

Participatory Variety Selection of Irish Potato (*Solanum Tuberosum*) Varieties in High Lands of Silite and Hadiya Zones, Southern Ethiopia

Tsegaye Terefe Kulelo

Southern Agricultural Research Institute, Worabe Agricultural Research Center, P.O. Box 21, Worabe, Ethiopia

Abstract

Adaptability of crops can vary from location to location depending on the agro-ecology of a particular area. Therefore, it is essential to conduct location specific adaptation trial to identify suitable variety. The experiment was carried out at four famres field and on station, at three different locations. The seven potato varieties was used as a treatment for the study and carried out using RCBD (Randomized Complete Block Design) with three replication. These varieties are Gudanie, Jalenie, Wechecha, Dancha, Bulle, Mara charre, and local variety. From the present investigations significant variation was observed among the varieties for tuber weight and tuber yield at three locations. But for Plant height significant variation was observed only at Kadmado site, whereas for tuber diameter significant variation was observed only at Misrek-Analemo and Kadmado site. The result across the three location revealed that varieties Gudanie and Dancha was showed better performances and preferred by farmers based on different criteria. Therefore famers who resides in similar agro-ecology use the above two outstanding varieties can benefit more and more.

Keywords: Potato, Potato tuber, plant height, tuber diameter, yield

1. INTRODUCTION

The Irish potato (*Solanum tuberosum* L.) is one of the most widely grown tuber crops in the world and contributes immensely to human nutrition and food security (Karim *et al.*, 2010). Ethiopia is endowed with suitable agro-ecologies favoring the cultivation of wide range of crops including potato. It is widely grown tuber crop and stands second next to Enset (*Ensete ventricosum*) in area coverage. It is widely grown in the highland and mid-altitude areas of Ethiopia (Girma *et al.*, 2004). It is grown as a major crop in areas with very large populations, in different climatological zones, including temperate regions, the sub tropics and tropics, under very different socio economics environments. . Potato is well cultivated and gives high yield in the altitude ranging from 1500-3000 masl with an annual rainfall of 600-1200mm.

It is a very important food and cash crop in Ethiopia, especially in the high and mid altitude areas. It has a promising prospect for improving the quality of the basic diet in both rural and urban areas of the country (Berga *et al.*, 1994). As a food crop, it has a great potential to supply high quality food within a relatively short period and is one of the cheapest sources of energy.

In spite of its remarkable importance, the national average yield is about 11.5 tons/ha, which is very low compared to the world average of 19 tons/ha (FAOSTAT, 2012). A number of production problems that account for such low yield have been identified. The major ones are the concentration of potato cultivation in the highlands with very little in the lowlands, lack of well adapted cultivars, unavailability and high cost of seed tubers, inappropriate agronomic practices, diseases, insect pests, inadequate storage, transportation and marketing facilities (Tekalign, 2005, Gildemacher *et al.*, 2009). In many parts of Southern Region of Ethiopia, the demand of improved potato seeds is increasing from time to time, as the local varieties are of low yielding and susceptible to pest and diseases. Moreover improved varieties on pipeline are available at different research centers of Ethiopia. Therefore; current study aimed to test the adaptability of different improved potato varieties through participatory variety selection approach and recommend the best performing variety to farmers to increase production and productivity.

2. Materials and Methods

The experiment was carried out at three locations namely Misrak Analemo, Fuchare and Kadmado. It was done at each of Misrak Analemo and Fuchare at two farmers, and at Fuchare on station, totally at four farmers and on one site. Misrak Analemo wereda is located at 7.65°N and 37.96°S with an altitude of 2400 m above sea level. The place has long term annual rainfall of about 1001-1200 mm. Average temperature in March ranges 18.6°C-27°C, while in July it ranges from 15.6°C-21.3°C. Fuchare and Kadmado are one of districts found in silite zone Alichu wuriro districts. Fuchare is located 7°49'17.904''N and 37°58'14.99''E with an altitude of 2978.6 m above sea level. Kadmado also located at 7°44'31.49''N and 37°53'40.71''E with an altitude of 2646.6 m above sea level.

The superior quality seven potato varieties was used as a planting materials for the study. These varieties are Gudanie, Jalenie, Wechecha, Dancha, Bulle, Mara charre, and local variety (that already have been on the hand

of farmers .Seed potato tubers were used free from any defects and adequately sprouted at planting time . They were sourced from Hawassa research center, Hawassa, Ethiopia and Areka research center, Areka, Ethiopia. The farm was winter ploughed, leveled and adequately prepared.

The experiment was carried out using RCBD (Randomized Complete Block Design) with three replication. Each treatment was arranged randomly in randomized complete block design. Plot sizes were kept constant at 4.5mx3m, between plots 1m and between replications 1.5 m. Plants were grown at a spacing of 75 by 30 cm.

Weeding was carried out by hand and cultivated three times until to harvest. A side dressing of DAP applied at a rate of 195 kg/ha and one third of 165 kg/ha urea were applied at planting, the remaining two third of urea was applied as top dressing during flowering.

The following quantitative parameters such, plant height, tuber diameter, number of tubers, weight of tubers, and tuber yield were collected and measured from each plots. Measurement of plant height was recorded at fully flowering stage. Tuber diameter was measured by taking five sample tubers from each plot.

Data was subjected to analysis of variance using General liner model (GLM) procedures of SAS (ver. 9.3, SAS Institute Inc., Cary, NC). Means were separated using to Fisher’s protected least significant differences (LSD) at $p<0.05$.

3. Result and Discussion

The current investigation revealed that significant variation was observed among the varieties for tuber weight and tuber yield at three locations ($P<0.05$). In addition to this all released varieties gave significantly higher tuber weight and yield over local variety (Table 2 and 4). Moreover, on average released varieties showed 50% yield advantage as compared to local variety. Plant height significant variation was observed only at Kadmado site, whereas for tuber diameter significant variation was observed only at Misrek-Analemo and Kadmado site (Table 1 and 3). The result across the three location revealed that varieties Gudanie and Dancha was showed better performances and preferred by farmers based on different criteria (Table 5 and 6).

According to Habtamu et al (2016) who reported the yield of potato varieties at three different locations: Gudanie, Mara chrre, Jalenie and Bulle gave 34.44-38.81, 34.98-45.81, and 31.84-40.43 and 24.15-29.86 t/ha respectively. In addition to this Addis Shiferaw et al (2017) reported the yield of Gudanie, Mara chrre and Jalenie 55.12, 38.01, and 52.01 t/ha at Bule Hora District of Borena Zone, Ethiopia respectively. Similarly, Dembi and Basha (2017) reported that Gudanie yielded 26.69t/ha on onfarm evaluation at Guji highlands of Oromia region .Ethiopia. The result of different authors who reported at different locations indicates the yield of different potato varieties affected by environment. The current investigation also agreed with these different scholars findings. The variation in total yield of potato genotypes at different location may be due to a response of the genotypes to growing environmental factors. This suggestion is in agreement with other authors who reported that yield differences among genotypes were attributed both by the inherent yield potential of genotypes and growing environment as well as the interaction of genotype x environment (Elfinesh, 2008 & Asmamawu, 2007).

Table 1: Effect of Varieties on plant height

Varieties	Mean plant height (cm)				
	Misrek Anlemo		Fuchare		Kadmado site
	F1	F2	F1	F2	
Jalenie	58	55.7	55	66.3	65.7a
Gudanie	63.7	61.7	62	68.7	67.7a
Mara charre	50	48	47.3	71.7	44.3a
Wechecha	57.3	55	57	68.3	72.3a
Dancha	58.3	55.7	55.7	64.3	70.7a
Bulle	46.3	43.7	45.3	52.7	62.3a
Locally variety	64	58.3	59	64.3	74.0b
CV	17.3	16.3	18.2	17.79	11.45
LSD	17.49(ns)	15.6 (ns)	17.6(ns)	20.6(ns)	13.3**

Means followed by the same letter in a column are not significantly different by DMRT at 5% level of Probability. F1=Farmer one and F2=Farmer two

Table 2: Effect of varieties on tuber weight

Varieties	Mean weight of tubers per plant /kg. /				
	Misrek Anlemo		Fuchare		Kadkado site
	F1	F2	F1	F2	
Jalenie	2.6a	1.6a	1.7a	1.0	1.3cd
Gudanie	1.9b	1.7a	1.5a	1.5ab	1.3cd
Mara charre	1.8b	1.4b	1.1b	1.8a	1.1d
Wechecha	1.9b	1.4b	1.6a	1.8a	1.7b
Dancha	2.0b	1.7a	1.6a	1.6a	2.0a
Bulle	1.9b	1.6a	1.3ab	1.3b	1.6ab
Locally variety	0.9c	0.7c	0.8c	0.7c	1.0d
CV	20.4	23.8	17.3	24	14.5
LSD (5%)	0.23	0.2	0.25	0.24	0.27

Means followed by the same letter in a column are not significantly different by DMRT at 5% level of Probability. F1=Farmer one, F2=Farmer two and NS=Not significant

Table 3: Effect of varieties on tuber diameter

Varieties	Mean of tubers diameter per plant /kg. /				
	Misrek Anlemo		Fuchare		Kadkado site
	F1	F2	F1	F2	
Jalenie	18.0ab	18.2ab	19.6	16.7	15.9bc
Gudanie	16.4b	17.0ab	21.1	12.3	14.4c
Mara charre	16.3b	17.7ab	20.9	20.1	16.3bc
Wechecha	16.3b	18.2ab	19.2	17.9	17.3ab
Dancha	17.8ab	19.2a	22.9	18.4	19.2a
Bulle	19.7a	17.2abc	21.5	18.5	18.3a
Locally variety	13.2c	15.2c	20	14.3	16.0bc
CV	9.7	6.4	12.1	23.4	6.2
LSD (5%)	2.9	1.99	NS	NS	1.86

Means followed by the same letter in a column are not significantly different by DMRT at 5% level of Probability. F1=Farmer one, F2=Farmer two and NS=Not significant

Table 4: Effect of varieties on tuber yield

Varieties	Mean weight of tubers per hectare (t/ha)				
	Misrak Anlemo		Fuchare		Kadkado site
	F1	F2	F1	F2	
Jalenie	29.14 ^d	28.69 ^d	30.10b	24.06d	27.94c
Gudanie	37.53 ^b	38.10 ^a	30.86b	31.10b	32,52a
Mara charre	31.26 ^c	26.77 ^c	28.17cb	35.79a	25.41d
Wechecha	31.33 ^c	30.12 ^c	33.16a	29.86b	31.63ab
Dancha	39.36 ^a	34.17 ^b	35.04a	32.26b	31.09b
Bulle	38.72 ^{ab}	23.88f	24.00cd	27.30cb	27.31c
Locally variety	23.46 ^c	15.11g	25.06c	27.77c	195.6e
CV	18.7	18.9	18.6	20	22.8
LSD	15.3	12.8	21.7	27.3	11.7

Means followed by the same letter in a column are not significantly different by DMRT at 5% level of Probability. F1=Farmer one and F2=Farmer two

Table 5. Farmer's preferences for Irish potato varieties trial at Fuchare

Ranks/1-5/							
Criteria	Jalane	Gudene	Marachare	Wochacha	Denecha	Bulle	Locally variety
Seed emergence	2	1	1	1	1	2	2
Disease and pest resistance	3	3	3	2	2	2	3
Early maturity	2	1	2	1	2	1	2
No. of shoot per plant	2	1	3	3	2	3	2
No. of tuber per hill	3	1	3	3	2	3	2
Seed size	2	1	2	2	2	3	3
Yield	3	1	2	3	2	4	5
Tuber color	1	1	1	1	1	1	3
Rank sum	18	10	17	16	14	19	22
Overall rank	5th	1st	4th	3rd	2nd	6th	7th

Rank 1-5 means, 1=Excellent,2=very good, 3=good, 4=satisfactory and 5=poor

Table 6. Farmer's preferences for Irish potato varieties at Misrak Anlemo

Ranks/1-5/							
Criteria	Jalane	Gudene	Marachare	Wochacha	Denecha	Bulle	Local variety
Seed emergence	1	1	1	2	1	1	2
Disease and pest resistance	3	3	3	3	2	2	3
Early maturity	2	2	2	2	2	2	1
No. of shoot per plant	2	1	3	3	2	3	1
No. of tuber per hill	2	1	3	3	1	3	3
Seed size	2	1	2	2	2	3	3
Yield	3	1	2	2	2	4	5
Tuber color	1	1	1	1	1	1	3
Rank sum	16	11	17	18	13	19	21
Overall rank	3rd	1st	4th	5th	2nd	6th	7th

Rank 1-5 means, 1=Excellent,2=very good, 3=good, 4=satisfactory and 5=poor

4. Conclusion and Recommendation

Current investigation revealed varieties tasted at different location have different yielding potential. Moreover, the released varieties sowed significant yield variation over locally variety. The result across the three location revealed that varieties Gudanie and Dancha was showed better performances and preferred by farmers based on different criteria. Therefore farmers who resides in similar agro-ecology use the above two outstanding varieties can benefit more and more. Since this result was one season, to come up with strong conclusion it need additional investigation.

Acknowledgement

I highly appreciate and acknowledge the effort made by Southern Agricultural Research Institute, Worabe Agricultural Research center for funding, field assistants and for their unreserved support and substantial contribution to accomplish this study. I would like to acknowledge Hawassa and Areka research centers, Southern Ethiopia for providing planting materials.

REFERENCES

- Addis S., Dessalegn R., & Wakene T. 2017. Irish Potato (*Solanum Tuberosum*) Variety Evaluation at Bule Hora District of Borena Zone. *Global Journal of Science Frontier Research: DAgriculture and Veterinary*. Volume 17 Issue 2 Version 1.0 Year 2017. USA
- Arsenault, W.J., D.A. LeBlanc, G.C.C. Tai and P. Boswall, 2001. Effects of nitrogen application and seed piece spacing on yield and tuber size distribution in eight potato cultivars. *American J. Potato Res.*, 78:301–309
- Asmamaw Y., (2007). Postharvest quality of potato (*Solanum tuberosum L.*) cultivars as influenced by growing environment and storage period. An M. Sc. Thesis submitted to the school of graduate studies of Haramaya University, 41-44p.
- Barry, P.B., T.S. Storey and R. Hogan, 1990. Effect of plant population and set size on yield of the main crop potato variety Cara. *Irish J. Agric.Res.*, 29: 49–60
- Beukema, H.P. & van der Zaag, D.E. 1990. Introduction to Potato Production. PUDOC. Wageningen, the Netherlands.
- Bernet, T., Thiele, G. & Zschocke, T. 2006. Participatory Market Chain Approach (PMCA): User Guide,

- International Potato Center (CIP), Lima, Peru.
- Berga Lemmaga, Gebremedihin Woldegiorgis, Terrissa Jalleta and Berke-TsehaiTuku, 1994. Potato agronomy research. pp. 101-119. In: Edward Herath and Lemma Dessalegne (Eds.). Proceedings of Ethiopia, Addis Ababa, 1-3 December 1992. Institute of Agriculture organization, Addis Ababa, Ethiopia.
- Caldiz, D. O. 2007. Producción, cosecha y almacenamiento de papa en la Argentina. BASF Argentina S.A. — McCain Argentina S.A. (1st ed.). Balcarce, Argentina.
- CIP. [International Potato Center]. 2007. Root and Tubers: The overlooked opportunity, Annual Report. CIP, Lima, Peru.
- Dembi K. and Basha K. 2017. On farm demonstration of adapted Irish Potato (*Solanum tuberosum*) in Highlands of Guji zone, Oromia Region, Ethiopia. *Academic Research Journal of Agricultural Science and Research*. Vol. 5(7), pp. 514-520, November 2017 DOI: 10.14662/ARJASR2017.082
- Elfinesh F., (2008). Processing quality of improved Potato (*Solanum tuberosum* L.) varieties as influenced by growing environment, genotype and blanching. An M. Sc. Thesis submitted to the school of graduate studies of Haramaya University
- FAO, 2009. Sustainable potato production guidelines for developing countries.. NeBambi Lutaladio *Plant Production and Protection Division FAO, Rome, Italy*
- FAOSTAT, 2012. Food and Agriculture Organization of the United Nations, for a world without hunger. Rome, Italy. <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567>.
- Habtamu G., Wahassu M., and Beneberu S. 2016. Evaluation of Potato (*Solanum tuberosum* L.) Varieties for Yield and Yield Components in Eastern Ethiopia. *Journal of Biology, Agriculture and Healthcare*. ISSN 2224-3208 (Paper) ISSN 2225-093X (Online) Vol.6, No.5, 2016
- Karim, M.R., M.M. Hanif, S.M. Shahidullah, A.H.M.A. Rahman, A.M. Akanda and A. Khair, 2010. Virus free seed potato production through sprout cutting technique under net-house. *African J. Biotech.*, 9: 5852–5858
- Robert E. & Whitson, 1998. Potato Production. Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma
- Tsegaw Tekalign, 2005 Response of potato to paclobutrazol of Reproductive Growth under Tropical condition. A PhD. Dissertation presented to the department of production and soil science. University of pretoria. 45P.
- Gildemacher P, Demo P, Barker I, Kaguongo W, Gebremedhin W, Wagoire WW, Wakahiu M, Leeuwis C, Struik PC (2009). A description of seed potato systems in Kenya, Uganda and Ethiopia. *Am. J. Potato Res.* 86(5): 373-382.