Original Research Article

BULKING BEHAVIOUR OF PROMISING POTATO VARIETIES IN NORTHERN REGION OF BANGLADESH

ABSTRACT

The experiment was conducted at Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh during the November to February of 2014-2015 (rabi season) to learn about the bulking behavior of promising potato varieties in Bangladesh with the suitable time of harvest for getting desirable yield. The experiment was employed with randomized complete block design (RCBD) with six harvesting time at 10 days interval started from 40 days after planting (DAP) and continued up to 90 DAP. Six promising potato varieties such as Bari Alu 40 (4.45w), Bari Alu 41 (5.183), Bari Alu42 (Agila), Bari Alu 43 (Atlas), Bari Alu 44 (Elgar) and Bari Alu 45 (Steffi) were included in the study. Tuber yield was increased up to 90 DAP for all the varieties. The highest tuber yield (55.86ton/ha) was recorded in Bari Alu 45 (Steffi) when harvested at 90 DAP. On the other hand, the lowest tuber yield was found in BariAlu43 (Atlas) when harvested at 90 DAP. The tuber yield increase rate of Bari Alu 45 (Steffi), Bari Alu 41 (5.183), Bari Alu 42 (Agila) and Bari Alu 40 (4.45w) were reasonable up to 90 DAP, while the increase rate of Bari Alu 43 (Atlas) was reasonable up to 80 DAP and Bari Alu 44 (Elgar) was up to 70 DAP. Bari Alu 44 (Elgar) may be harvested as early variety among the varieties. The percent dry matter was increased up to 90 DAP for all the varieties. The growth rate of tuber was higher at 60–70 DAP for all the varieties except Bari Alu 41 (5.183). In case of Bari Alu 41 (5.183) tuber growth rate was higher at 70-80 DAP. Finally, our study demonstrated that, the optimal period to harvest potatoes is 90 days after planting (DAP), when the tubers are at their largest size, have the most yield, and have accumulated the maximum dry matter.

Keywords: Dry matter, Days to harvest, Potato, Tuber growth rate and Yield

1. INTRODUCTION

In Bangladesh, the potato (*Solanum tuberosum* L.) is a significant cash crop (Rahman et al., 2019). In cool nations, it is also used as a food and cash crop. It can satisfy the demand for vegetables and supply the low-income population with the necessary nutrients (Islam et al., 2009; Miah and Hossain, 2012). In terms of production and area, it is the most widely grown vegetable in Bangladesh. However, despite being the seventh-largest producer of potatoes in the world and third in Asia ("Crops". FAOSTAT, 2018), Bangladesh has a low output per unit area of this crop when compared to other nations that also cultivate potatoes (Islam et al., 2017, Anon, 2007). According to FAO estimates, in 2020, over 359 million metric tons of potatoes were produced worldwide (Shahbandeh, 2022). On the other hand, current scenario of potato production in Bangladesh (BBS 2021), 9.87 million metric tons have been produced in 468.7 thousand hector land.

Nevertheless, A key consideration for choosing an early or late variety of potato, as well as one that would provide a higher yield, is the bulking behavior of the germplasm or variety. The fourth growth stage of the potato is known as tuber bulking. Tuber cells expand with the accumulation of water, nutrients and carbohydrates. Tubers become the dominant site for deposition of carbohydrates and mobile inorganic nutrients. Throughout the entire growing period, the bulking rate varies from variety to variety, mother tuber size, cutting of seed pieces, nutrition, moisture, pest management, planting date, and days to harvest, among other things. It is also influenced by a number of environmental factors, such as air and soil temperatures, light intensity and duration, humidity, and so on (Khan et al., 2011). Numerous studies have attempted to comprehend the early bulking behavior of various varieties, and it has been reported that at the early harvest stage, a greater number of small-sized tubers are found (Bijma et al., 2016; Shock et al., 2022). In addition, varieties with fast bulking produced high-quality chips and those with slow bulking produced dark-colored chips. Furthermore, the darkest chips were produced by varieties harvested late, but the tuber had more dry matter and

starch (Rytel, 2004; Lisinska, 2006). However, the planting dates were reported to have an impact on the maximum marketable and total tuber yield as well as the number (Hassanpanah et al., 2009).

In addition to this, the quantity of starch and dry matter in the potato tubers is a key element in determining yield and the quality of processed potato products (Kumar et al., 2011). Moreover, dry matter is a sign of higher processing quality because it reduces oil absorption and reduces frying time and better textured products (Vipul and Poonam 2014, Pedreschi et al., 2008) associated with high fat absorption at frying (Araújo *et al.* 2016). Moreover, to their genetic component, which affects the texture and nutritional value of the tubers, other factors that have an impact on tuber dry matter and starch content include soil type, fertilizer application, dates of planting and days to harvesting (Buono et al., 2009; Murniece et al., 2010; Hamouz et al., 2005; Herman et al., 1996; Marwaha et al*.,* 2005).

The primary goals of the current study, taking into account the aforementioned concerns, were to i) learn about the bulking behavior of promising potato varieties, ii) identify early varieties, and iii) determine the best time of harvesting for maximizing the production of large tubers needed for processing.

2. MATERIALS AND METHODS

2.1 Experimental design and methods:

The experiment was conducted at the Breeder Seed Production Center (BSPC), Bangladesh Agricultural Research Institute, Debiganj, Panchagarh during the rabi season (November to February) of 2014-2015. Six promising varieties VIZ: Bari Alu 40 (4.45W), Bari Alu 41 (5.183), Bari Alu 42 (Agila), Bari Alu 43 (Atlas), Bari Alu 44 (Elgar), Bari Alu 45 (Steffi) and six harvesting time viz 40, 50, 60, 70, 80, and 90 days after planting (DAP) were used in the study. The two-factor experiment was laid out in a randomized complete block design (RCBD) with three replications, where varietal difference was considered as factor A and days to harvesting time difference was considered as factor B. The unit plot was 3m x 1.8m with a spacing of 60cm × 25cm. Harvesting was done according to maturity of the crop. Fertilizer, Irrigation and necessary intercultural operations were done as per tuber crop research center (TCRC), Bangladesh Agricultural Research Institute (BARI) recommendation (Azad at el., 2012).

2.2 Data analysis:

Data on different growth yield and yield contributing characters were recorded. Data that were collected from the field experiments has been analyzed by MSTATC Program and means separation was done by Duncan's Multiple Range Test (DMRT).

3. RESULTS AND DISCUSSION

3.1 Effect of variety and date of harvest on the yield

The tuber yield of potato was significantly varied due to variety and harvesting time (Table-1). The highest tuber yield (55.86 ton/ha) was found in Bari Alu 45 (Steffi), which was statistically similar to Bari Alu 41 (5.183) and Bari Alu 42 (Agila), when potato was harvested at 90 DAP. The lowest tuber yield (40.24 ton/ha) was recorded in Bari Alu 43 (Atlas). Tuber yield of potato was increased sharply up to 70 DAP for all the varieties except Bari Alu 41 (5.183) and Bari Alu 45 (Steffi). After that increased rate was slightly lowered but continued. In case of Bari Alu 41 (5.183), tuber yield of potato was increased sharply up to 80 DAP and incase of Bari Alu 45 (Steffi), tuber yield of potato was increased sharply up to 90 DAP. Considerable accumulation of dry matter in the tuber after linear phase of bulking might be the reason of the higher yield at 90 DAP harvest compared to other days to harvest, caused by significant reductions in the percentage of large tubers and the tuber specific gravity at early and advanced stage of the crop (Silva, 2004). Similar findings were found by Sharkar et al., (2019), that the maximum total tuber yield was recorded at 90 DAP. They also stated that 90 DAP harvest could be considered advantageous for total tuber production of potato, since it was found significantly difference to other harvesting times, which was also align with our findings. However, the tuber yield increase rate of Bari Alu 45 (Steffi), Bari Alu 41 (5.183), Bari Alu 42 (Agila) and Bari Alu 40 (4.45w) were reasonable up to 90 DAP, while the increase rate of Bari Alu43 (Atlas) was reasonable up to 80 DAP and Bari Alu 44 (Elgar) was reasonable up to 70 DAP.

Table 1. Effect of Variety and date of harvest on the yield

Variety	Yield (ton/ha)					
	40DAP	50DAP	60DAP	70DAP	80DAP	90DAP
V_1 =Bari Alu 40 (4.45w)	2.60	9.61	20.59	33.88	42.08	49.07
V_2 =Bari Alu 41 (5.183)	1.67	7.89	18.30	29.36	45.44	51.44
V_3 = Bari Alu 42 (Agila)	3.36	11.29	22.96	38.89	46.04	51.90
V_4 = Bari Alu 43 (Atlas)	3.81	10.23	19.29	29.23	35.24	40.24
V_5 = Bari Alu 44 (Elgar)	6.98	18.08	27.16	38.25	41.45	45.25
V_6 = Bari Alu 45 (Steffi)	3.18	11.73	24.50	36.77	45.82	55.86
CV (%)	9.76					

3.2 Effect of variety and date of harvest on the dry matter

Though early harvesting of potato tubers provides economic support to farmers but affects quality and tubers harvested at higher maturity stages contain more dry matter than immature ones (Misra *et al.*, 1993). The dry matter of potato was significantly varied due to variety and harvesting time (Table 2). The highest dry matter (20.48%) was found in Bari Alu 43 (Atlas), while the lowest dry matter (16.61%) was recorded in Bari Alu 45 (Steffi). Dry matter (%) was increased sharply up to 70 DAP for all the varieties, after that the increase rate was gradually decreased up to 90 DAP except Bari Alu 43 (Atlas) and Bari Alu 45 (Steffi). In case of Bari Alu 43 (Atlas) the dry matter gradually increased up to 90 DAP and incase of Bari Alu 45 (Steffi), the dry matter gradually increased up to 80 DAP. According to Solaiman et al. (2015), dry matter 21.72% was found higher at 110 DAP than it was 16.94% at 80 DAP and again according to Sharkar et al., (2019) optimum dry matter content 24.07% was also recorded in 90 DAP. These findings were clearly reflected that the dry matter accumulation was increasing with higher harvest days which was similar to our findings in the present study. Moreover, similar to our findings, delaying harvest increases the starch and dry matter contents of potatoes, although their buildup relies on cultivar and growing circumstances, claimed Rytel (2004) and Lisinka (2006).

Table 2. Effects of Variety and date of harvest on the dry matter

Variety	Dry matter (%)					
	40DAP	50DAP	60DAP	70DAP	80DAP	90DAP
V_1 =Bari Alu 40 (4.45w)	15.16	16.10	17.40	18.73	18.76	18.82
V_2 =Bari Alu 41 (5.183)	14.87	15.95	16.72	17.38	17.59	17.70
V_3 = Bari Alu 42 (Agila)	12.79	13.65	13.73	14.74	14.83	15.20
V_4 = Bari Alu 43 (Atlas)	14.01	15.81	17.32	18.93	19.40	20.48
V_5 = Bari Alu 44 (Elger)	12.47	13.51	15.74	16.25	16.89	16.95
V_6 = Bari Alu 45 (Steffi)	12.36	12.58	14.51	15.44	16.40	16.61
CV (%)	3.37					

3.3 Tuber growth rate (TGR) of six potato varieties at different DAP

Tuber growth rate (TGR) significantly varied among the varieties as well as in different growth stage (Table-3). The highest tuber growth rate (289.01 kg/ha/day) was found in Bari Alu41 (5.183) at 70-80 DAP. The lowest tuber growth rate (66.89 kg/ha/day) was recorded in Bari Alu44 (Elgar) at 80-90 DAP. Tuber growth rate was increased sharply up to 60-70 DAP for all the varieties. Contrary to our discovery, Sen et al (2014) achieved the highest tuber growth rate at 45-60 days per day, while Mahmoud (2012) found the highest TGR in Asterix at 50-60 days per day. After that it was declining except Bari Alu41 (5.183). Incase of Bari Alu41 (5.183) tuber growth rate was increased up to 70-80 DAP, after that it was decreased. According to Klein Kopf et al., (2003), the maximum growth rate for

each individual variety in the field can be determined physiological seed age, time of harvest and environmental conditions during tuber formation dedication.

Table 3. **Tuber growth rate (TGR) of six potato varieties at different DAP**

Variety	Tuber growth rate (Kg/ha/day)				
	40-50DAP	50-60DAP	60-70DAP	70-80DAP	80-90DAP
V_1 =Bari Alu 40 (4.45w)	115.30	203.54	276.30	154.84	134.07
V_2 =Bari Alu 41 (5.183)	101.01	180.13	204.30	289.01	111.19
V_3 = Bari Alu 42 (Agila)	111.13	161.13	257.99	109.53	106.10
V_4 = Bari Alu 43 (Atlas)	108.35	172.36	219.22	130.33	140.45
V_5 = Bari Alu 44 (Elger)	157.22	183.23	194.06	78.52	66.89
V_6 = Bari Alu 45 (Steffi)	108.25	207.93	212.23	183.72	176.38
CV (%)	38.75				

4. CONCLUSION

The study showed that the various days to harvest had a significant impact on all of the parameters that were taken into consideration. Thus, it can be concluded that one of the most important aspects of potato cultivation in Bangladesh is the number of days until harvest. This is why, based on the results of figuring out the best time to harvest and choosing the right variety for the northern region of Bangladesh, producing a high yield is so important. Additionally, it can be deduced that the varieties recorded their highest tuber yield and dry matter when harvested at 90 DAP. When harvested at 90 DAP, the varieties with the highest tuber yield were Bari Alu 45 (Steffi) and Bari Alu 43 (Atlas), respectively. On the other hand, Bari Alu 44 (Elgar) can be harvested at early. However, in order to make a final recommendation, additional in-depth and systemic studies in a variety of climates are required.

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