

# Morphological Characters of Potato (*Solanum tuberosum* L.) as Influenced by Local and Improved Cultivars Grown in Eastern Ethiopia

Helen Teshome<sup>1\*</sup> Nigussie Dechassa<sup>2</sup> Tekalign Tsegaw<sup>2</sup>

1.Department of Horticulture, College of Agricultural Sciences, Wolaita Sodo University, Ethiopia

2.Department of Plant Sciences, College of Agriculture, Haramaya University, Ethiopia

\*E-mail: [helenteshome@yahoo.com](mailto:helenteshome@yahoo.com), P.O.Box 138

## Abstract

Field experiments were conducted at Haramaya and Hirna with the objective of assessing the morphological characteristics of local (farmers') and improved potato cultivars during the main cropping season of 2011. The treatments consisted of five released cultivars (Badhasa, Chala, Chiro, Gabbisa, Zemen) and four local (farmers') potato cultivars (Batte, Daddafa, Jarso, Mashenadima). The experiment was laid out as a Randomized Complete Block Design with three replications. There were significant differences within as well as between the farmers' and released potato cultivars in a number of morphological characteristics.

**Keywords:** potato (*solanum tuberosum* l.), yield Performance, Improved, local, Ethiopia

## Introduction

Potato is regarded as a high-potential food security crop because of its ability to provide a high yield of high-quality product per unit input with a shorter crop cycle (Adane *et al.*, 2010). It is a major part of the diet of half a billion consumers in the developing countries (Mondal, 2003). Potato is an important food and cash crop in Eastern and Central Africa, playing a major role in national food security and nutrition, poverty alleviation and income generation, and; provides employment in the production, processing and marketing sub-sectors (Lung'aho *et al.*, 2007).

Variation in a crop population is the result of the combination of the genotypic and environmental factors. The proportion of variation due to each source is of importance in plant breeding. Genetic variability is a primary interest to the plant breeder because proper management of this variation can produce permanent gain in the performance of the plant (Welsh, 1990, cited in Basazen, 2006). To be useful for plant breeders, genetic resources must be characterized by morphological and agronomic traits (Martins *et al.*, 2006). Moreover, the knowledge on diversity and the identification, differentiation and assessment of agronomic performances of cultivars provides an informative tool for the detection of duplicates in the collection, effective extension and better characterisation and use in improvement work of crops. Morphological and agronomic characterization is the first step in description and classification of plant genotypes (Smith and Smith, 1989).

However, to date, no systematic studies have been done to investigate and document the similarities and differences on morphological characteristics of local and improved potato cultivars grown in the Eastern Ethiopia. Therefore, this study was initiated with the objective of evaluating the morphological characters of major local and improved cultivars of potato grown in Eastern Ethiopia.

## Materials and Methods

### Description of the study area

The study were carried out at Rare, Horticulture section's research field, Haramaya University and Hirna research site of the University under rainfed condition during the 2011 main growing season. Rare research site is located at 9 °26' N latitude, 42 °3' E longitudes at an altitude of 1980 m.a.s.l. The mean annual rainfall is 760 mm (Belay *et al.*, 1998). Mean annual temprature 16 °C (Mishra *et al.*, 2004). The mean relative humidity is 50%, varying from 20 to 81%. The soil of the experimental site is alluvial type with organic carbon content of 1.15%, total Nitrogen content of 0.11%, available Phosphorus content of 18.2 mg kg soil<sup>-1</sup>, exchangeable Potassium content of 0.65 cmol<sub>c</sub> kg soil<sup>-1</sup>, pH of 8.0 and per cent sand, silt and clay content of 62.92, 19.64 and 17.44, respectively (Simret, 2010).

Hirna sub-station is located at 9 °12' N latitude, 41 °4' E longitudes at an altitude of 1870 m. a.s.l. The area receives mean annual rainfall of 990 to 1010 mm with an average temperature of 24 °C (HURC, 1996). The soil of Hirna is vertisol with organic carbon content of 1.75%, total Nitrogen content of 0.18%, available Phosphorus content of 32 mg kg soil<sup>-1</sup>, exchangeable Potassium content of 0.68 cmol<sub>c</sub> kg soil<sup>-1</sup>, pH of 7.09 and percent sand, silt and clay contents of 27, 28 and 45, respectively (Nebret, 2011).

### Description of Experimental Material

Five potato cultivars, which were released by Haramaya University at different times and four locally available potato cultivars were used for the experiment (Table 1).

Table 3. Potato cultivars used in the study, year of release and their sources.

Variety	Year of release	Source of planting material
Chiro	1998	HUPIP
Zemen	2001	HUPIP
Badhasa	2001	HUPIP
Gabbisa	2005	HUPIP
Chala	2005	HUPIP
Source (MoARD, 2010)		
Batte	Local	RHSPC
Mashenadima	Local	RHSPC
Jarso	Local	RHSPC
Daddafa	Local	RHSPC

Key: HUPIP = Haramaya University Potato Improvement Programme

RHSPC = Rare Hora Seed Producers' Cooperative

### Treatments and Experimental Design

The treatments are nine consisting of five improved cultivars (Chala, Chiro, Badhasa, Gabbisa and Zemen) and four local cultivars (Batte, Mashenadima, Jarso and Daddafa). The experiment was laid out as a Randomized Complete Block Design (RCBD) and replicated three times. Each plot was 3.60 m x 4.50 m = 16.2 m<sup>2</sup> wide consisting of six rows, which accommodated twelve plants per row and thus 72 plants per plot. The spacing between plots and adjacent replication were 1 m and 1.5 m, respectively. There was a total of 669.3 m<sup>2</sup> area for experimental site.

### Experimental Procedures

The experimental field was cultivated by a tractor to a depth of 25-30 cm and levelled and ridges were made by hand. Medium sized (39-75 g) Lung'aho *et al.*, (2007) and well sprouted tubers were planted at the sides of ridges at the spacing of 75 cm between ridges and 30 cm between tubers. Planting depth was maintained at 5 cm (Mahmood *et al.*, 2001). Phosphorus fertilizer at the rate of 92 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> in the form of Diammonium Phosphate (200 kg ha<sup>-1</sup>) was used and the whole rate was applied at planting. 75 kg Nitrogen ha<sup>-1</sup> was applied in the form of urea in two splits, half rate after full emergence (two weeks after planting) and half rate at the initiation of tubers (start of flowering). Potato plants were treated with Mancozeb 80% WP at the rate of 1.5 kg ha<sup>-1</sup> diluted at the rate of 40 g per 20 litre water once a week to control late blight disease.

### Plant Data Collection and Analysis

Post harvest observations were taken from randomly selected plants from each plot for all characters studied.

## Results and Discussion

### Morphological Characteristics of Potato Cultivars

The potato cultivars had variations in morphological characteristics such as growth habit, flower colour, number of inflorescence; tuber set characteristics, tuber skin colour, tuber shape, tuber eye depth, distribution of tuber eyes, eye number per tuber and tuber flesh colour. Cultivars under this experiment such as Badhasa, Batta, Chiro, Zemen, Daddafa showed semi-erect growth habit and Chala, Jarso, Mashenadima and Gabbisa showed erect growth habit. Badhasa, Batta, Chala and Gabbisa produced white flower color the remaining Mashenadima and Jarso dark-pink and also Zemen and chiro showed light pink flower in the other case all of the cultivars except cultivar Jarso which produced average flowering (5-20 inflorescence) the rest showed very few flowering (>5 inflorescence). From those nine cultivars six of them showed spreading tuber set characteristics (Badhasa, Batta, Chala, Jarso, Zemen and Gabbisa) and the rest three (Chiro, Mashenadima and Daddafa) showed compact tuber set characteristics. When we come to tuber skin texture all of improved cultivars except Gabbisa and Chala produced rough tuber skin texture and local cultivars (Batte and Daddafa) had rough and (Mashenadima and Jarso) produced smooth tuber skin texture. In the other case cultivar Badhasa, Chala, Mashenadima and Gabbisa produced white tuber skin colour, Chiro and Zemen brownish colour and Jarso and Daddafa produced white-cream tuber skin colour.

There have been three cultivars with oblong tuber shape those are Badhasa, Chiro and Gabbisa the other two Jarso and Daddafa produced round tuber shape but only Mashenadima produced long oblong tuber shape and Chala obovate and also Batte compressed tuber shape. Majority of the cultivars under this study produced shallow tuber eye depth those are Badhasa, Jarso, Chiro, Zemen and Gabbisa and the other Chala and Mashenadima protruding and Batte and Daddafa medium-deep tuber eye depth. There was cultivars with apical distribution of tuber eyes as well as cultivars with evenly distributing tuber eyes (Badhasa, Batte, Jarso, Daddafa) and (Chala, Chiro, Mashenadima, Zemen, Gabbisa), respectively but all of the cultivars produced intermediate eye number per tuber between 5-20 there was three cultivars with yellow tuber flesh colour (Batte, Jarso,

Daddafa) in addition two cultivars produced white tuber flesh colour (Mashenadima and Chala) there was also two which produced Yellow-cream tuber flesh colour ( Badhasa and Zemen) and the rest (Gabbisa and Chiro) produced white-cream tuber flesh colour. This difference showed that there was variation in genetic trait of cultivars which resulted difference in morphological characteristics that is important for morphologically differentiates cultivars (Table 2).

Table 2.Morphological characteristics of potato cultivars.

Cultivar	Growth habit	Flower colour	Number of inflorescence	Tuber set characteristics	Tuber skin texture	Tuber skin colour	Tuber Shape	Tuber eye depth	Distribution of tuber eyes	Eye number per tuber	Tuber flesh colour
Badhasa	Semi-erect	White	Very few flowering	Spreading	Rough	White	Oblong	Shallow	Apical	Intermediate	Yellow-cream
Batte	Semi-Erect	White	Very few flowering	Spreading	Rough	Brownish	Compressed	Medium deep	Apical	Intermediate	Yellow
Chala	Erect	White	Very few flowering	Spreading	Smooth	White	Obovate	Protruding	Evenly	Intermediate	White
Jarso	Erect	Dark pink	Average flowering	Spreading	Smooth	White-cream	Round	Shallow	Apical	Intermediate	Yellow
Chiro	Semi-erect	Light pink	Very few flowering	Compact	Rough	Brownish	Oblong	Shallow	Evenly	Intermediate	White-cream
Mashenadima	Erect	Dark pink	Very few flowering	Compact	Smooth	White	Long oblong	Protruding	Evenly	Intermediate	White
Zemen	Semi-erect	Light pink	Very few flowering	Spreading	Rough	Brownish	Oblong	Shallow	Evenly	Intermediate	Yellow Cream
Daddafa	Semi-erect	White	Very few flowering	Compact	Rough	White-cream	Round	Medium deep	Apical	Intermediate	Yellow
Gabbisa	Erect	White	Very few flowering	Spreading	Smooth	White	Oblong	Shallow	Evenly	Intermediate	White-cream

## Conclusion

There were a number of differences in morphological characteristics among and within the cultivars released by the Haramaya University and those developed through selection by farmers. Morphological characteristics such as growth habit, flower colour, number of inflorescence; tuber set characteristics, tuber skin colour, tuber shape, tuber eye depth, distribution of tuber eyes, eye number per tuber and tuber flesh colour in potato cultivars also had variations those variation in morphological characteristics may due to genetic factors.

## Reference

- Adane Hirpa, M.P.M. Meuwissen, A Tesfaye., W.J.M. Lommen, A.O. Lansink, A. Tsegaye and P.C. Struik, 2010. Analysis of Seed Potato Systems in Ethiopia. *American Potato Research Journal*. 87: 537-552.
- Basazen Fantahun, 2006. Genetic Variability and character associations in some triticale Genotypes at Kulumsa and Assasa, Arsi. An M.Sc. Thesis presented to the school of graduate studies of Haramaya University. 75p.
- Belay, S.C., W. Wortman and G. Hoogen boom, 1998. Haricot bean agro-ecology in Ethiopia: definition using agro-climatic and crop growth stimulation models. *African Crop Science Journal*. 6: 9-18.
- HURC (Haramaya University Research Centre), 1996. Proceedings of the 13<sup>th</sup> annual Research and extension review meeting. pp. 26-28.
- Kidane-Mariam, H.M., 1980. Project Proposal for the Development of an Ethiopian Potato Program. Addis Ababa. Manuscript.
- Lung'aho, C., B. Lemaga, M. Nyongesa, P. Gildermacher, P. Kinyale, P. Demo and J. Kabira, 2007. Commercial seed potato production in eastern and central Africa. Kenya Agricultural Institute, Kenya. 140p.
- Mahmood, M.M., A. Hussain and K. Farooq, 2001. "Aallo Ki Kasht" 9 p. National Potato Programme, NARC. 59p.
- Martins, S.R., F.J. Vences, L.E. Miera, M. R. Barrosa and V. Carnide, 2006. RAPD analysis of genetic diversity among and within Portuguese landraces of common white Bean (*Phaseolus vulgaris* L.). *Scientia Horticulturae Journal*. 108: 133-142.
- Mishra B.B., H.G. Kidan, K. Kibret, M. Assen and B. Eshetu, 2004. Soil and land resource inventory at Alemaya University research farm with reference to land evaluation for sustainable agricultural management and production: Synthesis of working papers, *Soil Science Bulletin*. Alemaya University, Ethiopia.
- MoARD (Ministry of Agriculture and Rural development), 2010. Animal and Plant Health Regulatory Directorate. Crop Variety Register. Crop Development Department, Issue No.13 June 2010, Addis Ababa, Ethiopia. 138p.
- Mondal, M.A.A., 2003. Improvement of potato (*Solanum tuberosum* L.) through hybridization and *in vitro* culture technique. A. Ph.D. Dissertation presented to Rajshahi University, Rajshahi, Bangladesh. 270p.
- Nebret Tadesse, 2011. The effect of Nitrogen and Sulfer on yield and yield component of common bean in Eastern Ethiopia. Unpublished M.Sc. Thesis presented to the school of graduate studies of Haramaya University. 13p.
- SAS (Statistical Analysis Software), 2007. Stat. Jahrbuch tuber Ernährung, Landwirtschaft und Forsten In German, Landwirtschaftsverlag Munster-Hiltrup, Germany, 2008.

- Simret Burga, 2010. Influence of inorganic nitrogen and potassium fertilizers on seed tuber yield and size distribution of potato (*Solanum tuberosum* L.). An. M. Sc Thesis Presented to the School of Graduate Studies of Haramaya University, Ethiopia. 65p.
- Smith, J.S.C. and O.S. Smith, 1989. The description and assessment of distances between inbred lines of maize: The utility of morphological, biochemical and genetic descriptors and a scheme for the testing of distinctiveness between Inbred Lines. *Maydica*. 34: 151-161.
- Welsh, R.J. 1990. Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York. 387p.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:  
<http://www.iiste.org>

## CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

**Prospective authors of journals can find the submission instruction on the following page:** <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

## MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

## IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

