Fundamental and Applied Agriculture
Vol. 4(4), pp. 1054–1059: 2019
doi: 10.5455/faa.59383

Crop Science
ORIGINAL ARTICLE

Assessment of some exotic potato genotypes for their yield performance under Bangladesh condition

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ARTICLE INFORMATION

Article History
Submitted: 31 Jul 2019
Revised: 07 Oct 2019
Accepted: 08 Oct 2019
First online: 29 Dec 2019

Academic Editor
Parviz Almasi
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ABSTRACT

A field research was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period between November 2011 and February 2012 to determine the yield performance of some exotic potato accessions/cultivars. The experiment was laid out in randomized complete block design (RCBD) with three replications. The experiment comprised of six exotic potato accessions *viz*. AC10064, AC10076, AC10097, AC10109, AC10123 and AC10190, and one cultivar 'Cardinal' as control. Data on yield and yield contributing characters were recorded. The lowest days required for plant emergence at accession AC10109 (6.25 d) and the maximum days required at variety Cardinal (10.02 d). The highest tuber length (7.11 cm) and diameter (5.70 cm) were found in the accession AC10109 and lowest length (5.85 cm) and diameter (3.81 cm) of tubers were found in the variety Cardinal. The maximum (274.74 g) and the minimum (130.11 g) yield of tubers hill^{-1} were found in accession AC10109 and Cardinal, respectively. The maximum yield of tubers was obtained from the accession AC10109 (29.31 t ha^{-1}) closely followed by AC10064 (28.88 t ha^{-1}) and the minimum yield of tubers was obtained from the accession Cardinal followed by AC10190 (15.97 t ha^{-1}). Considering the yield performance, potato accession AC10109 was the best performer followed by AC10064 and performed better than popular existing variety Cardinal. Therefore, these two accessions may be considered for further multi-location trial before final recommendation.

Keywords: Potato, accession, growth, yield

Cite this article: Chowdhury MMH, Islam MA, Rahman MH, Rahim MA, Atikuzzamman M, Sathi MA. 2019. Assessment of some exotic potato genotypes for their yield performance under Bangladesh condition. Fundamental and Applied Agriculture 4(4): 1054–1059. doi: 10.5455/faa.59383

1 Introduction

Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world after rice, maize and wheat (Nasif et al., 2018; Karim et al., 2018). It is an important supplementary food crop in Bangladesh. It has the capacity of producing more calories and protein per unit land area with minimum time and water than most other major food crops (Upadhya, 1995). In the year 2017-2018, total 4,77,529 ha land was under potato cultivation that produced 97,44,000 metric tons with an average yield of 19.1 metric t ha^{-1} (BBS, 2018)

which was quite low (10.85 metric t ha^{-1}) in 1992 (Eaton et al., 2017). Last year, contribution of potato was 3.13% of total crop production (area coverage) in Bangladesh (BBS, 2018). This increase of potato production is due to cultivation of high yielding varieties. In Bangladesh, potato is primarily used as a vegetable, although in many countries of the world it constitutes the staple food and contributes more than 90% of the carbohydrate food source. The principal use of potatoes is to make potato curry along with fish, meat, and eggs, there exists a great diversity in the consumption of potatoes. Notable among potato-based food items are the boiled potato, fried potato, mashed potato, baked potato, potato chop, potato vegetable mix, potato singara, potato chips, French fry etc. In recent years, bakeries and fast food shops have started preparing a wide variety of potato-based food delicacies.

Despite the improvement in production, the yield of potatoes in Bangladesh is still lower than that in other countries. The weather condition for potato cultivation was not in favor during the sowing, growing and harvesting period of the survey year 2017-18. The cultivation area under local variety decreases with regard to previous year (BBS, 2018). In 2017, potato yield in Bangladesh was 20.44 t ha^{-1} compared to 38.95, 47.56, 43.68, 42.32, 46.78 and 40.05 t ha^{-1} in Australia, Belgium, Denmark, France, Germany and Netherlands, respectively, for the same year (FAOSTAT, 2017). There are several reason behind the low productivity where use of low yielding varieties, the low resistance of these varieties to insects and diseases, and the lack of availability of quality seed tubers are notable (Eaton et al., 2017). To increase the yield, the very first step is to select the high yielding varieties suitable for the local agroclimatic conditions (Alam et al., 2003). That is why there is need to evaluate different improved varieties of potato for yield under the climatic conditions of Bangladesh. This study aims to evaluate the comparative yield performances of six exotic potato accessions along with a popular potato cultivar Cardinal (as control) and to identify the potential potato accession(s) under Bangladesh conditions.

2 Materials and Methods

2.1 Study site

The study was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh (24°43′8.3″N, 90°25′41.2″E) in the time between November 2011 and February 2012. The soil of the experimental plot was silty-loam in texture belonging to the Old Brahmaputra Flood Plain of AEZ 9 (UNDP, 1988) having non-calcareous dark grey flood plain soil (FAOSTAT, 2017). The experimental area was under the subtropical climate, which is characterized by heavy rainfall during the month of June to October and scanty rainfall during the rest period of the year. Rainfall starts in May and continues up to October and 95% of the annual rainfall occurs in the monsoon. The average maximum temperature during the period of experiment was 28.75 °C and average minimum was 12.43 °C. The relative humidity ranged from 71.97% to 83.58%; highest was observed in December and lowest in February. Maximum monthly total sunshine (210.2 h) was in February while maximum monthly total rainfall (18 mm) was occurred in January.

2.2 Plant materials

One control variety and six improved exotic potato accessions were used as plant material in this study. The accessions comprised AC10064, AC10076, AC10097, AC10109, AC10123, AC10190 and control variety is Cardinal. Those potato accessions were brought from University of Wisconsin in USA.

2.3 Experiment details

Experimental treatments included six exotic potato accessions and one popular potato variety (control). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. At first, the research plot was divided into three blocks (replication), each block was divided into 7 unit plots and thus total plots number was 21. The treatments were allotted randomly to each replication. The plot size was 1.8 m $\times$ 1.2 m. Distance between two neighboring plots and blocks were 0.5 m $\times$ 0.5 m. Fertilization and other intercultural operations were done according to Bangladesh Agricultural Research Institute (BARI) Handbook. The sprouted seed tubers were planted in the experimental plots on 15 November 2011 at a depth of 5 cm maintaining 60 cm $\times$ 30 cm spacing. Each unit plot accommodated 12 seed tubers in two rows, each row containing six tubers. The soil along the rows of seed tubers were ridged up immediately after planting. The crop was harvested after 95 days of planting. The maturity of plant was indicated by the plant showing 80-90% of leaf senescence, the top leaves started drying and lodging of stems to the ground. Harvesting was done on 20 February, 2012. Five sample plants were randomly harvested at first from each plot and then the whole plot was harvested with the help of spade.

2.4 Data collection

Five sample plants were selected randomly to record data on various morphological, yield contributing characters and yield. Data on several parameters i.e. days required for plant emergence, plant height at different Days after planting (DAP), number of

main stems hill^{-1}, number of compound leaves hill^{-1}, weight of plant, number of tubers hill^{-1}, tuber length, tuber diameter, tuber yield hill^{-1}, tuber yield plot^{-1}, and yield ha^{-1} were recorded.

2.5 Statistical analysis

The collected data were assembled and analyzed statistically using computer package program MSTAT-C. Morphological difference and yield performance among the genotypes/accessions were determined by Analysis of Variance (ANOVA) by F-test. The significance of the variance between pairs of treatment means was estimated by least significant difference (LSD) test and 1% level of probability (Gomez and Gomez, 1984).

3 Results and Discussion

The research was carried out to investigate the performance of yield attributes of different potato accessions/cultivar. A few data have been displayed and articulated in a table and rests are in figures for simplicity of argument, assessment and comprehension.

3.1 Plant emergence

Present study revealed that there was significant effect of accessions on the days required to plant emergence of potato tubers. The minimum time (6.25 d) required for plant emergence was recorded with accession AC10109, and the maximum (10.02 d) was required by check variety Cardinal. This variation in time required for plant emergence may be due to genetic characters of the potato accessions (Fig. 1).

3.2 Plant growth parameters

Plant height of potato was differed significantly among the accessions (Table 1). At all the observations, At 90 DAP, plant height of the accession AC10109 was maximum (118.39 cm) and the minimum (61.48 cm) was recorded with the variety Cardinal. Eaton et al. (2017) reported taller plants in Cardinal. Accessions/cultivar effect on number of main stems hill^{-1} was significant at 1% level. The highest number of main stems hill^{-1} was found in the accessions AC10109 (6.25), and the minimum number of main stems hill^{-1} was found in the check variety Cardinal (3.01) (Table 1), which is similar with the findings reported by Bashar (1978). On the other hand, findings of Linta et al. (2018) contradict with this result. Potato accessions significantly varied in number of compound leaves hill^{-1} among themselves (Fig. 2). The lowest number of compound leaves hill^{-1} was found in Cardinal (37.16), while the uppermost number of compound leaves hill^{-1} found in AC10109 (63.71) at 90 DAP (Fig. 2).

3.3 Yield parameters

Potato yield parameters like number of tubers hill^{-1}, tuber length and tuber diameter were significantly influenced by potato accessions (Table 1). The maximum number of tubers per hill was recorded in the accession AC10109 (9.18), and the lowest with the variety Cardinal (4.20). Eaton et al. (2017) also find minimum tubers in the variety cardinal. Tuber length was found the highest in the accession AC10109 (7.11 cm), and lowest in the variety Cardinal (5.85 cm). The highest (5.70 cm) and the lowest (3.81 cm) tuber diameter were recorded in accession AC10109 and Cardinal, respectively (Table 1). In present investigation, the diameter of tubers ranged from 3.81 to 5.7 cm which was slightly lower than that reported by CPRI (2009) but was at par with that reported by Lisinska and Leszczynski (1989).

3.4 Tuber yield

Potato accessions had significant effect on tuber yield hill^{-1}, plot^{-1} and ha^{-1}. The maximum (274.74 g) and the minimum (130.11 g) yield of tubers hill^{-1} were found in accession AC10109 and Cardinal, respectively (Table 1) but Alam et al. (2003) found maximum yield (380 g) in Cardinal. Similar trends were also found in case of yield per plot and yield ha^{-1} respectively. The maximum (2.11 kg) and the minimum (0.87 kg) yield of tubers plot^{-1} were recorded in accession AC10109 and Cardinal, respectively (Fig. 3a).

Similarly, the maximum yield of tubers ha^{-1} was obtained from the accession AC10109 (29.31 t ha^{-1}) closely followed by AC10064 (28.88 t ha^{-1}) and the lowest yield of tubers was obtained from the accession Cardinal followed by AC10190 (15.97 t ha^{-1}) (Fig. 3b). This result contradicts with the findings of Rahman (1980), Anam et al. (1980) and Rashid et al. (1981). In general, locally grown tubers give significantly lower yield compared exotic high yielding ones (Thongjiem and Chouvalitwongporn, 1985). The highest yield was contributed by large number of leaves and stems which helps in deposition of greater amount of photosynthates and ultimately maximize the yield. There are also reports that yield of tubers has a positive relationship with the number of stems hill^{-1} (Davies, 1969; Siddique et al., 1987).

4 Conclusions

Considering the growth and yield performances of the potato accessions studied it may be concluded that the accession AC10109 was the best performer followed by accession AC10064. Therefore, these two potato accessions may be considered for further trial before final recommendation for cultivation under Bangladesh conditions.

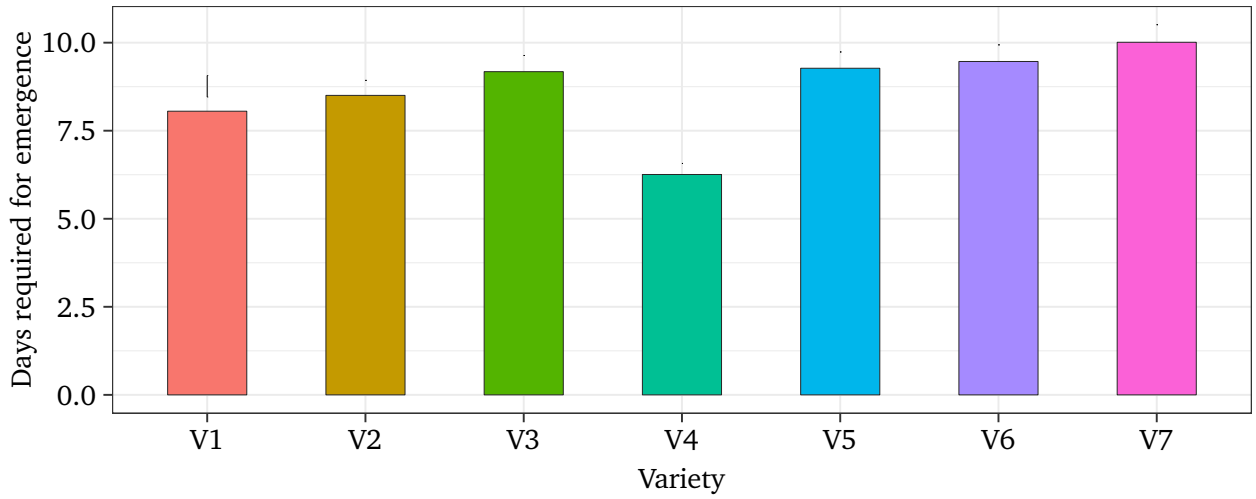

Figure 1. Effect of accessions/varieties on days required for plant emergence. Vertical bar represents LSD at 1% level of probability. V1 = AC10064, V2 = AC10076, V3 = AC10097, V4 = AC10109, V5 = AC10123, V6 = AC10190, and V7 = Cardinal

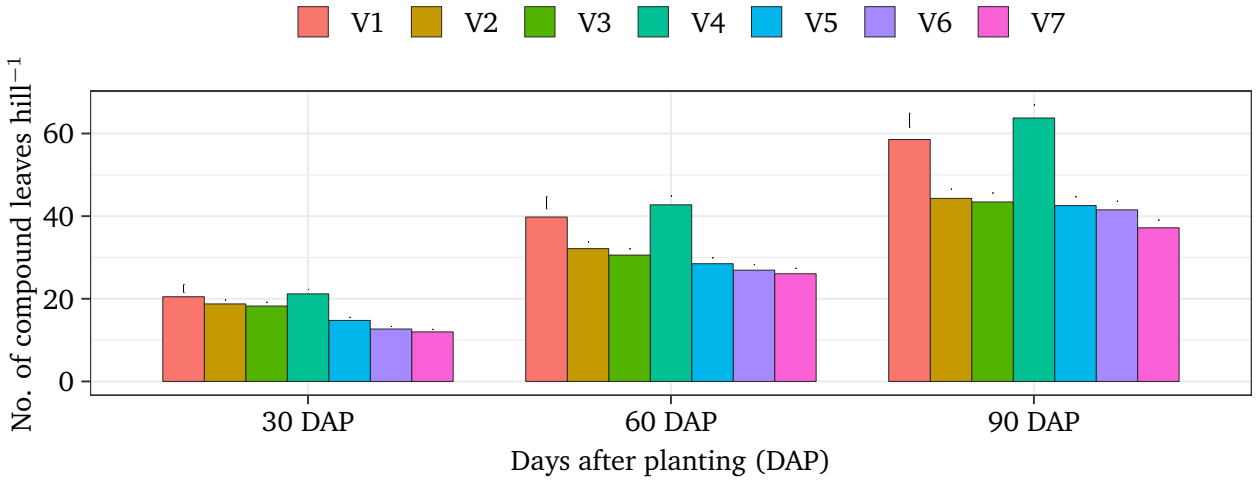

Figure 2. Effect of accessions/varieties on number of compound leaves at different DAP. Vertical bars represent LSD at 1% level of probability. V1 = AC10064, V2 = AC10076, V3 = AC10097, V4 = AC10109, V5 = AC10123, V6 = AC10190, and V7 = Cardinal

Table 1. Growth, yield parameters and yield of different potato accessions

Accession	Main stem hill^{-1} (no.)	Plant height (cm)			Tubers hill^{-1} (no.)	Tuber len. (cm)	Tuber dia. (cm)	Tubers yield hill^{-1} (g)
		30 DAP	60 DAP	90 DAP				
AC10064	6.02	9.35	84.69	114.61	8.96	6.53	5.12	255.62
AC10076	5.45	8.28	83.99	110.14	7.04	6.43	4.35	233.7
AC10097	4.94	7.8	83.15	102.56	6.47	6.35	4.16	215.67
AC10109	6.25	10.23	89.89	118.39	9.18	7.11	5.7	274.74
AC10123	4.51	7.44	73.78	91.9	5.49	6.21	4.07	162.38
AC10190	4.11	6.62	70.07	88.08	4.75	5.98	3.92	153.71
Cardinal	3.01	5.01	49.04	61.48	4.2	5.85	3.81	130.11
$LSD_{0.05}$ †	0.061	0.109	0.555	0.51	0.086	0.052	0.061	2.166
$LSD_{0.01}$	0.08	0.145	0.738	0.678	0.114	0.07	0.08	2.881
Sig. level	**	**	**	**	**	**	**	**

† LSD= Least significant difference; ** = Significant at 1% level of probability; len. =length, dia. = diameter

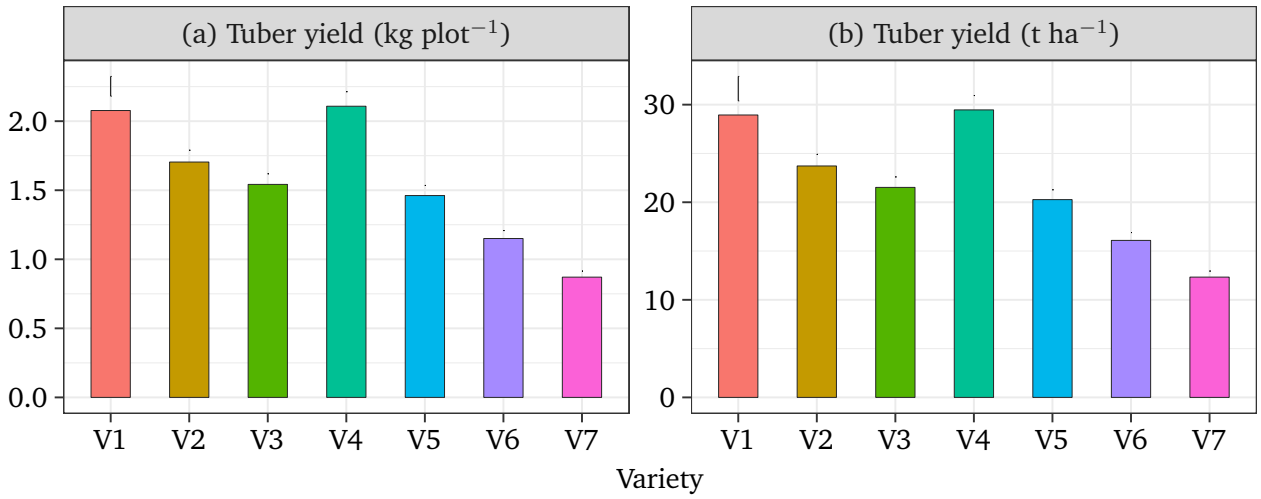

Figure 3. Effect of accessions/varieties on yield of tubers. Vertical bar represents LSD at 1% level of probability. V1 = AC10064, V2 = AC10076, V3 = AC10097, V4 = AC10109, V5 = AC10123, V6 = AC10190, and V7 = Cardinal

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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The Official Journal of the **Farm to Fork Foundation**
ISSN: 2518–2021 (print)
ISSN: 2415–4474 (electronic)
http://www.f2ffoundation.org/faa