

Growth and yield of two indigenous potato varieties as influenced by organic manures

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Abstract: An experiment was carried out at the Germplasm Center, Department of Horticulture, Patuakhali Science and Technology University (PSTU) during November 2014 to March 2015 to find out the growth and yield of two indigenous potato varieties as influenced by organic manures. Two factors experiment consisted of two indigenous potato varieties viz., Shilbilati and Lalpakri and five different types of organic manures 0 (control), 15 t ha⁻¹ cowdung, 12 t ha⁻¹ vermicompost, 5.0 t ha⁻¹ mustard oil cake and 7.0 t ha⁻¹ poultry litter designated as T₀, T₁, T₂, T₃ and T₄ respectively. Significant variations were observed between potato varieties and sources of plant nutrients in respect of all growth and yield parameters. The variety Shilbilati showed better performance in case of most growth and yield parameters compared to the variety Lalpakri. Among the characteristics of growth and yield of potato, mustard oil cake @ 5 t/ha gave the highest results compared to control and other treatments. The treatment combination Shilbilati × mustard oil cake @ 5 t/ha gave significantly greater results on growth and yield parameters. The maximum number of stem per hill (15.62), the tallest plant (96.19 cm), maximum number of leaves per plant (27.61), the highest tuber per hill (18.48), tuber weight (508.0 g), the maximum gross yield of 23.13 t/ha and the maximum marketable tuber yield (20.74 t/ha) were obtained from the treatment combination of Shilbilati × mustard oil cake @ 5 t/ha. The variety Shilbilati and mustard oil cake @ 5 t/ha alone and their combinations were more effective for better growth and yield compared to Lalpakri in combinations with organic manures.

Key words: Potato, organic manure, growth, yield.

Introduction

Potato (*Solanum tuberosum* L.) belonging to the family Solanaceae is the 4th important food crop of the world and the third most important crop of Bangladesh followed by rice and wheat (Illias, 1998). It contributes not only energy but also substantial amount of high quality protein and essential vitamins, minerals and trace elements to the human diet. Recent reports indicate that 8.2 million tons of potato was produced in Bangladesh from 430 thousand ha of land in 2011-2012 (BBS, 2012). The average yield of potato was 14.89 t/ha in Bangladesh, which is very low in comparison to that of other leading potato growing countries in the world, such as USA (43.49 t/ha), Denmark (39.41 t/ha) and UK (43.38 t/ha) (FAO, 2008). Nutritionally, the tuber is rich in carbohydrates or starch and is a good source of protein, vitamin C and B, potassium, phosphorus, and iron.

Growth and yield of potato depend on nutrient availability in soil, which is related to the judicious application of manures and fertilizers. The growth parameters and the yield gradually increased with the increase in the rate of organic matter (Ahmed, 2004). Nutrient may be applied through organic and inorganic sources. Increased use of inorganic fertilizer in crop production causes health hazards, creates problem to the environment and badly affects the soil physical and chemical properties. On the other hand, organic manures like cowdung, poultry litter, farmyard manure, vermicompost play a greater role in encouraging organic crop production which is socially acceptable, economically feasible, eco-friendly and sustainable in nature. The nutrient content of organic manures are greatly depends on the input material. It usually contains higher levels of most of the mineral elements, which are in available forms than the parent material. It improves the physical, chemical and biological properties of soil. There is good evidence that organic manures promote the growth of plants and it has been found to have a favorable influence on all yield parameters of crops like wheat, paddy and sugarcane (Ansari, 2007). Different manures contain different amount of nutrient proportion and their mode of nutrient release is not same. So, different manures may influence the growth and yield in different angles. Considering the above facts, the

present research was undertaken to study the growth and yield parameters of two indigenous potato varieties combined with most effective doses of organic manures for better growth and yield.

Materials and Methods

Experimental site: The experiment was conducted at the Germplasm centre, Department of Horticulture, Patuakhali Science and Technology University, Dumki, Patuakhali, during November to March 2015. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and three blocks. Each block consisted of 10 unit plots.

Planting materials: Two indigenous potato varieties were used in the present study such as Lalpakri and Shilbilati. The seeds of the varieties were collected from Multi Location Testing (MLT) site, Joypurhat, OFRD, Bogra.

Crop establishment and management: The experiment consisted of two factors such as factor A two potato varieties and factor B different organic manures viz. control, cowdung, poultry litter, farm yard manure, vermicompost. The treatment combinations of organic manures and potato varieties were; T₀V₁ (Control) (Lalpakri without organic manure), T₁V₁ (Lalpakri × Cowdung 15 t/ha), T₂V₁ (Lalpakri × Vermicompost 12 t/ha), T₃V₁ (Lalpakri × Mustard oil cake 5 t/ha), T₄V₁ (Lalpakri × Poultry litre 7 t/ha), T₀V₂ (Control) (Shilbilati without organic manure), T₁V₂ (Shilbilati × Cowdung 15 t/ha), T₂V₂ (Shilbilati × Vermicompost 12 t/ha), T₃V₂ (Shilbilati × Mustard oil cake 5 t/ha), T₄V₂ (Shilbilati × Poultry litre 7 t/ha) used in the experiment. The land was prepared by 4-5 ploughing followed by laddering with good looking. The basal doses of nitrogen, phosphorus, potassium, sulphur, boron and zinc were applied during final land preparation in the form of Urea, Triple Super Phosphate (TSP), Muriate of potash (MOP), Gypsum (CaSO₄.2H₂O), Borax, and Zinc sulphate, respectively and were mixed thoroughly. Then 25-30g healthy and disease free seed tubers were planted in furrows on 30 November 2014 maintaining a spacing of 60 cm x 15 cm with 8 cm depth. The crop was always kept under careful observation. After planting the seeds in main field, intercultural operations viz. irrigation, weeding

(twice at 25 and 45 DAP), mulching, earthing-up (twice at 30 and 60 DAP) and plant protection were accomplished for better growth and development of the plants.

Harvest and yield: The crops were periodically harvested to study growth and development rate from 20 DAP to 80 DAP at 20 days interval and the final harvest was done at 80 days after planting. The yield of tuber was taken plot wise and converted into t/ha.

Data collection and analysis: Data were recorded on Number of stem per hill, Plant height (cm), Number of leaves per plant, Number of tuber per hill, Weight of tuber per hill (g), Gross yield of tubers (t/ha) and Marketable yield (t/ha). Data were analyzed using the MSTAT-C computer package program. The mean values for all the parameters were calculated and the analysis of variance for the characteristics was accomplished by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

The different varieties showed significant differences in combination with different organic manures in the growth and yield performances of potato.

Effect of varieties: Number of stem per hill (Table 1), plant height (Table 2), no. of leaves per plant (Table 3), no.

of tuber per hill, tuber weight per hill, gross yield and marketable yield were significantly influenced by potato varieties at different days after planting (Table 4). Number of stem per hill was always higher (12.17, 13.42, 13.96 and 14.09) in the variety Shilbilati compared to the variety Lalpakri (11.22, 12.38, 13.01 and 13.17) at 20, 40 60 and 80 days after planting, respectively. Between the two varieties, plant height was always higher in Shilbilati (21.96, 40.73, 70.09 and 80.30 cm) than Lalpakri (19.58, 25.33, 36.97 and 45.42 cm) at 20, 40 60 and 80 days after planting, respectively (Table 1 and Fig. 1). Numbers of leaves per plant increased continuously up to 80 DAP. The number of leaves per plant (7.72, 15.30, 20.30 and 26.68) at 20, 40, 60 and 80 DAP, respectively, was significantly greater in Shilbilati than Lalpakri (6.22, 12.40, 15.89 and 20.22) potato variety. Shilbilati produced higher number of tuber per hill (13.562) than Lalpakri (13.141) at harvest. Between two varieties, the maximum tuber weight per hill was recorded (422.7 g) from Shilbilati compared to Lalpakri potato variety (407.2 g) at harvest. The higher gross yield and marketable yield of tuber were recorded from Shilbilati variety (18.30 t/ha and 16.32 t/ha) compared to Lalpakri variety (17.79 t/ha and 15.48 t/ha) respectively.

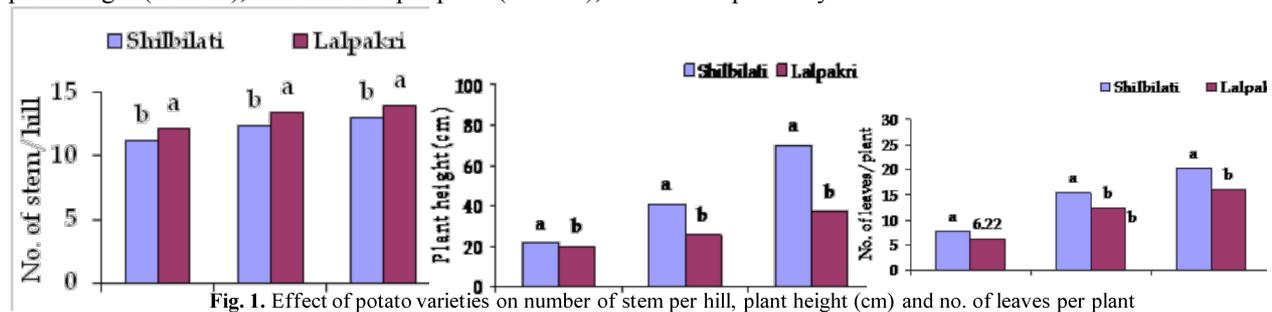


Fig. 1. Effect of potato varieties on number of stem per hill, plant height (cm) and no. of leaves per plant

Table 1. Combined effect of potato varieties and organic manures on plant per hill at different days after planting

Varieties	Organic manure	Stem per hill at different DAP			
		20	40	60	80
V ₁	T ₀	9.85 d	11.20 d	11.50 e	12.27 d
	T ₁	10.67 c	12.45 c	13.27 cd	13.37 c
	T ₂	11.93 b	12.44 c	13.20 cd	13.30 cd
	T ₃	12.49 b	13.30 bc	13.47 a	13.61 ab
	T ₄	11.23 c	12.36 c	12.48 bc	12.68 c
V ₂	T ₀	10.19 d	11.69 cd	11.86 de	12.35 d
	T ₁	11.43 c	13.63 bc	13.75 bc	13.79 c
	T ₂	12.21 b	13.39 bc	14.17 b	14.30 c
	T ₃	13.88 a	15.00 a	15.51 a	15.62 a
	T ₄	12.79 ab	13.73 b	14.19 b	14.36 b
LSD _(0.05)		1.09	1.23	0.65	0.56
CV (%)		5.19	4.60	3.62	3.36

Values having same letter(s) within the column do not differ significantly at 5% level of probability analyzed by DMRT. T₀: Control, T₁: Cowdung 15 t ha⁻¹, T₂: Vermicompost 12 t ha⁻¹, T₃: Mustard oil cake 5.0 t ha⁻¹, T₄: Poultry litre 7.0 t ha⁻¹, V₁: Lalpakri and V₂: Shilbilati

Effect of organic manures: On the other hand, in case of the effect of different organic manures the maximum number of stem per hill (13.05, 14.15, 14.42 and 14.70) was recorded from the treatment of mustard oil cake 5.0 t ha⁻¹ at 20, 40, 60 and 80 DAP, respectively while the minimum number of stem per hill (10.20, 11.57, 11.68 and 11.93) was recorded in the control treatment (Table 1). The tallest plant (27.95, 43.28, 66.42 and 75.59 cm) was observed from mustard oil cake 5.0 t ha⁻¹ (T₃) treatment which was followed by the poultry litre 7 t ha⁻¹ (T₄) treatment (21.73, 35.38, 57.36 and 67.09 cm) at 20, 40, 60

and 80 DAP, respectively, which was significantly different from other treatments at all stage of growth (Table 2). Similar trend was also observed by Hossain *et al.* (2003) who reported that the plant height increased linearly and very significantly in response to the application of organic manure and nitrogen inorganic fertilizer. Among the different organic manures, mustard oil cake 5.0 t ha⁻¹ produced the maximum number of leaves per plant (8.30, 16.17, 22.15 and 25.78) whereas the minimum number of leaves per plant (5.670, 11.69, 14.69 and 18.05) was found from control treatment at 20, 40, 60

and 80 DAS, respectively (table 3). The highest number of tuber per hill (18.24) was recorded from mustard oil cake 5.0 t ha⁻¹ treatment followed by poultry litter 7 t ha⁻¹ (14.47) whereas the lowest number of tuber per hill (9.507) was recorded from control treatment (Table 4). These results are more or less similar to those of Hossain *et al.* (2003) who reported that the number of tubers per hill increased when cow dung and mustard oil cake 5.0 t ha⁻¹ were applied association with chemical fertilizers. These

result revealed that the number of tubers production significantly increased with the application of mustard oil cake because nutrient content in mustard oil cake is higher than other organic manures used in this experiment. Mustard oil cake @ 5.0 t ha⁻¹ gave the higher gross yield (23.02 t/ha) marketable yield (20.40 t/ha) comparatively than that of other organic manure application whereas the lowest gross yield (12.11 t/ha) and marketable yield (10.47 t/ha) were observed in control condition.

Table 2. Combined effect of potato varieties and organic manures on plant height at different days after planting

Varieties	Organic manures	Plant height (cm) at different DAP			
		20	40	60	80
V ₁	T ₀	15.47 f	20.62 f	30.29 h	34.05 h
	T ₁	16.97 e	21.27 f	33.45 gh	42.51 g
	T ₂	17.69 e	21.92 f	36.42 fg	46.19 fg
	T ₃	26.87 b	36.00 cd	46.12 f	54.99 e
	T ₄	20.95 d	26.86 e	38.57 d	48.95 f
V ₂	T ₀	17.51 e	34.83 d	57.80 c	67.65 d
	T ₁	20.45 d	37.66 c	64.03 c	77.36 c
	T ₂	20.26 d	36.72 cd	65.77 c	75.08 c
	T ₃	29.09 a	50.57 a	86.72 a	96.19 a
	T ₄	22.52 b	43.91 b	76.15 b	85.24 b
LSD _(0.05)		1.45	2.53	4.23	3.77
CV (%)		4.19	2.60	2.12	0.56

Table 3. Combined effect of potato varieties and organic manures on number of leaves per plant at different days after planting

Varieties	Organic manures	Number of leaves per plant at different DAP			
		20	40	60	80
V ₁	T ₀	5.44 d	10.56 e	13.22 e	17.06 g
	T ₁	5.73 cd	11.72 de	13.94 de	17.28 g
	T ₂	6.31 c	12.37 d	15.67 cd	20.69 ef
	T ₃	7.50 b	14.84 c	20.05 b	23.62 cd
	T ₄	6.11 cd	12.55 d	16.56 c	22.50 de
V ₂	T ₀	6.33 c	12.83 d	15.43 cd	19.05 fg
	T ₁	7.38 b	14.78 c	19.72 b	24.83 bc
	T ₂	7.33 b	15.11 bc	19.59 b	25.19 bc
	T ₃	9.11 a	17.50 a	24.04 a	27.61 a
	T ₄	8.44 a	16.28 b	22.72 a	26.66 ab
LSD _(0.05)		0.77	1.22	2.07	0.74
CV (%)		4.19	2.60	2.12	0.56

Table 4. Combined effect of organic manures and variety on number of tuber, tuber weight, gross yield and marketable yield of potato at harvest

Varieties	Treatments	Number of tuber/hill	Tuber weight /hill (g)	Gross yield (t/ha)	Marketable yield (t/ha)
V ₁	T ₀	9.33 e	356.70 f	11.74 d	10.07 e
	T ₁	10.50 de	370.50 ef	16.67 c	14.67 d
	T ₂	13.56 c	393.00 d	17.43 c	15.15 d
	T ₃	16.80 b	482.00 b	21.41 b	19.26 b
	T ₄	14.32 c	433.70 c	20.24 b	17.45 c
V ₂	T ₀	9.68 de	364.30 f	12.48 d	10.87 e
	T ₁	11.11 d	387.00 e	16.92 c	14.96 d
	T ₂	13.72 c	411.70 d	17.72 c	15.85d
	T ₃	18.48 a	508.00 a	23.13 a	20.74 a
	T ₄	14.82 c	450.70 c	21.26 b	19.23 b
LSD _(0.05)		1.64	0.18	1.57	1.46
CV (%)		1.35	1.35	1.30	2.34

Combined effect of varieties and organic manures: The combined effect of organic manures and potato varieties were found to be significant in case of number of stem per hill. At 20 and 40 DAP, the maximum number of stem per hill (13.88 and 15.00) was noted from the treatment combination mustard oil cake 5.0 t ha⁻¹ × Shilbilati potato variety which was statistically similar to that of poultry liter × Shilbilati potato variety treatment combinations whereas the minimum number of stem per hill (9.85 and

11.20) was recorded from the potato variety Lalpakri when cultivated without organic manures (Table 1). In respect of plant height at 40 DAP, the highest plant height (50.57 cm) was recorded from the treatment combination mustard oil cake 5.0 t ha⁻¹ × Shilbilati whereas Lalpakri × control treatment showed the lowest plant height (20.62 cm). At 60 DAP, treatment combination of mustard oil cake 5.0 t ha⁻¹ × Shilbilati produced the tallest plant (86.72 cm) where without treated plant of potato variety Lalpakri

produced shortest plant height (30.29 cm). At 80 DAP, the highest plant height (96.19 cm) was recorded under the treatment combination of mustard oil cake 5.0 t ha⁻¹ x Shilbilati. On the other hand, variety Lalpakri x no organic manures produced the shortest plant (34.05 cm) (Table 2). The treatment combinations of organic manures and potato varieties had significant effects on number of leaves per plant. At 20 DAP, the maximum number of leaves per plant (9.110) was found from mustard oil cake x Shilbilati potato variety treatment which was statistically similar to the treatment combination poultry litter 7 t ha⁻¹ x Shilbilati while the minimum number of leaves per plant (5.447) was observed from Lalpakri potato variety with control treatment. At 40 DAP, mustard oil cake 5.0 t ha⁻¹ x Shilbilati potato variety produced the highest number of leaves per plant (17.50) followed by the treatment combination V₂T₄ and V₂T₂ whereas the lowest number of leaves per plant (10.56) was recorded from the control treatment with Lalpakri potato variety (Table 3). The combined effect of different organic manures and potato varieties had significant effect on number of tuber per hill. The maximum number of tuber per hill (18.48) was found in mustard oil cake 5.0 t ha⁻¹ x Shilbilati potato variety treatment which was followed by the treatment combination poultry litter 7 t ha⁻¹ x Shilbilati (16.80) whereas the lowest number of tuber per hill (9.330) was observed in the without organic manure (control) x Lalpakri combination (Table 4). Among the treatment combinations, the potato variety Shilbilati x mustard oil cake 5.0 t ha⁻¹ gave the highest weight of tuber per hill (508.0 g) followed the by the variety Lalpakri with same treatment (482.0 g) while the lowest tuber weight per hill (356.7 g) was observed from the variety Lalpakri with control treatment. Combined effect between variety and organic manures on gross yield and marketable yield were found significant. The treatment combination mustard oil cake 5.0 t ha⁻¹ x Shilbilati potato variety showed the highest gross yield and marketable yield (20.74 t/ha and 23.13 t/ha) of tuber followed by the treatment combinations V₂T₃ (21.41 t/ha and 19.26 t/ha), V₁T₄ (21.26

t/ha and 19.23 t/ha) while the lowest (11.74 t/ha and 10.07 t ha⁻¹) was recorded from the treatment combination V₁T₀ and it was statistically similar to the treatment combination V₂T₀ (12.48 t/ha and 10.87 t/ha) (Table 4). Kaur and Singh (2001) reported that application of organic manures along with chemical fertilizers increased tuber size, which increased tuber yield of potato.

From the present research work, it may be concluded that the variety Shilbilati gave the best results on growth and yield of potato. Mustard oil cake 5.0 t/ha showed the best performance among the organic manures used in the present experiment in respect of growth and yield of potato. Application of mustard oil cake 5.0 t/ha with Shilbilati potato gave the highest yield. Further study may also be needed to ensuring the growth and yield performance of indigenous potato in different parts of Bangladesh for regional adaptability.

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