



Effects of Organic Amendments on Yield Performance of Winter and Summer Seasons Vegetables at Charlands in Bangladesh

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Abstract

The experiment was conducted at the farmer's fields of Charlands in Bangladesh during November 2020 to July 2021 to investigate the effects of different organic fertilizers along with inorganic fertilizers on growth and yield of different crops. The experiments were established in a randomized complete block design using six treatments and three replications. Treatments of the experiments were T1 = FP (Farmers' Practice) (Control), T2 = RF (Recommended Fertilizer) + Vermicompost (3t/ha), T3 = RF (Recommended Fertilizer) + Quick Compost (3t/ha), T4 = RF (Recommended Fertilizer) + Standard Organic Fertilizers (3t/ha), T5 = RF (Recommended Fertilizer) + Poultry Manure (3t/ha) and T6 = RF (Recommended Fertilizer) + Biochar (3t/ha). Results of the experiment showed that application of organic manures along with inorganic fertilizers produced significant ($p < 0.05$) variation in yield and production contributing characters of pumpkin, sweet potato and indian spinach compared to Farmer's practice. During winter trial for pumpkin experiments, among the Charlands, the maximum yield per plant 84.86kg was recorded in T6 treatment and the minimum yield per plant 23.29kg was obtained from T1 treatment from Naobhangar Char. Among the Charlands, the highest total income 1270000.00 tk/ha was recorded in T6 treatment and the lowest total income 349400.00 tk/ha was obtained from T1 treatment from Naobhangar Char. Among the Charlands, the highest BCR 3.37 was recorded in T6 treatment and the lowest BCR 0.90 was obtained from T1 treatment from Naobhangar Char. During winter trial for sweet potato experiments among the Charlands, the maximum fresh yield of tuber 95.23t/ha was recorded in T5 treatment and the minimum fresh yield of tuber 35.49t/ha was obtained from T1 treatment from Char Shaluka. Among the Charlands, the maximum total income 1430000.00 tk/ha was recorded in T5 treatment and the minimum total income 532400.00 tk/ha was obtained from T1 treatment from Char Shaluka. Among the Charlands, the maximum BCR 3.65 was recorded in T5 treatment but the minimum BCR 1.08 was obtained from T1 treatment from Char Shaluka. During summer trial, for pumpkin experiments among the Charlands, the highest total yield per plant 86.08kg was recorded in T6 treatment while the lowest total yield per plant 28.72kg was obtained from T1 treatment from Naobhangar Char. Among the Charlands, the highest total income 1290000.00 tk/ha was recorded in T6 treatment while the lowest 430794.00 tk/ha was obtained from T1 treatment from Naobhangar Char. Among the Charlands, the highest BCR 3.41 was recorded in T6 treatment while the lowest BCR 1.12 was obtained from T1 treatment from Naobhangar Char. During summer trial, for indian spinach experiments among the Charlands, the highest total fresh

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yield 61.30 t/ha was recorded in T6 treatment from Maijbari Char but the minimum total fresh yield 45.18 t/ha was obtained from T1 treatment from Naobhangar Char. Among the Charlands, the highest total income 919450.00 tk/ha was recorded in T6 treatment from Maijbari Char but the lowest total income 677700.00 tk/ha was obtained from T1 treatment from Naobhangar Char. Among the Charlands, the highest BCR 2.45 was recorded in T6 treatment from Maijbari Char but the lowest BCR 1.78 was obtained from T1 treatment from Naobhangar Char. Comparatively higher yield and production of different crops were obtained from biochar and poultry manure treated fields

Keywords: Charlands, organic fertilizers, Biochar, poultry manure, BCR.

Introduction

Bangladesh is a country of rivers, has been shaped by accumulation of sediments carried by the combined flow of the 3 mighty rivers: The Ganges, the Brahmaputra and the Meghna Rivers. These rivers are morphologically very dynamic, forming chars between their channels and wearing these depositional options in addition because the major riverbanks. The accretion and erosion are not confined to inland areas only, but spread to estuary and coastal areas of the country. This has dramatic values within the lives of native individuals, shifting between 200,000 and up to one million individuals per annum (Alam. *et al.*, 2017; Elahi. *et al.*, 1991; Ferdous. *et al.*, 2019). Eight districts of Bangladesh (Kurigram, Gaibandha, Jamalpur, Bogra, Sirajganj, Tangail, Pabna and Manikganj) belong to the erosion-prone zone on the Jamuna stream, another eight districts (Rajbari, Faridpur, Pabna, Manikganj, Dhaka, Munshiganj, Shariatpur, and Chandpur) on the Padma stream and five districts (Barisal, Bhola, Chandpur, Lakshmipur, and Noakhali) on the lower Meghna stream. Around 30–40% of the country's population sleeps in these erosion-prone areas (Naz. 2019). Pumpkin is one of the main cucurbitaceous fruit vegetables grown all around Bangladesh. The crop is diversely called 'Misti kumra' or 'Misti lau' or 'Misti kadu' in numerous components of Bangladesh and is consumed by most of the folks of the country. Its fruits are extensively used as vegetables each in immature and mature stage. The yellow and orange flesh fruits are terribly wealthy in carotene that is that the precursor of antiophthalmic factor with Vitamins B and C,

and it's significantly necessary for the provision of antioxidants and particularly carotenoids in foods (Gupta and Rai, 1990). Pumpkins are very popular with farmers because of their deliciousness, high nutritional value, excellent shelf life, long availability, and better transportation options (Hazra. *et al.*, 2007; Rashid. 1999). For these reasons pumpkin's demand is increasing day by day in the country. Pumpkin grows mostly two seasons in Bangladesh. The contribution of pumpkin in production of total vegetables is nearly 14% (8% in rabi and 6% in kharif seasons) (BBS, 2013). Pumpkin may be a very popular vegetable in several tropical and subtropic countries. In Bangladesh it ranks next to eggplant and radish in space beneath cultivation (9,600ha) and production (38,500t/annum) (BBS, 2009). Pumpkin positions third in respect of both area and production following to brinjal and radish. In Bangladesh, pumpkin occupies an area of 27,500 ha with an annual production of 2,18,000 tons accounting to an average yield of 7.93 t/ha (BBS, 2013) that is miserably low compared to other countries. The production of pumpkin more than 20 t/ha is enough (Rashid. 1999).

Sweet potato is the fourth important crop in Bangladesh after rice, wheat and potato (Delowar and Hakim, 2014). Sweet potato is mostly cultivated by the marginal farmers in an irregular way in different charlands and seasonally overwhelmed flood plains (Ahmed. *et al.*, 1998). Sweet potato is broadly grown in all the regions of Bangladesh predominantly by the side of rivers and in the charlands. Sweet potatoes were produced

about 0.31 million metric tons from 31.1 thousand ha of land in Bangladesh in the year 2009-10 (BBS, 2010). Bangladesh ranks 23 in the world in terms of sweet potato production in 2011 (FAOSTAT, 2012). In present time, Indian spinach occupies the most popular and nutritious vegetable crops in Bangladesh. Sweet potato is broadly grown in Bangladesh as well as in tropical Asia and Africa (Bose. *et al.*, 2008).

At present, frequent applications of inorganic fertilizers and pesticides are being used by the farmers to get a better productions of different field crops. These inorganic fertilizers and pesticides reduced soil fertility and initiated health problems to the consumers. Due to adverse effects of chemical fertilizers, interest has been stimulated for the use of organic manures (Alam. *et al.*, 2007). Therefore, the objective of this study was to determine the effects of different organic fertilizers along with inorganic fertilizers on yield and production of different crops in the study charlands of Bangladesh.

Materials and Methods

The experiment was conducted at the farmer's field in Char Shaluka of Sariakandi upazila in Bogura district, Naobhangar Char of Jamalpur Sadar upazila in Jamalpur district and Maijbari Char of Kazipur upazila in Sirajgonj district during November 2020 to March 2021 and March 2021 to July 2021 to investigate the effects of different organic fertilizers along with inorganic fertilizers application on growth and yield of some winter (pumpkin and sweet potato) and summer season (pumpkin and indian spinach) crops.

The experiments were established in a randomized complete block design using six treatments and three replications. Treatments of the experiments were T_1 = FP (Farmers' Practice) (Control), T_2 = RF (Recommended Fertilizer) + Vermicompost (3t/ha), T_3 = RF (Recommended Fertilizer) + Quick Compost (3t/ha), T_4 = RF (Recommended Fertilizer) + Standard Organic Fertilizers (3t/ha), T_5 = RF (Recommended Fertilizer) + Poultry Manure (3t/ha) and T_6 = RF (Recommended Fertilizer) + Biochar (3t/ha). In all the plots, chemical

fertilizer was applied in line with the fertilizer recommendation guide of the Bangladesh Agricultural Research Council (BARC, 2018). For pumpkin, the required amount of urea, TSP, MoP, gypsum, zinc sulphate and boric acid were as follows: Recommended Fertilizer (RF): N-P-K-S-Zn-B @ 100-48-80-28-3-2.1 kg/ha. For sweet potato the required amount of urea, TSP, MoP, gypsum, zinc sulphate and boric acid were as follows: Recommended Fertilizer (RF): N-P-K-S-Mg-Zn-B @ 140-60-140-20-12-3.0-1.5 kg/ha. For indian spinach the required amount of urea, TSP, MoP and gypsum were as follows: Recommended Fertilizer (RF): N-P-K-S @ 120-24-80-20kg/ha.

The field trials were conducted at the three selected sites (Char Shaluka, Naobhangar Char and Maijbari Char) of the projects. The test crops under the trial were pumpkin and sweet potato during November 2020 to March 2021. The test crops under the fourth trial were pumpkin and Indian spinach during March 2021 to July 2021.

Experimental yield and production data were collected and analyzed statistically with the help of computer package STATISTIX 10. The mean differences of the treatments were obtained from least significant difference (LSD) test at 5% level of probability for the interpretation of results (Gomez and Gomez, 1984).

Results and Discussion

Results of the Field Trial during November 2020 to March 2021

Number of Fruits Per Plant of Pumpkin in the Charlands

The pumpkin experiments showed a significant variation with regard to number of fruits per plant at all the Charlands. In Char Shaluka the number of fruits per plant ranged from 9.00 to 13.33 and the maximum number of fruits per plant 13.33 was recorded in T_6 (RF+ Biochar) treatment which was closely followed by T_2 , T_3 , T_4 and T_5 treatments but the minimum number of fruits 9.00 per plant was obtained from T_1 (Farmers' practice) treatment. In Naobhangar Char, the number of fruits per plant ranged from 7.00 to 13.66 and the highest number of fruits per plant

13.66 was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₂, T₃ and T₄ treatments but the lowest number of fruits 7.00 per plant was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the number of fruits per plant ranged from 8.66 to 12.66 and the maximum number of fruits per plant 12.66 was recorded in T₃ (RF+ Quick Compost) treatment which was closely followed by T₂, T₄, T₅ and T₆ treatments but the minimum number of fruits (8.66) per plant was obtained from T₁ (Farmers' practice) treatment (Table 1). (Ahmed. *et al.*, 2017) found fruits per plant ranged from 2.96 to 7.58. (Akter. *et al.*, 2013) showed that fruits per plant ranging from 1.52 to 4.60 in their experiment.

Average Fruit Weight (Kg) of Pumpkin in the Charlands

The pumpkin experiments indicated a significant variation with regard to average fruit weight at all the Charlands. In Char Shaluka, the average fruit weight ranged from 3.47kg to 6.27kg and the highest average fruit weight 6.27kg was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₄ treatment but the lowest average fruit weight 3.47kg was obtained from T₁(Farmers' practice) treatment. In Naobhangar Char, the average fruit weight ranged from 3.33kg to 6.21kg and the maximum average fruit weight 6.21kg was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₄ treatment but the minimum average fruit weight 3.33kg was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the average fruit weight ranged from 3.49kg to 6.28kg and the highest average fruit weight 6.28kg was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₄ treatment but the lowest average fruit weight 3.49kg was obtained from T₁ (Farmers' practice) treatment (Table 2). (Ahmed. *et al.*, 2011) reported significant variation present in average fruit weight and it ranged from 1.51 to 4.20 kg. (Pandey. *et al.*, 2003) obtained that the average fruit weight of pumpkin in the range of 1.33 to 9.10 kg. (Ahmed. *et al.*, 2017) obtained that the

average fruit weight ranged from 1.41 to 5.78 kg.

Fresh Fruit Yield Per Plant (Kg) of Pumpkin in the Charlands

The pumpkin experiments exposed a significant variation with regard to fruit yield per plant at all the Charlands. In Char Shaluka, the fruit yield per plant ranged from 31.12kg to 83.66kg and the maximum yield per plant 83.66kg was recorded in T₆ (RF+ Biochar) treatment but the minimum yield per plant 31.12kg was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the fruit yield per plant ranged from 23.29kg to 84.86kg and the highest yield per plant 84.86kg was recorded in T₆ (RF+ Biochar) treatment while the lowest yield per plant 23.29kg was obtained from T₁(Farmers' practice) treatment. In Maijbari Char, the fruit yield per plant ranged from 29.94kg to 77.36kg and the highest yield per plant 77.36kg was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₂, T₄ and T₅ treatments but the lowest yield per plant 29.94kg was obtained from T₁(Farmers' practice) treatment (Table 3). (Ahmed. *et al.*, 2011) obtained significant variation in yield per plant in different Pumpkin genotypes in the range of 5.94 to 36.12 kg.

Total Income (Tk/Ha) of Pumpkin in the Charlands

The pumpkin experiments revealed a significant variation due to long term incorporation of different organic amendments with regard to total income at all the Charlands. In Char Shaluka, the total income ranged from 466800.00 to 1260000.00 tk/ha and the maximum total income 1260000.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment but the minimum total income 466800.00 tk/ha was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the total income ranged from 349400.00 to 1270000.00 tk/ha and the highest total income 1270000.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment while the lowest total income 349400.00 tk/ha was obtained from T₁(Farmers' practice) treatment. In Maijbari Char, the total income ranged from 449200.00 to 1160000.00 tk/ha and the highest total

income 1160000.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment which was statistically similar with T₂, T₄ and T₅ treatments but the lowest total income 449200.00 tk/ha was obtained from T₁ (Farmers' practice) treatment (Table 4). Gross return of pumpkin 261760.14 tk/ha was found in their experiment (Begum. *et al.*, 2018).

Total Cost (Tk/Ha) at the Charlands of Pumpkin in the Charlands

The pumpkin experiments exposed a variation with regard to total cost at all the Charlands. In the Charlands, the total cost in T₁ (385559.00 tk/ha), T₂ (369233.32 tk/ha), T₃ (375233.32 tk/ha), T₄ (378233.32 tk/ha), T₅ (369233.32 tk/ha) and T₆ (378233.32 tk/ha). Moreover, the maximum total cost was recorded in T₁ (385559.00 tk/ha) treatment and minimum total cost was obtained from T₂ and T₅ (369233.32 tk/ha) treatments (Table 5). Production cost of pumpkin 128494 tk/ha was found in their experiment (Begum. *et al.*, 2018).

Benefit Cost Ratio (Bcr) (Total Cost Basis) of Pumpkin in the Charlands

The pumpkin experiments demonstrated a significant variation due to long term incorporation of different organic amendments with regard to BCR (Total cost basis) at all the Charlands. In Char Shaluka, the BCR ranged from 1.21 to 3.32 and the maximum BCR 3.32 was recorded in T₆ (RF+ Biochar) treatment but the minimum BCR 1.21 was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the BCR ranged from 0.90 to 3.37 and the highest BCR 3.37 was recorded in T₆ (RF+ Biochar) treatment while the lowest BCR 0.90 was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the BCR ranged from 1.17 to 3.07 and the highest BCR 3.074 was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₂, T₄ and T₅ treatments but the lowest BCR 1.17 was obtained from T₁ (Farmers' practice) treatment (Table 6). A benefit-cost ratio (BCR) of pumpkin was found 1.9 to 2.0 in their experiment (Begum. *et al.*, 2018).

Table 1: Effects of different organic manures for pit experiments with number of fruits per plant of pumpkin at the Charlands

Treatments	Number of fruits per plant		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	9.00b	7.00c	8.66b
T ₂	11.66a	11.66ab	11.66ab
T ₃	12.00a	11.66ab	12.66a
T ₄	11.66a	11.00ab	10.00ab
T ₅	11.66a	10.33b	12.00a
T ₆	13.33a	13.66a	12.33a
CV (%)	8.31	13.89	16.24
SE (±)	0.78	1.23	1.48

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 2: Effects of different organic manures for pit experiments with average fruit weight of pumpkin at the Charlands

Treatments	Average fruit weight (kg)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	3.47e	3.33d	3.49d
T ₂	5.43c	5.57b	5.34b
T ₃	4.66d	4.38c	4.54c
T ₄	6.14a	6.14a	6.27a
T ₅	5.66b	5.41b	5.51b
T ₆	6.27a	6.21a	6.28a
CV (%)	2.18	4.68	4.74
SE (±)	0.09	0.19	0.20

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 3: Effects of different organic manures for pit experiments with fresh fruit yield per plant of pumpkin at the Charlands

Treatments	Fresh fruit yield per plant (kg)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	31.12d	23.29c	29.94c
T ₂	63.37bc	65.15b	62.41ab
T ₃	56.06c	51.18b	57.74b
T ₄	71.60b	67.71b	62.79ab
T ₅	66.04bc	56.16b	65.96ab
T ₆	83.66a	84.86a	77.36a
CV (%)	9.08	15.88	16.75
SE (±)	4.59	7.52	8.11

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having

similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 4: Effects of different organic manures for pit experiments with total income of pumpkin at the Charlands

Treatments	Total income (tk/ha)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	466800.00d	349400.00c	449200.00c
T ₂	950550.00bc	977350.00b	936250.00ab
T ₃	841000.00c	767800.00b	866200.00b
T ₄	1070000.00b	1020000.00b	941900.00ab
T ₅	990600.00bc	842500.00b	989400.00ab
T ₆	1260000.00a	1270000.00a	1160000.00a
CV (%)	9.08	15.88	16.75
SE (±)	68895	112947.00	121796.00

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 5: Effects of different organic manures for pit experiments with total cost of pumpkin at the Charlands

Treatments	Total cost (tk/ha) at the Charlands
T ₁	385559.00
T ₂	369233.32
T ₃	375233.32
T ₄	378233.32
T ₅	369233.32
T ₆	378233.32

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha),

T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer.

Table 6: Effects of different organic manures for pit experiments with BCR (total cost basis) of pumpkin at the Charlands

Treatments	BCR (Total cost basis)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	1.21d	0.90c	1.17c
T ₂	2.57bc	2.65b	2.54ab
T ₃	2.24c	2.05b	2.31b
T ₄	2.84b	2.69b	2.49ab
T ₅	2.68b	2.28b	2.68ab
T ₆	3.32a	3.37a	3.07a
CV (%)	9.00	15.92	16.74
SE (±)	0.18	0.30	0.32

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Number of Tuberous Roots Per Plant of Sweet Potato in the Charlands

The sweet potato experiments showed a significant variation with regard to number of tubers roots per plant at all the Charlands. In Char Shaluka, the number of tubers roots per plant ranged from 37.00 to 55.00 and the maximum number of tubers roots per plant 55.00 was recorded in T₂ (RF+ Vermicompost) treatment which was closely followed by T₅ (RF+ Poultry Manure) treatment but the

lowest number of tubers roots per plant 37.00 was obtained from T₁(Farmers' practice) treatment. In Naobhangar Char, the number of tubers roots per plant ranged from 34.33 to 54.33 and the maximum number of tubers roots per plant 54.33 was recorded in T₂ (RF+ Vermicompost) treatment which was closely followed by T₄ and T₅ treatments but the lowest number of tubers roots per plant 34.33 was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the number of tubers roots per plant ranged from 41.33 to 53.33 and the maximum number of tubers roots per plant 53.33 was recorded in T₅ (RF+ Poultry Manure) treatment which was closely followed by T₂ (RF+ Vermicompost) treatment but the lowest number of tubers roots per plant 41.33 was obtained from T₁(Farmers' practice) treatment (Table 7). (Rahman. *et al.*, 2015) found that the number of tuberous roots per plant was 6.53 in their study report.

Fresh Yield of Biomass (T/Ha) of Sweet Potato in the Charlands

The sweet potato experiments indicated a significant variation with regard to fresh yield of biomass at all the Charlands. In Char Shaluka, the fresh yield of biomass ranged from 15.24t/ha to 40.52 t/ha and the maximum fresh yield of biomass 40.52 t/ha was recorded in T₃ (RF+ Quick Compost) treatment but the lowest fresh yield of biomass 15.24t/ha was obtained from T₁(Farmers' practice) treatment which was closely followed by T₆ (RF+ Biochar) treatment. In Naobhangar Char, the fresh yield of biomass ranged from 15.47t/ha to 41.67 t/ha and the maximum fresh yield of biomass 41.67 t/ha was recorded in T₃ (RF+ Quick Compost) treatment but the lowest fresh yield of biomass 15.47t/ha was obtained from T₁(Farmers' practice) treatment which was closely followed by T₆ (RF+ Biochar) treatment. In Maijbari Char, the fresh yield of biomass ranged from 15.46t/ha to 41.68t/ha and the maximum fresh yield of biomass 41.68t/ha was recorded in T₃ (RF+ Quick Compost) treatment but the lowest fresh yield of biomass 15.46t/ha was obtained from T₁(Farmers' practice) treatment which was closely followed by T₆ (RF+ Biochar) treatment (Table 8).

Fresh Yield of Tuber (T/Ha) of Sweet Potato In The Charlands

The sweet potato experiments indicated a significant variation with regard to fresh yield of tuber at all the Charlands. In Char Shaluka, the fresh yield of tuber ranged from 35.49t/ha to 95.23t/ha and the maximum fresh yield of tuber 95.23t/ha was recorded in T₅ (RF+ Poultry Manure) treatment but the lowest fresh yield of tuber 35.49t/ha was found from T₁ (Farmers' practice) treatment. In Naobhangar Char, the fresh yield of tuber ranged from 36.33t/ha to 95.02t/ha and the maximum fresh yield of tuber 95.02t/ha was recorded in T₅ (RF+ Poultry Manure) treatment but the lowest fresh yield of tuber 36.33t/ha was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the fresh yield of tuber ranged from 35.60t/ha to 94.65t/ha and the maximum fresh yield of

tuber 94.65t/ha was recorded in T₅ (RF+ Poultry Manure) treatment which was similarly followed by T₄ (RF+ Standard Organic Fertilizer) treatment on the other hand, the lowest fresh yield of tuber 35.60t/ha was obtained from T₁ (Farmers' practice) treatment (Table 9). Ahmed. *et al.* (2015) showed 23.12 t/ha average production of tuber in their report. Rahman. *et al.* (2015) found yield of tuber 22.83 t/ha in their experiment. The average yield of sweet potato was found 23.12 tons/ha in their experiment (Ahmed. *et al.*, 2015).

Total Income (Tk/Ha) of Sweet Potato in The Charlands

The potato experiments presented a significant variation due to long term incorporation of different organic amendments with regard to total income at all the Charlands. In Char Shaluka, the total income ranged from 532400.00 to 1430000.00 tk/ha and the maximum total income 1430000.00 tk/ha was recorded in T₅ (RF+ Poultry Manure) treatment but the minimum total income 532400.00 tk/ha was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the total income ranged from 545050.00 to 1430000.00 tk/ha and the highest total income 1430000.00 tk/ha was recorded in T₅ (RF+ Poultry Manure) treatment while the lowest total income 545050.00 tk/ha was obtained from T₁(Farmers' practice) treatment. In Maijbari Char, the total income ranged from 534050.00 to 1420000.00 tk/ha and the highest total income 1420000.00 tk/ha was recorded in T₅ treatment which was similar with T₆ treatment but the lowest total income 534050.00 tk/ha was obtained from T₁(Farmers' practice) treatment (Table 10). Gross margin of sweet potato was found Tk 30736/ha in the study (Awal. *et al.*, 2007). The Gross return of sweet potato was found BDT 167,663.5 per hectare in their experiment (Ahmed. *et al.*, 2015).

Total Cost (Tk/Ha) at The Charlands of Sweet Potato in The Charlands

The sweet potato experiments revealed a variation with regard to total cost at all the Charlands. In the Charlands, the total cost in

T₁ (491559.00 tk/ha), T₂ (391683.48 tk/ha), T₃ (397683.48 tk/ha), T₄ (400683.48 tk/ha), T₅ (391683.48 tk/ha) and T₆ (400683.48 tk/ha). Moreover, the maximum total cost was recorded in T₁ (491559.00 tk/ha) treatment and minimum total cost was obtained from T₂, T₃ and T₅ (391683.48 tk/ha) treatments (Table 11). Average cost of sweet potato Tk 28525/ha on total cost basis was found in the study (Awal. *et al.*, 2007). The total cost of sweet potato was found 84,904.57 BDT/ha in their experiment (Ahmed. *et al.*, 2015).

Benefit Cost Ratio (Bcr) (Total Cost Basis) of Sweet Potato in the Charlands

The sweet potato experiments demonstrated a significant variation due to long term incorporation of different organic amendments with regard to BCR (Total cost basis) at all the Charlands. In Char Shaluka,

the BCR ranged from 1.08 to 3.65 and the maximum BCR 3.65 was recorded in T₅ (RF+ Poultry Manure) treatment but the minimum BCR 1.08 was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the BCR ranged from 1.11 to 3.64 and the highest BCR 3.64 was recorded in T₅ treatment while the lowest BCR 1.11 was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the BCR ranged from 1.09 to 3.63 and the highest BCR 3.63 was recorded in T₅ treatment but the lowest BCR 1.09 was obtained from T₁ (Farmers' practice) treatment (Table 12). Average benefit-cost ratios (BCR) of sweet potato was obtained with 1.43 to 3.37 (Awal. *et al.*, 2007). Benefit-cost ratios (BCR) of sweet potato was found 1.97 in their experiment (Ahmed. *et al.*, 2015).

Table 7: Effects of different organic manures for field experiments with number of tuberous roots per plant of sweet potato at the Charlands

Treatments	Number of tuberous roots per plant		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	37.00d	36.33bc	35.66d
T ₂	55.00a	54.33a	53.00a
T ₃	35.00d	34.33c	34.66d
T ₄	50.00b	51.00a	48.33b
T ₅	53.00a	50.33a	53.33a
T ₆	40.33c	41.66b	41.33c
CV (%)	2.49	6.80	5.03
SE (±)	0.91	2.48	1.82

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 8: Effects of different organic manures for field experiments with fresh yield of biomass of sweet potato at the Charlands

Treatments	Fresh yield of biomass (t/ha)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	15.24c	15.47c	15.46c
T ₂	24.99b	24.90b	25.26b
T ₃	40.52a	41.67a	41.68a
T ₄	25.43b	25.77b	26.01b
T ₅	25.33b	25.63b	25.47b
T ₆	15.33c	16.67c	17.46c
CV (%)	1.36	3.16	7.44
SE (±)	0.27	0.64	1.53

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 9: Effects of different organic manures for field experiments with fresh yield of tuber of sweet potato at the Charlands

Treatments	Fresh yield of tuber (t/ha)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	35.49f	36.33f	35.60e
T ₂	75.32c	75.46c	74.82b
T ₃	46.25e	47.53e	47.34d
T ₄	90.38b	89.97b	91.64a
T ₅	95.23a	95.02a	94.65a
T ₆	69.83d	69.78d	70.45c
CV (%)	0.39	2.33	2.62
SE (±)	0.21	1.31	1.47

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 10: Effects of different organic manures for field experiments with total income of sweet potato at the Charlands

Treatments	Total income (tk/ha)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	532400.00f	545050.00f	534050.00e
T ₂	1130000.00c	1130000.00c	1120000.00b
T ₃	693800.00e	712950.00e	710150.00d
T ₄	1360000.00b	1350000.00b	1370000.00a
T ₅	1430000.00a	1430000.00a	1420000.00a
T ₆	1050000.00d	1050000.00d	1060000.00c
CV (%)	0.39	2.33	2.62
SE (±)	3283.80	19722.00	22144.00

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant

Table 11: Effects of different organic manures for field experiments with total cost of sweet potato at the Charlands

Treatments	Total cost (tk/ha) at the Charlands
T ₁	491559.00
T ₂	391683.48
T ₃	397683.48
T ₄	400683.48
T ₅	391683.48
T ₆	400683.48

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 12: Effects of different organic manures for field experiments with BCR (total cost basis) of sweet potato at the Charlands

Treatments	BCR (Total cost basis)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	1.08f	1.11f	1.09f
T ₂	2.89c	2.89c	2.86c
T ₃	1.75e	1.79e	1.78e
T ₄	3.38b	3.37b	3.43b
T ₅	3.65a	3.64a	3.63a
T ₆	2.61d	2.61d	2.64d
CV (%)	0.38	2.22	2.45
SE (±)	0.01	0.05	0.05

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Results of the Field Trial during March 2021 to July 2021

Total Number of Fruits Per Plant of Pumpkin in the Charlands

The pumpkin experiments showed a significant variation due to long term incorporation of different organic amendments with regard to total number of fruits per plant at all the Charlands. In Char

Shaluka the total number of fruits per plant ranged from 8.89 to 13.64 and the maximum total number of fruits per plant 13.64 was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₂, T₃, T₄ and T₅ treatments but the minimum total number of fruits 8.89 per plant was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the total number of fruits per plant ranged from 7.70 to 13.88 and the highest total number of fruits per plant 13.66 was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₂ and T₃ treatments but the lowest total number of fruits 7.70 per plant was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the total number of fruits per plant ranged from 9.13 to 13.82 and the maximum total number of fruits per plant 13.82 was recorded in T₆ treatment which was closely followed by T₅ treatment but the minimum

total number of fruits (9.13) per plant was obtained from T₁ (Farmers' practice) treatment (Table 13). (Ahmed. *et al.*, 2017) found total fruits per plant ranged from 2.96 to 7.58. (Akter. *et al.*, 2013) showed that total fruits per plant ranging from 1.52 to 4.60 in their experiment.

Average Fruit Weight (Kg) of Pumpkin in the Charlands

The pumpkin experiments presented a significant variation due to long term incorporation of different organic amendments with regard to average fruit weight at all the Charlands. In Char Shaluka, the average fruit weight ranged from 3.86 to 5.84kg and the highest average fruit weight 5.84kg was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₃ and T₅ treatments but the lowest average fruit weight 3.86kg was obtained from T₁(Farmers' practice) treatment. In Naobhangar Char, the average fruit weight ranged from 3.73 to 6.20kg and the maximum average fruit weight 6.20kg was recorded in T₆ (RF+ Biochar) treatment but the minimum average fruit weight 3.73kg was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the average fruit weight ranged from 3.86 to 6.22kg and the highest average fruit weight 6.22kg was recorded in T₆ (RF+ Biochar) treatment but the lowest average fruit weight 3.86kg was obtained from T₁ (Farmers' practice) treatment (Table 14). (Ahmed. *et al.*, 2011) reported significant variation present in average fruit weight and it ranged from 1.51 to 4.20 kg. (Pandey. *et al.*, 2003) obtained that the average fruit weight of pumpkin in the range of 1.33 to 9.10 kg. (Ahmed. *et al.*, 2017) obtained that the average fruit weight ranged from 1.41 to 5.78 kg.

Total Fruit Yield Per Plant (Kg) Of Pumpkin in the Charlands

The pumpkin experiments demonstrated a significant variation due to long term incorporation of different organic amendments with regard to total fruit yield per plant at all the Charlands. In Char Shaluka, the total fruit yield per plant ranged from 34.25 to 72.12kg and the maximum total yield per plant 72.12kg was recorded in T₆

(RF+ Biochar) treatment which was closely followed by T₃ and T₅ treatments but the minimum total yield per plant 34.25kg was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the total fruit yield per plant ranged from 28.72 to 86.08kg and the highest total yield per plant 86.08kg was recorded in T₆ (RF+ Biochar) treatment while the lowest total yield per plant 28.72kg was obtained from T₁(Farmers' practice) treatment. In Maijbari Char, the total fruit yield per plant ranged from 35.24 to 85.96kg and the highest total yield per plant 85.96kg was recorded in T₆ (RF+ Biochar) treatment but the lowest yield per plant 35.24kg was obtained from T₁(Farmers' practice) treatment (Table 15). (Ahmed. *et al.*, 2011) obtained significant variation in total yield per plant in different pumpkin genotypes in the range of 5.94 to 36.12 kg.

Total Income (Tk/Ha) of Pumpkin in the Charlands

The pumpkin experiments unveiled a significant variation due to long term incorporation of different organic amendments with regard to total income at all the Charlands. In Char Shaluka, the total income ranged from 513795.00 to 1190000.00tk/ha and the maximum total income 1190000.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₃ and T₅ treatments but the minimum total income 513795.00 tk/ha was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the total income ranged from 430794.00 to 1290000.00 tk/ha and the highest total income 1290000.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment while the lowest total income 430794.00 tk/ha was obtained from T₁(Farmers' practice) treatment. In Maijbari Char, the total income ranged from 528604.00 to 1290000.00 tk/ha and the highest total income 1290000.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment but the lowest total income 528604.00 tk/ha was obtained from T₁(Farmers' practice) treatment (Table 16).

Total Cost (Tk/Ha) at the Charlands of Pumpkin in the Charlands

The pumpkin experiments displayed a variation with regard to total cost at all the Charlands. In the Charlands, the total cost in T₁ (385559.00 tk/ha), T₂ (369233.32 tk/ha), T₃ (375233.32 tk/ha), T₄ (378233.32 tk/ha), T₅ (369233.32 tk/ha) and T₆ (378233.32 tk/ha). Moreover, the maximum total cost was recorded in T₁ (385559.00 tk/ha) treatment and minimum total cost was obtained from T₂ and T₅ (369233.32 tk/ha) treatments (Table 17).

Benefit Cost Ratio (Bcr) (Total Cost Basis) of Pumpkin in the Charlands

The pumpkin experiments showed a significant variation due to long term incorporation of different organic amendments with regard to BCR (Total cost

basis) at all the Charlands. In Char Shaluka, the BCR ranged from 1.33 to 3.16 and the maximum BCR 3.16 was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₂, T₃ and T₅ treatments but the minimum BCR 1.33 was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the BCR ranged from 1.12 to 3.41 and the highest BCR 3.41 was recorded in T₆ (RF+ Biochar) treatment while the lowest BCR 1.12 was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the BCR ranged from 1.37 to 3.41 and the highest BCR 3.41 was recorded in T₆ (RF+ Biochar) treatment but the lowest BCR 1.37 was obtained from T₁ (Farmers' practice) treatment (Table 18). A benefit-cost ratio (BCR) of pumpkin was found 2.40 to 2.46 in their study (Khatun. *et al.*, 2017.)

Table 13: Effects of different organic manures for pit experiments with total number of fruits per plant of pumpkin at the Charlands

Treatments	Total number of fruits per plant		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	8.89 b	7.70c	9.13c
T ₂	12.29a	12.06ab	12.05b
T ₃	12.42a	12.12ab	11.60b
T ₄	12.15a	11.20b	10.86bc
T ₅	12.54a	11.72b	12.57ab
T ₆	13.64 a	13.88a	13.82a
CV (%)	6.85	10.21	8.18
SE (±)	0.67	0.95	0.78

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 14: Effects of different organic manures for pit experiments with average fruit weight of pumpkin at the Charlands

Treatments	Average fruit weight (kg)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	3.86d	3.73e	3.86e
T ₂	5.54b	5.58bc	5.24d
T ₃	5.58ab	5.38cd	5.55c
T ₄	5.21c	5.14d	5.28d
T ₅	5.75ab	5.75b	5.85b
T ₆	5.84a	6.20a	6.22a
CV (%)	2.93	2.87	2.17
SE (±)	0.13	0.12	0.09

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 15: Effects of different organic manures for pit experiments with total fruit yield per plant of pumpkin at the Charlands

Treatments	Total fruit yield per plant (kg)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	34.25c	28.72c	35.24d
T ₂	68.12b	67.36b	63.26c
T ₃	69.50ab	65.29b	64.36c
T ₄	63.34b	57.75b	57.31c
T ₅	72.12ab	67.37b	73.40b
T ₆	79.61a	86.08a	85.96a
CV (%)	8.99	11.32	7.49
SE (±)	4.73	5.74	3.87

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of

Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 16: Effects of different organic manures for pit experiments with total income of pumpkin at the Charlands

Treatments	Total income (tk/ha)		
	Char Shaluka	Naobhangar Char	Maijbari Char
T ₁	513795.00c	430794.00c	528604.00d
T ₂	1020000.00b	1010000.00b	948830.00c
T ₃	1040000.00ab	979368.00b	965350.00c
T ₄	950144.00b	866289.00b	859621.00c
T ₅	1080000.00ab	1010000.00b	1100000.00b
T ₆	1190000.00a	1290000.00a	1290000.00a
CV (%)	8.99	11.32	7.49
SE (±)	71013.00	86082.00	58021.00

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ

significantly as per LSD at 5% level of significant.

Table 17: Effects of different organic manures for pit experiments with total cost of pumpkin at the Charlands

Treatments	Total cost (tk/ha) at the Charlands
T ₁	385559.00
T ₂	369233.32
T ₃	375233.32

T ₄	378233.32
T ₅	369233.32
T ₆	378233.32

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer.

Table 18: Effects of different organic manures for pit experiments with BCR (total cost basis) of pumpkin at the Charlands

Treatment s	BCR (Total cost basis)		
	Char Shaluk a	Naobhanga r Char	Maijbar i Char
T ₁	1.33c	1.12c	1.37d
T ₂	2.77ab	2.74b	2.57c
T ₃	2.78ab	2.61b	2.57c
T ₄	2.51b	2.29b	2.27c
T ₅	2.93ab	2.74b	2.98b
T ₆	3.16a	3.41a	3.41a
CV (%)	8.98	11.29	7.52
SE (±)	0.19	0.23	0.16

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Plant Height (Cm) of Indian Spinach in the Charlands

The indian spinach experiments presented a significant variation due to long term incorporation of different organic amendments with regard to plant height at all the Charlands. In Char Shaluka, the plant height ranged from 56.72 to 69.29 cm and the highest average fruit weight 69.29 cm was recorded in T₆ (RF+ Biochar) treatment but the lowest plant height

56.72 cm was obtained from T₁(Farmers' practice) treatment. In Naobhangar Char, the plant height ranged from 54.39 to 68.96 cm and the maximum plant height 68.96 cm was recorded in T₆ (RF+ Biochar) treatment which was closely similar to T₅ treatment but the minimum plant height 54.39 cm was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the plant height ranged from 54.72 to 68.95 cm and the highest plant height 68.95 cm was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₅ treatment but the lowest plant height 54.72 cm was obtained from T₁ (Farmers' practice) treatment (Table 19). (Hamid. *et al.*, 1989) found that the highest plant height of indian spinach was 85.25 cm in their experiment.

Total Fresh Yield (T /Ha) of Indian Spinach in the Charlands

The indian spinach experiments presented a significant variation due to long term incorporation of different organic amendments with regard to total fresh yield at all the Charlands. In Char Shaluka, the total fresh yield ranged from 46.51 to 60.30 t/ha and the highest total fresh yield 60.30 t/ha was recorded in T₆ (RF+ Biochar) treatment but the lowest total fresh yield 46.51 t/ha was obtained from T₁(Farmers' practice) treatment. In Naobhangar Char, the total fresh yield ranged from 45.18 to 60.63 t/ha and the maximum total fresh yield 60.63 t/ha was recorded in T₆ (RF+ Biochar) treatment but the minimum total fresh yield 45.18 t/ha was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the total fresh yield ranged from 46.52 to 61.30 t/ha and the highest total fresh yield 61.30 t/ha was recorded in T₆ (RF+ Biochar) treatment but the lowest total fresh yield 46.52 t/ha was obtained from T₁ (Farmers' practice) treatment (Table 20). The significantly maximum Indian Spinach yield was recorded (55.01 ton/ha) in their experiment (Basunia. *et al.*, 2020). (Hamid. *et al.*, 1986) reported that the highest

yield of Indian Spinach (79.34 ton/ha) was obtained in their experiment.

Total Income (Tk/Ha) of Indian Spinach in the Charlands

The indian spinach experiments demonstrated a significant variation due to long term incorporation of different organic amendments with regard to total income at all the Charlands. In Char Shaluka, the total income ranged from 697700.00 to 904450.00 tk/ha and the maximum total income 904450.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment but the minimum total income 697700.00 tk/ha was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the total income ranged from 677700.00 to 909450.00 tk/ha and the highest total income 909450.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment while the lowest total income 677700.00 tk/ha was obtained from T₁(Farmers' practice) treatment. In Maijbari Char, the total income ranged from 697700.00 to 919450.00 tk/ha and the highest total income 919450.00 tk/ha was recorded in T₆ (RF+ Biochar) treatment but the lowest total income 697700.00tk/ha was obtained from T₁(Farmers' practice) treatment (Table 21).

Total Cost (Tk/Ha) at the Charlands of Indian Spinach in the Charlands

The indian spinach experiments revealed a variation with regard to total cost at all the Charlands. In the Charlands, the total cost in T₁ (379559.00 tk/ha), T₂ (366224.32 tk/ha), T₃ (372224.32 tk/ha), T₄ (375224.32 tk/ha), T₅ (366224.32 tk/ha) and T₆ (375224.32 tk/ha). The maximum total cost was recorded in T₁ (379559.00 tk/ha) treatment and minimum total cost was obtained from T₂ and T₅ (366224.32 tk/ha) treatments (Table 22).

Benefit Cost Ratio (BCR) (Total Cost Basis) of Indian Spinach in the Charlands

The indian spinach experiments unveiled a significant variation due to long term incorporation of different organic amendments with regard to BCR (Total cost basis) at all the Charlands. In Char Shaluka, the BCR ranged from 1.84 to 2.41 and the maximum BCR 2.41 was recorded in T₆ (RF+ Biochar) treatment which was closely

followed by T₅ treatment but the minimum BCR 1.84 was obtained from T₁ (Farmers' practice) treatment. In Naobhangar Char, the BCR ranged from 1.78 to 2.42 and the highest BCR 2.42 was recorded in T₆ (RF+ Biochar) treatment which was closely followed by T₅ treatment while the lowest BCR 1.78 was obtained from T₁ (Farmers' practice) treatment. In Maijbari Char, the BCR ranged from 1.85 to 2.45 and the highest BCR 2.45 was recorded in T₆ (RF+ Biochar) treatment but the lowest BCR 1.85 was obtained from T₁ (Farmers' practice) treatment (Table 23). Benefit-cost ratios (BCR) of Indian spinach was obtained from 2.60 to 4.52 in their experiment (Khan. *et al.*, 2008).

Table 19: Effects of different organic manures for field experiments with plant height of indian spinach at the Charlands

Treatment s	Plant height (cm)		
	Char Shaluk a	Naobhanga r Char	Maijbar i Char
T ₁	56.72d	54.39c	54.72c
T ₂	61.56c	62.23b	61.89b
T ₃	62.03c	62.03b	62.03b
T ₄	62.06c	61.39b	62.39b
T ₅	66.84b	66.51a	67.18a
T ₆	69.29a	68.96a	68.95a
CV (%)	1.95	2.55	2.66
SE (±)	1.00	1.30	1.36

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 20: Effects of different organic manures for field experiments with total fresh yield of indian spinach at the Charlands

Treatment s	Total fresh yield (t/ha)		
	Char Shaluk a	Naobhanga r Char	Maijbar i Char
T ₁	46.51d	45.18d	46.52d
T ₂	52.79c	53.12c	53.12c
T ₃	53.57c	53.57c	52.90c
T ₄	52.44c	52.44c	52.77c
T ₅	57.17b	57.17b	57.50b
T ₆	60.30a	60.63a	61.30a
CV (%)	2.50	3.07	2.21
SE (±)	1.10	1.35	0.98

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 21: Effects of different organic manures for field experiments with total income of indian spinach at the Charlands

Treatmen ts	Total income (tk/ha)		
	Char Shaluka	Naobhang ar Char	Maijbari Char
T ₁	697700.0 0d	677700.00 d	697700.0 0d
T ₂	791800.0 0c	796800.00c	796800.0 0c
T ₃	803550.0 0c	803550.00c	793550.0 0c
T ₄	786600.0 0c	786600.00c	791600.0 0c
T ₅	857500.0 0b	857500.00 b	862500.0 0b
T ₆	904450.0 0a	909450.00a	919450.0 0a
CV (%)	2.50	3.07	2.21
SE (±)	16474.00	20190.00	14635.00

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Table 22: Effects of different organic manures for field experiments with total cost of indian spinach at the Charlands

Treatments	Total cost (tk/ha) at the Charlands
T ₁	379559.00
T ₂	366224.32
T ₃	372224.32
T ₄	375224.32
T ₅	366224.32
T ₆	375224.32

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer.

Table 23: Effects of different organic manures for field experiments with BCR (total cost basis) of indian spinach at the Charlands

Treatment s	BCR (Total cost basis)		
	Char Shaluk a	Naobhanga r Char	Maijbar i Char
T ₁	1.84c	1.78c	1.85d
T ₂	2.16b	2.18b	2.18c
T ₃	2.16b	2.16b	2.13c
T ₄	2.09b	2.09b	2.11c
T ₅	2.34a	2.34a	2.36b
T ₆	2.41a	2.42a	2.45a
CV (%)	2.54	3.06	2.26
SE (±)	0.05	0.05	0.04

T₁= FP (Control), T₂=RF+ Vermicompost (3t/ha), T₃=RF+ Quick Compost (3t/ha), T₄=RF+ Standard Organic Fertilizer (3t/ha), T₅=RF+ Poultry Manure (3t/ha), T₆=RF+ Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer.

Biochar (3t/ha), FP= Farmers' practice, RF= Recommended fertilizer, CV= Co-efficient of Variation, SE= Standard Error for Comparison, in a column figures having similar letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per LSD at 5% level of significant.

Conclusion

Results of the experiment showed that application of organic manures along with inorganic fertilizers produced significant ($p < 0.05$) variation in yield and production contributing characters of pumpkin, sweet potato and indian spinach compared to Farmer's practice. During winter trial for pumpkin experiments, among the Charlands, the maximum yield per plant 84.86kg was recorded in T₆ treatment and the minimum yield per plant 23.29kg was obtained from T₁ treatment from Naobhangar Char. Among the Charlands, the highest total income 1270000.00 tk/ha was recorded in T₆ treatment and the lowest total income 349400.00 tk/ha was obtained from T₁ treatment from Naobhangar Char. For all Charlands, the maximum total cost was recorded in T₁ (385559.00 tk/ha) treatment and minimum total cost was obtained from T₂ and T₅ (369233.32 tk/ha) treatments. Among the Charlands, the highest BCR 3.37 was recorded in T₆ treatment and the lowest BCR 0.90 was obtained from T₁ treatment from Naobhangar Char. During winter trial for sweet potato experiments among the Charlands, the maximum fresh yield of tuber 95.23t/ha was recorded in T₅ treatment and the minimum fresh yield of tuber 35.49t/ha was obtained from T₁ treatment from Char Shaluka. Among the Charlands, the maximum total income 1430000.00 tk/ha was recorded in T₅ treatment and the minimum total income 532400.00 tk/ha was obtained from T₁ treatment from Char Shaluka. For all Charlands, the maximum total cost was recorded in T₁ (491559.00 tk/ha) treatment and minimum total cost was obtained from

T₂, T₃ and T₅ (391683.48 tk/ha) treatments. Among the Charlands, the maximum BCR 3.65 was recorded in T₅ treatment but the minimum BCR 1.08 was obtained from T₁ treatment from Char Shaluka. During summer trial, for pumpkin experiments among the Charlands, the highest total yield per plant 86.08kg was recorded in T₆ treatment while the lowest total yield per plant 28.72kg was obtained from T₁ treatment from Naobhangar Char. Among the Charlands, the highest total income 1290000.00 tk/ha was recorded in T₆ treatment while the lowest 430794.00 tk/ha was obtained from T₁ treatment from Naobhangar Char. For all Charlands, the maximum total cost was recorded in T₁ (385559.00 tk/ha) treatment and minimum total cost was obtained from T₂ and T₅ (369233.32 tk/ha) treatments. Among the Charlands, the highest BCR 3.41 was recorded in T₆ treatment while the lowest BCR 1.12 was obtained from T₁ treatment from Naobhangar Char. During summer trial, for indian spinach experiments among the Charlands, the highest total fresh yield 61.30 t/ha was recorded in T₆ treatment from Maijbari Char but the minimum total fresh yield 45.18 t/ha was obtained from T₁ treatment from Naobhangar Char. Among the Charlands, the highest total income 919450.00 tk/ha was recorded in T₆ treatment from Maijbari Char but the lowest total income 677700.00 tk/ha was obtained from T₁ treatment from Naobhangar Char. For all Charlands, the maximum total cost was recorded in T₁ (379559.00 tk/ha) treatment and minimum total cost was obtained from T₂ and T₅ (366224.32 tk/ha) treatments. Among the Charlands, the highest BCR 2.45 was recorded in T₆ treatment from Maijbari Char but the lowest BCR 1.78 was obtained from T₁ treatment from Naobhangar Char. Comparatively higher yield and production of different crops were obtained from biochar and poultry manure treated fields.

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