

Participatory Evaluation and Selection of Improved Irish Potato Varieties at Daro Lebu and Oda Bultum Districts of Western Hararghe Zone, Oromia Regional State, Ethiopia

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Abstract: Potato (*Solanum tuberosum* L.) is one of the most important food crops in developed as well as developing countries. This activity was conducted during the 2013 main cropping season at Daro Lebu and Oda Bultum districts of West Hararghe Zone to identify and select among potato varieties that are adaptable to local conditions and accepted by farmers and consumers at large and to generate knowledge and information that can contribute for the seed value chain development. A total of four farmers were participated on the experiment. Gudane, Bubu, Toluma, Bete and Local check varieties were evaluated on 25m² and 100m² plots at Daro Lebu and Oda Bultum districts, respectively. Economic data (cost of input and revenue obtained), agronomic data and farmer feedback/preference were collected. The collected data were analyzed through descriptive statistic (mean and standard deviation) and graphs by SPSS software and qualitatively. The agronomic result shows that the average total yield harvested from Gudane and Bubu varieties were 21 ton/ha and 20.24 ton/ha, respectively. In addition, participants of field day were also select those varieties based on criteria's like disease reaction, tuber size, marketability, number of tubers and ways of giving tubers from one plant, color, perish ability, yield amount, sweetness and short time take during catering. Economically, Gudane and Bubu varieties were more beneficiary as compared to Bete, Toluma and Local variety, which were 83,500 Eth.birr and 77,420 Eth.birr, respectively. According to other agronomic data result shows that and farmer preference criteria like disease resistant, high yielder, larger tuber size, marketable, good color and high number of tuber and others, Gudane and Bubu varieties were selected as compared to Toluma, Bete and Local varieties. Therefore, Gudane and Bubu varieties will recommend for further scale up/out for Oda Bultum and Daro Lebu districts and others area which is similar agro-ecology to Oda Baso and Jilbo kebeles.

Keywords: Participatory Variety Selection, Evaluation, Irish Potato, Varieties

1. Introduction

Potato (*Solanum tuberosum* L.) is one of the most important food crops in developed as well as developing countries. Among the world's food crops it ranks in the top five in tonnage, and as a source of food energy. It provides about one sixth as many calories as since, wheat and maize. It is one of the most widely grown root and tuber crops and stands second next to inset in area of coverage. It is very important

food and cash crop in our country especially when the grain depleted from the store and contributes to food security [1]. It is also efficient in converting resources such as labor and capital in to a high-energy food. Its efficiency of protein production is higher than commonly sliced. If carefully managed it gives the highest yield of nourishment per hectare of all basic foodstuff in tropical and subtropical countries. Furthermore, the growing period is only 90-125 days which enabling multiple cropping for optimum use of the available

land and moisture. It is noted that in potato producing areas double cropping is possible [2].

Among several root and tuber crops, potato plays significant dietary role for human beings provided that good quality and high yield is guaranteed. It is not by chance that precisely the potato has to come to play on important part in more and better food supply. This tuber is so structural that it is supplier not only carbohydrate for body heat and work out put, but also high quality protein that the body can easily absorb. In addition to a number of minerals and nutrient salt the potato contain several vitamins from group B and large amount of the vital vitamin C [2]. Now a day besides its consumption potato is an excellent cash crop. However potato varieties available at hand of farmers in the major years and susceptible to disease particularly late blight [3].

Irish potato is the first root crops produced in Ethiopia next to Taro/*Godere* and sweet potato that accounts 70,131.32 ha in 2015/16 *meher* cropping season [4]. The estimated potato production was 9,432,334.43 quintals with average yield obtained is 134.5 quintals per hectare. The estimated producers of potatoes in both *belg* and *meher* season was accounted 3,705,879 holders in the country [5]. Similarly, West Hararghe is one of the zone that produce potatoes in the country. Potatoes are the third major root crops produced next to onion and sweet potato in the area. The estimated producers of potatoes were accounted 5,489 holders in the zone [4].

Based on CSA report of 2015/16 the national average yield of potato was 13.45 tons per hectare. However, the potential attainable average yields of the crop on under research and farmers' fields are 45 and 25 tons per hectare [6]. There are number of biophysical and socio-economic constraints that hinder the productivity of potato under farmers' circumstances at Mechara. Among others, lack of high yielding and acceptable quality, and pest resistance/tolerant varieties has been the limiting factors. Hence, lack of high yielding adaptable potato varieties which are tolerant/resistant to major disease and insect pest is becoming a major problem. On the other hand, varieties that are developed by research center and other institutions may not accept by the farmers because they have their own selection criteria. To address the problem of farmers, developing environmentally, friendly, adaptable high yielding and disease tolerant varieties with a participation of farmers and other stockholders is a priority concern. So, this experiment was initiated to evaluate and select well adapted and acceptable potato variety/ies for Western Hararghe to increase production and productivity of the crop and there by contributing to food security. Therefore, this study was conducted with the following objectives.

2. Objectives

1) To identify and select among potato varieties that are adaptable to local conditions and accepted by farmers and consumers at large using farmers' criteria and indigenous knowledge and breeder's articulations.

2) To generate knowledge and information that can contribute for the seed value chain development.

3. Materials and Methods

The experiment was conducted in 2013/14 cropping season with collaboration of districts Agricultural Development office and Haramaya University, Integrated Seed Sector Development, East Oromia Unit. Sites and farmers were selected purposively based on potential producing areas and interest of farmers as criteria's for executing the experiment on farmers' field. Accordingly, one *kebeles* (Jilbo and Oda Baso) from each district and two farmers from each *kebele* were selected from Oda Bultum and Daro Lebu districts. Then, it was implemented in 10m*10m plot size area of land at Oda Bultum district and 5m*5m plot size area of land at Daro Lebu district. Four improved varieties (Gudane, Bubu, Bete and Toluma) and one local variety were sowed on each selected experimental farmers. Spacing of 70cm and 30cm between rows and plants respectively were used for the experiment. Recommended rate of 200kg/ha of DAP and 100kg of UREA fertilizer were used to conduct experiment. All other recommended agronomic practices were maintained equally for all plots. Finally, field day and training materials (leaflet) were prepared at farmer's field.

3.1. Description of the Study Area

Oda Bultum is one of the districts found in west Hararghe zone. The capital town of the district is named as Baddessa is located at 08054, 3180N, 0400, 0210E. Its Altitudinal range is from 1040 - 2500 m.a.s.l, the average altitude of the district is 1770 m.a.s.l. From the total land area/topography of the district; 60% is plain and 40% is steep slope. The annual rain fall is 900 mm-1100 mm). It has a mean maximum and mean minimum temperature of 28°C and 25°C; respectively. The maximum rainfall and minimum rainfall is 1200mm and 900 mm [7]. The district has an estimated total population of 158, 282 from which 81,029 were males and 77,253 were females [8].

Daro Lebu is one of district found under West Hararghe Zone. The capital town of the district Mechara is found at about 434 km South East of Addis Ababa. The district is situated between 7052°10' and 8042°30' N and 40023°57' and 4109°14'E. The district is characterized mostly by flat and undulating land features with altitude ranging from 1350 up to 2450 m.a.s.l. Ambient temperature of the district ranges from 14 to 26°C with average of 16°C with average annual rainfall of 963 mm/year. The pattern of rain fall is bimodal and its distribution is mostly uneven. Generally, there are two rainy seasons: the short rainy season '*Belg*' lasts from mid-February to April whereas the long rainy season '*kiremt*' is from June to September. The rainfall is erratic; onset is unpredictable, its distribution and amount are also quite irregular. Consequently most *kebeles* frequently face shortage of rain; hence moisture stress is one of major production constraints in the district [9]. The district has an estimated

total population of 198,918 from which 102,014 were males and 96,904 were females; 26,404 of its population are urban

dwellers, whereas 182,057 are rural dwellers [8].

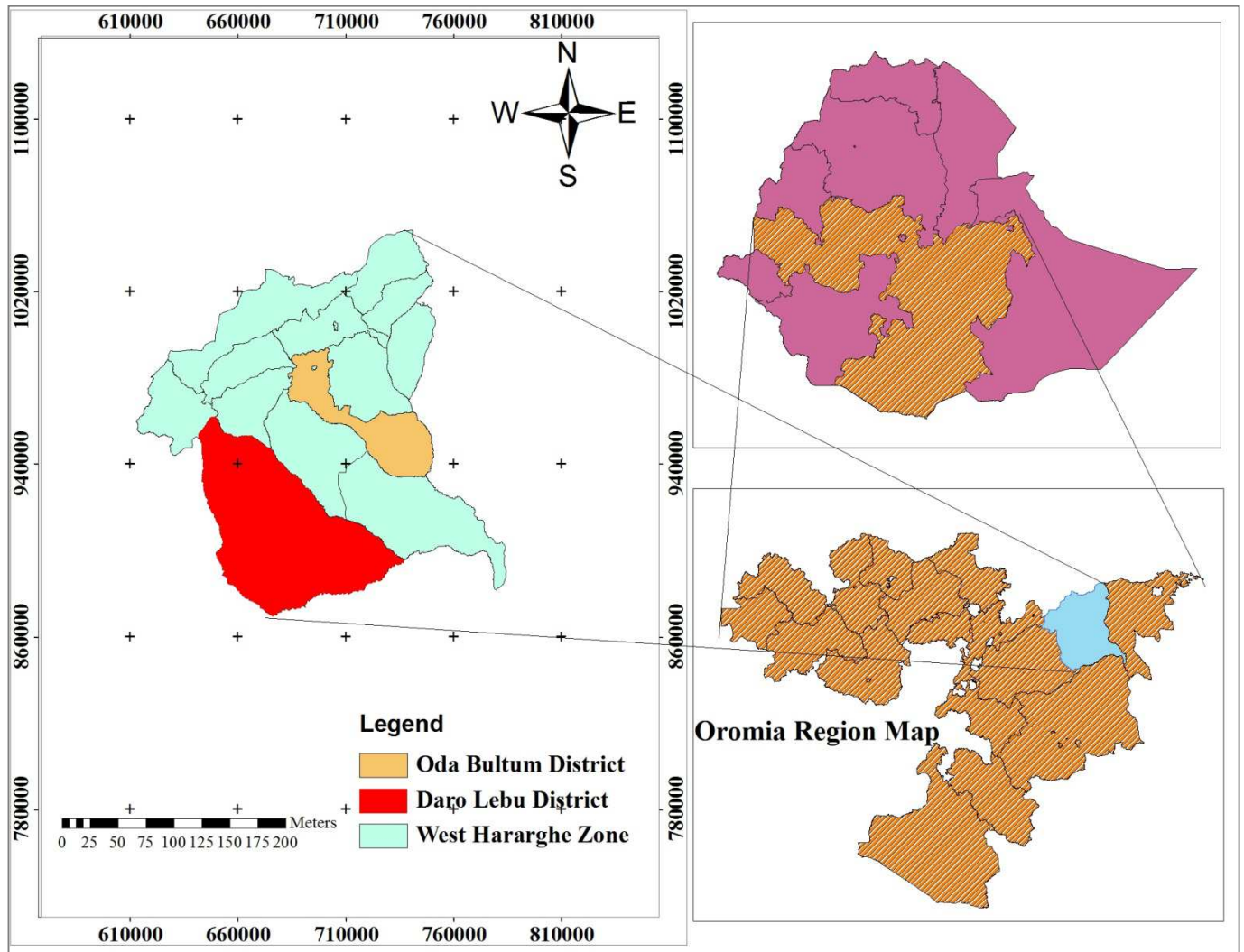


Figure 1. Map of the Study Area.

3.2. Data Collected

Economic data (Cost of input like fertilizer, seed, labor and total revenue like yield), farmer feedback/preference and agronomic data (emergency date, 50% flowering, maturity date, and stand count at one month, and at harvest, plant height (cm), number of main branches, number of tuber per plant, average number of tuber/plant, marketable tuber yield (ton/ha), unmarketable tuber yield (ton/ha) and disease and pest reaction was collected.

3.3. Method of Data Collection

Checklist & data collection sheet were developed prior to planting to collect agronomic and economic data. Then, personal observation, individual contact (listening to trial farmers) during site visit were data collection methods. Farmer preference was collected during field day through group discussion, interview of trial farmer and participants and developing sheet selection criteria to choice variety

accordingly.

3.4. Important Tools for Implementation

Continues supervision of field, conducting training for knowledge sharing, development of training materials (leaflet) and field day was conducted to implement and achieve objectives of participatory selection.

3.5. Monitoring and Evaluation

From beginning of site selection until harvesting, frequent visits to farmers, monitoring and provision of technical advice, follow up actions were designed based on emerging knowledge/ skill and technical needs. Researchers, extension agent, supervisor of extension agent, experts and farmers were jointly participated on continues supervision of the experiment. The outstanding variety/ies were finally evaluated and, then, selected jointly with farmers' group, researchers from Mechara Agricultural Research Center (McARC), extension workers and other stakeholders.

3.6. Method of Data Analysis

Farmer preference/feedback was analyzed qualitatively and ranking of varieties was conducted based on criteria's. The collected agronomic data were analyzed by SPSS Ver. 20 software descriptively (graphs, mean and standard deviation). Economic data was analyzed by cost-benefit analysis. Farmers' selection data were analyzed using simple ranking

method in accordance with the given value [10]. Simple ranking is a tool often used to identify promising varieties based on farmers' preferences. The ranking procedure was explained for farmer participants and then each selection criterion was ranked from 1 to 5 (5=very good, 4=good, 3=average, 2=poor and 1=very poor) for each variety. Ranking was done on consensus where differences are resolved through discussion [10].

4. Result and Discussion

4.1. Vegetative Parameters

Table 1. Vegetative parameters of Irish Potato varieties on farmers' field.

Variety	Plot	DS	DE	SCM	FD	PH	NMB	MD	SCH	DH
Gudane	1	17	19	145	64	103.8	2	102	145	129
Bubu	2	17	20	129	64	99.8	2	103.	129	129
Bete	3	17	18	289	64	69	2	103	289	129
Toluma	4	17	16	330	61	72.5	2	103	330	129
Local	5	17	27	258	76	46.7	2	112	258	129
Mean		17	20	230	66	78.36	2	105	230	129
Standard deviation		0	4.18	89.01	5.85	23.62	0	4.159	89.01	0

Source: Own result, 2013/14

DS=Date of Sowing, DE=Date of Emergency, SCM=Stand Count at 1 & $\frac{1}{2}$ Month, FD=Flowering Date, PH=Plant Height (Cm), NMB=Number of Main Branch, MD=Maturity Date, SCH=Stand Count at Harvest, DH=Date of Harvesting

Different vegetative data were collected from farmers' field. Table 1 indicates that Toluma and Bete varieties were early emerged as compared to other varieties with the average date 16 and 18 days. This was due to tubers of the varieties were germinated well prior to planting. The highest

mean numbers of plants in one and half month were recorded Toluma and Bete varieties which accounts 330 and 289 plants per plot. The results obtained because of seed of those varieties were easily germinated while sowing. The highest mean of plant height of varieties were recorded from Gudane and Bubu which accounts 103.8cm and 99.8cm, respectively. Our findings were contradicted with [11] finding obtained from Gudane variety is by half lower than ours in plant height of the variety.

4.2. Yield and Yield Component Parameters

Table 2. Yield and yield components of Irish Potato on farmers' field.

Variety	Plot	Average Tuber per plant	Marketable yield (ton/ha)	Unmarketable yield (ton/ha)	Total yield (ton/ha)
Gudane	1	12.86	16.73	4.27	21
Bubu	2	13.67	14.97	5.27	20.24
Bete	3	8.5	10.1	4.17	14.27
Toluma	4	10.67	13.57	4.67	18.24
Local	5	3.67	3.07	1.53	4.6
Mean		9.87	11.68	3.98	15.67
Standard deviation		4.01	5.39	1.44	6.72

Source: Own result, 2013/14

The highest numbers of average tuber per plant were obtained from Gudane and Bubu varieties which account 12.86 and 13.67 tubers, respectively. But, the finding of Gudane variety average tuber per plant obtained by [11] is below our findings. The average marketable yield of Gudane and Bubu varieties were high as compared to the other varieties that accounts 16.73 and 14.97 ton/ha, respectively. Similarly, the study conducted by [12] the highest mean marketable yields were recorded from Gudane and Bubu varieties. The lowest average of unmarketable yields were obtained from local cultivar and Bete varieties that account 1.53 and 4.17 ton/ha, respectively. The highest mean of total

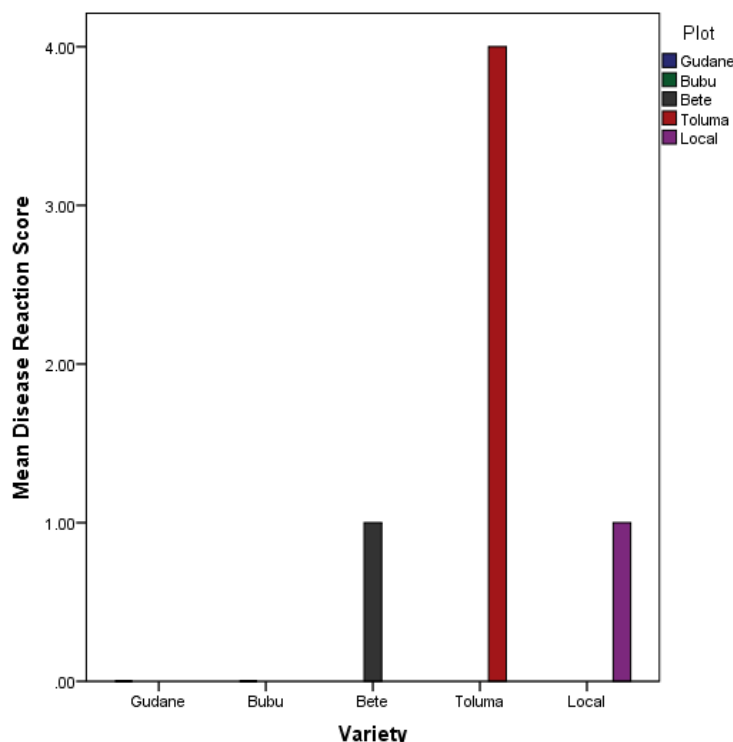
yield were recorded from Gudane and Bubu varieties which accounts 21 and 20.24 ton/ha, respectively. Similarly, the study conducted by Wassu (2014), the highest mean of total yields was recorded from Gudane and Bubu varieties.

4.3. Disease Reaction Score

The highest average disease reaction score was recorded from Toluma variety which was four (4) scores where as Gudane and Bubu varieties were disease resistant which have both zero (0) scores. Toluma variety was highly affected by late blight (*Phytophthora infestans*) and bacterial wilt

(*Ralstonia (Pseudomonas) solanacearum*). Those were the major potatoes disease recorded from farmers' field in our experiment. Toluma variety is highly susceptible than others

varieties. Contrary to this, the study conducted by [12] Gudane and Bubu varieties were moderately resistant to disease.



0=highly disease resistant, 1=disease resistant, 2=moderate disease resistant, 3=susceptible, 4=highly susceptible, 5=Very susceptible.

Figure 2. Mean of disease score per varieties.

4.4. Farmer Preference of the Varieties

To select varieties and achieve objective of the experiment, field day was prepared in farmer's field. Researchers, experts, head of district and zonal agricultural development office, extension agents, farmers and other stake holders were participated on selection of varieties. Two phases of selection

ways were used in the field day. The first was select varieties through observing seeds harvest from each plot. The second was through testing by eating of each cooked variety on different materials. In general, field day was prepared at maturity and harvesting stage. Both genders were participated.

Table 3. Field day participants in potatoes variety selection at farmers' field.

Location	Number of participants by gender (N=69)											
	Farmers			Development agents			Experts			Total		
	W	M	T	W	M	T	W	M	T	W	M	T
Oda Bultum district	15	30	45	1	3	4	1	19	20	17	52	69

Source: Own result, 2013/14

W-Women, M-Men, T-Total

Table 4. Ranking of varieties madeby participant in field day.

No	Varieties	Participants selection criteria's									Mean	Rank
		TS	MA	NTP	DR	CO	PA	YD	ST	OP		
1	Gudane	21	26	30	28	18	25	25	26	25	24.9	1
2	Bubu	25	20	26	25	17	22	26	20	23	22.7	2
3	Bete	8	10	5	10	10	13	5	8	6	8.3	4
4	Toluma	15	8	8	0	14	0	13	12	12	9.1	3
5	Local	0	5	0	6	10	9	0	3	3	4	5

Source: Own result, 2013/14

TS=Tuber Size, MA=Marketability, NTP=Number of Tuber per Plant, DR=Disease Reaction, PA=Perish ability, YD=Yield, ST=Sweetness, OP=Overall Performance.



(a)



(b)

Figure 3. (a): Observing banana yield output on the field. (b): Group discussion held on field day at Oda Baso Kebele.

The (Table 4) results indicate that participants of variety selection were select Gudane and Bubu varieties on their own criteria's. Accordingly, the overall mean of Gudane and Bubu varieties accounts 24.9 and 22.7, respectively. This varieties were disease resistant both at vegetative and maturity stage that were not perishable in the field, more of their seed were marketable, large tuber size and high number of tuber from

plant were obtained, good color, high yielder and good taste while eating varieties. The rest varieties (Toluma, Bete and Local) were attack by late blight and bacterial wilt and perishables, low yielder as compared to selected varieties. Gudane and Bubu varieties were selected and ranked by participants for further scaling up and multiplication on their agro-ecologies.

4.5. Economic Benefit Gained

Table 5. Economic benefit gained from the activity.

Varieties	Cost of input (Eth.birr)				Total Cost input (Eth.birr)	Total Revenue (Eth.birr)	Net Benefit gained (Eth.birr)
	Seed	Fertilizer		Wage (labor) in four month			
		DAP	UREA		Land in rent		
Gudane	32,000	3200	1300	40,000	8,000	84,500	168,000
Bubu	32,000	3200	1300	40,000	8,000	84,500	161,920
Toluma	32,000	3200	1300	40,000	8,000	84,500	114,160
Bete	32,000	3200	1300	40,000	8,000	84,500	127,680
Local	20,000	3200	1300	40,000	8,000	72,500	32,200
							-40,300

Beside agronomic data and farmer preference, economic data of the activity were collected to identify the profitability of the improved Irish potato technologies. The overall benefit obtained from Gudane and Bubu varieties were high which accounts were 83,500 Eth.birr and 77,420 Eth.birr, respectively (Table 5). Economically, Gudane and Bubu varieties were more profitable as compared to Bete, Toluma and Local varieties. Because, the yield obtained from those varieties were higher and also disease resistant than the rest varieties.

5. Conclusion and Recommendation

In general, according to agronomic data result shows that and farmer preference criteria like disease resistant, high yielder, larger tuber size, marketable, good color and high number of tuber and others Gudane and Bubu varieties were selected as compared to Toluma, Bete and Local varieties. Therefore, Gudane and Bubu varieties will recommend for further scale up and scale out for Oda Bultum and Daro lebu districts and others area which is similar agro-ecology to Oda Baso and Jilbo *kebeles*. The unions, research organization, agricultural development office, NGOs, private and public seed sector, farmers cooperative and others organization mainly focus on seed sector will promote and scale up those varieties in reducing quality seed problem of country and boost the economy by reducing poverty and addressing food security.

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