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Evaluation of some F₁C₇ clonal potato genotypes in Bangladesh

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ABSTRACT

An experiment was conducted at Breeder Seed Production Centre (BSPC), Bangladesh Agricultural Research Institute (BARI), Debiganj, Panchagarh during cropping seasons to investigate comparative potentiality of five clonal potato hybrids, 4.5 W, 4.15, 4.26 R, 4.27 and 4.40 for releasing as variety in the country. In the investigation two outstanding varieties, Diamant and Cardinal were used as check. All the genotypes under study expressed excellent plant vigour showing above seven score (at 1-10 rating scale). Plant height ranged from 58.73 to 68.20 cm. The highest tuber weight/hill was found at 4.26 R (763.7 g) which was statistically similar to 4.5 W (741.7 g) and 4.40 (670.3 g) while the lowest was found at 4.15 (537.7 g). The highest yield was found from clone 4.40 (29.57 t/ha) at 65 days after planting (DAP) which was statistically similar to all other genotypes except 4.27 (22.44 t/ha). Regarding yield the clones/varieties may be arranged in order to descending as 4.5 W (47.36 t/ha), 4.26 R (46.02 t/ha), 4.40 (44.69 t/ha), Cardinal (40.46 t/ha), 4.27 (40.23 t/ha), Diamant (39.81 t/ha) and 4.15 (35.83 t/ha). Among them clone 4.5 W and 4.26 R gave significant higher yield than Diamant and Cardinal. Therefore, these two genotypes could be selected for variety for Bangladesh condition with further trails in other parts of the country.

Key Words: Potato, Clonal genotype and Yield

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I. Introduction

Potato (*Solanum tuberosum* L.) is the third important food crop in Bangladesh. It is truly a global crop. Bangladesh is an agro-based country. We are nearly at the door of self-sufficiency in cereals but deficient in minor crops in general, fruits and vegetables. Millions of people are suffering from malnutrition.

Potato can play an important role in supplying vegetable throughout the year and can solve the nutritional problems to a great extent for the lower income group. The area under this crop is increasing rapidly and the farmers are gradually adopting it as a cash crop. 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). 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. 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 2007, Bangladesh produced 10 million tonnes 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 is rapidly increasing day by day in the north-west region of Bangladesh but the average yield is not satisfactory. 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). Potato production, certification and value chain; resource and agricultural inputs requirements have been further reported by several authors (Siddique et al. 2015; Hossain and Siddique, 2015; Sultana et al. 2015). However, 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 2006). In northern region of Bangladesh, winter comes earlier and ends later than other regions. 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 are. The potato crop is also very sensitive to other environmental factors such as soil fertility, soil moisture and other external factors. Varieties also differ greatly in their response to the environmental conditions. To increase potato tuber yield, it needs to develop high yielding variety. Hybridization is a technique to develop new variety. Hybridizations program in potato has been initiated with a view to improve the genetic base of the parent population and to create variability among the population for subsequent variety selection. Clonal selection after hybridization is a continuous process of early generation. Hybridization is a way of developing a new variety. That is why, we have taken steps for variety development through hybridization. Maximum varieties in our country released through introduction. To minimize introduction of germplasm from abroad hybridization and selection program was initiated in 1999. This trial was under regional yield trial (RYT) which determines the fate of a variety whether it is suitable for releasing, as a variety in the country or not. A variety comes up under RYT when it successfully crosses the stages of preliminary yield trial (PYT), secondary yield trial (SYT) and advanced yield trial (AYT). Here the study was undertaken for selection of suitable variety(s) for commercial cultivation.

II. Materials and Methods

An experiment was conducted at Breeder Seed Production Centre, Bangladesh Agricultural Research Institute (BARI), Debiganj, Panchagarh during 2010-11 to test the potentiality of five clonal potato hybrids with two check outstanding varieties Diamant and Cardinal. The clones were 4.5 W, 4.15, 4.26 R, 4.27 and 4.40. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 3m x 3m, maintaining 60cm x 25cm spacing between two rows and from tuber to tuber. Well sprouted whole tubers of all varieties and lines were used as planting material. The doses of manures and fertilizers viz. Cow dung 10 t/ha, Urea 350 kg/ha, Triple super phosphate (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, Murate of potash (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. Seed tubers were planted on 22 November 2010. 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 times earthing up were done during the crop growing period. The first earthing up was done at 30 DAP along with urea and second one after 45 DAP. 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 was 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. The severity of devastating disease called late blight caused by *Phytophthora infestans* was recorded when it showed up in the plot after planting following 1-9 rating scale according to Henfling (1979) by selecting 10 plants randomly from each unit plot. To control late blight of potato contact and systemic fungicide were used at 7 days interval until harvest the crop. Percentages of disease reaction on stem canker, potato leaf roll virus, potato mosaic virus 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 Duncan multiple range test (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. The plant height ranged from 58.73 to 68.20 cm and its highest was observed at Cardinal (68.20 cm) which was statistically similar to 4.26 R, 4.27 and 4.40. The highest foliage coverage was found at 4.26 R (91.67%) which was statistically similar to all other genotypes except 4.27 (82.33). All the genotypes under study expressed excellent plant vigor showing above seven (at 1-10 rating scale). The highest number of stem/hill was counted at Cardinal (7.93) which was statistically similar to Diamant, 4.40 and 4.26 R and lowest was counted at 4.27 (5.27). The highest number of tuber/hill was counted at 4.26 R (15.90) which was statistically similar to all other genotypes except Cardinal (9.39). The highest tuber weight/hill was found at 4.26 R (763.7 g) which was statistically similar to 4.5 w (741.7 g) and 4.40 (670.3 g). The lowest tuber weight/hill was found at 4.15 (537.7 g). At 65 DAP the highest yield was found at 4.40 (29.57 t/ha) which was statistically similar to all other genotypes except 4.27 (22.44 t/ha). At 90 DAP the highest yield was harvested at 4.5 w (47.36 t/ha) which was statistically similar to 4.26 R (46.02 t/ha) and 4.40 (44.69 t/ha). Regarding yield the varieties may be arranged in order to descending as; 4.5 w (47.36 t/ha), 4.26 R (46.02 t/ha), 4.40 (44.69 t/ha), Cardinal (40.46 t/ha), 4.27 (40.23 t/ha), Diamant (39.81 t/ha) and 4.15 (35.83 t/ha). Similar result was found from Haque (2007) where around 40 t/ha tuber yield was recorded from the maximum potato germplasm of that study of evaluation of 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). Clonal potato hybrid 4.5 w, 4.26 R and 4.40 provided higher yields might be due to higher plant height, higher foliage coverage and higher tuber weight per hill. Higher plant height and higher foliage coverage 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.

Table 03 represents the tuber grades by number and weight as expressed in percentage. Results showed that all the varieties produced maximum seed tubers both by number and weight within grade of 28-55 mm which were comparable to the check varieties indicated that all varieties are acceptable in production of marketable tubers. Results of diseases reaction of tested potato genotypes are presented in Table 04. All genotypes showed good performance against late blight disease. Clonal potato hybrids 4.15, 4.5 W, 4.26 R and 4.40 showed lower percentage of stem canker disease compared to check variety Diamant and Cardinal. Clonal potato hybrids 4.5 W and 4.26 R exhibited good performance against potato leaf roll virus compared to check variety Diamant and Cardinal. Lower percent of mosaic virus

was found in clonal potato hybrids 4.26 R and 4.40 than check variety Diamant and Cardinal. Regarding common scab, 4.5 W, 4.26 R and 4.40 showed very good performance compared to check variety Diamant and Cardinal.

Table 01. Performance of F₁C₇ clonal potato hybrids in respect of percent emergence, plant height, foliage coverage, plant vigor and number of stem/hill

| Treatment | Percent emergence at 30 DAP | Plant height at 60 DAP (cm) | Foliage Coverage (%) at 60 DAP | Plant vigor (1-10 scale) | Number of Stem/hill |
|-----------|-----------------------------|-----------------------------|--------------------------------|--------------------------|---------------------|
| 4.15 | 94.45 a | 58.73 c | 90.00 ab | 8.67 a | 5.73 b |
| 4.27 | 97.22 a | 67.47 ab | 82.23 b | 8.67 a | 5.27 b |
| 4.5 W | 94.45 a | 62.53 de | 90.67 a | 8.67 a | 5.67 b |
| 4.26 R | 98.33 a | 67.60 ab | 91.67 a | 8.33 ab | 6.27 ab |
| 4.40 | 97.78 a | 66.80 ab | 88.33 ab | 8.33 ab | 6.67 ab |
| Diamant | 94.44 a | 59.53 c | 88.33 ab | 7.33 b | 7.80 a |
| Cardinal | 95.55 a | 68.20 a | 88.33 ab | 7.33 b | 7.93 a |
| CV % | 2.71 | 4.42 | 5.07 | 7.30 | 16.34 |

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

Table 02. Performance of F₁C₇ clonal potato hybrids on yield and yield parameters

| Treatment | Number of Tuber/hill | Tuber weight/hill (g) | Yield at 65 DAP (t/ha) | Yield at 90 DAP (t/ha) |
|-----------|----------------------|-----------------------|------------------------|------------------------|
| 4.15 | 14.14 a | 537.7 c | 23.55 ab | 35.83 c |
| 4.27 | 15.12 a | 620.3 bc | 22.44 b | 40.23 bc |
| 4.5 W | 14.45 a | 741.7 a | 29.31 a | 47.36 a |
| 4.26 R | 15.90 a | 763.7 a | 25.65 ab | 46.02 a |
| 4.40 | 15.49 a | 670.3 ab | 29.57 a | 44.69 ab |
| Diamant | 15.24 a | 597.3 bc | 26.94 ab | 39.81 bc |
| Cardinal | 9.39 b | 707.0 bc | 24.76 ab | 40.46 bc |
| CV % | 15.65 | 10.31 | 14.63 | 7.35 |

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 F₁ C₇ hybrids in 2010-2011

| Variety/line | Grade of tuber by number (%) | | | Grade of tuber by weight (%) | | |
|--------------|------------------------------|---------|-------|------------------------------|---------|-------|
| | >28mm | 28-55mm | >55mm | >28mm | 28-55mm | >55mm |
| 4.15 | 23.83 | 75.36 | 0.81 | 5.29 | 92.25 | 2.56 |
| 4.27 | 20.26 | 77.44 | 2.31 | 3.83 | 87.39 | 8.78 |
| 4.5 w | 22.79 | 72.91 | 4.30 | 3.32 | 83.14 | 13.54 |
| 4.26 R | 28.16 | 69.15 | 2.69 | 5.65 | 85.61 | 8.75 |
| 4.40 | 25.87 | 73.06 | 1.07 | 4.87 | 90.73 | 4.43 |
| 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 F₁C₇ hybrids at 60 DAP in 2010-2011

| Variety/line | Late blight (1-9 scale) | Stem canker (%) | Potato leaf roll virus (%) | Potato virus (mosaic) (%) | Common scab |
|--------------|-------------------------|-----------------|----------------------------|---------------------------|-------------|
| 4.15 | - | 4.44 | 3.0 | 6.11 | 16.40 |
| 4.27 | - | 7.22 | 10.0 | 7.22 | 1.94 |
| 4.5 W | - | 6.11 | 0.56 | 6.67 | 3.15 |
| 4.26 R | - | 5.27 | 2.6 | 5.5 | 3.50 |
| 4.40 | - | 4.50 | 3.5 | 6.5 | 3.00 |
| Diamant | - | 7.22 | 3.89 | 7.78 | 20.50 |
| Cardinal | 1.11 | 8.89 | 2.78 | 6.67 | 22.50 |

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

V. Conclusion

From the results of the present research, it can be concluded that the performance of 4.5 W and 4.26 R clonal potato genotypes are better in respect of phenology, yield and yield contributing characters and disease reaction. Therefore, based on overall performances, two clonal potato genotypes 4.5 W and 4.26 R performed better as compared to check variety Diamant and Cardinal. Further studies are suggested in other growing regions of the country.

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