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Influence of Organic and Inorganic Fertilizers on Floating Bed Cultivation of Okra and Cucumber during Summer Season in Southern Part of Bangladesh

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Abstract

Some trails were carried out with a view to evaluate the performances of organic and inorganic fertilizers on growth and yield of okra (*Abelmoschus esculentus* L.) and cucumber (*Cucumis sativus* L.) in floating bed cultivation applying water hyacinth in 2014 and 2015 at Gopalpur union under Tungipara upazila of Gopalganj district in Bangladesh. The single factor experiment was conducted following Randomized Complete Block Design (RCBD) involving four treatments with three replications viz. T_1: control (without organic and inorganic fertilizer), T_2: cow dung, T_3: recommended dose of NPK and T_4: 50% cow dung + 50% recommended dose of NPK. Different growth parameters in respect of okra grown in 2014 and 2015, the longest plant height (171.73 cm and 164.03 cm), maximum number of branches (5.67 and 5.67) and leaves (60.33 and 69.67) were found in the treatment T_3. Regarding yield parameters, significantly higher number of fruits plant^{-1}, fruit length (cm), fruit diameter (cm), individual fruit weight (g), fruits weight plant^{-1} (g) and yield (t·ha^{-1}) were 24.00 & 23.33, 16.61 & 16.59 cm, 6.01 & 6.17 cm, 23.47 & 24.74 g, 617.33 & 660.33 g, 13.01 & 13.21 t·ha^{-1} obtained respectively grown in 2014 and 2015 by applying the treatment T_3 were identically similar with those in receiving the treatment T_4. The lowest output was recorded in control in both seasons for all the cases. Similar trend of growth and yield were also observed during the cultivation of cucumber under the same treatment conditions in both the seasons. Results revealed that there was no identical differences in growth and yield attributes in between the treatments T_3

and T_4, where as the production cost was subjected to lower in T_4 compare to T_3. However, from the economic point of view, the treatment T_4 *i.e.* application of 50% cow dung + 50% recommended dose of NPK fertilizers in floating bed cultivation was exposed to be more feasible and suitable as cost effective for the growth and yield of okra and cucumber in the experimental area.

Keywords

Water Hyacinth, Floating Bed, Cow Dung, NPK Fertilizers, Vegetable Cultivation, Economic Analysis

1. Introduction

Bangladesh today faces the multidimensional effects of climate change in the forms of flood, cyclone, rising sea levels, drainage congestion, salinity in freshwater systems etc. Climate variability makes agriculture in Bangladesh highly vulnerable. It is inferred in the available literatures that crop production would be extremely vulnerable under climate change scenarios, and as a result, food security of the country will be at risk [1] [2] [3] [4] [5].

Floating bed cultivation of vegetable could be one of such measures and an alternate production technology that avoids saltwater intrusion, because it offers new opportunities using indigenous knowledge and techniques that are well adapted to local environmental conditions [6]. But lack of proper knowledge in building technique of floating bed, materials required for bed preparation, thickness of the bed, method of cultivation, dose of organic and inorganic fertilizers and method of application, intercultural operations done that impact on yield of floating bed vegetable production.

Floating beds can be prepared in places where water remains more than six months per year and an abundance of water hyacinth exist. Floating farms in costal districts of Barisal, Goplaganj and Pirojpur in the southern part of Bangladesh, most affected by floods, farmers don't have enough cropping space in terms of access to land, so people have learnt to make the most use of flood water. In this context, a floating agricultural practice was developed to rear plants and crops in floating bed, made of water hyacinth, algae or other plant residues. The system is traditionally called "dhap" in Bangladesh and "kaing" in Burma, where a floating platform is made of decomposing heaps of water hyacinth, keeping the upper surface stuffed with mud or soil [7]. A scientific method similar to hydroponic or soilless agriculture practice was adopted. With the easily available, locally abundant materials, as water hyacinth (Eichhornia crassipes) and other aquatic weeds, local communities construct reasonably sized floating platforms or rafts on which vegetables and other crops can be cultivated.

The application of cow dung manure and vermicompost increases soil organic matter content, and this leads to improved water infiltration and water holding capacity as well as an increased cation exchange capacity. As per Mandal *et al.*

[8] integration of inorganic, organics and biofertilizers can produce more yield. According to Adegunloye *et al.* [9] C:N ratio in cow dung manure is an indication that it could be a good source of protein for the microbes which involved in decomposition of organic matter. Manure and urine raise the pH level and accelerate the decomposition of organic matter and termite activity [10] [11]. If inorganic fertilizer, especially nitrogen, is combined with manure, the manure reduces soil acidification and improves the nutrient buffering capacity and the release of nutrients [12]. It is thus important to find out the most potential manure and fertilizer combination that will increase our production and meet our food demand. Inorganic fertilizer supplies sufficient nutrients for growth and development of plant. But increased use of inorganic fertilizers in crop production causes health hazards, create problem to the environment including the pollution of air, water, soil etc. Use of organic manures is essential for proper growth and development of crops. In addition to being a good source of plant nutrients, organic manure improves texture, structure, humus, aeration, water holding capacity and microbial activity of growing media and soil and thus helps to increase the productivity. Organic manure contains all plant nutrients in a relatively small amount. On the other hand, inorganic fertilizers contain large amount of specific plant nutrient in a readily available form. Therefore, inorganic fertilizers in combination with organic manure may lead to better performance regarding growth and yield of the crops.

To increase the vegetables production in dhap, integrated use of organic and inorganic fertilizers has been introduced. So, it is necessary to find out an appropriate dose of organic and inorganic fertilizers to obtain economic yield from floating bed vegetables production. Considering the points in view, the present study was conducted to develop a suitable model for floating bed vegetables production by identifying the combined impact of organic/cow dung and inorganic/NPK fertilizers on the performance of okra and cucumber cultivation during summer season in southern part of Bangladesh.

2. Materials and Methods

2.1. Experimental Site, Design and Planting Materials

A single factor experiment was conducted during summer season in 2014 and 2015 at Gopalpur union of Tungipara upazila under Gopalganj district, Bangladesh following Randomized Complete Block Design (RCBD) with three replications. The experimental area is situated in the southern part of Bangladesh where water remains more than six months per year. As it is the part of the costal district, most affected by floods, farmers don't have enough cropping space in terms of access to land, so people have learnt to make the most use of flood water. Water hyacinth is the main material required for floating bed preparation. Okra (*Abelmoschus esculentus* L.) and cucumber (*Cucumis sativus* L.) seeds were used as planting materials in this study. The floating bed (dhap) was prepared with desired thickness, width and length. The size of each unit floating bed

(dhap) was 2.5 m height (water hyacinth thickness) × 5 m length × 1 m width.

2.2. Floating Bed (dhap) Preparation and Treatments

Matured water hyacinths were collected from the nearby river and canal where it grows profusely. After collecting water hyacinths, a first layer was made with 1.7 m thickness, 1.0 m width and 5 m length. Water hyacinths were again dump on the first layer after 10 days later from the first dumping with 0.8 m thickness. So that required thickness was completed and then the bed was left for decomposition before planting of seedlings.

Bamboos were used as anchorage of floating beds to keep them fixed in a place. The decomposed parts of floating bed, roots of water hyacinth were cutting and put them underneath the seedlings or put the chopped materials on the floating bed 30 cm away from the edge of the bed. Four treatments viz. T_1: control (without organic and inorganic fertilizer); T_2: cow dung; T_3: recommended dose of NPK and T_4: 50% cow dung + 50% recommended dose of NPK were applied to cultivate okra (*Abelmoschus esculentus* L.) and cucumber (*Cucumis sativus* L.) in this study.

2.3. Raising of Seedlings and Transplanting on Floating Bed

A small ball like structure was made with decomposed water hyacinth that locally called as "Tema". Treated seeds of okra and cucumber at the age of two day after sprouting were put inside the Tema. Two sprouted seeds were sown in each Tema then put the Tema on seedbed. A hole or pit was made on floating bed before transplanting of seedlings. A plant spacing of 50 cm × 50 cm for okra and plant to plant spacing 80 cm for cucumber were maintained. The seedlings at 14 day old were transplanted in a hole placing in the middle portion of the floating bed in one row. Four treatments were then distributed randomly among each block so as to all treatments were placed once in each block.

2.4. Application of Manure and Fertilizers and Other Intercultural Operations

Manure and fertilizers were applied according to the treatments considering the recommended fertilizer dose on the basis of decomposed water hyacinth test value for respective crops [13]. Cow dung, Urea, TSP, MoP and Gypsum were applied @ 3.71, 24.12, 18.56, 14.85 and 12.99 g/Floating bed for okra and 3.71, 16.70, 14.84, 12.06 and 12.99 g/Floating bed for cucumber. Irrigation, weeding and plant protection measures were done as and when needed especially at the primary stage of seedlings established. Fungicide "Thiovit" and insecticide "Diazinon" were used to control powdery mildew in cucumber and shoot and fruit borers in okra respectively.

2.5. Cost Return Analysis

The cost and return analysis of a crop grown in a particular year may not

represent exactly, the same with the crop grown in another year. The cost and return analysis was performed based on the crop yield as well as factors such as cost of inputs, labor and market price of harvested material, which may vary from year to year. However, economic analysis was done to find out the most economic treatment applying the combination of cow dung and recommended dose of NPK fertilizers on floating bed condition. All input *i.e.* seed, bamboo, net, cow dung, fertilizers, boat rent and labor cost were considered for calculating cost of production. But the cost of water hyacinth was not considered. The cost and return analysis was done in details according to the procedure of Iqbal *et al.* [14].

$$\text{Net return} = \text{Gross return} - \text{Total cost of production}$$

$$\text{Benefit cost ratio}(\text{BCR}) = \text{Gross return} \div \text{Total cost of production}$$

2.6. Data Collection and Statistical Analysis

Five plants were selected randomly from each unit dhap/plot and the parameters were recorded at 15 day intervals. Material, non-material and over head costs including harvesting of okra were recorded for all treatments on unit bed basis and converted to per hectare. Plant height/main stem length (cm), number of leaves, branches and fruits $plant^{-1}$, length and diameter of fruit (cm), individual fruit weight (g), weight of harvested fruits $plant^{-1}$ and fruit yield per hectare were measured and put down during the cultivation and after harvesting of okra and for cucumber. Recorded data were analyzed statistically with the help of computer package program MSTAT-C and the mean differences were adjudged by DUNCAN'S NEW MULTIPLE RANGE TEST (DMRT) at 5% level of probability for interpretation of the results [15].

3. Results and Discussion

3.1. Effects on Growth Parameters of Okra

Growth parameters of okra varied significantly ($P \leq 0.05$) due to application of organic manure and inorganic fertilizers (Table 1). During the cultivation of the experiment in 2014 and 2015 the highest plant height (171.73 cm and 164.03 cm), number of branches (5.67 and 5.67) and number of leaves (60.33 and 69.67) were found in receiving the recommended dose of NPK denoted as T_3 followed by T_4 treatment *i.e.* 50% cow dung + 50% recommended dose of NPK. These results were significantly greater than those of the treatments T_1 and T_2. However, the obtaining results exposed that there were no identical differences among all the parameters in between the treatments T_3 and T_4. The lowest output in all cases was recorded from the control in all treatments in both the years.

This result might be (found in) due to the combined impact of recommended dose of fertilizers, cow dung and decomposed water hyacinth as organic matter. Usually, the decomposed water hyacinth and cow dung release the nutrients slowly and steadily into the system and enables the plant to absorb nutrients.

Table 1. Growth contributing characters of okra as influenced by organic and inorganic fertilizer in floating bed cultivation.

Treatments	Plant height (cm)		Number of branches plant^{-1}		Number of leaves plant^{-1}	
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr
T$_1$	133.30 b	134.20 b	3.00 c	4.00 b	36.00 c	40.33 c
T$_2$	139.60 b	138.77 b	4.67 b	4.33 b	45.00 b	48.67 bc
T$_3$	171.73 a	164.03 a	5.67 a	5.67 a	60.33 a	69.67 a
T$_4$	168.90 a	159.67 a	5.33 a	5.33 a	55.00 a	55.33 ab
CV (%)	9.52	6.54	8.94	8.13	15.90	13.50

Figures in a column having common letter(s) do not differ significantly (P ≤ 0.05). Here, T$_1$: Control, T$_2$: Cow dung, T$_3$: Recommended dose of NPK and T$_4$: 50% cow dung + 50% Recommended dose of NPK.

Chatto *et al.* [16] found similar output in their experiment with plant height where they reported that combination of individual organic sources with inorganic fertilizer in equal proportion (50:50), exhibited a beneficial response in plant height. There was an agreement with these results in getting the highest number of branches worked out by Malik *et al.* [17] adapting the integrated application of organic and inorganic fertilizers. Same trend of findings regarding more number of leaf in fluted pumpkin were reported by Idem *et al.* [18] under similar condition.

3.2. Effects on Yield Components of Okra

The cultivation results of 2014 and 2015 exposed in Table 2 that the number of fruits plant^{-1} varied from 14.33 to 25.33 and 11.33 to 24.00, fruit length varied from 13.24 to 16.66 and 13.86 to 16.60 cm, and fruit diameter varied from 5.54 to 6.15 and 5.68 to 6.09 cm, individual fruit weight varied from 17.13 to 24.29 and 20.17 to 23.52 g respectively. Weight of fresh fruit plant^{-1} varied from 396.33 to 643.33 and 396.33 to 660.33 g while yield varied from 7.76 to 13.01 and 7.93 to 13.21 t·ha^{-1} respectively in the same consecutive two years (2014 and 2015). However, it was observed that all yield parameters under the treatments T$_3$ and T$_4$ were significantly greater than those in getting with the other treatments T$_1$ and T$_2$. The highest yield (13.01 and 13.21 t·ha^{-1}) and other yield contributing attributes in both the cultivation years were obtained in receiving the treatment T$_3$. In spite of it, there were no identical difference between the treatments T$_3$ (recommended dose of NPK) and T$_4$ (50% cow dung + 50% recommended dose of NPK) for all the parameters in okra cultivation. The control treatment T$_1$ showed the lowest yield for both the years.

The increase in yield of okra could be attributed to the fact that plant nutrients were more readily available by applying recommended dose of NPK on floating bed with decomposed water hyacinth as organic matter. Among the yield contributing characteristics number of fruits plant^{-1} is the most important

Table 2. Yield and yield contributing characters of okra as influenced by organic and inorganic fertilizers in floating bed cultivation.

Treat.	Fruits plant^{-1} (No.)		Fruit length (cm)		Fruit diameter (cm)		Individual fruit weight (g)		Fruits weight plant^{-1} (g)		Yield (t·ha^{-1})	
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr
T$_1$	14.33 c	11.33 c	13.24 c	13.86 c	5.54 b	5.68 b	17.13 c	20.17 b	396.33 b	396.33 b	7.76 b	7.93 b
T$_2$	19.00 b	17.67 b	14.59 b	15.29 b	5.75 b	5.73 b	18.99 bc	22.10 ab	474.00 b	476.33 b	9.48 b	9.53 b
T$_3$	24.00 a	23.33 a	16.61 a	16.59 a	6.01 a	6.17 a	23.47 ab	24.74 a	617.33 a	660.33 a	13.01 a	13.21 a
T$_4$	25.33 a	24.00 a	16.16 a	16.60 a	6.15 a	6.09 a	24.29 a	23.52 a	643.33 a	649.00 a	12.87 a	12.98 a
CV (%)	11.94	13.54	6.45	7.06	6.50	6.33	11.73	5.56	12.53	10.06	12.45	10.06

Figures in a column having common letter(s) do not differ significantly (P ≤ 0.05). T$_1$: Control, T$_2$: Cow dung, T$_3$: Recommended dose of NPK and T$_4$: 50% cow dung + 50% Recommended dose of NPK.

fact that indicates total yield plant^{-1} there by determines economic return from each plant. Fruit size is another important factor that quantifies the yield of the crop. However, in the case of okra, the fruit should be left unplucked to the plant up to a definite size depending upon variety. Attigah *et al.* [19] indicated similar findings where they found the maximum fruit length and diameter in combined application of organic and inorganic fertilizer. Ferreira *et al.* [20] reported that the use of organic and mineral fertilizer significantly increased the yield of okra with the increasing rate of manure and mineral fertilizers.

3.3. Economic Analysis

The details of economic analysis of okra production over two years have been shown in Table 3. The total variable cost of production in two years ranged from Tk. 267,000.00 to 429,080.00 among the treatments. The highest cost of production (Tk. 429,080.00) was found in T$_3$: recommended dose of NPK fertilizers followed by T$_4$: 50% cow dung + 50% recommended dose of NPK (Tk. 385,540.00) and T$_2$: cow dung (Tk. 317,000.00), and the lowest (Tk. 167,000.00) was in control.

The value of gross return from different treatments ranged from Tk. 274,750.00 to 458,850.00 and net return ranged from Tk. 7750.00 to 67,010.00 per hectare obtained from the total income by selling okra @ Tk. 35,000.00 per ton. The economic analysis exposed that the treatment T$_4$ gave the highest net return worth Tk. 67,010.00 followed by T$_3$ (Tk. 29,770.00) and T$_2$ (Tk. 15,850.00) whereas, the lowest (Tk. 7750.00) was found from the control.

From the results, significant variations in respect of the benefit cost ratio (BCR) were found among the treatments. The highest value of BCR (1.17) was recorded from the treatment T$_4$ which was significantly different from the other treatments and the lowest BCR (1.03) was found in control. There were no significant differences in BCR values among the treatments T$_1$, T$_2$ and T$_3$. However, results revealed that T$_4$ treatment *i.e.* 50% cow dung + 50% recommended dose of NPK was found to be suitable for higher economic return from okra under

Table 3. Cost and return analysis of okra production due to application of organic & inorganic fertilizers in floating bed cultivation in 2014 and 2015.

Treatment	Mean marketable yield of two years (t·ha^{-1})	Mean total cost of two years Tk (t·ha^{-1})	Mean gross return of two years Tk (t·ha^{-1})	Mean net return of two years Tk (t·ha^{-1})	Mean benefit cost ratio of two years (BCR)
T_1	7.85 c	267,000.00 d	274,750.00 c	7750.00 b	1.03 b
T_2	9.51 b	317,000.00 c	332,850.00 b	15,850.00 b	1.05 b
T_3	13.11 a	429,080.00 a	458,850.00 a	29,770.00 a	1.07 b
T_4	12.93 ab	385,540.00 b	452,550.00 a	67,010.00 a	**1.17 a**
CV (%)	4.1	4.01	2.92	11.44	3.2
Level of significance	*	*	*	*	*

*= Significant at 5% level. Means followed by common letter(s) in a column do not differ significantly by DMRT. Here, T_1 = Control, T_2 = Cow dung, T_3 = Recommended dose of NPK, T_4 = 50% cow dung + 50% Recommended dose of NPK, Sales price of marketable okra @ Tk. 35,000 per ton.

the climatic conditions of Gopalganj.

3.4. Effects on Growth Parameters of Cucumber

Results of vine length, number of branches and leaves of cucumber showed a significant variation (P ≤ 0.05) among different treatments (Table 4).

The longest vine length 259.47 cm and 273.47 cm were obtained from recommended dose of NPK (T_3) while the lowest 148.10 cm and 177.60 cm were from the control in 2014 and 2015 respectively. The highest number of branches (12.33 and 12.00) and leaves (66.00 and 74.43) per plant were recorded in receiving the treatment T_4 (50% cow dung + 50% recommended dose of NPK) and the lowest number of branches (6.33 and 5.67) and leaves (48.67 and 57.00) per plant were from the control in the same growing years respectively. No significant differences among growth parameters were found in between the treatments T_1 and T_2 and in between T_3 and T_4. These results were supported by the work done by Ahmed *et al.* [21] and Abdel-Mawgoud *et al.* [22] who reported an increase in cucumber vine length with an increase in nitrogen application.

3.5. Effects on Yield Components of Cucumber

Yield and yield components viz. fruit number, length and diameter of fruit, individual fruit weight, fruit weight per plant^{-1} and yield of cucumber varied significantly with the addition of organic and inorganic fertilizers (Table 5). Among the yield contributing characteristics number of fruits plant^{-1} is most important that indicates total yield plant^{-1} there by determines economic return from each plant. Fruit size is another important factor that determines the yield of the crop.

Number of fruits plant^{-1} varied from 10.00 to 23.67 and 7.00 to 22.00. Fruit length varied from 14.72 to 16.87 and 14.45 to 17.87 cm while fruit diameter

Table 4. Growth contributing characters of cucumber as influenced by organic and inorganic fertilizers under floating bed cultivation.

Treat.	Main stem/vine length (cm)		Branches plant^{-1} (No.)		Leaves plant^{-1} (No.)	
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr
T$_1$	148.10 c	177.60 c	6.33 b	5.67 b	48.67 b	57.00 b
T$_2$	188.53 b	233.20 b	9.00 b	8.00 b	55.67 b	61.03 b
T$_3$	259.47 a	273.47 a	12.33 a	11.67 a	65.67 a	72.10 a
T$_4$	244.87 a	265.67 a	12.33 a	12.00 a	66.00 a	74.43 a
CV (%)	11.37	10.47	13.82	9.27	9.13	9.19

Figures in a column having common letter(s) do not differ significantly (P ≤ 0.05). Here, T$_1$ = Control, T$_2$ = Cow dung, T$_3$ = Recommended dose of NPK, T$_4$ = 50% cow dung + 50% Recommended dose of NPK.

Table 5. Yield & yield contributing characters of cucumber as influenced by organic and inorganic fertilizers in floating bed cultivation.

Treat.	Fruits plant^{-1} (No.)		Fruit length (cm)		Fruit diameter (cm)		Individual fruit weight (g)		Fruits weight plant^{-1} (kg)		Yield (t·ha^{-1})	
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr
T$_1$	10.00 b	7.00 c	14.72 b	14.45 b	15.16 b	13.41 b	138.70 c	136.50 c	3.35 b	3.40 b	20.08 b	19.74 b
T$_2$	14.33 b	13.00 b	15.91 ab	14.88 b	16.51 a	15.51 a	164.57 b	162.93 b	3.65 ab	3.69 ab	21.92 ab	22.12 ab
T$_3$	21.00 a	20.67 a	16.87 a	17.80 a	16.96 a	16.80 a	226.99 a	225.13 a	4.22 a	4.24 a	25.31 a	25.46 a
T$_4$	23.67 a	22.00 a	16.08 a	17.87 a	16.65 a	16.35 a	216.54 a	217.30 a	4.12 a	4.13 a	24.70 a	24.80 a
CV (%)	12.84	10.24	4.21	5.09	3.52	3.81	5.79	8.96	7.86	7.96	7.96	7.13

Figures in a column having common letter(s) do not differ significantly (P ≤ 0.05). Here, T$_1$ = Control, T$_2$ = Cow dung, T$_3$ = Recommended dose of NPK, T$_4$ = 50% cow dung + 50% Recommended dose of NPK.

varied from 15.16 to 16.96 and 13.41 to 16.80 cm and individual fruit weight varied from 138.70 to 226.99 and 136.50 to 225.13 g in the two cultivation years of 2014 and 2015 respectively. The highest yield 25.31 and 25.46 t·ha^{-1} were obtained respectively in the same years from the recommended dose of NPK (T$_3$) followed by T$_4$ (50% cow dung + 50% recommended dose of NPK). The lowest yield 20.08 and 19.74 t·ha^{-1} were recorded in control for 2014 and 2015 respectively. The fresh yield per plant also followed the similar trend of increment. It was observed that there was no significant differences among different yield attributes in the treatments between T$_3$ (recommended dose of NPK) and T$_4$ (50% recommended dose of NPK + 50% cow dung).

This result is supported by the previous findings of Ahmed *et al.* [21] who also reported that fruit weight of cucumber increased linearly with an increase in Nitrogen fertilizer rate. Similarly, Choudhari and More [23] also observed that 150:90:90 kg NPK ha^{-1} produced maximum fruit weight (g) in cucumber plant. Proper nutrients promote vigorous growth of cucumber plant, which ultimately increase the number of fruits per plant confirming the observation of Waseem *et al.* [18] [24] for cucumber when 80 kg N ha^{-1} was applied. Fuchs *et al.* [25] re-

ported that nutrients from mineral fertilizers enhanced the establishment of crops through the mineralization of organic matter promoted yield by using the combination of manures and fertilizers.

3.6. Economic Analysis

The economic analysis over two years considering material, non-material and over head costs including harvesting of cucumber were recorded for all treatments on unit bed basis and converted to per hectare have been shown in Table 6. The total cost of production ranged from Tk. 326,660.00 to 388,060.00 among the treatments. The variation was due to different input costs along with the variable cost of organic and inorganic fertilizers. The highest cost of production (Tk. 388,060.00) was required for the treatment T_3 (recommended dose of NPK) followed by T_4 (Tk. 361,540.00; 50% cow dung + 50% recommended dose of NPK) and T_2 (Tk. 361,540.00) whereas, the lowest (Tk. 326,660.00) was found from the control.

The gross return from different treatments ranged from Tk. 497,750.00 to 634,750.00 per hectare. Gross returns were obtained from the total income through selling cucumber @ Tk. 25,000.00 per ton. It was found from the economic analysis that the treatment T_4 (50% cow dung + 50% recommended dose of NPK) gave the highest net return of Tk. 257,210.00 followed by recommended dose of NPK (Tk. 246,690.00) and cow dung only (Tk. 198,840.00), and the lowest (Tk. 171,090.00) was observed from the control.

Significant variations were found among the treatments in respect of the benefit cost ratio (BCR). The treatment T_4 (50% cow dung + 50% recommended dose of NPK) gave the significantly highest BCR (1.71) value among all other treatments, and the second highest BCR (1.64) value was found in T_3 treatment. The lowest BCR (1.52) value was recorded in the control. Therefore, results

Table 6. Cost and return analysis of cucumber production due to application of organic & inorganic fertilizers in floating bed in 2014 and 2015.

Treatment	Mean marketable yield of two years (t·ha^{-1})	Mean total cost of two years Tk (t·ha^{-1})	Mean gross return of two years Tk (t·ha^{-1})	Mean net return of two years Tk (t·ha^{-1})	Mean benefit cost ratio of two years (BCR)
T_1	19.91 c	326,660.00 c	497,750.00 c	171,090.00 b	1.52 c
T_2	22.02 b	351,660.00 bc	550,500.00 b	198,840.00 ab	1.57 bc
T_3	25.39 a	388,060.00 a	634,750.00 a	246,690.00 a	1.64 b
T_4	24.75 a	361,540.00 ab	618,750.00 a	257,210.00 a	1.71 a
CV(%)	4.25	4.18	2.77	13.88	5.6
Level of significance	*	*	*	*	*

*= Significant at 5% level. Means followed by common letter(s) in a column do not differ significantly by DMRT. Here, T_1 = Control, T_2 = Cow dung, T_3 = Recommended dose of NPK, T_4 = 50% cow dung + 50% Recommended dose of NPK, Sales price of marketable cucumber @ Tk. 25,000 per ton.

exposed that the treatment T_4 combined with organic and inorganic fertilizers *i.e.* 50% cow dung + 50% recommended dose of NPK was found to be suitable for greater economic return in cultivating cucumber with the climatic conditions of Gopalganj.

4. Conclusion

Both organic and inorganic fertilizers exhibited positive influence on the performance of okra and cucumber in floating bed cultivation. Plant height, number of branches and leaves of okra grown in 2014 and 2015 were found maximum in the treatment T_3, and the yield attributes viz. number of fruits, fruits size, individual fruit weight were significantly higher in receiving the same treatment. No significant differences were observed between T_3 and T_4 among all growth and yield parameters, the lowest output was recorded in control for all growth and yield attributes in the both growing seasons. Similar growth and yield trend were also observed during the cultivation of cucumber under the same treatment conditions in both the growing seasons. However, results obtained from the growing season 2014 and 2015 applying the recommended dose of NPK assigned as the treatment T_3 were identically similar with those in receiving the treatment T_4 *i.e.* 50% cow dung + 50% recommended dose of NPK. In the economic context, the treatment T_4 was exposed to be more feasible and suitable as cost-effective for the growth and yield of okra and cucumber in floating bed cultivation of that experimental region.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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