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YIELD PERFORMANCE OF DIFFERENT POTATO VARIETIES AS INFLUENCED BY VERMICOMPOST

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Abstract

Use of vermicompost had significant effect on most of the yield contributing parameters studied under the experiment. Results demonstrated that the yield of different potato varieties varied with different combinations of vermicompost. Among the 16-treatment combination, BARI TPS-1 with vermicompost @ 6 t/ha produced the maximum yield (34.75 t/ha); Lady Rosetta with vermicompost @ 6 t/ha produced the maximum yield (35.96 t/ha); Asterix with vermicompost @ 4 t/ha produced the maximum yield (36.01 t/ha) and Courage with vermicompost @ 2 t/ha produced the maximum yield (32.28 t/ha). It may be suggested that the potato growers of Bangladesh may apply vermicompost on their field for maintaining better yield.

Introduction

Potato (*Solanum tuberosum* L.) belonging to the Solanaceae is grown in nearly 150 countries and is the world's single most important tuber crop with a vital role in the global food system and food security (Singh 2010). It is the fourth world crop after wheat, rice and maize. The total world potato production was estimated at 388,190,674 ton in 2017 (FAOSTAT 2018). It is the most highly produced non-grain staple crop in the world, with one third of total production harvested in densely-populated developing countries, like China and India (CIP 2008). In world top 25 potato producing countries, Bangladesh ranks seventh (FAOSTAT 2018, Mostofa 2019). In Bangladesh, it ranks second after rice in production (FAOSTAT 2018). During 2017 - 2018, the total area under potato crops, per ha yield and total production in Bangladesh are 499,725 hectares, 20.44 t/ha and 10,215,957 metric ton, respectively (BBS 2018). The total production is increasing day by day because of an alternative food crop against rice and wheat is a crop of rich nutrient substances as such its consumption is also rapidly increasing in Bangladesh (BBS 2018).

Nowadays gradual deficiencies in soil organic matter and reduced yield of crop and quality are alarming problem in Bangladesh. The cost of inorganic fertilizers is very high. On the other hand, the organic manure is easily available to the farmers and its cost is low compared to that of inorganic fertilizers.

Vermicompost is a good source of different macro- and micronutrients particularly NPKS. The increased microbial activity improves the availability of soil phosphorous and nitrogen. Vermiculture is the science of rearing of earthworms for mass propagation on organic wastes under semi-natural conditions and vermicomposting is the bioconversion of organic waste materials through earthwormic ways (Senapati *et al.* 1992). Senesi *et al.* (1996) mentioned that

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vermicomposting is a controlled, aerobic, biological process and able to convert biodegradable humus like organic substances and suitable for the application of soil amendment. Vermiculture is a cost-effective tool for environmentally sound waste management (Banu *et al.* 2001, Asha *et al.* 2008). Earthworms are the crucial drivers of the process, as they aerate condition and fragment the substrate and thereby drastically alter the microbial activity and their biodegradation potential (Fracchia *et al.* 2006, Lazcano *et al.* 2008). Due to the increasing demand of consumers and foreign importers on this important crop, special attention should be given to increase its yield and quality. The area and production of potato in Bangladesh has been increasing during last decades but the yield per unit area remains more or less static. The yield is very low in comparison to that of the other leading potato growing countries of the world, 40.16 t/ha in USA, 42.1 t/ha in Denmark and 40.0 t/ha in UK (FAO 2009).

Thus, use of different amount of vermicompost materials may contribute in improving quality of potato in Bangladesh condition. Response of vermicompost on yield of potato is still unknown specially in Bangladesh condition.

Materials and Methods

The field experiment was conducted at the research field under the Institute of Seed Technology at Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from November 1, 2014 to April 30, 2015 in Rabi season. The experimental area was situated at $23^0$77' N latitude and $90^0$33' E longitude at an altitude of 8.6 meter above the sea level (Anon. 2004). The experiment comprised two factors, namely: Factor A: Potato varieties; V_1: BARI TPS-1, V_2: BARI Alu-28 (Lady Rosetta), V_3: BARI Alu-25 (Asterix), V_4: BARI Alu-29 (Courage), Factor B: Vermicompost level; M_1: 0 t/ha, M_2: 2 t/ha, M_3: 4 t/ha and M_4: 6 t/ha. Experiment was conducted by using split-plot design with 3 replications where variety was assigned to main plot and vermicompost to sub-plot. Row to row and plant o plant distance were 50 cm and 25 cm, respectively. Plot to plot distance was 75 cm. The size of the unit plot was 2 m × 2.5 m. Certified grade seed potato (45-55 mm in size) was collected from Tuber Crops Research Centre (TCRC), Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh. The crop was planted on 1 November, 2014 and harvested on 25 February, 2015 following all necessary intercultural operations as per TCRC recommendation. All yield contributing parameters were recorded as per treatments. The collected data was analyzed by using Statistix-10 (2013) software following ANOVA technique and means were adjusted by using Least Significant Difference (LSD) at 5% level of probability.

Results and Discussion

Profound variation was observed among different varieties to number of tubers per hill. The maximum (9.833) number of tubers was found in V_2 and minimum (6.500) in V_4 treatment (Table 1).

Significant variation was found among different levels of vermicompost on number of tubers per hill. The maximum (8.248) number of tubers was recorded in M_4 which was statistically similar to M_2 and minimum (7.418) was found in M_3 (Table 2).

Much variation was found among different varieties to weight of tuber per hill. The highest (390.0 g) weight of tuber was found from V_2 and the lowest (324.6 g) was found from V_1 (Table 1).

Significant variation was found among different levels of vermicompost on weight of tuber per hill. The highest (387.3 g) weight of tuber was found from M_4 and the lowest (347.6 g) was found from M_2 (Table 2).

Profound variation was found among different varieties to average tuber weight. The highest (53.57 g) average weight of tuber was found from V_4 and the lowest (40.17 g) was found from V_2 which was statistically similar to V_1 (Table 1).

Remarkable variation was found among different levels of vermicompost on average tuber weight. The highest (50.75 g) average weight of tuber was found from M_3 which was statistically similar to M_4 and the lowest (40.24 g) was found from M_1 (Table 2).

Table 1. Effect of variety on yield and yield contributing characters of potato.

Varieties	No. of tuber/hill	Weight of tuber/ hill (g)	Average tuber weight (g)	Tuber yield (t/ha)
V_1	7.582 b	324.6 c	42.95 c	25.97c
V_2	9.833 a	390.0 a	40.17 c	31.20 a
V_3	7.416 b	356.8 b	48.69 b	28.55 b
V_4	6.500 c	344.8 b	53.57 a	27.5bc
CV (%)	9.03	13.19	6.29	6.14
$LSD_{0.05}$	0.706	3.73	2.91	1.73
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $p < 0.05$. ** = Significant at 1% level of probability; V_1 - BARI TPS-1, V_2 - Lady Rosetta, V_3 - Asterix, V_4 - Courage.

Table 2. Effect of vermicompost on yield and yield contributing characters of potato.

Vermicompost level	No. of tuber/hill	Weight of tuber/ hill (g)	Average tuber weight (g)	Tuber yield (t/ha)
M_1	7.667 bc	308.5 d	40.24 c	24.68 c
M_2	7.998 ab	347.6 c	45.69 b	27.81 b
M_3	7.418 c	372.8 b	50.75 a	29.82 a
M_4	8.248 a	387.3 a	48.68 a	30.99 a
CV (%)	5.42	4.82	7.29	7.44
$LSD_{0.05}$	0.358	14.38	2.85	1.78
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $p < 0.05$.
** = Significant at 1% level of probability; M_1 - Control, M_2 - 2 t/ha, M_3 - 4 t/ha, M_4 - 6 t/ha.

Significant variation was found among different varieties to tuber yield. The highest (31.20 t/ha) yield of tuber was found from V_2 and the lowest (25.97 t/ha) was found from V_1 (Table 1). That yields of different cultivars of potato were significantly different from each other was reported by Kundu *et al.* (2012). Similar trend of yield performance was also reported by Das (2006), Dhar *et al.* (2009) and Hossain (2011). The probable reason for variation in yield due to the heredity of the variety, difference in agro-ecological condition and soils of the experimental site (Eaton *et al.* 2017).

Significant variation was found among different levels of vermicompost on tuber yield. The highest (30.99 t/ha) yield of tuber was found from M_4 which was statistically similar to M_3 and the lowest (24.68 t/ha) was found from M_1 (Table 2). This variation might be due to change the yield contributing character under different vermicompost level.

Remarkable variation was found among different varieties to marketable yield. The highest (26.55 t/ha) marketable yield of tuber was found from V_2 and the lowest (22.10 t/ha) was found from V_1 (Table 3). This variation might be due to different tuber size of potato varieties.

Profound variation was found among different levels of vermicompost on marketable yield. The highest (26.55 t/ha) marketable yield of tuber was found from M_4 and the lowest (20.85 t/ha) was found from M_1 (Table 4). This variation might be due to change in tuber size under different vermicompost level.

Table 3. Effect of variety on grading of yield for marketing and yield for seed purpose of potato.

Varieties	Marketable yield (t/ha)	Non-marketable yield (t/ha)	Seed potato (t/ha)	Non-seed potato (t/ha)
V_1	22.10 c	3.872 b	17.75 c	8.227 c
V_2	26.55 a	4.793 a	21.73 a	9.467 a
V_3	24.29 b	4.260 b	19.67 b	8.875 b
V_4	23.47 bc	4.238 b	18.95 b	8.632 bc
CV (%)	5.94	9.61	5.19	6.70
$LSD_{0.05}$	1.42	0.412	1.01	0.589
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $p < 0.05$. ** = Significant at 1% level of probability; V_1 - BARI TPS-1, V_2 - Lady Rosetta, V_3 - Asterix, V_4 - Courage.

Table 4. Effect of vermicompost on grading of yield for marketing and yield for seed purpose of potato.

Vermicompost levels	Marketable yield (t/ha)	Non-marketable yield (t/ha)	Seed potato (t/ha)	Non-seed potato (t/ha)
M_1	20.85 d	3.952 b	16.71 d	7.972 b
M_2	23.61 c	4.347 a	19.07 c	8.747 a
M_3	25.40 b	4.429 a	20.66 b	9.160 a
M_4	26.55 a	4.433 a	21.66 a	9.323 a
CV (%)	5.20	9.83	5.27	7.72
$LSD_{0.05}$	1.06	0.356	0.867	0.572
Level of significance	**	*	**	**

Numbers in columns followed by the same letter are not statistically different at $p < 0.05$. ** = Significant at 1% level of probability, * = Significant at 5% level of probability. M_1 - Control, M_2 - 2 t/ha, M_3 - 4 t/ha, M_4 - 6 t/ha.

Significant variation was found among different varieties to non-marketable yield. The highest (4.793 t/ha) non-marketable yield of tuber was found from V_2 and the lowest (3.872 t/ha) was found from V_1 which was statistically similar to V_3 and V_4 (Table 3). This variation might be due to different tuber size and percentage of tuber size of potato varieties.

Significant variation was found among different varieties to non-marketable yield. The highest (4.433 t/ha) non-marketable yield of tuber was found from M_4 which was statistically similar to M_4 and M_4. The lowest yield (3.952 t/ha) was found from M_1 (Table 4). This variation might be due to change in tuber size under different vermicompost level. Present experiment showed that amount of non-marketable tuber number increases with increasing vermicompost levels.

The highest (21.73 t/ha) yield as seed potato was found from V_2 and the lowest (17.75 t/ha) was found from V_1 (Table 3). This variation might be due to different tuber size of potato varieties.

Profound variation was found among different varieties to seed potato yield. The highest (21.66 t/ha) yield as seed potato was found from M_4 and the lowest (16.71 t/ha) was found from M_1 (Table 4). This variation might be due to change in tuber size under different vermicompost level.

Remarkable variation was found among different varieties to non-seed potato yield. The highest (9.467 t/ha) yield as non-seed potato was found from V_2 and lowest (8.22 t/ha) was found from V_1 (Table 3).

Different varieties to non-seed potato yield also showed variations. The highest (9.323 t/ha) yield as non-seed potato was found from M_4 which was statistically similar to M_3 and M_2. The lowest yield (7.972 t/ha) was found from M_1 (Table 4).

In respect of tuber number per hill due to different varieties and vermicompost levels was found statistically significant. The maximum (11.3) number of tubers was found from V_2M_4 and the minimum (5.66) was from V_1M_1 (Table 5).

In case of weight of tuber per hill due to different varieties and vermicompost levels was found statistically significant. The highest weight (450.2 g) of tuber was found in V_3M_3 which was statistically similar to V_2M_4 and V_1M_4 and lowest weight (230.4 g) was found from V_1M_1 (Table 5).

Table 5. Combined effect of variety and vermicompost on yield, yield contributing characters, grading of yield for marketing and yield for seed purpose of potato.

Combi-nation	No. of tuber/hill	Weight of tuber/ hill (g)	Average tuber weight (g)	Tuber yield (t/ha)	Marketable yield (t/ha)	Non-marketable yield t/ha	Seed potato (t/ha)	Non-seed potato (t/ha)
V_1M_1	5.66 h	230.4 i	40.96 c-e	18.43 g	15.55 h	2.89 g	11.95 i	6.49 g
V_1M_2	7.33 de	333.8 ef	46.81 b-d	26.71 de	22.66 ef	4.04 d-f	18.20 fg	8.51 c-e
V_1M_3	8.00 cd	299.9 g	37.48 e	23.99 ef	20.44 f	3.55 e-g	16.35 g	7.64 d-g
V_1M_4	9.33 b	434.4 ab	46.54 b-d	34.75 ab	29.76 a	5.00 ab	24.49 ab	10.2 a
V_2M_1	10.0 b	406.0 bc	40.60 de	32.48 a-c	27.48 b	5.00 ab	22.77 bc	9.71 a-c
V_2M_2	10.0 b	307.0 fg	30.70 f	24.56 ef	20.87 f	4.26 b-e	16.65 g	7.91 d-f
V_2M_3	8.00 cd	397.6 c	49.70 b	31.81 bc	27.08 bc	4.72 a-d	22.12 cd	9.68 a-c
V_2M_4	11.3 a	449.5 a	39.66 e	35.96 a	30.78 a	5.18 a	25.39a	10.5 a
V_3M_1	8.00 cd	332.8 ef	41.59 c-e	26.62 de	22.50 ef	4.12 c-f	18.09 fg	8.53 c-e
V_3M_2	8.33 c	346.3 de	41.55 c-e	27.70 de	23.51 de	4.20 c-e	18.99 ef	8.71 b-e
V_3M_3	7.00 ef	450.2 a	64.31 a	36.01 a	30.66 a	5.36 a	25.29 a	10.7 a
V_3M_4	6.33 f-h	298.1 g	47.31 bc	23.85 ef	20.48 f	3.36 fg	16.31 g	7.53 e-g
V_4M_1	7.00 ef	264.8 h	37.83 e	21.19 fg	17.88 g	3.80 ef	14.03 h	7.16 fg
V_4M_2	6.33 f-h	403.5 c	63.71 a	32.28 a-c	27.40 bc	4.88 a-c	22.42 c	9.86 ab
V_4M_3	6.67 e-g	343.5 de	51.53 b	27.48 de	23.40 de	4.08 c-f	18.89 ef	8.59 b-e
V_4M_4	6.00 gh	367.3 d	61.21 a	29.38 cd	25.19cd	4.19 c-e	20.46 de	8.92 b-d
CV (%)	5.42	4.82	7.29	7.44	5.20	9.83	5.27	7.72
$LSD_{0.05}$	0.717	28.76	5.69	3.55	2.11	0.711	1.73	1.14
Level of significance	**	**	**	**	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $p < 0.05$. ** = Significant at 1% level of probability. V_1 - BARI TPS-1, V_2 - Lady Rosetta, V_3 - Asterix, V_4 - Courage; M_1 - Control, M_2 - 2 t/ha, M_3 - 4 t/ha, M_4 - 6 t/ha.

The average tuber weight due to different varieties and vermicompost levels was found statistically significant. The highest (64.31 g) average weight was found from V_3M_3 which was statistically similar to V_4M_2 and V_4M_4. The lowest (30.70 g) was fond from V_2M_2 (Table 5).

The tuber yields due to different varieties and vermicompost levels was found statistically significant. The highest (36.01 t/ha) tuber yield was found from V_3M_3 which was statistically similar to V_2M_4, V_1M_4, V_2M_1 and V_4M_2. The lowest (18.43 t/ha) tuber yield was found from V_1M_1 (Table 5).

Significant variation was found among different combination of varieties and vermicompost levels on marketable yield of tuber. The highest (30.66 t/ha) marketable yield of tuber was found from V_3M_3 which was statistically similar to V_2M_4 and V_1M_4. The lowest (15.55 t/ha) tuber yield was found from V_1M_1 (Table 5).

Different combinations of varieties and vermicompost levels on non-marketable yield of tuber showed much variations. The highest (5.36 t/ha) non-marketable yield of tuber was found from V_3M_3 which was statistically similar to V_2M_4, V_1M_4, V_2M_1 and V_4M_2. The lowest (2.89 t/ha) tuber yield was found from V_1M_1 (Table 5).

Remarkable variation was found among different combinations of varieties and vermicompost levels on yield as seed of tuber. The highest (25.39 t/ha) yield as seed of tuber was found from V_2M_4 which was statistically similar to V_1M_4 and V_3M_3. The lowest (11.95 t/ha) tuber yield as seed was found from V_1M_1 (Table 5).

Significant variation was found among different combinations of varieties and vermicompost levels on yield as non-seed of tuber. The highest (10.7 t/ha) non-seed yield of tuber was found from V_3M_3 which was statistically similar to V_1M_4, V_2M_1, V_2M_3, V_2M_4 and V_4M_2. The lowest (6.49 t/ha) tuber yield was found from V_1M_1 (Table 5).

On the basis of results from the present study it can be concluded that, the variety and vermicompost had shown the statistically significant variation in the parameters studied under the experiment. Most of the yield contributing traits showed the better performance in responsive to V_2 and in respect of vermicompost levels; most of the yield contributing traits performed the better results at M_4 treatment. But, in case of yield, the V_3M_3 combination exhibited the maximum (36.01 t/ha) one whereas, the V_1M_1 combination exhibited the minimum (18.43 t/ha) one. The potato growers of Bangladesh may apply vermicopmpost on their field at the rate of 6 tons per hectare for better yield in combination of Lady Rosetta and Asterix. To validate the present result, more research programs should be conducted to assess the combined effect of variety and vermicompost on the basis of findings from the study in different major potato growing areas of Bangladesh.

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