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Research article

Effect of organic fertilizers on the performance of seed potato

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Abstract: The experiment was conducted for the evaluation of the performance of seed potato to organic fertilizers. Two potato varieties *viz*. Asterix (V_1) and Diamant (V_2) were subjected to different inorganic fertilizers *viz*. Control (T_1), Cowdung (T_2), Annapurna organic fertilizer (T_3), 75% Annapurna organic fertilizer + 25 % Vermicompost (T_4) and Vermicompost (T_5). Early 80% emergence was found from T_1 (V_1: 26.3 days; V_2: 23.3 days) while early tuberization from T_2 for V_1 (36.0 days) and T_1 for V_2 (29.0 days). Both varieties performed differently to the organic fertilizers used in the experiment. T_4 was the best for V_1 (14.3 kg per plot and 28.8 $t.ha^{-1}$) while T_3 was best for V_2 (14.1 kg per plot and 28.3 $t.ha^{-1}$). Asterix yielded more tuber than diamant variety. The performances of both varieties were not varied significantly among the treatments for different graded tuber except for 28–55 mm graded tuber in asterix. From the study it is suggested to use of 75% Annapurna organic fertilizer + 25% Vermicompost for asterix variety with BARI recommended inorganic fertilizers in order to get more yielding seed potato.

Keywords: Annapurna - Vermicompost - Asterix - Diamant - Yield.

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INTRODUCTION

Potato (*Solanum tuberosum*) is the 3rd (just after rice and wheat) most consumed food crop in the world (Champouret 2010, Verzaux 2010, Visser *et al.* 2009). The growth and yield of potato largely depends on the soil and soil conditions can be improved throughout the use of different organic fertilizer. Approximately 4% organic matter is essential of any agricultural soil while soil of our 60% cultivable land contains organic matter below 1% (Ferdoushi *et al.* 2010). Deficiencies of soil organic matter reduced the crop yield which is in important fact for Bangladesh's agriculture. Bangladeshi farmers generally used the inorganic fertilizers judiciously to get high yield and this judicious application of the inorganic fertilizers destroy our agricultural soil. Now it is important to concern about the soil health. Though single nutrient source may supply the respective required nutrients for plant but integrated use of all sources is required for balanced plant nutrition (Arora 2008). Vermicompost used as a fertilizer and soil conditioner (Munroe 2007, Rajesh *et al.* 2003) responsible for the improvement of the physical properties of soil and supply vital plant nutrients (Smith *et al.* 2014). Tuber yield of potato is much more after using organic manures than the recommended dose of inorganic fertilizers only (Boke 2014). Balance fertilization is required for most of the crops also for potato (Alam *et al.* 2007, Sharma *et al.* 2003) but tuber yield increases with the application of high amount of manures (Roy *et al.* 2001, Fageria *et al.* 1997, Johnston 1986). Lack of quality seed potato and high yielding varieties with poor agricultural management was the key factor for low yield of potato (Amede *et al.* 2006, Mehdin *et al.* 2000). The hypothesis tested in this study to improve the tuber yield using organic fertilizers. Organic fertilizers were supplemented with adequate nitrogen in available form for plant (Atiyeh *et al.* 2000, Bayite-Kasule 2009). The current study was done to evaluate the growth and yield performance of seed potato throughout the application of organic fertilizers.

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MATERIALS AND METHOD

An experiment was conducted at Domar Foundation Seed Potato Production Farm, BADC, Nilphamari, Bangladesh. Two potato varieties *viz*. Asterix (V_1) and Diamant (V_2) were assigned to different inorganic fertilizers *viz*. Control (T_1), Cowdung (T_2), Annapurna organic fertilizer (T_3), 75% Annapurna organic fertilizer + 25% Vermicompost (T_4) and Vermicompost (T_5) using three replication. In total 60 tubers (in three rows *i.e.*, 20 tubers/row) were planted on 2.0 m × 2.5 m plot. The row to row distance was 60.96 cm. The tuber size ranged from 20–40 mm and tuber to tuber distance was 12.7 cm. Urea, TSP, MP, gypsum and zinc sulphate were applied @ 220, 120, 220, 100 and 10 kg.ha^{-1} as basal dose (BARI 2011). Half of urea and entire dose of the rest inorganic fertilizers were applied during final land preparation. Rest half of urea was applied at 30 days after planting. Data were collected on different parameters and analyzed by MSTAT-C computer package program. Means for all the treatments were calculated and the analysis of variance for each of the character was performed by F (variance ratio) test. Data are presented as the mean ± standard error (SE). Difference between treatments was evaluated by least significant difference (LSD) test at 1% level of significance (Gomez & Gomez 1984).

RESULTS

Day to 80% emergence and tuberization: Days to 80% emergence was varied significantly among the treatments in both varieties. Early 80% emergence was found from T_1 (V_1: 26.3 days; V_2: 23.3 days) while late 80% emergence was found from T_4 (V_1: 29.7 days; V_2: 26.0 days) (Table 1). Days to tuberization were statistically identical among the treatments in both varieties. However, earliest tuberization was found in T_2 for V_1 (36.0 days) and in T_1 for V_2 (29.0 days) (Table 1). V_2 showed early 80% emergence and tuberization than V_1.

Plant height: Plant height was varied significantly among the treatments. The tallest plant was found from T_4 (V_1: 63.4 cm; V_2: 63.3 cm) while the shortest plant was found from T_1 (V_1: 61.5 cm; V_2: 56.7 cm) (Table 1).

Table 1. Effect of different fertilizer on days to 80% emergence, days to tuberization and plant height of two potato varieties.

Treatments	Days to 80% emergence		Days to tuberization		Plant height (cm) at 60 DAP	
	V_1	V_2	V_1	V_2	V_1	V_2
T_1	26.3^{b} ± 0.19	23.3^{c} ± 0.38	36.3^{a} ± 0.19	29.0^{a} ± 0.07	61.5^{c} ± 0.33	56.7d ± 1.58
T_2	27.2^{b} ± 0.19	24.0^{bc} ± 0.33	36.0^{a} ± 0.07	29.3^{a} ± 0.19	62.3^{b} ± 0.33	58.3c ± 1.58
T_3	27.3^{b} ± 0.39	24.0^{bc} ± 0.14	36.3^{a} ± 0.13	29.3^{a} ± 0.19	62.8^{b} ± 0.33	59.7b ± 0.19
T_4	29.7^{a} ± 0.19	26.0^{a} ± 0.11	36.3^{a} ± 0.17	29.7^{a} ± 0.15	63.4^{a} ± 1.00	63.3a ± 1.64
T_5	27.4^{b} ± 0.39	25.3^{a} ± 0.19	36.3^{a} ± 0.18	29.3^{a} ± 0.18	62.1^{b} ± 0.67	59.3b ± 0.69
LSD0.01	2.01	1.46	1.46	1.42	0.51	1.12
CV%	3.4	3.24	1.42	1.76	3.12	6.25

Note: Values are means of three replicates ± SE; Values in a column with having similar and dissimilar superscript letter(s) are significantly similar and different (p>0.01) respectively; Control (T_1), Cowdung (T_2), Annapurna organic fertilizer (T_3), 75% Annapurna organic fertilizer + 25% Vermicompost (T_4) and Vermicompost (T_5).

Table 2. Effect of different fertilizer on tuber yield of two potato varieties[X].

Treatments	Tuber yield			
	kg per plot		t.ha^{-1}	
	V_1	V_2	V_1	V_2
T_1	10.7^{b} ± 0.39	10.1^{b} ± 0.34	23.5^{cd} ± 0.48	21.0^{b} ± 0.13
T_2	11.3^{b} ± 0.20	11.2^{b} ± 0.35	22.2^{d} ± 0.15	23.5^{b} ± 0.66
T_3	12.7^{ab} ± 0.11	14.1^{a} ± 0.37	26.0^{bc} ± 0.20	28.3^{a} ± 0.72
T_4	14.3^{a} ± 0.37	13.7^{a} ± 0.05	28.8^{a} ±0.41	27.7^{a} ± 0.13
T_5	12.8^{ab} ± 0.27	11.2^{b} ± 0.29	26.2^{b} ± 0.42	22.9^{b} ± 0.21
LSD0.01	2.2	1.7	2.5	3.695
CV%	6.6	5.0	3.62	5.47

Note: Values are means of three replicates ± SE; values in a column with having similar and dissimilar superscript letter(s) are significantly similar and different (p>0.01) respectively; Control (T_1), Cowdung (T_2), Annapurna organic fertilizer (T_3), 75% Annapurna organic fertilizer + 25% Vermicompost (T_4) and Vermicompost (T_5).

Yield: Yield of potato varieties varied significantly among the treatments. In case of V_1, maximum yield was found from T_4 (14.3 kg per plot and 28.8 t.ha^{-1}) while minimum from T_1 (10.7 kg per plot and 22.2 t.ha^{-1}) whereas for the V_2, maximum yield was found in T_3 (14.1 kg per plot and 28.3 t.ha^{-1}) and minimum was found

from T_1 (10.1 kg per plot and 21.0 t.ha^{-1}) (Table 2). V_1 was found as more yielder variety than V_2.

Grade wise tuber yield: Yield of different graded tuber was not varied significantly among the treatments in both varieties (except V_1: 28–55 mm). Maximum yield was found in T_4 at 28–55 mm graded tuber (V_1: 12.74 kg per plot and V_2: 12.31 kg per plot) (Table 3). In this case V_1 also found as the better performer than V_2.

Table 3. Effect of different fertilizer on grade wise tuber yield of two potato varieties[X].

Treatments	Yield (kg per plot) according to different tuber grade					
	<28 mm		28–55 mm		>55 mm	
	V_1	V_2	V_1	V_2	V_1	V_2
T_1	0.65^{a} ± 0.07	0.81^{a} ± 0.09	9.30^{d} ± 0.42	9.02^{a} ±0.31	0.73^{a} ± 0.06	0.49^{a} ± 0.11
T_2	0.75^{a} ± 0.05	1.02^{a} ± 0.06	9.92^{cd} ± 0.25	10.12^{a} ±0.79	0.66^{a} ± 0.11	0.61^{a} ± 0.10
T_3	0.91^{a} ± 0.09	0.74^{a} ± 0.07	11.86^{ab} ± 0.45	12.31^{a} ±0.53	0.57^{a} ± 0.02	0.69^{a} ± 0.06
T_4	0.78^{a} ± 0.04	0.95^{a} ± 0.06	12.74^{a} ± 0.66	11.48^{a} ±0.41	0.41^{a} ± 0.10	0.74^{a} ± 0.09
T_5	0.64^{a} ± 0.13	0.57^{a} ± 0.14	10.67^{bc} ± 0.72	10.43^{a} ±0.59	0.44^{a} ± 0.13	0.53^{a} ± 0.13
LSD0.01	0.71	0.68	1.34	3.92	0.83	0.74
CV%	14.63	10.45	14.42	11.42	13.96	12.94

Note: Values are means of three replicates ± SE; values in a column with having similar and dissimilar superscript letter(s) are significantly similar and different (p>0.01) respectively; Control (T_1), Cowdung (T_2), Annapurna organic fertilizer (T_3), 75% Annapurna organic fertilizer + 25% Vermicompost (T_4) and Vermicompost (T_5).

DISCUSSION

The results showed seed potato performed differently on growth and yield to different organic fertilizers. Nitrogen content increases in soil by the application of organic fertilizers may stimulate the faster plant growth that lead to more yield (Nogales *et al.* 2005). The stimulation of the plant growth in organic fertilizers arises by the presence of the phytohormones (Nogales *et al.* 2005, Smith *et al.* 2014). Our results showed that additional application of organic fertilizers with inorganic fertilizers increases the total tuber yield also different graded tuber. Integrated nutrient management by the application of both inorganic fertilizers and organic manures increases the different grades tuber production (Kumar *et al.* 2008, 2011, Das *et al.* 2009) and total tuber yield (Kumar *et al.* 2001, Raghav & Kamal 2008). Yield of tuber increases due to the availability of N, P and K contents in soil through the application of organic manures (Kumar *et al.* 2008, Baishya 2009, Zaman *et al.* 2011). The maximum advantages from applications of additional organic fertilizers with recommended doses of inorganic fertilizers might be found and *i.e.*, to enhance uptake of fertilizer, to increased soil physical and chemical properties. Besides, by providing macro and micronutrient organic manure improve crop production. Potato yielded more tuber from manure application along with inorganic fertilizers (Johnston 1986, Nyiraneza & Snapp 2007, Bereez *et al.* 2005, Alam *et al.* 2007, Gruhn *et al.* 2000, Daniel *et al.* 2008). In our study potato tuber size <28 mm, 28–55 mm, >55 mm were considered as undersized, marketable and oversized as similar to Chilephake & Trautz (2014). In case of the 28–55 mm grade tuber, all the treatments had significant effect in asterix but it was not found any significant effect in diamant variety. Significant difference for grade wise tuber yield was found among different genotypes (Bhardwaj *et al.* 2008) and different treatments (Banjare *et al.* 2014, Chilephake & Trautz 2014) while non-significant difference was also found by Banjare *et al.* (2014).

CONCLUSION

Both the asterix and diamant variety were very popular to farmers in Bangladesh. It was found that asterix was better than diamant variety considering tuber yield. The asterix variety showed best performance in T_4 (75% Annapurna organic fertilizer + 25% Vermicompost) with BARI recommended inorganic fertilizers among the treatments used in the study. Annapurna organic fertilizer (T_3) was found as the best treatment for diamant. It is recommended to use BARI recommended inorganic fertilizers with T_4 treatment for asterix and T_3 for diamant. But further research is suggested using combination of organic and inorganic fertilizers in different areas of Bangladesh. From the results of the current study it can be concluded that use of the organic fertilizers with BARI recommended inorganic fertilizers can improve the tuber yield of potato.

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