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Evaluation of some exotic potato germplasm in northern region of Bangladesh

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ABSTRACT

An experiment was conducted at Breeder Seed Production Centre, Bangladesh Agricultural Research Institute, Debigonj, Panchagoarh during rabi (winter) season of 2010-11 to test comparative potentiality of four exotic variety for releasing as a variety in the country. The tested materials were Redfantasy, Bellini, Redbaron and Omega along with two checks of popular varieties Diamant, and Cardinal. All the genotypes under the study expressed excellent plant vigor showing above seven (at 1-10 rating scale) except Redbaron. The highest number of stem/hill was counted at Cardinal (7.93) which was statistically similar to Diamant, and lowest was counted at Redbaron (4.20). The highest number of tuber/hill was counted at Diamant (15.23) which was statistically significant and lowest was found in Red fantasy (8.96). The highest yield was harvested at Redfantasy (43.08 t/ha) which was statistically similar to all other varieties except Omega (38.43 t/ha). Regarding yield at 90 DAP the varieties may be arranged in order to descending as; Redfantasy (43.08 t/ha), Bellini (41.17 t/ha), Cardinal (40.46 t/ha), Redbaron (40.18 t/ha), Diamant (39.81 t/ha) and Omega (38.43 t/ha). When tubers were graded and expressed in percentage, all the varieties produced maximum seed tubers both by number and weight within grade of 28-55 mm. based on overall performances, Redfantasy performed better as compared to check variety Diamant and Cardinal.

Key Words: Potato, Exotic potato germplasm and Yield

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I. Introduction

Potato (*Solanum tuberosum* L.) belonging to the family *Solanaceae* is an important food crop of the world grown in more than 100 countries under temperate, subtropical and tropical conditions. It is one of the three leading staple food crops of the world next to wheat and rice. Its total production is about 388 million tons in 2017 (FAOSTAT 2019). Potatoes are a good source of several vitamins and minerals, particularly potassium and vitamin C (Weichselbaum 2010). It forms an ideal basis for any section of the population, as it provides the needed calories with carbohydrates, high quality proteins, minerals, essential vitamins (vitamin C in reasonable quantities), and trace elements to the human diet (Tack 2014). Potato provides more calories and protein per unit land area with minimum time and water than most other major food crops (Upadhya 1995) and cereals.

It is also one of the most important vegetables as well as the cheapest source of carbohydrate in Bangladesh. Almost every family of the country consumes it year round. At present, potato ranks first among the vegetables in terms of area and production, and is regarded as the third largest food crops in Bangladesh. In 2017, Bangladeshi farmers harvested about 10 million tons of potatoes, which placed the country at No. 7 among the world's potato producers and No. 4 in Asia (World Potato Statistics 2019). The area under potato cultivation and production is rapidly increasing day by day in the north-west region of Bangladesh but the average yield is not satisfactory (Siddique et al. 2015). The main reason for increasing area is favorable environmental conditions particularly prolonged winter. The optimum temperature for canopy photosynthesis is 24°C early in the growth period (Timlin et al. 2006). Higher biomass of potato is produced in 20°C temperature at end of-season (Timlin et al. 2006). It was observed that tuber initiation and bulking are favored by temperature below 20°C. End-of-season tuber mass and the ratio of tuber to total biomass decrease with increasing temperature above 24°C (Timlin et al. 2006). The crop season from planting to harvest in different regions has to be carefully chosen to provide favorable temperatures for the longest period in the growing season, for plant development and yield. However, planting and lifting should be so limited as to provide temperature above the minimum but below the maximum necessary for these operations.

The potato crop is very sensitive to environmental factors such as soil fertility, soil moisture and other external factors. Northern region of Bangladesh is favorable for potato because of winter comes earlier and ends later in than other regions of Bangladesh. But the average yield of potato in Bangladesh is very low as compared to many potato-growing countries of the world, and is only 19.65 t/ha (BBS 2018). The major constraints for potato production are low yield, high cost and non-availability of quality seed tubers, improper agronomic management practices, and rapid dissemination of degenerative diseases in developing countries, like Bangladesh. Varieties also differ greatly in their response to the environmental conditions. Therefore, high yielding potato varieties are needed to increase potato yield. Introduction and selection of exotic varieties especially in potato due to some limitations of hybridization is one of the important methods of crop improvement. Introductions are the process of introducing new varieties from their growing locality to a new locality and compare the desired characters to the existing types. Every year new germplasms are introduced in the country through government organizations or by different private sectors to evaluate their potential in our local climate condition. The current study was undertaken with some exotic varieties to determine their suitability as a variety in Bangladesh condition.

II. Materials and Methods

The experiment was conducted at Breeder Seed Production Centre, Bangladesh Agricultural Research Institute, Debiganj, Panchagarh during rabi season of 2010-11 to test comparative potentiality of four exotic material for releasing as a variety in the country. The tested materials were Redfantasy, Bellini, Redbaron and Omega along with two check popular varieties Diamant, and Cardinal. According to the soil test report, doses of manures and fertilizers viz. Cow dung 10 t/ha, Urea 350 kg/ha, TSP 250 kg/ha, MP 275 kg/ha, Gypsum 120 kg/ha, Magnesium sulphate, Zinc sulphate 10 kg/ha and boric acid 5 kg/ha were applied in the field. Cow dung, half of the dose of Urea, TSP, MOP, Gypsum, Magnesium sulphate, Zinc sulphate and Boric acid were used as basal. The remaining half of the dose of Urea was applied during earthing up. Irrigation and other intercultural operations were done as and when

necessary. The experiment was laid out randomized complete block design (RCBD) having three replications. The unit plot size was 3m × 3m, maintaining 60 cm × 25 cm spacing between two rows and from tuber to tuber. Well sprouted whole tubers were planted on 22.11.10. Weeding was done by manually as and when necessary to keep the plots free from weeds. For easy aeration and to conservation of soil moisture the soil was mulched by breaking the crust. First irrigation was done after 30 days after planting and subsequently 3 irrigations were done at 20 days interval after first application. Two earthing up was done during the growing period. The first earthing up was done at 30 day of planting along with urea and second one after 45 days of planting. Percent emergence was measured by recording the emergence of tubers at 30 DAP out of 60 tubers planted and converting it to percentage. The height of the plant sample was measured in centimeter from the ground level to the tip of the longest shoot. Percent foliage coverage was recorded by eye observation at 60 days after planting. Plant vigor was also measured by eye estimation. It was scored up to 8. Higher the vigor higher was the score. Number of Stem/hill were recorded at 60 days after planting. Number of Tuber/hill, Tuber weight/hill was taken during final harvest. Yield data were recorded two times, one at 65 and another at 90 days after planting. Yield data was taken from the whole plot. Disease Severity caused by *Phytophthora infestans* was recorded at 60 days after planting following 1-9 rating scale (Henfling 1979) by selecting 10 plants randomly from each unit plot. Percentage of disease reaction on stem canker, potato leaf roll virus, Potato mosaic virus and common scab were also observed at 60 days after planting. The data obtained for yield contributing character and yield were statistically analyzed to find out the significance of differences among the treatments. The mean values of all the characters were evaluated and analysis of variance was performed by MSTAT software package (Gomez and Gomez 1984). The significance of the differences among pairs of treatment means was calculated by DMRT.

III. Results and Discussion

Results of emergence, vegetative growth, plant vigor, yield and yield contributing characters are presented in Table 01 and Table 02 and revealed that there were significant variations among the varieties on test parameters except percent emergence, tuber weight per hill and yield at 65 DAP. The highest plant height was observed at Bellini (71.80 cm) which was statistically similar to Red fantasy, Cardinal, and Omega. Plant height ranged from 59.53 to 71.80 cm. The highest foliage coverage was found at Diamant and Cardinal (88.33%) which was statistically similar to Red fantasy (86.67%). The lowest foliage coverage was found in Redbaron (60.00%). All the genotypes under study expressed excellent plant vigor showing above seven (at 1-10 rating scale) except Redbaron. The highest number of stem/hill was counted at Cardinal (7.93) which was statistically similar to Diamant, and lowest was counted at Redbaron (4.20). The highest number of tuber/hill was counted at Diamant (15.23) which was statistically significant and lowest was found in Red fantasy (8.96). Tuber weight per hill ranged from 597.3 g to 646.3 g. At 65 DAP, the highest yield was found at Redbaron (28.83 t/ha) which was statistically similar to all other genotypes. At 90 DAP, the highest yield was harvested at Redfantasy (43.08 t/ha) which was statistically similar to all other varieties except Omega (38.43 t/ha).

Table 01. Performance of exotic potato varieties during 2010-2011

Treatment	Per cent emergence at 30 DAP	Plant height at 60 DAP (cm)	Foliage coverage (%) at 60 DAP	Plant vigor (1-10 scale)
Redfantasy	98.33 a	70.87 a	86.67 ab	8.00 a
Bellini	97.78 a	71.80 a	80.33 b	8.00 a
Redbaron	95.00 a	61.93 b	60.00 c	6.33 b
Omega	94.45 a	65.33 ab	80.00 b	7.33 a
Diamant	94.44 a	59.53 b	88.33 a	7.33 a
Cardinal	95.55 a	68.20 ab	88.33 a	7.33 a
CV %	2.10	7.33	5.27	5.88

Means bearing same letter within same column do not differ significantly at 5% level by LSD.

Regarding yield the varieties may be arranged in order to descending as; Redfantasy (43.08 t/ha), Bellini (41.17 t/ha), Cardinal (40.46 t/ha), Redbaron (40.18 t/ha), Diamant (39.81 t/ha) and Omega (38.43 t/ha). The result was similar to the result of Haque (2007) where he got around 40 t/ha tuber

yield from maximum exotic germplasm in his study of evaluation of exotic potato germplasm. When tubers were graded and expressed in percentage, all the varieties produced maximum seed tubers both by number and weight within grade of 28-55 mm (Table 03) but there were considerable variations among the tested varieties regarding proportion of seed size. Similar result was reported by Haque (2007).

Table 02. Performance of exotic potato varieties showing yield contributing parameters during 2010-2011

Treatment	Number of Stem/hill	Number of Tuber/hill	Tuber weight/hill (g)	Yield at 65 DAP (t/ha)	Yield at 90 DAP (t/ha)
Redfantasy	4.93 b	8.96 d	646.3 a	26.02 a	43.08 a
Bellini	4.40 b	9.98 cd	617.3 a	28.72 a	41.17 ab
Redbaron	4.20 b	9.19 d	611.3 a	28.83 a	40.18 ab
Omega	5.73 b	11.72 bc	621.0 a	27.07 a	38.43 b
Diamant	7.80 a	15.23 a	597.3 a	26.94 a	39.81 ab
Cardinal	7.93 a	12.72 b	607.0 a	24.76 a	40.46 ab
CV %	17.20	10.99	5.96	14.38	5.72

Means bearing same letter within same column do not differ significantly at 5% level by LSD.

Table 03. Grade of tuber by number (%) and by weight (%) of exotic potato varieties during 2010-2011

Variety/line	Grade of tuber by number (%)			Grade of tuber by weight (%)		
	>28mm	28-55mm	>55mm	>28mm	28-55mm	>55mm
Redfantasy	13.62	77.63	8.76	1.80	73.40	24.80
Bellini	18.04	77.61	4.35	2.32	85.30	12.38
Redbaron	14.43	73.73	11.84	1.72	69.37	28.91
Omega	21.97	73.15	4.55	3.13	82.73	14.14
Diamant	26.97	71.42	1.61	5.38	88.86	5.76
Cardinal	26.86	73.57	2.24	4.57	87.23	8.13

Table 04. Disease reaction of exotic potato varieties at 60 DAP during 2010-2011

Variety/line	Late blight (%)	Stem canker (%)	Potato leaf roll virus (%)	Potato virus Mosaic (%)	Common scab (%)
Redfantasy	0.0	5.00	0.0	8.33	3.14
Bellini	0.0	3.89	16.11	13.89	16.14
Redbaron	0.0	6.11	11.11	11.67	24.42
Omega	0	0	1.11	11.11	4.34
Diamant	0.0	7.22	3.89	7.78	11.33
Cardinal	1.11	8.89	2.78	6.67	28.91

It was observed that the genotype Redfantasy and Bellini produced higher proportion of seed sized tuber. Among tested exotic potato genotypes, Redfantasy and Bellini provided higher yields might be due to higher plant population, higher plant height, higher plant vigor, higher tuber weight per hill, and higher number of large sized tuber and might be due to proper physiological maturity of seed tubers and better adaptability under the climatic condition of Bangladesh. Higher plant population and higher plant height help in deposition of greater amount of photosynthates and ultimately maximize the yield. The result was agreement with the result of Alam *et al.* (2003) where they showed large number of leaves and stems contributed to deposit of greater amount of photosynthates and ultimately maximize the yield.

Results of diseases reaction of tested potato genotypes are presented in Table 04. All genotypes showed good performance against late blight disease. Genotypes Omega, Bellini and Redfantasy showed lower percentage of stem canker disease compared to check variety Diamant and Cardinal.

Redfantasy and Omega exhibited good performance against potato leaf roll virus compared to check variety Diamant and Cardinal. Regarding mosaic virus, little bit higher infection was found in Redfantasy than check variety Diamant and Cardinal. On the other hand, Redfantasy and Omega showed very low infection against common scab as compared to check variety Diamant and Cardinal.

V. Conclusion

From the results of the present research, it can be concluded that the performance of Redfantasy is better in respect of yield and yield contributing characters and disease reaction. Although Bellini produced higher yield than both check varieties, but it showed higher infection of potato leaf roll virus, potato mosaic virus and common scab. Therefore, based on overall performances, Redfantasy performed better as compared to check variety Diamant and Cardinal.

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