RESEARCH ARTICLE

EFFECT OF ORGANIC MANURES AND PLANTING TIME ON GROWTH, YIELD, QUALITY AND ECONOMICS OF SQUASH UNDER MEDIUM HIGH LAND CONDITION OF DINAJPUR REGION

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ARTICLE DETAILS

ABSTRACT

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The experiment was conducted at the research field of Agricultural Research Station, Rajbari, Dinajpur during rabi season of 2018-19 and 2019-20 to develop a profitable and economic fertilizer dose and optimum planting time for Squash and to increase the productivity and yield. Two different dates of planting viz. 15 November and 30 November considered as factor A and different organic manures viz., vermicompost, poultry manure and cowdung considered as factor B. The experiment was laid out in randomized complete block (RCB) design (Factorial) with three replications. Organic manures and planting time showed significant effects on most of the parameters. In case of organic manures, highest individual fruit weight (1707.50 g) and fruit yield (32.43 tha^{-1}) was recorded from vermicompost whereas the lowest fruit weight (1233.17 g) and fruit yield (23.52 tha^{-1}) was recorded from cowdung application. In case of planting time, the highest individual fruit weight (1747.11 g) and fruit yield (29.61 tha^{-1}) was recorded from 15 November planting date whereas the lowest fruit weight (1196.44 g) and fruit yield (25.86 tha^{-1}) was recorded from 30 November planting date. For combination, highest individual fruit weight (2153.66g) and fruit yield (34.06 tha^{-1}) were recorded from vermicompost with 15 November planting date while the lowest individual fruit weight (1105.33g) and fruit yield (20.56 tha^{-1}) were recorded from cowdung with 30 November planting date. Vermicompost with 15 November planting date was found suitable for total productivity and economic return of the system.

KEYWORDS

Productivity, vermicompost, complete block, fruit weight.

1. INTRODUCTION

Bangladesh ranked 3rd in global vegetable production, alongside China and India. Farmers are making a big profit from the cultivation of vegetables, which is changing their lives. Vegetables are gradually acknowledged as crucial for food and nutrition security (Pepijn et al., 2018). Today, the cheapest source of vitamins and minerals which are required for good health are vegetables. Squash is a newly arrival vegetable crop that cultivated mainly Rabi season in Bangladesh and its cultivation is gradually gaining popularity in various parts of Bangladesh. It is easy to cultivate and requires limited resources and time, which makes cultivating squash very profitable. Squash is rich in vitamin C, beta-carotene, folate, and fiber, making it a health benefiting food against diseases like cancers, heart disease, arthritis and asthma. (Mohammad et al., 2011). Most vegetables require fertilizer (organic and inorganic) for growth and optimum yield. The nutrient requirement of squash is generally high due to lots of biomass been produced by the plant (Oloyede et al., 2013).

Organic fertilizers releases nutrients overtime thereby creating a healthy

growing environment, while a fast release of nutrients is provided by inorganic fertilizers. Manures are a good source of fertilizer as they are natural products used to provide nutrients to plant by farmers. Inorganic fertilizers application tends to release fast nutrients to sustain soil fertility and crop production and it has led to reduced crop yield, soil acidity and nutrient imbalance (Agbede et al., 2008; Uyovbisere et al., 2000). Fertility and nutrient status of the soil is a major factor for improving crop yield and quality (Kolodziej, 2006). The amount of fertilizer used as soil amendment, including organic and inorganic fertilizers have a positive impact on the availability of nutrients for the crop and nutrients status of the soil (Bijlsma et al., 2000). Thus, the use of different organic fertilizers solely or in combination with inorganic fertilizer enhanced yield and quality of crop (Zhang and Fana, 2007). Soil amelioration and improvement via integrated soil fertility management strategy including organic and inorganic fertilizer is a major intervention component that has improved crop production worldwide (Chand et al., 2006).

Vermicompost enhances the effect of soil microbial activity, increases oxygen supply, retains normal soil temperature, increases soil porosity and water penetration, improves nutrient content and increases plant

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growth, yield and quality (Arora et al., 2011). Poultry manure is another successful soil amendment that provides nutrients for crop growth and when applied in the proper amount, enhances soil quality because it is rich in organic matter content and other nutrient elements required for plant growth. (Van Ryssen et al., 1993). Egerszegi stated that with the use of poultry manure, the soil bulk density was reduced while the water-soluble properties and carbon content were increased (Egerszegi, 1990). Nutrient shortage due to inappropriate use of fertilizer is a major problem for sustainable vegetable production. (Shaheen et al., 2010). Ideal nutrient supply is essential for plant development and yield (Liu et al., 2010). In the tropics, soils fertility declining from excessive rainfall and continuous cultivation have led to the soils lacking essential nutrients (Obalum et al., 2012). A combination of both organic and inorganic sources of nutrients for crops are becoming major aspects of environmentally smart agriculture. The trial was laid out to find out the integrated effect of chemical fertilizers with organic manures to achieve the maximum economic return on growth yield and quality of Squash.

2. MATERIALS AND METHODS

The experiment was conducted at the research field of Agricultural Research Station, BARI, Rajbari, Dinajpur (Latitude: 25.63671° N; Longitude: 88.65269° E) during *rabi* season of 2018-19 and 2019-20. Maximum, minimum temperature and total rainfall during the cropping period have been presented in Fig. 1. Soil texture of the experiment field was clay loam to sandy loam having 6.05 P_H, 2.10% organic matter, 0.10% total nitrogen, 42.12 µgml⁻¹ available phosphorous, 0.12 meq 100g⁻¹ soil available potassium, 8.09 µgml⁻¹ sulphur, 0.79 µg ml⁻¹ boron and 0.38 µg ml⁻¹ zinc. Two different dates of planting viz. 15 November and 30 November considered as factor A and different organic manures viz., vermicompost, poultry manure and cowdung considered as factor B. The experiment was laid out in randomized complete block (RCB) design (Factorial) with three replications. The unit plot size was 5.0m×4.0m. Squash spacing was 100cm×80cm and squash var. Bulam House was used in the experiment.

Fifteen days old squash seedlings were transplanted according to the treatments. The land of the experimental plot was prepared with a power tiller by ploughing and cross ploughing followed by laddering and the soil was brought into good tilth. The crop was fertilized as per treatments with a blanket dose @ N_{80.64}P₃₅K₁₇S₁₈Zn_{4.3}B_{1.7} kg/ha and Organic manures viz; Vermicompost, poultry manure and Cowdung were applied 3 t ha⁻¹, 5 t ha⁻¹ and 3 t ha⁻¹ respectively. The sources of N, P, K, S, Zn and B were urea, triple super phosphate (TSP), muriate of potash (MOP), gypsum, zinc sulphate and boric acid, respectively. All organic manures will be applied at the time of final land preparation. All of phosphorus, sulphur, zinc and boron were applied in pit before one week of transplanting seedlings. Nitrogen and potassium were applied in three equal splits at 15, 30, and 45 DAT as ring method around the plants and mixed thoroughly with the soil.

Fungicide (Indofil M-45) @ 1ml/liter water was sprayed at every 10 days interval beginning from 25 days after planting to 70 days after planting for preventing fungal disease as well as Confidor and vertimec were done to control aphid, jassids, thrips, white fly and mite. Pheromone traps (Cue lure) were used to control cucurbit fruit fly in the squash field @ 100 traps/ha from 30days after planting up to harvesting of squash (Cork et al., 2003). Squash was harvested upon maturity from the last week of January to first week of March in both the years. Data on yield contributing parameters of squash such as plant height (cm), days to flowering, fruit plant⁻¹ (no.), fruit length (cm), fruit diameter (cm), individual fruit wt.(g) and fruit yield (t ha⁻¹) were recorded. Intercultural operations like watering, weeding and pest control were done as and when required. Yield components of squash were taken from randomly selected 10 plants from each plot. Fruit yield was taken from whole plot. Collected data were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test (Gomez and Gomez. 1984).

Table 1: Nutrient status of vermicompost, poultry manure and cowdung used in the experimental field

Organic manure	PH	OM %	K	Total N	P	S	B	Zn
Vermicompost	6.9	24.80	1.02	1.21	2.0	0.88	0.017	0.10
Poultry manure	7.9	17.69	0.88	2.11	2.52	0.89	0.013	0.13
Cowdung	6.6	11.68	0.55	1.12	1.30	0.35	0.015	0.14

Moisture content of VC= 12.50% PM= 12.30% and CD= 12.50%

Figure 1: Average maximum temperature, minimum temperature and rainfall during the cropping period from 2018-20 at ARS, BARI, Dinajpur

3. RESULTS AND DISCUSSION

3.1 Effect of Planting date

Planting time also significantly influenced the yield and yield contributing characters viz., days to flowering, plant height, fruit plant⁻¹, fruit length, fruit diameter, individual fruit weight and fruit yield (Table 2). The days required for flowering was found the earliest (61.11 days) at 30 November planting date (P₂) while the flowering was detected delayed (66.77 days) at 15 November planting date (P₁). Similar trend was found in case of first harvesting. Plant height of squash was significantly influenced by planting date. The highest plant height (35.46 cm) was obtained from 15 November planting date (P₁) and lowest was obtained from 30 November planting date (P₂) (30.73 cm). The highest number of fruits (4.72) were recorded from 15 November planting date (P₁) and the lowest number of fruits (3.34) were recorded at 30 November planting date (P₂).

The maximum fruit length (46.26 cm) was recorded from 15 November planting date (P₁) and the lowest fruit length (33.09 cm) was recorded from 30 November planting date (P₂). On the other hand, the maximum fruit diameter (7.36 cm) was recorded from 15 November planting date (P₁) and the minimum fruit diameter (6.60 cm) was counted from 30 November planting date (P₂). The highest fruit weight per plant (1747.11 g) was obtained from 15 November planting date (P₁) and the lowest fruit weight per plant (1196.44 g) was obtained from 30 November planting date (P₂). The highest marketable fruit yield was recorded (29.61 t ha⁻¹) from 15 November planting date (P₁) whereas the lowest fruit yield (25.86 t ha⁻¹) was recorded from 30 November planting date (P₂). This may be because of the maximum size of the fruit, the average weight of the fruit and the number of fruits per plant. This finding was supported by some researchers reported that early sowing significantly increases plant height, fruit/plant, fruit size and ultimately increase total productivity (Wadas et al., 2011).

Table 2: Effect of planting time on the yield and yield contributing characters of squash (Pooled average of 2018-19 and 2019-20)

Planting date	Plant height (cm)	Days to flowering (days)	Fruit/Plant (no.)	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Yield (t ha ⁻¹)
15 November (P ₁)	35.46	66.77	4.72	46.26	7.36	1747.11	29.61
30 November (P ₂)	30.73	61.11	3.34	33.09	6.60	1196.44	25.86
LSD (0.05)	1.55	3.21	0.40	7.08	0.28	118.39	1.53
CV (%)	4.46	4.77	9.45	16.98	3.77	7.65	5.25

3.2 Effect of organic manures

Application of organic manures significantly influenced the days to flowering, plant height, fruit plant⁻¹, fruit length, fruit diameter, individual fruit weight and fruit yield (Table 3). The earliest flowering was detected at cowdung (N₃) application treatment (63.66 days) followed by poultry manure (N₂) application treatment (63.67 days). Application of organic manures exhibited a significant influence on plant height of squash. The tallest plant height was measured from vermicompost (N₁) application treatment and the shortest was recorded from cowdung (N₃) application treatment. The results indicated that higher fertilizer dose enhanced crop growth. Similar trend was observed in the case of fruit/plant (Table 3). The higher number of fruit plant⁻¹ was recorded in vermicompost (N₁) followed by that in poultry manure (N₂) and the lowest in cowdung (N₃).

application treatment in both years. More number of fruits/plants is related with the vegetative growth of the plant.

When the plants have increased number of leaves (food factory) this will result in vigorous growth of plants. Hence nutrition is responsible for the vigorous growth of plants (vegetative) and resulted in a greater number of leaves, which gives more number of fruits/plant ultimately. Similar results have been reported (Aminifard et al., 2010; Biswas et al., 2015; Khanum et al., 2020). The maximum (44.71 cm) fruit length was recorded from vermicompost (N_1) application treatment and the minimum (35.06 cm) length of fruit was recorded in cowdung (N_3) application treatment. Similar trend was observed in the case of fruit diameter (Table 3). Individual fruit weight was the highest in vermicompost (N_1) application treatment (1707.50) and lowest in cowdung (N_3) application treatment (1233.17). Fruit yield was recorded the highest in N_1 (vermicompost) (32.43 t/ha) followed by N_2 (poultry manure) (27.26 t/ha) and producing the lowest in N_3 (cowdung) (23.52 t/ha).

Table 3: Effect of Organic manures on the yield and yield contributing characters of squash (Pooled average of 2018-19 and 2019-20)

Organic manures	Plant height (cm)	Days to flowering (days)	Fruit/Plant (no.)	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Yield (tha ⁻¹)
Vermicompost (N_1)	36.73	64.50	5.03	44.71	7.81	1707.50	32.43
Poultry manure (N_2)	32.60	63.67	4.02	39.27	6.87	1474.66	27.26
Cowdung (N_3)	29.96	63.66	3.05	35.06	6.28	1233.17	23.52
LSD (0.05)	1.90	3.93	0.49	8.67	0.34	145.00	1.87
CV (%)	4.46	4.77	9.45	16.98	3.77	7.65	5.24

3.3 Combined effect of planting time and organic manures of squash

Combined effect of organic manures and planting time had influenced on different yield parameters (Table 4). The earliest (60.00 days) flowering was found in cowdung (N_3) with 30 November planting date. Similarly, the plant height (39.86cm), number of fruits per plant (4.27), fruit size (51.12 cm × 8.33 cm), individual fruit weight (2153.66 g) of vermicompost (N_1) with 15 November planting date showed better performance than other combinations. The highest marketable fruit yield (34.06 tha⁻¹) was obtained from vermicompost (N_1) with 15 November planting date followed by poultry manure (N_2) with 15 November planting date (30.78 tha⁻¹) whereas, the lowest yield (20.56 tha⁻¹) was recorded from cowdung with 30 November planting dates.

Table 4: Combined effect of organic manures and planting time on the yield and yield contributing characters of squash (Pooled average of 2018-19 and 2019-20)

Combined effect	Plant height (cm)	Days to flowering (days)	Fruit/Plant (no.)	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Yield (tha ⁻¹)
N_1P_1	39.86	67.00	5.90	51.12	8.33	2153.66	34.06
N_2P_1	35.00	67.33	4.60	45.94	7.18	1726.66	30.78
N_3P_1	31.53	66.00	3.66	41.71	6.58	1361.00	26.47
N_1P_2	33.60	62.00	4.16	38.29	7.28	1261.33	28.28
N_2P_2	30.20	60.00	3.43	32.58	6.55	1222.66	26.23
N_3P_2	28.40	61.33	2.43	28.40	5.99	1105.33	20.56
LSD (0.05)	2.50	4.95	1.96	10.81	8.19	180.38	2.47
CV (%)	4.46	4.77	9.45	16.98	3.77	7.65	5.25

N_1 = Vermicompost, N_2 = Poultry manure, N_3 = cowdung, P_1 = 10 November planting date, P_2 = 30 November planting date

Figure 2: Effect of different organic manures on 15 November planting date

Table 5: Correlation among the characters studied in the experiment (Pooled average of 2018-19 and 2019-20)

	Plant height (cm)	Fruit/plant (no.)	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Yield (tha ⁻¹)
Days to flowering	0.71	0.70	0.89	0.59	0.80	0.69
Plant height		0.99**	0.93*	0.98**	0.94	0.95**
Fruit/plant			0.93**	0.98**	0.93*	0.98***
Fruit length				0.87	0.92*	0.93**
Fruit diameter					0.88*	0.94***
Individual fruit wt.						0.89**

3.4 Correlation study

Correlation coefficient among different characters has been presented in Table 5. Fruit yield showed significant positive correlation almost all other characters except days to flowering ($r=0.69$). Plant height showed a positive and significant relationship with fruit plant⁻¹ (0.99**), fruit length (0.93*), fruit diameter (0.98**) and fruit yield (0.95**). Fruit/plant also exhibit significant positive association with all parameters. Fruit length has a significant positive correlation with all the characters whereas insignificant positive correlation showed with days to flowering which could be the factor for selection to improve the yield. Fruit diameter showed a positive and significant relationship with plant height (0.98**), fruit/plant (0.98**). Individual fruit weight has significant and positive correlation with fruit/plant (0.93*), fruit length (0.92*), and fruit diameter (0.88*). The findings are in agreement with the findings of (Uddain et al., 2019). The yield of squash was positively correlated with fruit length, fruit diameter, fruit/plant and Individual fruit weight.

3.5 Economic evaluation

The cost and return analysis of different treatments are presented in Table 6. The result reported that the highest gross return (Tk. 340600 ha⁻¹) as well as gross margin (Tk. 245600 ha⁻¹) was obtained in vermicompost with 15 November planting date followed by that in poultry manure with 15 November planting date and the lowest gross return (Tk. 205600 ha⁻¹) and gross margin (Tk. 122600 ha⁻¹) were obtained from the cowdung with 30 November planting date. The highest BCR (3.58) was also obtained from the vermicompost with 15 November planting date.

Table 6: Combined effect of organic manures and planting time on economics of squash cultivation (Average of two years)

	Gross Return	Total variable cost	Gross Margin	Benefit cost Ratio
N_1P_1	340600	95000	245600	3.59
N_2P_1	307800	95000	212800	3.24
N_3P_1	264700	83000	181700	3.18
N_1P_2	282800	88500	194300	3.19
N_2P_2	262300	88500	173800	2.96
N_3P_2	205600	83000	122600	2.47

Squash= Tk. 10 kg⁻¹, N_1 = Vermicompost, N_2 = Poultry manure, N_3 = cowdung, P_1 = 10 November planting date, P_2 = 30 November planting date

4. CONCLUSION

On the basis of experimental results, it is clearly observed that application of organic manures significantly increased the plant height, fruit plant⁻¹, fruit length, fruit diameter, individual fruit weight and fruit yield. Application of vermicompost at 15 November planting date appeared as the best combination for maximizing the yield of squash as well as soil improvement of Old Himalayan piedmont plain under AEZ-1. Organic manures (PM & CD) with chemical fertilizer 15 November planting date may be alternative source of improvement of soil health as well as yield of squash.

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