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Original article

Pre extension demonstration of improved potato at midland districts of Guji Zone, Southern Oromia, Ethiopia

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ABSTRACT

Highland and midland districts of Guji are well potential for potato production. However, there is shortage of extension service in providing improved potato varieties and lack of farmers' knowledge and skill on potato production. So that this pre extension demonstration of improved potato was initiated to evaluate yield and profitability of improved potato varieties, to enhance the knowledge and skills of farmers' on production of potato and to identify farmers preference of varietal traits for potato production. The study was conducted during 2020 year at Adola Rede and Wadera districts. Two kebeles per district were selected based on their potato production potential. Gudane and Bubu varieties were demonstrated on 5mx5m area with seed rate of 18 quintals/ha, 75cm between rows and 30cm between tubers. 200kg/ha NPS and 100kg/ha of UREA fertilizers were applied. Data was collected by measurement, observation and interview and analyzed by descriptive statistics, net benefit analysis, matrix ranking and t test. Training, exchange visit and mini field day were used to increase knowledge and skills of farmers' on potato production. The result of this demonstration indicated that high yield (209.17 qt/ha) was obtained from Gudane variety than Bubu variety (158.33 qt/ha). In addition, Gudane variety had more number of tubers than Bubu. Both varieties generated more yield at Adola Rede than Wadera district. The result of t-test ($p = .042 < .05$) showed that there was

significant difference (at 5%) in yield between Gudane and Bubu variety. Gudane variety generated a net benefit of 13313.33 ETB/ha than Bubu variety (88813.13 ETB/ha). Gudane variety was selected by experimental farmers based on its high yield, more disease tolerant, more number of tubers per plant and non-lodging status than Bubu variety. Thus, pre scaling up of Gudane variety was recommended for potato production in the study area.

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1. Introduction

In Ethiopia, potato (*Solanum tuberosum* L.) has improving the quality of the basic diet in both rural and urban areas (Abebe et al., 2017). Potato became one among the most economically important crops as a source of food and cash especially on the highland and mid-altitude areas of the country (Adane et al., 2010). Potato has been considered as a strategic crop to enhance food security and economic benefits to the country (Korji and Kebede, 2017).

The potential for high yield, early maturity, and excellent food value give the potato great potential for improving food security, increasing household income, and reducing poverty (Devaux et al., 2014). It contains practically all essential dietary constituents like carbohydrates, essential nutrients, protein, vitamins, and minerals (Sriom et al., 2017).

The government of Ethiopia and its agricultural research institutions have invested a lot of money and time to improve potato production for smallholder farmers (Basha et al., 2017). About 36 varieties were formally released for production for wider adaptation (MOA, 2016).

Highland and midlands of Guji is highly suitable for potato production. Despite the zone is potential the production of crop is mainly characterized by lack of improved varieties and inaccessibility of tuber seed for farmers. To solve these problems adaptation of different potato varieties were done at different parts of the zone. However, adaptation study by biological researchers may not fulfill farmer's preference for varieties unless farmers themselves observed the varieties on their field. Thus, pre extension demonstration is important for further promotion of improved potato varieties in the target areas. Therefore, this activity was initiated with the objectives to evaluate yield performance of improved potato varieties under farmers' condition, to enhance the knowledge and skills of farmers on production of potato, to estimate profitability of potato production at the study area and to identify farmers' preference of varietal traits for potato production.

2. Materials and methods

2.1. Description of study areas

Adola Rede District is located in Southern part of Oromia, Ethiopia, at a distance of 468 km from Finfinne, the capital of Ethiopia. The district is located between 5°44'10"-6°12'38" latitudes and 38°45'10"-39°12'37" longitudes. The district is characterized by three agro-climatic zones, namely humid, sub humid and dry arid zones. In terms of the agricultural calendar, the rain fall pattern of the district is bimodal for lowlands and midland areas and mono-modal for highland parts. The dry arid agro-climatic zones attributed to little rainfall while the humid agro-climatic zones receive extremely high rainfall. Rain-fed agriculture is a common practice for many farm households in this district. However, a semi-nomadic economic activity is also practiced as a means of livelihood by some of its dwellers. Teff, wheat, barley and maize, pulses such as haricot bean, and others such as fruits and vegetables were produced by farmers in the district. They also engaged in the production of coffee as means of livelihood.

Wadera district is situated at a distance of 535 km from Finfinne and 60 km from the zonal capital town, Negele. Astronomically, the district is located between 5° 39'5"-6° 2'28" northing latitudes and 39° 5'30"-39° 27'52" easting longitudes. Wadera district is one of agro pastoral district of Guji zone bordered by Bale zone to East, Girja district to North, Adola Rede and Oddo Shakiso district to the North West and South West respectively

and Goro Dola district to South East direction. The district is characterized by two typical climatic zones, namely, an arid (60%) and semi-arid (40%) climate. The annual rainfall ranges between 915 mm and 1900 mm. The larger portion of the district lies between 950-1900 masl. Generally, teff, maize, haricot bean, wheat, barley, tubers and fruits are the major crops produced in the district.

2.2. Site and experimental farmers selection

Adola Rede and Wadera districts were selected purposively based on potential potato production and accessible for monitoring the activity. From each district two kebeles were selected based on their potential production for potato variety. At each *kebele* 15 farmers were grouped as one Farmer Research Group (FRG). From each FRG two experimental farmers were selected based on their willingness to provide land for the activity. Totally there were 4 experimental farmers at Adola Rede district and 4 experimental farmers at Wadera district. Due to covid-19 and insecurity at Wadera district the activity was not appropriately monitored on time so that two experimental farmers' data was missed for data analysis.

2.3. Materials used and research design

The two improved Irish potato used for demonstration were Gudane and Bubu varieties. The activity was conducted during 2020 year production. Land was prepared by farmers during onset of rain mainly in April month. For each variety 5m x 5m area was used with seed rate of 18 quintals/ha. 200kg/ha NPS and 100kg/ha of UREA fertilizers were applied. UREA was used in the form of split (1/2 at planting and ¼ at earthing and ¼ at flowering stage). A space of 75cm between rows and 30cm between tubers were used. Weeding, hoeing and earthing up were done by farmers.

2.4. Methods of data collection and analysis

Yield data, farmers' data and costs of potato production were collected by measurement, observation and interview. The collected data was analyzed by descriptive statistics, net benefit analysis, matrix ranking and t test. Tables and histogram were used to present the data.

3. Results and discussion

3.1. Capacity building

The main intention of agricultural extension is to enhance the knowledge and skills of farmers on recommended agricultural technologies. Therefore, during this demonstration farmers' knowledge and skills were enhanced by training, exchange visit, mini field day and monitoring and evaluation on demonstrated potato varieties (Table 1).

Table 1
Capacity building and number of stakeholders participated on potato demonstration.

Capacity building methods	Stakeholders	Composition		
		Male	Female	Total
On spot training	Farmers	40	20	60
	DAs	3	1	4
	SMSs	2	-	2
Exchange visit	Farmers	8	2	10
	DAs	1	1	2
	SMSs	-	-	-
Mini field day	Farmers	29	11	40
	DAs	3	1	4
	SMSs	2	1	3
Monitoring & Evaluation	Farmers	15	5	20
	DAs	3	1	4
	SMSs	3	-	3

3.2. Yield and tuber/plant of demonstrated varieties

Table 2 indicated that Gudane variety gave higher yield (209.17 qt/ha) than Bubu variety (158.33 qt/ha). In addition, Gudane variety had more number of tubers per plant (13.33) than Bubu variety (11.83). In both varieties, more yields was obtained at Adola Rede district than Wadera district (Figure 1).

Table 2

Yield performance and number of tubers/plant of potato demonstration.

Potato variety demonstrated	Parameters	N	Min	Max	Mean	Std. Dev
Bubu	Yield (qt/ha)	6	120	200	158.33	36.56
	Number of tubers/plant	6	6	17	11.83	4.12
Gudane	Yield (qt/ha)	6	150	250	209.17	38.78
	Number of tubers/plant	6	7	22	13.33	5.57

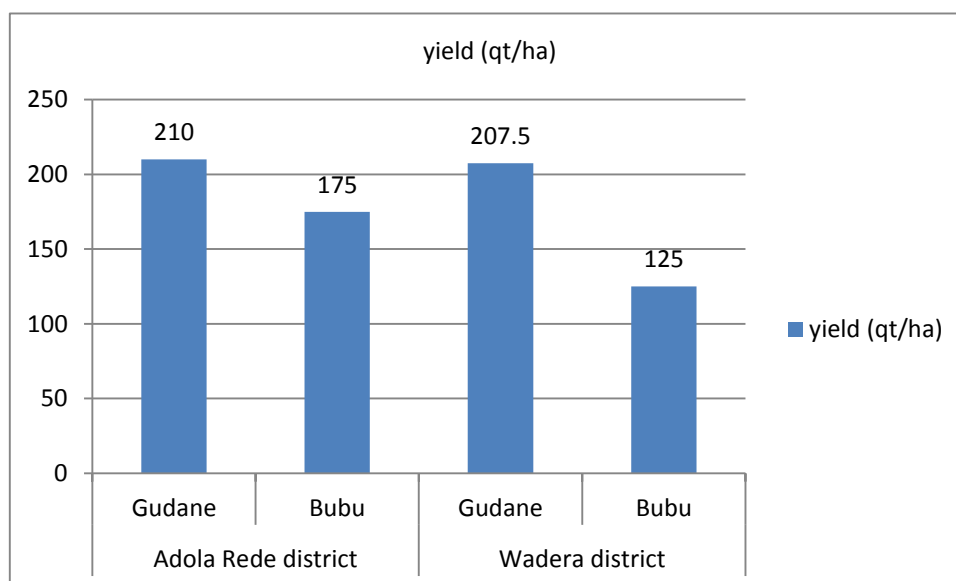


Fig. 1. Yield performance across districts.

Independent t test was used to explain the mean yield (qt/ha) difference between potato varieties. A significance value of .042 (less than .05) indicates that there was a significant difference mean yield between Gudane and Bubu variety. Based on the results of independent t-test ($p = .042 < .05$), it was concluded that there was significant difference in yield between Gudane and Bubu variety in the study area.

Table 3

Independent t test result.

	t-test for Equality of Means				
	T	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference
Yield per hectare	2.336	10	.042**	50.833	21.759

** Significant at 5%

3.3. Profitability of potato demonstration

During production season one quintal (1qt=100kg) was sold by 800 ETB (Ethiopian birr) at harvesting time. Cost of seed (tubers) of Bubu during plantation was 1200 ETB/qt. Gudane variety was 1000 ETB/qt. For one hectare 18 quintals was recommended. Two quintals of NPS and one quintal of UREA was recommended for potato production. One quintal of NPS costs 1400 ETB and UREA costs 1400 ETB. Therefore, 4200 ETB was required

for total fertilizers required for potato production. Total variable costs included for potato production was costs of seed, fertilizer, sowing, weeding, harvesting and other costs. Fixed cost was the cost of land used for potato production. Total revenue was calculated as yield obtained times farm gate price and gross margin is calculated as total revenue minus total variable costs. Net benefit was calculated as gross margin minus fixed cost. Accordingly, Gudane variety generated higher return (133133.33 ETB) than Bubu variety (88833.33 ETB). This showed that potato production at midland districts of Guji was profitable for farmers. The high standard deviation on net benefit might be due to variation of experimental farmers' management on potato production. Good managements (weeding and earthing up of potato) increase the yield which has direct impact on net benefit.

Table 4
Profitability of potato demonstration.

Parameters	Bubu variety		Gudane variety	
	Mean	Std. Dev.	Mean	Std. Dev
Yield/ ha in quintals	158.33	36.56	209.17	38.78
Farm gate price	800.00	.000	800	.00
Cost of seed	21600.00	.000	18000.00	.00
Cost of fertilizers	4200.00	.000	4200.00	.00
Cost of weed	3450.00	561.25	3450.00	561.25
Cost of sowing	975.00	133.23	975.00	133.23
Other costs	208.33	80.10	208.33	80.10
Cost of harvesting	675.00	98.74	675.00	98.74
Total fixed cost	6000.00	.00	6000.00	.00
Total variable costs	31108.33	785.12	27508.33	785.12
Total costs	37175.00	806.07	33508.33	785.12
Total revenue	126666.67	29248.36	167333.33	31026.87
Gross margin	95558.33	28750.94	139825.00	30676.21
Net benefit	88833.33	29235.71	133133.33	31026.87

3.4. Farmers' preference on potato production

Experimental farmers of the study were asked to traits preferred on potato production in their area. Yield per hectare, disease reaction, lodging status and number of tubers per plant were identified by farmers as the most traits used for potato production in midland areas. The number of time a trait had been found to be more important was measured by counting the number of times trait number appeared in the matrix. The trait number to appear most times said to be the most important trait. In this case trait "yield per hectare" appears more times (three times) in the matrix than any other traits. Therefore, yield trait was considered to be the most traits to be focused on potato research and development (Table 5). Gudane variety gave higher yield than Bubu variety. But the seed size of Bubu variety was greater than Gudane. Maturity, marketability and sweetness traits were the same for both varieties. Gudane variety was more disease reaction, had more number of tubers per plant and lower lodging status than Bubu. Thus, farmers selected Gudane variety for potato production in their area (Table 6).

Table 5
Farmers' selection trait on potato varieties (n=6).

	Yield	Lodging status	Disease reaction	Number of tubers per plant	Total score	Rank
Yield	3				3	1
Lodging status		0			0	4
Disease reaction			1		1	2
Number of tubers per plant				1	1	2

Table 6
Direct ranking of potato varieties by farmers (n=6).

Selection criteria	Yield	Disease reaction	Number of tubers	Lodging status	Total score	Rank
Relative importance	4	3	3	2	-	-
Bubu	16 (4)	9 (3)	6 (2)	9 (3)	40	2 nd
Gudane	20 (5)	9 (3)	9 (3)	9 (3)	47	1 st

Note: Numbers in the bracket indicates the performance rating value of each variety given from 1-5 (5 = excellent, 4 = very good, 3 = good, 2 = poor and 1 = very poor) and numbers written outside the bracket indicate total score of a variety as per each selection criteria, which was obtained by multiplying the relative weight of each selection criteria with that of the performance rating number in the bracket. The relative weight (5 = the most important, 4 = very important, 3 = important, 2 = somewhat important, 1 = little important).

4. Conclusion

Pre extension demonstration of potato was done in midland areas of Guji zone to evaluate yield and profitability of improved potato varieties. Two improved potato varieties namely Bubu and Gudane were demonstrated on farmers' field. Higher yield was obtained from Gudane variety (209.17 qt/ha) while lower yield was obtained from Bubu variety (158.33 qt/ha). Production of Gudane variety generated a net benefit of 13313.33 ETB/ha than Bubu variety (88813.13). Variety that generates more yields was preferred by farmers. Gudane variety was selected by experimental farmers based on its high yield, more disease tolerant, more number of tubers per plant and non-lodging status than Bubu variety. Thus, pre scaling up of Gudane variety was recommended for potato production in the study area.

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