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Effects of nutrient management and netting on growth and yield of okra

Shirin Akhter[1], M Ashraful Islam[1*], Md Rezaul Karim[1]

[1]Department of Horticulture, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

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*Corresponding Author
M Ashraful Islam
ashrafulmi@bau.edu.bd

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ABSTRACT

The experiment was conducted on the growth and yield of okra using nutrient management through different types of fertilizers and netting at the Horticulture Farm of Bangladesh Agricultural University (BAU), Mymensingh. There were netting treatments, *viz.* N1 = Control (no net) and N2= Net (blue color) along with fertilizer treatments *viz.* T1 = no fertilizer (control), T2 = vermicompost @ 10 t ha^{-1}, T3 = vermicompost @ 15 t ha^{-1}, T4 = combined application of 2/3 part organic (T3) and 1/3 part inorganic (T5), and T5 = inorganic fertilizers. Temperature (°C) and relative humidity (%) were recorded under net and at the open condition daily during production stage (month of May) However, the value didn't differ significantly. Growth parameters of okra *viz.* plant height, pod length, pod diameter, and pods of okra were found the highest from T4N2 treatment combination which was significantly higher from other combinations. The lowest growth and yield of okra was found from the treatment combination of T1N1. First flowering was observed in T4N2 at 32 days after planting of okra seeds. Vermicompost at different rates (10 t ha^{-1} and 15 t ha^{-1}) with net gave lower production of okra compared to inorganic fertilizer treatments with net. The highest yield of okra (19.65 t ha^{-1}) was found from the combined effect of T4N2 which was 56.74% higher compared to control (T1N1).

Keywords: Okra, vermicompost, fertilizer, net, growth, yield

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1 Introduction

Use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in the years to come for sustainable agriculture. Organic manures generally improve the soil physical, chemical and biological properties along with conserving the moisture holding capacity of soil. The soil fertility deterioration which ultimately affects the quality and quantity of agricultural crops, fruits and vegetables has become a key concern to farmers because of consumer demands for quality produce. Soil management technique has become a major part of farming practice to improve the soil fertility of farming activities (Durán Zuazo and Rodríguez Pleguezuelo, 2008). Reduction and elimination of the adverse effects of synthetic fertilizers and pesticides on human health and the environment is a strong indicator that organic agriculture is gaining worldwide attention. Organic fertilizers are environmentally friendly, since they are originated from organic sources. Vermicompost is a good source of nutrient for plant as organic fertilizer. The organic fertilizers provide nutritional requirements, suppress plant pest populations,and increase the yield and quality of agricultural crops in ways similar to inorganic fertilizers (Bulluck et al.,

2002).

The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable food production. Also, agricultural production is suffered due to increase in air temperature and intensity of solar radiation because of the climate changes and urbanization. In this case, color shade nets can be effective solution, because it can improve microenvironment for plant growths.

Netting is frequently used to improved plant microenvironment, protect crop from excessive solar radiation, improving the thermal climate protect crop from environmental hazards, pests, exclusion of bird and insect-transmitted virus diseases (Kittas et al., 1999; Teitel et al., 2005). Okra is one of the most important vegetable crops grown throughout the world. In Bangladesh, the area under okra cultivation was 26 thousand hectares with a total production in Bangladesh of 285 thousand metric tons (BBS, 2016). Okra is grown in the summer season of Bangladesh. It is a rich source of iron and also has some medicinal value, and a mucilaginous preparation from the pod can be used as a blood plasma replacement or blood volume expander (Gemede, 2015).However, production of okra varies in differentregions of Bangladesh due to varieties, seasons, climatic conditions, planting times, management practices and soil properties.

The sustainability of conventional agriculture in Bangladesh is under threat from the continuous degradation of land. There are some reports that combination of organic and inorganic fertilizers gave better result in tomato and cabbage production (Islam et al., 2017a,b). There is no work has been done in Bangladesh on the okra production considering the net and nutrient management.

With this view in mind, the objective of the present study was undertaken to evaluate the effect of organic and inorganic fertilizers combined with or without net on the growth and yield of okra.

2 Materials and Methods

Afield experiment was conducted at the Horticulture Farm (24°42′56.7″N, 90°25′50.5″E) of the Bangladesh Agricultural University (BAU), Mymensingh in during the period from March 2016 to June 2016.Two factors experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. Factor A (net-N): N1: Control (no net); N2: Net (blue color), and factor B (different types of fertilizers-T): T1: Control; T2: Vermicompost (10 t ha^{-1}); T3: Vermicompost (15 t ha^{-1}), T4: Combined application of 2/3 part organic (T3) and 1/3 part inorganic(T5) and T5: inorganic fertilizers (Urea = 174 kg ha^{-1}, TSP = 150 kg ha^{-1}, MoP = 150 kg ha^{-1}, according to BARC (2012)) were used in this experiment. So total numbers of plots were 5×2×3=30.

Hybrid variety (Kironmala) of okra was used in this experiment. Seeds were soaked for whole night and dibbling with maintaining spacing at 60 cm × 40 cm in the plot size of 2.4 m × 1.2 m and watered immediately after dibbling. Vermicompost was applied during the final land preparation. MoP and TSP fertilizers were applied at recommended doses in therespected plots (T5). Nitrogen was applied in three equal splits at 20, 40 and 60 days after dibbling of seeds. The experimental plot was irrigated after fertilizer application. Weedingand other intercultural operations were done as and when necessary. Botanical pesticides (Neem extract) and fungicide (Dithane M-45 @ 2 g L^{-1}) were applied to control the insect pests and diseases. Meteorological data like temperature (°C) and relative humidity (% RH) were recorded using thermo-hygrometer (Zeal, Uk) during the production stage (month of May) of okra. Both under net and in open condition, temperature and RH were recorded daily three times (morning: 9 am, noon: 1 pm and afternoon: 5 pm). To collect plant growth data, five plants were randomly selected from each plot. Average value of five plants considered as one replication in case of each parameters. Plant height was measured from the ground to the tip of stem using scale in cm. Number of fruits, days to first flowering and number of branches per plant were recorded. Fruits were harvested and recorded the weight to get marketable yield. Individual pod weight (g), pod length (cm), pod diameter (cm) were recorded using a slide calipers (Model Mitutoyo, Japan); and pods were cut in small pieces and oven dried for to get the percent dry matter content of pods.

Data were statistically analyzed by analysis of variance (General Linear Model procedure) and Tukey's pair wise comparison test ($p<0.05$) using Minitab Version 17 (Minitab Inc., State College, PA, USA).

3 Results and Discussion

The plant height and number of branches per plant of okra was recorded after 20, 40 and 60 days after planting of seeds. Plant height was significantly influenced by different types of fertilizer application and using net (Table 1). ANOVA results showed that the effect of combined application of fertilizers and netting on growth and yield of okra is highly significant (Table 1 and Table 2).

Better growth and yield were obtained from combined fertilizer treatments (T4: mixed of organic and inorganic fertilizer) compared to other treatment combinations. The application of T4N2 produced the highest number of branches (6.17) at 60 days after sowing (DAS), number of pods per plant (20.90), pod length (20.52 cm), pod diameter (3.81 cm), pod yield (19.65 t ha^{-1}) and dry matter content (9.66%). From this combination, the highest plant height reached to

Table 1. Effects of fertilizer management and netting system on the growth of okra

Treatment	Plant height (cm)			Days to	No. of nodes at	No. of branches /plant		
	20 DAS	40 DAS	60 DAS	1st flowering	1st flowering	20 DAS	40 DAS	60 DAS
T1N1	13.15	24.50	56.11	42.00	4.66	1.19	1.33	1.87
T2N1	13.25	26.03	58.13	37.00	5.78	1.33	1.89	2.33
T3N1	13.62	28.01	60.47	36.67	6.18	1.50	2.00	3.45
T4N1	14.02	32.91	62.78	33.00	7.65	2.00	4.88	5.33
T5N1	13.86	29.88	60.61	36.33	6.88	1.67	2.45	3.69
T1N2	13.54	31.00	57.45	40.33	5.76	1.21	1.45	2.00
T2N2	14.34	31.90	62.12	36.00	6.24	1.56	1.90	2.67
T3N2	14.67	32.58	64.14	35.00	7.00	1.67	2.34	3.54
T4N2	21.41	35.30	68.38	32.33	8.50	2.33	5.00	6.17
T5N2	15.79	33.28	66.40	33.00	7.50	1.90	3.67	4.33
$LSD_{0.05}$	0.701	0.858	0.858	1.170	0.196	0.108	0.217	0.243
Sig. level	**	**	**	**	**	**	**	**

Table 2. Effects of fertilizer management and netting system on the yield contributing characters of okra

Treatment	No. of pods plant^{-1}	Individual pod wt. (g)	Pod length (cm)	Pod dia (cm)	DM content (%)
T1N1	13.03	15.50	11.19	1.60	4.54
T2N1	15.00	16.00	13.51	1.97	6.21
T3N1	16.54	17.50	13.78	2.18	6.89
T4N1	19.34	22.5	15.00	3.18	8.56
T5N1	17.68	21.00	14.09	2.61	7.26
T1N2	15.50	15.90	12.91	1.77	4.99
T2N2	16.50	17.67	14.20	2.02	5.52
T3N2	17.25	18.00	15.44	2.63	6.99
T4N2	20.90	22.55	20.52	3.81	9.66
T5N2	19.07	21.3	16.97	2.90	7.85
$LSD_{0.05}$	0.611	0.609	0.640	0.203	0.316
Sig. level	**	**	**	**	**

** = Significant at 5% level of probability, T1 = control, T2 = vermicompost 10 t ha^{-1}, T3 = vermicompost 15 t ha^{-1}, T4 = 2/3 part of of T3 + 1/3 part of T5, T5 = inorganic fertilizer, N1 = no netting, N2 = netting

Table 3. Weather data in the experimental site during the study period

Condition	Temperature (°C)			Relative humidity (%)			Average Temp. (°C)	Average RH (%)
	M	N	A	M	N	A		
Net (inside)	27.8	32.2	30.1	81.7	80.0	79.7	30.1	80.5
Open field	27.5	31.8	29.3	81.4	79.9	79.8	29.5	80.4

M = morning, N = noon, A =afternoon

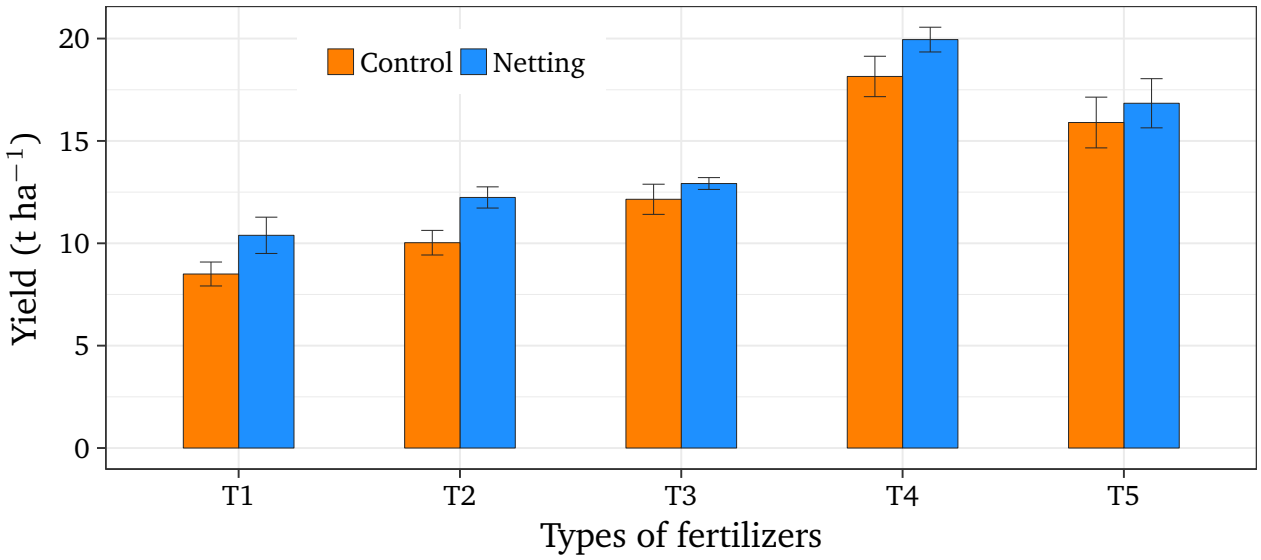

Figure 1. Effects of different types of fertilizer and netting system on pod yield of okra. Vertical bars represent ±SE (standard error). T1 = control, T2 = vermicompost 10 t ha^{-1}, T3 = vermicompost 15 t ha^{-1}, T4 = 2/3 part of of T3 + 1/3 part of T5, T5 = inorganic fertilizer, N1 = no netting, N2 = netting

65.58 cm after 60 days after planting seeds of okra. On the other hand, control plot gave the lowest performance considering the growth and yield of okra.

Single application of vermicompost at different rates (10 t ha^{-1} and 15 t ha^{-1}) and inorganic fertilizer with or without net did not gave the highest production of okra but inorganic fertilizer (T5) gave the better yield compared to the single application of vermicompost (T2 and T3) with or without net. Pod yield was found higher from the netting with the treatment of mixed application of organic and inorganic fertilizers (T4N2) compared to other treatment combinations. In this combination, number of pods per plant, individual weight of pod and pod length and diameter are found significantly higher compared to other treatments combination (Table 2 and Fig. 1).

These results clearly show the reasons of higher yield from the combination of T4N2. Islam et al. (2017a,b) also support the result, where the highest yield of cabbage and tomato were found from the mixed application of organic and inorganic fertizer. Similar results were found in brinjal (Ullah et al., 2010). It might be reason of the nutrient supply to plant from both organic and inorganic fertilizers. Inorganic fertilizers help to quickly release the nutrient for plant and organic fertilizer (vermicompost) release the macro and micronutrient slowly for the plant. On the other hand, this result is motivating to reduce the application of inorganic fertilizer which can help to improve the soil quality, ultimately the sustainable production of crops. In case of netting, spinach production was found higher under different colored shade nets such as red, green, black, white along with control (Meena and Vashisth, 2014), which support the result of the present study. In the present experiment, relative humidity (RH) and temperature were recorded inside and outside of net (Table 3). Although, significant variation of RH and temperature were not found from the inside and outside of net considering the three times (morning, noon and afternoon) as well as the average data of the month May (Table 3). However, there are some others microclimatic environmental impact can have on the production of okra.

Earlier flowering (32 days) was observed from treatment combinations T4N2 and finally flowering of all the treated plots were observed by 42 days after sowing of seeds. Early flowering has given the opportunity to get more pods from the plant, ultimately the higher production of okra. Okra plant commonly produces numerous fruiting pods borne in the angle between a branch or leaf along the side shoots. Okra pods usually require 4 to 6 days after flowering to enlarge into a marketable size product. Due to the rapid rate of growth and development, okra was harvested every other day to ensure pods remain within the marketable size range or smaller sized okra was adjusted for consumption.

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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