiraro and Gurura kebeles).

Demonstration design

The demonstration consisted of two treatments; plot1 with newly released OFSP variety (Alamura) and plot2 with the standard check (kulfo) were planted on separated plot size of10*20m=200m of each variety on 1FTC and 10 farmers' field. The variety "kulfo' was used as a standard check due to the absence of other OFSP varieties used before the demonstration. The vein intera and interspacing were 30cm and 60 cm respectively and only organic fertilizer (compost) was applied during panting and after planting (harrowing time).

Mode of implementation and evaluation of demonstration

As participant list indicated in table-1, before starting implementation, farmers and other concerned bodies were well trained about newly released OFSP variety, its agronomic practices, its contribution to nutritional security (richness of beta carotin), organic fertilizer(compost) preparation and application, and overall awareness of variety from planting to marketing (consumption) by the biological breeder. Then necessary inputs (newly released and standard check OFSP Vein) were provided to the farmers from Hawassa agricultural research center (HwARC). Also, periodic follow-ups and essential technical support (advice) were given from the respective research discipline.

Table-1 participant list in training

S.no	**Participants**	**Sex**			**Location**
		Male	Female	Total	
1	Farmers	8	2	10	Atoti ulo district
2	Extension personnel	6	1	7	
3	Researchers	6	2	8	
4	TA	1	-	1	
5	Other stakeholders	6	3	9	
6	Total	27	8	35	

The demonstration plots were evaluated at an early establishment, mid growing, early maturity/root setting, and late maturity/harvesting stages). Also, further evaluation and popularization of the variety was conducted at field day sessions by participating farmers (beneficiary and surrounding), multi-disciplinary researchers, extension personnel, and other concerned bodies. Field day participants evaluated the variety by observing its field performance, root size, and root number per single pit, and checking its food test and nutritional value by eating boiled OFSP and prepared foodstuffs from it.

Table-2 participant list in field day

S.no	Participants	Sex			Location
		Male	Female	Total	
1	Farmers	36	20	56	Atoti ulo district
2	Extension personnel	12	4	16	
3	Researchers	10	5	15	
4	TA	2	-	2	
5	Other stakeholders	13	5	18	
6	Total	73	34	107	

Fig 1: Photo from field day session at Atoti Ulo district

Methods of data collection

The agronomic data were collected by observing the growth stage and field performance of the variety. Yield data were collected by harvesting root yield from the selected sample area and weighting(measuring) root mass on-field spot. Farmer's preference-related data regarding disease resistance, number of tubers per single plant, ability to tolerate drought, earliness, root size, and marketability were collected through a prepared checklist by asking and recording the responses from focused group discussion (FGD) with beneficiary farmers. Also, feedback was collected from Keble development agents, surrounding farmers of host farmers by conducting FGD and field visits at different evaluation sessions. Evaluation of culinary/eating quality was

conducted on field day session by preparing boiled and other foodstuffs of OFSP and accessing field day participants to evaluate the root yield test and promoting foodstuffs that could be prepared from the variety. Evaluation criterion of boiled root test based on: appearance/color, taste, flavor, starchiness, and fibrousness. Then, they were asked independently to give scores for the above-mentioned criteria using a prepared checklist including preference measuring questions (very good, good, and poor) for each preferring criterion. Twenty farmers (15 men farmers and 5 female farmers) were selected among field day participants, so among evaluators:10 farmers were the host for the demonstration plot and 10 were surrounding farmers who were invited for field day participation. Their responses were recorded Separately on the independent datasheet. Economic data/market price of OFSP root were collected from the local market by visiting the local market and randomly and repetitively asking selling price of 1kg and 1quiantal of OFSP root.

Fig 2 photho from field when potato root yied data collection

Methods of data analysis

Yield data collected from the field were analyzed by using descriptive statistics by applying SPSS ver.20. Qualitative data (farmers' preferences) were analyzed by using a rank matrix and scoring farmers' responses then ranking the mean score regarding each of their preference criteria.

Food taste analysis was done by evaluating food tests of the cooked root of OFSP from each demonstrated variety separately. Then registering to repossess each farmer in a separated datasheet regarding the culinary quality of each variety. Finally, scoring of cumulative responses of each culinary quality of each variety and ranking mean score.

Result and discussion

Table -3Yield performance in ton/hectare

Variety	min yield in ton/ha	max yield in ton/ha	Mean yield in ton/ha	Mean Yield in ton/ha on FTC	Mean difference (yield on farmers field)	Relative yd. adv.
New variety alamura (N=10)	22	28	22.5	31	12	114.3%
Standard check /kulfol(N=10)	8.6	12.5	10.5	14		

Indicated in table-3 the average tuber yield performance of the new and standard check OFSP verities were 22.5 ton/ha and 10.5 ton/ha respectively. This result reveals new OFSP variety (Alamura) has higher root yield producing potential over its standard check, which leaves a great role on nutritional and food security for farming families due to its high productivity per unit area and richness in important nutrients.

Farmers' preferences

The demonstration was evaluated different follow-up periods by farmers, researchers, and extension personnel Accordingly, the evaluation was undertaken at the location of the demonstration, starting from the early establishment stage to the late maturity stage, thus, farmers evaluated the demonstration based on their preference criteria which depending on the physical characteristics of each variety show. Additionally, final farmers' preferences data were collected from beneficiary farmers on a prepared check by using the listed preference criterion listed in table-4.

Table-4Farmer's preferences

s/no	Evaluation Criteria	Farmers' rank					
		New variety (Alamura)			Standard check (kulfo)		
		Very good (3)	Good (2)	Poor (1)	Very good (3)	Good (2)	Poor (1)
1	Earliness	8	1	1	2	3	5
2	Productivity	9	1	-	4	6	-
3	Food taste	8	2	-	2	4	4
4	Root thickness	5	5	-	6	4	-
5	Number of roots per a pit	8	2	-	4	3	3
6	Disease/sweet potato virus resistant	9	1	-	2	3	5
7	Marketability	7	3	-	6	6	-
	Mean score	2.3	0.43	0.3	1.1	0.83	0.23
	Rank	1st			2nd		

As indicated in farmers' preference evaluation table-4, the evaluation means score value of newly introduced OFSP variety (Alamura) was greater than that of the standard check. This indicates that at the demonstration location, farmers selected improved variety (Alamura) as first based on their selective criteria: earliness, productivity, root color, and disease resistance.

Cost-benefit analysis

Table-5 total production cost

s.no	Cost reason	measurement	Required amount	Unit price	Total cost in ETB	
					Alamura/new	**Kulfo/standard check**
1	Vein	number	55555	0.30	16666.5	16666.5
2	Land preparation	Person/day	100	40	4000	4000
3	Weeding	Person/day	100	40	4000	4000
4	Harvesting	Person/day	100	40	4000	4000
Total cost=A					**28666.5**	**28666.5**

Table-6 total benefit from root yield sale

s.no	Benefit reason	measurement	average tuber yield in quintal		Unit price in ETB		Total benefit in ETB	
			new	**Std check**	**New variety**	**Standard check**	**Alamura/new**	**Kulfo/standard check**
1	Root sale	kg	22500	10500	5	4.5	112500	47250
Total benefit=B							**112500**	**47250**

Table-7, the net benefit

s.no	Demonstrated variety	Total production cost	The total benefit of root sale	Net benefit(A-B)	Net benefit advantage in ETB
1	Alamura/new	28666.5	112500	83833.5	+65250.1
2	Kulfo/standard check	28666.5	47250	18583.4	-65250.1

As indicated in table-5 the production costs of the two verities were equal. It indicates that the required vein number/ha and required agronomic practices of two varieties were equally applied. As indicated in table -6, the total root sale benefit obtained from the new variety and standard checks were 112500 ETB and 47250 ETB respectively. As table-7 indicated, the net benefit obtained from the new variety and standard checks were 83833.5 ETB and 18583.4 ETB respectively from the area of land/one hectare. This result reveals that producing new OFSP variety/Alamura/ on one hectare of land can gains 65250.1 ETB additional net benefit advantages comparable to producing standard check/kulfo/ the same area of land.

Conclusion and recommendation

Newly introduced OFSP variety (alamura) showed better yield performance both on farmers' fields and FTC, over its standard check. The average root yield of variety alamura is **22.5** and **31**tons per hectare on farmers' fields and FTC. Also, the standard check showed **10.5** tons and **14** tons on farmers and FTC respectively. producing newly introduced OFSP variety has **114. 3%** relative yield advantageous compare to standard check, which contributes a great share for household food security and income generation.

Also, the newly introduced OFSP variety has a high mean score value of farmers' preference and was selected as first regarding its selective characteristics; productivity, marketability, color, and sweet potato virus-resistant relative to its respective standard check, so it is selected as first.

Therefore, expanding the production of the variety (alamura) for Atoti Ulo district and similar agro-ecological conditions are recommendable to improve the OFSP production and productivity of smallholder farmers, ultimately which leave great share on household food and nutritional security, besides on household income. Thus, all concerned bodies (extension workers, woreda, and zone agricultural officers and seed multipliers) need to play their major role by accessible the technology for farmers.

Authors Declaration

Hereby, I declare that this submission is entirely my own work, written entirely in my own words, and that all sources used in research are fully acknowledged, as are all quotations. It has not been submitted for publication, in whole or in part, by me or another person. I am aware of the ethical implications of my research, and this work satisfies the requirements of the Ethics Committee of the Southern Ethiopia Agricultural Research Institution.

Conflict of interest

The authors approve that there is no conflict of interest for this research Authorship and any other issue regarding this publication

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