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DEMONSTRATION OF IMPROVED POTATO VARIETIES AT KOFFELE DISTRICT, WEST ARSI ZONE, OROMIYA, ETHIOPIA

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ABSTRACT: *The study was carried out at Guchi and Hulabera peasant association/Kebele of Kofale District west Arsi Zone, Oromiya Ethiopia. The study was carried with the intension to transfer the potato production technology to increase production. The district is among the potential area for potato production in the west Arsi Zone. From the two kebeles, 14 farmers were selected 7 from each kebele based on their interest to participate in the demonstration activity. Two varieties of potato Belete and Gudanie varieties, those are suitable for high lands of Ethiopia were used in the study with Local variety as reference. All participant farmers were interested and allocated 100m^2 for intended experiment. Seed were planted based on its recommended rate and NPS fertilizer was used 195kg/ha. All necessary data qualitative and quantitative were collected starting from the time of planting to harvesting stage. Participatory field visiting was conducted with the participation of farmers, agricultural development agent workers and researchers. Descriptive statistics like mean and tabulation for yield data analysis and also independent t-statistics for yield comparison of the experiment were used. Qualitative data collected during field observation and after yield data collection were analyzed by means of summarization. In addition to the varieties yield for comparison partial budget analysis was used for profitability study. Based on the study result, Belete has more yield advantage than the other. However, in terms of test and market prefer ability Gudanie was preferred. Although Belete has more yield advantage as compared with the other, the yield advantage between Belete and Gudanie was insignificant as compared to the yield difference between Belete and Local. Interms of partial budget analysis, Gudanie was ranked first thus based on the aggregate result Gudanie was recommended for further production and popularization in the study area.*

KEY WORDS: Potato, improved varieties, district, demonstration

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the most consumed food crop world-wide next to wheat and rice (Champouret, 2010) and over half of all production occurs in developing countries (Devaux et al. 2014), with nearly 400 million tons produced worldwide every year, leading to stability in food supply and socioeconomic impact (Halterman et al. 2016). Potato is also the fastest growing staple food crop and source of cash income for smallholder farmers in Ethiopia (Berhanu and Getachew, 2014). It is a critical crop in terms of food security (Birch et al. 2012). In developing countries and under marginal growing conditions, potato is a cheap source of nutrients, thus playing an important role in guaranteeing food security, income generation, and employment opportunity (Lutaladio

and Castaidi, 2009). Potato's short cropping cycle allows it to serve as a hunger-breaking crop, and makes it suitable for intercropping and double cropping, especially in cereal-based production systems in Africa and Asia (Cromme et al. 2010). Like many other countries in the world, potato is a very important food and cash crop especially on the highland and mid altitude areas of Ethiopia (Borgal et al. 1980).

Global production of potatoes was 388 million tonnes, led by China with 64% of the world total. Now the biggest potato producer, and almost a third of all potatoes are harvested in China and India is secondary producer (FAOSTAT, 2019). In Africa the top producers were Algeria and Egypt. The current average potato yield in Africa has been reported to be about 13.22 t ha^{-1} which is well below the maximum yield of 20.11 t ha^{-1}. Ethiopia is 9th potato producer country in Africa (FAOSTAT, 2019).

In Ethiopia, we identified three seed potato systems, namely informal, alternative and formal. The informal seed potato system is a seed potato system in which tubers to be used for planting are produced and distributed by farmers without any regulation. This seed system exists in all potato growing areas of Ethiopia. It is the major seed potato system. According to Gildemacher et al. (2009), it supplies 98.7% of the seed tubers required in Ethiopia. The seed tubers supplied by this system have poor sanitary, physiological, physical and genetic qualities (Lemaga et al. 1994; Mulatu et al. 2005; Endale et al. 2008; Gildemacher et al. 2009). The alternative seed potato system is a seed potato system that supplies seed tubers produced by local farmers under financial and technical support from NGOs and breeding centers. In Ethiopia there are community-based seed supply systems which are undertaken by the community with technical and financial assistance of NGOs and breeding centers.

Objectives of the Study

- To Improve the knowledge of farmers and train them on clean potato seed production
- To enhance production and productivity of potato

RESEARCH METHODOLOGY

The research site

The study was conducted at Guchi and Hula bera villages of Kofale woreda west Arsi Zone Oromiya Region. As Wiki2 the district was located at 7º 00'N 38º45'E with an elevation of 2695 m.a.s.l. Kofale district has a total 43 Kebeles, among these 38 are under rural administration and 5 are under urban administration. Among all kebeles, 22 ranged high land, 16 mid land and 5 low land. It has annual rain fall and annual average temperature of 2200mm and 20c^{o} respectively. Guchi and Hulabera Villages are categorized under high land and have loam soil type. The villages are located in the South direction of kofale town at the distance 10km and 5km respectively.

Farmers and site selection

The farmers were selected using multistage sampling procedure. First of all the district /Kofale district/ was selected using purposive sampling procedure as it is the potential area for potato

production found in west Arsi Zone. The next step was involved village selection using simple random sampling procedure and two kebeles namely Guchi and Hulabera were selected for the study. And finally participant farmers were selected purposively considering management practices should be done properly hence the total of 14 farmers were included in the study. The demonstration sites for both kebeles have similarities in soil type and agroecology. Farming system for the selected area was basically rain-fed and the area has more than 6 months of annual rain fall. Following the identification of farmers, training on potato seed production, pre-harvest and post-harvest handlings were provided for farmers who were identified. After training, potato seed namely Gudane and Belete varieties were provided to the farmers. Follow up has been done immediately after planting, during crop growth and development, until harvest. Well performed farmers' fields were identified for the purpose of filed days and field day had been conducted at appropriate time when the crop was at good growth stage.

Experimental Design

For the study two improved potato varieties were used on the fields of selected farmers in the study area namely Gudane and Balete varieties those were compared with locally available potato variety. The land sizes for each farmer were 10*10m=100$m^{2.}$ Row planting method was used 30cm between plant and 75 cm between rows. NPS fertilizer 195kg/ha was applied. All necessary management practices including hoeing and weeding throughout growing stage were done.

Table 1. Year of released and convenient altitude for the improved potato varieties

No	Variety	Resealed year	Breeder/Maintainer	Recommended Altitude(m.a.s.l)
1	Moti	2011	Sinnana Research center	2400-3350
2	Belete	2010	Holeta Research center	1600-2800
3	Bubu	2010	Haramaya University	1700-2000
4	Ararsa	2006	Sinnana Research center	2400-3350
5	Gudenie	2006	Holeta Research center	1600-2800
6	Bule	2005	Awassa research Center	1700-2700
7	Gabisa	2005	Haramaya University	1700-2000

Source: Habtamu G. et al.(2016)

DATA COLLECTION AND ANALYSIS

Data collection methods

In the data collection, farmer's field observation and agronomic practice assessment also considered. All Valuable information was collected from farmers regarding the value and importance of the technology that they provided on potato production. Again data were collected from Focus group discussion (FGD) about the difference between traditional production and improved methods. In Addition to the individual farmers, there were 2 Focus groups for FGD were participated for data collection. Again the yield difference between the local varieties they familiar with in their village so far and the new varieties were also collected.

Data analysis and presentation

For data analysis and presentation, both qualitative and quantitative methods were used in order to analyse collected data through field observation, participant farmers' interview, and FGDs. The quantitative data collected from the respondents were encoded in to SPSS (Statistical Package for Social Science) version 20. Descriptive statistics such as percentage, mean, and tabulation were used for analysis. Additionally t-statistics was used to analyse mean yield difference. The qualitative data gathered through the FGDs were also summarized. For economic analysis partial budget analysis was used in order to evaluate and compare profitability among the varieties.

Π= TR-TPC ----------1
TR=TY*PQ----------2
CBR= TR/TC----------3
Where:
Π = Net profit obtained, TR = total revenue from product, TPC = Total production cost (seed cost, fertilizer cost and all costs incurred during management practice), TY = Total Yield, PQ = price per quintal, CBR = cost benefit ratio, TR = total revenue, TC = Total Cost.

RESULT AND DISCUSSION

Potato yield obtained

As collected yield data the mean yield for Gudane variety was 391.43 qt/ha with standard deviation of 8.99 and yield for Belete was 405.71 qt/ha with standard deviation of 9.75. The yield data for local variety was 172.85 qt/ha with standard deviation of 9.5. The result on the table 2 shows the result for both improved varieties were better than that of the local one and the yield of Belete variety was greater than all of them.

Table 2. Expermental Kebele and variety Used at Kofale District

Kebeles	Variety Used	Number of farmers	Land size
Guchi	Gudane and Local	7	100*7=700m^2
Hulabera	Belete and Local	7	100*7=700m^2

Percentage yield of improved varieties over the local

Table.3 percentage yield advantage of both varieties

Varieties	Yield Difference	% yield difference
Belete over Local	405.71-172.85=232.86	134%
Gudene over Local	391.43-172.83=218.60	126%

Comparing both varieties with local one, the yield for both varieties was high. Which is 134% and 126% yield advantage that both Belete and Gudanie have over the local.

Table 4. Yield/ha result for three variety including Local

Variety	min	max	Sum	Mean/yield	Std.Dev
Gudane	380	400	2740	391.43	8.99
Belete	400	410	2840	405.71	9.75
Local	160	180	1210	172.83	9.51

As indicated on the table 2, both Belete and Gudene varieties have yield advantage over that of the local. However among the percentage yield difference that both Belete and Gudanie varieties have, the first has more yield advantage than the second which is 134% yield difference as compared to 126% of Gudene over the local. This implies that both improved varieties have preferred in terms yield than that of local varieties with the same management. Both Belete and Gudanie were better in disease resistance on the field as compared to the local varieties that susceptible to diseases.

Table 5. Statistical yield comparison

t-test	Belete to Gudenie	Belete to Local	Gudanie to Local
Yield Difference	14.28	232.88	218.57
Standard Error	5.017	5.150	4.948
95% CI	3.3547 to 25.2168	221.6345 to 244.0797	207.7891 to 229.3837
t-statistics	2.847	45.208	44.167
DF	12	12	12
Significance level	P=0.015	P=0.005	P=0.005

An independent sample t-test was conducted so as to compare yield difference of improved potato varieties and Local variety. There was a significant difference in the yield for improved (both Belete and Gudanie) varieties over the local variety. There was significance difference between yields for Belete variety (M = 405.7, SD = 9.76) and Local variety (M = 172.85, SD =9.51) conditions; t (12) = 45.2, p = 0.005. Also there was significance difference between yields for

Gudanie variety (M=391.42, SD=8.99) and local Variety (M = 172.85, SD = 9.51) conditions; $t(12) = 44.16$, $p = 0.005$.

These result suggests that improved varieties (both Belete and Gudanie) have positive advantage or yield difference as compared to local which is susceptible to diseases that minimizes the yield to be obtained.

Participatory field observation and farmers preference result

Table. 6 farmers' participant preference for varieties selection

Vrieties	Tuber size	Yield per plant	Early maturity	Disease resistance	Test	Total score	Rank
Belete	5	5	5	5	4	24	2nd
Gudnie	4.7	4.7	5	5	5	24.4	1st
Local	3.5	3.5	4.5	4	5	20.5	3rd

Note: Value 5=Excellent
Value 4=Very Good
Value 3=Good
Value 2=poor
Value 1=Very poor

In order to collect feedback from participant farmers, 17 farmers (15 women and 2 men) from both kebeles and development agent workers of kebeles/villages visited both fields of improved potato demonstration site. This was done at maturity stage of the plant and after yield collection intentionally to know the preference of the farmers. The farmers and development agent were ranked the varieties as follows;-

The Farmers and participants ranked the varieties in terms of its Yield, disease resistance and test/prefer ability by the market, maturity. Hence they preferred; Gudanie variety as the first due to its test, disease resistance and also has insignificant yield difference with that of Belete which has more yield as compared to both Gudanie and that of Local one. However there was yield difference between Belete and Gudanie, it was insignificant thus based on its test and market prefer ability Gudanie was prioritized to be selected by farmers and other participants.

Table 7. Production cost (In Ethiopian Birr/hectare)

Variety	Plough and Hoeing	Seed	Sowing	Fertilizer	Total Cost
Belete	30000	14000	5000	3600	52600
Gudanie	30000	15000	5000	3600	53600
Local	30000	15000	5000	3600	50600

Table 8. Net Benefit gained

Variety	Average Yield	Market price for 1Quin.	Total revenue	Total Cost	Net benefit
Belete	405.71	500	202,855	52600	150,255
Gudanie	391.43	550	215,287	53600	161,687
Local	172.83	500	86,415	50600	35,815

Benefit cost ratio for potato producers

Table 5, 6 and 7 shows total cost, total revenue and Benefit cost ratio of the potato production. During planting season the price of potato seed for 1kg reaches 9-10 Birr which costs around 900 to 1000 Birr per quintal. Plough and hoeing expense for one hectare is the highest cost as on the table. Among the three varieties, net benefit for Gudanie variety was the highest 161687 per hectare of land as compared to Belete and Local one. During the study, Benefit cost ratio of potato production in the study area implies potato production is profitable as benefit cost ratio for the three varieties is greater than 1. It indicates that for every invest in Gudane, Belete and local variety potato production, there is 3.02, 2.86 and 0.71 Birr gain respectively (Table 7).

Table 9. Benefit cost ratio

Variety	Total yield(yield/ha) in quintal	Total Revenue	Total cost	Benefit cost ratio
Belete	405.71	202,855	52600	3.86
Gudanie	391.43	215,287	53600	4.02
Local	172.83	86,415	50600	1.71

CONCLUSION AND RECOMMENDATIONS

The result of the study revealed that the yield obtained from improved varieties was 405.71 and 391.43 respectively for both Belete and Gudanie varieties as compared to 172.83 quintal yield of Local varieties thus there is high significant result between the yield of improved and Local varieties. This indicates that improved varieties have 134% and 126 % yield advantage over the local. As the result from field observation revealed, the local variety was highly susceptible to diseases which affects the tuber whereas the improved varieties were tolerant as compared with the local one. Based on the yield advantage, Belete and Gudanie were selected as first and second. Following yield advantage and its market prefer ability in the study area, economically based on partial budget analysis Gudanie has more advantage than both Belete and Local varieties. Thus, Gudanie variety was recommended for further production in the study area. So, giving training and

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