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Registration of "Milki" a Newly Released Potato Variety for Bale Highlands, Ethiopia

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Abstract: Ethiopiahas suitable environmental condition for potato production. However, the productivity of potato is very low as compared with world average due to lack of stable, high yielding, and disease resistant cultivars. Therefore, the objective of this study was to evaluate the promising genotypes and verify the most stable, high yielding and disease resistant potato genotype for highlands of Bale. For the study, the experiment was carried out at three locations from 2009 to 2011 production seasonusing 11 genotypes including local and standard checks. Randomized complete block design with three replications was used for the experiment. One of the experiments was conducted at the research farm of Sinana Agricultural Research Center, Oromia Agriculture Research Institute, Sinana and the others at the farmers' field, Dinsho and Shalo. The study found that the Milki (CIP-394640.539) varietyhad above average yield performance in most test environments, out yielded the Jalane, Ararsa and Hunde. The average tuber yield of Milkiover locations and over years is about 49.31 t/ha. It has also better yield stability than checks. Milkiis, therefore, released in 2012/13 for production for all potato growing environments in the highlands of Bale and other similar agro-ecologies.

Keywords: Milki, Variety Registration, Genotypes, Stability

1. Introduction

Potato (*Solanumtuberosum*L.), is origin in the high Andes of South America and it was introduced to Ethiopia in 1858 by the German botanist Shimper (Berga *et al*., 1992). Potato is the fourth most important crop after rice, wheat, and maize, and has historically contributed to food and nutrition security in the world (FAOSTAT, 2015; FAO, 2015). Among root and tuber crops in Ethiopia, potato ranks first in volume produced and consumed followed by Cassava, Sweet potato and Yam (CSA, 2013). Potato is mainly produced as food and income security crop to overcome seasonal food shortage due to food crops depletion from stores. Its high yield per unit area and best maturity period are double advantages to be a food security crop. The fact that potato matures during the time when there is a food shortage and its short life cycle to mature enables it to deserve appreciation by farmers (Girma*et al*, 2004). The food potential of horticultural crops, particularly that of root and tuber crops, has not yet been fully exploited and utilized despite their significant contributions towards food security, income generation, provision of food energy and resource base conservation (Gebremedhin *et al.,* 2008). Potato's nutritional value is higher than most of the food crops. It is considered as the richest source of carbohydrates (Ali *et al.,* 2015). Moreover, the high cash rewards encouraged farmers to be involved in potato production (Elraiah *et al.,* 2013). Potato produces more energy and protein per cultivated area and per unit of time than most other major crops; and it is fat-free and contains substantial amount of vitamins especially vitamins B and C, and minerals (CIP, 1988). The balance of proteins to calories, the balance among the more important amino acids in protein, and the level and spread of minerals make potato second only to eggs in nutritional value (Swamintha and Sawyer, 1983). Its shorter growing period makes it possible for the small farmer to use this crop in a system where more than one crop is possible on the same land per season (Majisu, 1982). Potato has been widely described as global food and nutritional security option particularly for the poor people (Singh and Rana, 2013).

Farmers consider potato as a transitional crop that helps

them survive the severe and prevailing food shortage that occur every year (Semagn *et al*., 2007). The farmers need varieties that show high performance for yield and other essential agronomic traits. Their superiority should be reliable over a wide range of environmental conditions and also over years (MulugetaGedif and DessalegnYigzaw, 2014). Efforts have been done with different researchers to overcome the low productivity of potato. Different cultivars screened under Gaza Strip condition showed were different in vegetative growth, yield, and tuber properties (Abu-Zinada and Mousa, 2015). Alsharari *et al*., (2007) reported that significant differences have been reported among cultivars in term of plant height, number of branches, leaf area, tuber number and tuber weight. Ranjbar and Mirzakhan (2012) indicated that cultivarsCosima and Ramus were significantly superior to other varieties in term of growth indices i.e. plant height, number of stems plant^{-1}, number of tubers plant^{-1} and mean weight of tubers. Belhjati *et al*., (2013) the evaluation of 11 new potato clones showed that the highest and the lowest yield were for Clone No. 397031-1 and Lady Rosetta respectively.

In Ethiopia, about 70% of the available agricultural lands is located at an altitude of 1800-2500 m.a.s.l and receives an annual rainfall of more than 600mm, which is suitable for potato production (Ermias *et al.,*2007). The area under potato cultivation is increasing at an average annual rate of 15%. As in most developing countries, the growth in production of potato was brought about by an expansion in acreage rather than productivity. Three decades ago Ethiopia's national potato area was estimated at 30.000 hectares, reaching 50.000 hectares by the mid 1980's, and 160.000 hectares by 2001 (Gebremedhin *et al.*, 2001). Even though the country has suitable environmental condition the regional (9.35t/ha) as well as national (7.99t/ha) (CSA, 2013) productivity of potato during 2013 season is very low as compared with world average of 17.16 t/ha. A number of production problems that accounts for low regional as well as national yield have been identified(Girma *et al*, 2005). Major ones are lack of stable, well-adapted, high yielding, acceptable and disease resistant cultivars and poor access of the available cultivars are still major constraints for potato production. The local cultivars, in addition to their being genetically poor yielding, are highly susceptible to late blight, which sometimes leads to 100% yield loss (Gebremedhin *et al*., 2008, Bekele *and* Eshetu, 2008, Endale *et al*, 2008). Therefore, the objective of this study was to evaluate the promising genotypes and verify the most stable, high yielding and disease resistant potato genotype for highlands Bale and other similar agro-ecologies in the country.

2. Material and Methods

The experiment was carried out at three locations. One of the experiments was conducted at the research farm of Sinana Agricultural Research Center, Oromia Agriculture Research Institute, Sinana and the others at the farmers' field, Dinsho and Shalo. Sinana Agricultural Research Center (7°N latitude and 40°E longitudes; and 2400 m.a.s.l) is located 463km south east of Addis Ababa and east of Robe, the capital of Bale zone. The other location 'Shalo' is located 20 km from Sinana Agricultural Research Center and about 15km from Robe in the east direction; 'Dinsho' is located 53 km from Sinana Agricultural Research Center and about 20 km from Robe in the south west direction.

The experiment was conducted from the screening nursery till verification trial (2007 to 2012/13) under rain fed conditions. In 2007, 25 genotypes were evaluated in observation nursery at main research center, Sinana. In 2008, 20 genotypes including local and previously released varieties were selected from the previous generation and evaluated in the yield trial again at main research center, Sinana for one season. At this time agronomic data such as days to flower, days to maturity, plant height, number of branch per plant, number of tuber per plant, average tuber weight, and yield was collected on plant and plot basis. Then from 2009 to 2011 eleven genotypes including local and previously released varieties which were selected from the yield trial were evaluated in multi-location trial (Sinana, Dinsho and Shalo) to see its yielding potential and its reaction to some potato disease. The genotypes in multi-location trial were evaluated using randomized complete block design with three replications. Agronomic and yield data were collected and subjected to statistical analysis in order to identify the best genotypes of the evaluated genotypes. After the multi-location trial had been conducted for the above three consecutive years, Milki was selected out of 11 genotypes to be verified for one more season at 9 locations and then evaluated by national variety releasing committee as per the guide line of the variety releasing and registration of the country.

3. Results and Discussion

3.1. Varietal Charecters

Milki was medium plant size with pink flower color, erect growth habit, obovate tuber shape, shallow eye depth, white tuber color, andwhite flesh color. On average this variety needs 64 days to flowering and 114 days to physiological maturity. It has plant height of 58cm. The variety gives tuber yield of *43.79-83.64* t/ha at Research field where as *32.96-63.30* t/ha at farmers field.

3.2. Yield Performance

Highly significant variations among potato genotypes in marketable and total tuber yield in all study years and locations were observed. The mean yield ranged from 49.31 to 20.6 t/ha for total yield; while it was 47 to 15t/ha for marketable tuber yield. The highest overall mean tuber yield over years and locations was recorded for the variety Milki (49.31 t/ha) followed by the genotype 387967-3 (44.9t/ha)and standard check Hunde (41.9t/ha) whereas, the lowest tuber yield was recorded for local check (20.6 t/ha) among the test

entries (Table 1). The variety has yield advantage of 26.24%, 23.04%, and 21.96% over the three standard checks Jalane, Ararsaand Hunde respectively (Table 2).

Table 1. *Combined summary of mean tuber yield, other agronomic traits, and disease of potato variety trial over years and over three locations.*

Treatment	DE	DF	SCE	DM	PH	MTN	UTN	TTN	MTY	UTY	TTY	DI
Jalane	20.2	70.4	18.9	120.9	56.2	13.8	9.1	22.8	36.8	2.8	39.6	2.7
90147-15	20.3	66.7	23	113.3	45.2	14.1	10.1	24.2	32.3	2.8	35.1	4
392637-500	20.2	69.6	18.8	116.4	47.5	10	4.1	14.2	28.1	1.2	29.4	4.4
390012-2	19.9	68.4	20.8	117.1	48.1	12.4	8.9	21.3	34.8	2.5	37.3	3.1
90170-37	21.3	69.1	17.2	119.5	52.8	12.9	8.6	21.5	31.3	2.4	33.7	3
Hunde	21.1	69.3	21	118.9	48.6	14.8	12.5	27.2	38.2	3.7	41.9	2.4
CIP-394640-539 (Milki)	18.9	64.3	20.3	114.1	58.2	14.3	7.3	21.7	47	2.4	49.3	3.3
90147-46	20.9	68.3	18.5	116.9	48.5	8.7	7.8	16.5	23.5	2.5	26	3.6
Ararsa	19.1	66.2	20.5	117.6	52	11.5	5.2	16.7	39.7	1.6	41.3	3.5
387967-3	18.6	68.8	22.1	118.5	56	15.3	6.5	21.8	42.7	2.2	44.9	2.2
Local	18.3	67.2	22.1	110.9	50.5	9.1	20.5	29.6	15	5.6	20.6	4.3
MEANS	19.8	68.2	20.5	117	51.7	12.8	9.3	22.1	34.9	2.8	37.7	3.2
LSD (5%)	1.8	4.5	6	5.5	12.9	6.3	6.8	5	19.1	2.4	19.3	1.5
CV	5.7	4.1	18.2	2.9	15.5	30.7	45.5	27.9	34	52.6	31.8	29.2

Note: DF=days to flower, PH=plant height, DI=late bligtht MTN=marketable tuber number per hill, DM=days to Maturity, MTY=marketable tuber yield t/ha, and TTN=total tuber number per hill, TTY=total tuber yield t/ha, UTN=unmarketable tuber number per hill, UTY=unmarketable tuber yield t/ha, DE=days of emergency, SCE=stand count at emergency.

Table 2. *Tuber yield, other agronomic traits and disease reaction of milki and other checks in multi- location test during 2009 to 2011.*

Treatment	DE	DF	SCE	DM	PH	MTN	UTN	TTN	MTY	UTY	TTY	DI
Jalane	20.2	70.4	18.9	120.9	56.2	13.8	9.1	22.8	36.8	2.8	39.6	2.7
Hunde	21.1	69.3	21	118.9	48.6	14.8	12.5	27.2	38.2	3.7	41.9	2.4
CIP-394640-539 (Milki)	18.9	64.3	20.3	114.1	58.2	14.3	7.3	21.7	47	2.4	49.3	3.3
Ararsa	19.1	66.2	20.5	117.6	52	11.5	5.2	16.7	39.7	1.6	41.3	3.5
Local	18.3	67.2	22.1	110.9	50.5	9.1	20.5	29.6	15	5.6	20.6	4.3

Note: DF=days to flower, PH=plant height, DI=late bligtht MTN=marketable tuber number per hill, DM=days to Maturity, MTY=marketable tuber yield t/ha, and TTN=total tuber number per hill, TTY=total tuber yield t/ha, UTN=unmarketable tuber number per hill, UTY=unmarketable tuber yield t/ha, DE=days of emergency, SCE=stand count at emergency.

3.3. Reaction to Disease

The major potato disease according their importance in the growing areas is potato late blight (*Phytophthorainfestans*). In 1-9 rating scale, Milki scored a mean of 3.3 for this disease. The variety is characterized by moderately resistance types of reaction to this major disease at all the sites. The disease score for the variety and the checks are summarized in Table 2.

3.4. Adaptation

Milki is released for the highlands of Bale. It performs very well in areas having an altitude 2350-3350 m.a.s.l. and annual rainfall of 500-1000mm. It can also possibly extend the production of this variety to other areas having similar agro-ecologies.

3.5. Variety Maintenance

Breeder and foundation seed of the variety is maintained by Sinana Agricultural Research center.

4. Conclusion

The development of cultivars, which are adapted to a wide range of diversified environments, is ultimate aim of breeders in crop improvement program. The adaptability of a variety over diverse environments is commonly evaluated by the degree of its interaction with different environments in which it is grown. A variety is considered to be more stable if it has high mean yield but a low degree of fluctuation in yielding ability when planted over diverse environments (Becker, 1988). The milki variety had above average yield performance in most test environments, out yielded theJalane, Ararsa and Hunde. The average tuber yield of milki over locations and over years is about 49.31 t/ha. It has also better yield stability than checks. The variety has yield advantage of 26.24%, 23.04%, and 21.96% over the three standard checks Jalane, Ararsa and Hunde respectively. The variety is characterized by moderate resistance types of reaction to the important potato disease in the growing areas; the potato late blight (*Phytophthorainfestans*) at all sites. Milki is, therefore, released for production for all potato growing environments in the highlands of Bale and other similar agro-ecologies.

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