Optimization of fertilizer for common fig (*Ficus carica*) cultivation in South western Bangladesh

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ABSTRACT

Egyptian common fig (Ficus carica) showed cultivation potential with year round bearing in Bangladesh. As fertilizer dose is a prerequisite for proper cultivation, an experiment was conducted in Batiaghata, Khulna, Bangladesh to recommend a fertilizer dose for successful fig cultivation. Two manures (farm yard manure, vermi compost) and different doses of NPK were applied. Different growth and yield contributing parameters were observed and benefit cost ratio was calculated. In response to applied fertilizer and manure, T_7 (Vermicompost (VC) @ 7.5kg + N @ 160g + P_2O_5 @ 105g + K_2O @ 105g plant^{-1}) showed superiority over other doses in both growth and yield parameters and also showed viable benefit cost ratio (3.95). T_7 produced 18.33 cm long and 16.52 cm wide leaves; 4.33 shoots (3.00 fruiting) and 65.44 cm plant height with 9.30 cm plant girth in an average. Results of all these parameters were about 1.5 folds than the control. Earliest fruit set (at 66.00 days), maximum number of fruits per plant (31.67) with the largest size and the highest weight (57 g fruit^{-1}),the earliest fruit maturity (4 days earlier than control) along with maximum yield (4.53 ton ha^{-1}) were recorded in T_7. The research concludes that, common fig (Ficus carica) can successfully and commercially be cultivated in south-western Bangladesh using 7.5 kg vermicompost with N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}.

***Keywords*:** Benefit cost ratio**,** Common fig, farm yard manure, fertilizer, vermicompost

INTRODUCTION

Figs (*Ficus carica* L.) are believed to be one of the oldest cultivated plants. For centuries, these fruits have been used fresh or dried as food for humans and animals. Figs can supply a lot of vitamins and minerals and can combat the hidden hunger caused by the micronutrient deficiency (Ashrafuzzaman *et al*., 2021). Figs have been popular not only because of their pleasant taste but possibly also because of their medicinal properties (Veberic and Petkovsek, 2016). But this fruit is not prevalent in Bangladesh, though some wild figs such as *Ficus pumila, Ficus recemosa*, *Ficus hispida* etc. grow spontaneously which are mostly used as animal food in the wild. In some specific locality, these figs are used as vegetables. In the world market, there is an increasing demand for fresh and dried figs for its high nutrient, mineral and polyphenol content (Salimpour *et al*., 2019).

Figs are deciduous subtropical species, native to arid, semi-desert regions and can be cultivated under rain fed conditions. Excellent table figs may grow where the temperature is moderate but it can be cultivated under a wider range of ecological conditions (Botti *et al*., 2003). Bangladesh is blessed with magnificent fertile land with a variety of soil type along with copious irrigation water and zestful human resources which may grant fig cultivation as a fruit crop. The soil and climatic conditions of Bangladesh was suggested to be suitable for commercial fig cultivation (Mehraj *et al.,* 2013). So, to mitigate the malnutrition problem year round fruits like figs are of immense importance and can successfully be inserted in the fruit production schedule of Bangladesh.

An optimum combination of fertilizers impacts a lot to determine the total growth. For successful cultivation of fig (*Ficus carica*), determination of fertilizer dose is essential. However, no effort has been taken for the optimization of fertilizer for fig cultivation in Bangladesh. To determine an optimum fertilizer dose, the influence of different

combination of organic (Farm yard manure and vermicompost) and inorganic (NPK) fertilizers on growth and yield of fig was studied.

MATERIALS AND METHODS

The experiment was conducted in Kismat Fultola village under Batiaghata Upazilla, Khulna, Bangladesh during August, 2020 to June, 2021. Weather data of the experimental site during experiment period, were presented in the Table 1. Two composite soil samples (on January and April) were collected from the experimental plot and analyzed in the laboratory of Soil Resource Development Institute, Daulatpur, Khulna under the Ministry of Agriculture, Peoples Republic of Bangladesh. The nutritional status of the soil has been shown in Table 2.

Egyptian variety of *Ficus carica* was used as plant material in this study. Saplings were grown from cuttings by using coco-peat as rooting media in the month of August. The saplings became ready and planted in the main field on mid-October. Land of the experimental site was prepared through weeding followed by 4-5 ploughing with power tiller and the soil of top 15 cm depth was made friable. Except nitrogen (applied at 10 days after planting) all of the fertilizers *viz.*, TSP and MOP along with 20g furadan (Carbofuran/carbamate pesticide) was applied as basal dose in 0.5m × 0.5 m× 0.5m planting holes. After receiving the assigned fertilizers (according to different treatments) pits were covered with soil and left for six weeks. After three weeks, the soil of the pits was mixed well and kept for another three weeks as before.

Healthy saplings of 30 days old were transplanted in the field at a distance of 2m×2 m on October 19, 2020, in the afternoon. Different intercultural operations were performed as per requirement. Mancer 75 WP (fungicide with Carbendazim 12% + Mancozeb 63%) at 2g per liter and Intrepid 10 SC (insecticide) at 1 ml per liter were sprayed on the plants at 10 days interval with the beginning of nitrogenous fertilizer application (10 Days after planting) and ended at 70 days after transplanting. On 30 days after planting and 60 days after planting, Thiovit 80 WG (Sulphur fungicide) was applied with Intrepid instead of Mancer 75 WP.

The fruits were harvested when they were fully matured and turned to pinkish red in color. Harvesting of fruits was started at 121 days after transplanting and continued up to 165 days with an interval of 3 days. Harvesting was usually done by hands. Fruits immerged after 20 days of the first fruit set were considered for yield count.

Design of experiment and treatments

Randomized Complete Block Design (RCBD) was followed with three replications for the treatments containing one plant in each replication. The treatments were as follows:

T_0 = Control
T_1 = Farm Yard Manure @ 12.5kg + N @ 160g + P_2O_5 @ 105 g + K_2O @ 105g plant^{-1}
T_2 = FYM @ 12.5kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130g plant^{-1}
T_2 = FYM @ 12.5kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}
T_3 = FYM @ 25 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}
T_4 = FYM @ 25 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}
T_5 = FYM @ 25 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}
T_6 = Vermicompost (VC) @ 7.5kg + N @ 160g + P_2O_5 @ 105g + K_2O @ 105g plant^{-1}
T_8 = VC @ 7.5 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}
T_9 = VC @ 7.5 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}
T_{10} = VC @ 15 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}
T_{11} = VC @ 15 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}
T_{12} = VC @ 15 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}

Nitrogenous fertilizer (urea) was applied in three splits viz. at 10, 35 and 60 days after transplanting. P_2O_5 was applied in the form of Triple Super Phosphate (TSP) and K_2O was through Muriate of Potash (MoP).

Observations recorded

Growth parameters

For growth parameters, data were recorded at 30 days interval up to 90 days after planting and for yield contributing parameters from fruit set to harvest. Data were collected on growth parameters like days required for first leaf emergence, number of leaves (total leaves which were fully opened, matured and not senescent at the day of data recording including the leaves prevailing during planting), number of nodes, leaf length (cm) (from the base of the petiole to the leaf apex along the midrib), leaf width (cm) (the most spacious part of leaf blades), number of shoot, plant height (cm) (from the collar of the plant to the terminal growing point of the main stem) and shoot girth (measured at the base of the plant). From each plant, 5 leaves were taken and the average length and width were expressed in centimeters.

Yield contributing parameters

Recorded yield parameters were - days required for fruit set (the day when it was clear that the bud developed on the leaf axis is a fruit not shoot), number of fruiting shoot, number of fruits per plant, average fruit length (mm), average fruit diameter (mm), average fruit girth (mm), average fruit weight (g), total fruit per plant (kg) and yield per hectare (ton). Fruit length and diameter were measured with a digital slide calipers and girth was measured with a centimeter tape. Data of each fruit was recorded and the average of all the treatments was calculated. The fruits were harvested when they reached at their desired shape and color. From bud initiation to harvesting of the fruits, the days were calculated for each fruit and the average days needed to mature were determined for each treatment.

Fruit yield

Fruit yield per plant (kg) was determined by adding the total fruit weight over all of the pickings from each treatment and was expressed in kilograms (kg). The fruit yield plant^{-1} of *Ficus carica* was converted into per hectare and has been expressed in tonnes (t). It was measured by using the following formula :

$$\text{Yield (ton) per hectare} = \frac{\text{Fruit yield per plant (kg)} \times 10000\text{m}^2}{\text{Area of plot in square meter (m}^2\text{)} \times 1000(kg)}$$

Benefit cost ratio (BCR)

Production cost includes all expenditures including land rent, labor, power tiller rent, cost for sapling, fertilizer, transportation and all other management costs up to marketing and sales. The economic indicator BCR was calculated using following formula for each treatment.

$$\text{Benefit cost ratio} = \frac{\text{Gross income(Tk)}}{\text{Total cost of production(Tk)}}$$

Here, "Gross income" means the total selling price without deducting the production cost.

Statistical analysis

Collected data were subject to two way analysis of variance (ANOVA) by Statistical Tool for Agricultural Research (STAR) (IRRI, 2013). The effects of various treatments were assessed within ANOVA and the level of significance was tested by Tukeys's Honest Significant Difference (HSD) following significant ($P \leq 0.01$) F test. The assumptions on normality of data and homogeneity of variance were checked to ensure the validity of analysis.

RESULTS AND DISCUSSION

Effect of manures and fertilizers on leaf parameters

Earliest leaf initiation (9.67 days) was observed in T_{12} (VC @ 15 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}) followed by T_{11} (11.67 days) which is statistically similar to T_6, T_8 and T_9 (13.00, 13.00 and 13.33 days respectively). Most delayed first leaf initiation (18.67 days) was witnessed in control (T_0) (Table 3).

Similarly, T_{12} resulted in maximum number of leaf production (47.78) that was followed by T_{11} (45.44), T_9 (43.22), T_{10} (42.33), T_6 (42.11)and T_8 (41.22). Control produced lowest number of leaves (30.00).Though lower dosed of VC and combination of NPK in T_7 (VC @ 7.5 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}) exhibited best performance for leaf length and width (18.33 cm and 16.52 cm, respectively) followed

Table 1: Weather conditions of study area from August 2020 to June 2021 (BMD, 2020 and 2021)

Month	Monthly average max. temperature (°C)	Monthly average min. temperature (°C)	Monthly average relative humidity (%)	Monthly total rainfall (mm)
August 2020	32.8	27.0	86	265
September 2020	33.6	27.0	85	172
October 2020	33.2	26.2	83	90
November 2020	30.7	20.0	76	06
December 2020	26.1	15.0	80	00
January 2021	26.1	14.2	79	00
February 2021	29.5	15.9	73	03
March 2021	34.4	22.4	67	00
April 2021	36.4	24.9	67	02
May 2021	35.4	26.0	73	124
June 2021	32.6	26.3	85	468

Table 2: Nutritional status of the experimental plot

Sl. no	Soil property	Field soil -1 (January)	Field soil-2 (April)
01	P^H	8.2	8.1
02	Salinity (dSm^1)	3.9	4.7
03	Organic matter (%)	1.57	2.04
04	Total Nitrogen (%)	0.091	0.119
05	Phosphorus µgm gm^1 soil	25.35	15.05
06	Potassium mleq. gm^1 soil	0.19	0.20
07	Sulphur µgm gm^1 soil	76.01	105.34
08	Zinc µgm gm^1 soil or %	3.17	1.19
09	Boron µgm gm^1 soil	0.50	10.2

by higher doses of FYM and combinations of NPK in T_4(13.55 cm and 11.76 cm) and T_5 (13.22 cm and 11.82 cm) without any significant difference between them. On the other hand, shortest (10.43 cm) and narrowest (9.03 cm) leaves were found in the plants treated with higher doses of VC and NPK combinations (Table 3).

The leaf initiation started before the application of nitrogenous fertilizer that means leaf initiation was influenced by initial application of fertilizers as FYM, Vermicompost, TSP and MoP. This result was in conformity to Mordogan *et al. (*2013). Different fertilizer combination displayed significant effect on leaf characters of fig. With the higher rate of fertilizers, all leaf parameters showed better performance initially (on 30 DAT. But with the course of time (on 90 DAS) they decreased gradually except leaf number and leaves became smaller, thicker, dark green and leathery in higher doses. This result is in accordance with Khan *et al*. (2020) Pal *et al*. (2015) and Blouin *et al*. (2019). They reported small and thick leaves caused by excessive nitrogen applied and good impact of FYM and vermicompost in combination with recommended dose of fertilizer on nutrient availability and nitrogen dynamics which ultimately influences crop growth and yield.

Shoot response of *F. carica* to different combination of manures and fertilizers

Like leaf parameters, shoot parameters were also significantly influenced by different manure and fertilizer combinations. Node number was highest in T_{12} (50.33) followed by T_{11} (48),T_9 (46.11) and $T_{10.}$ (45.11) while maximum shoot number was noted in T_7 (4.13) followed by T_1 (3.45), T_2 (3.22) and T_4 (3.22) (Table 4) which are statistically similar. Again, highest plant height (65.44 cm) and plant girth (9.3 cm) were also obtained from T_7

Table 3: Response of the *Ficus carica* leaf to different combination of manure and fertilizer

Treatment	days to leaf initiation	Leaf number			Date mean	Leaf length (cm)			Date mean	Leaf width (cm)			Date mean
		30 DAT	60 DAT	90 DAT		30 DAT	60 DAT	90 DAT		30 DAT	60 DAT	90 DAT	
T_0	18.67 a	11.67 g	29.33 h	49.00 g	30.00 H	7.67 cd	13.33 bc	14.33 cd	11.78 BC	6.67 c-e	11.33 cd	12.97 b-d	10.32 B
T_1	16.67 b	13.33 fg	34.33 g	54.33 f	34.00 G	7.00 d	15.33 b	17.00 b	13.11 B	5.17 e	15.20 b	15.67 b	12.01 B
T_2	15.00 c	15.33 ef	36.00 g	56.33 ef	35.89 F	9.33 b-d	11.00 cd	12.67 de	11.00 C	6.67 c-e	9.27 de	11.00 c-e	8.98 C
T_3	14.67cd	18.00 cd	39.67 ef	58.33 de	38.67 E	9.67 bc	10.00 d	11.67 ef	10.45 C	6.83 b-e	7.73 e	10.03 de	8.20 C
T_4	13.67 c-e	16.33 d-f	44.33 bc	55.33 ef	38.67 E	9.33 b-d	15.00 b	16.33 bc	13.55 B	6.50 de	13.27 bc	15.50 b	11.76 B
T_5	13.33 de	17.67 c-e	45.67 a-c	58.00 de	40.45 D	10.00 a-c	14.33 b	15.33 bc	13.22 B	8.23 a-e	13.60 bc	13.63 bc	11.82 B
T_6	13.00 ef	18.67 cd	47.33 ab	60.33 d	42.11 CD	10.67 ab	10.00 d	11.67 ef	10.78 C	8.07 a-e	8.67 cd	9.93 de	8.89 C
T_7	13.33 de	15.00 ef	37.33 fg	65.00 c	39.11 E	11.67 ab	21.33 a	22.00 a	18.33 A	9.8 a-c	19.33 a	20.43 a	16.52 A
T_8	13.00 ef	16.33 d-f	41.00 de	66.33 bc	41.22 D	11.00 ab	13.33 bc	14.33 cd	12.89 B	8.7 a-d	11.67 cd	12.90 b-d	11.09 B
T_9	13.00 ef	20.33 bc	43.33 cd	66.00 bc	43.22 C	10.00 a-c	11.00 cd	12.67 de	11.22 C	9.03 a-d	9.00 de	11.5 c-e	9.84 C
T_{10}	13.33 de	18.67 cd	41.00 de	67.33 bc	42.33 C	11.33 ab	13.33 bc	14.67 b-d	13.11 B	10.00 ab	11.33 cd	13.83 bc	11.72 B
T_{11}	11.67 f	22.00 ab	45.33 a-c	69.00 ab	45.44 B	12.33 a	13.00 bc	14.00 c-e	13.11 B	10.93 a	11.33 cd	12.53 b-d	11.60 B
T_{12}	9.67 g	23.67 a	48.00 a	71.67 a	47.78 A	12.33 a	9.33 d	9.67 f	10.44 C	10.00 ab	8.43 de	8.67 e	9.03 C
Treatment mean			17.46 *C*	40.97 *B*	61.31 *A*		10.18 *C*	13.10 *B*	14.33 *A*		8.2 *C*	11.55 *B*	12.97 *A*

HSD (*P*d"0.01)for days to leaf initiation=1.57; for leaf number: comparison of date at each level of treatment=1.77, comparison of treatment at each level of date = 3.05; for leaf length: comparison of date at each level of treatment= 1.40, comparison of treatment at each level of date = 2.40; for leaf width: comparison of date at each level of treatment =1.90, comparison of treatment at each level of date =3.27* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Tukeys's Honest Significant Difference (HSD)Test.T_0 = Control, T_1 = Farm Yard Manure (FYM) @ 12.5kg + N @ 160g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_2 = FYM @ 12.5kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130g plant^{-1}, T_3 =FYM @ 12.5kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_4 = FYM @ 25 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_5 = FYM @ 25 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_6 =FYM @ 25 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_7 = Vermicompost (VC) @ 7.5kg + N @ 160g + P_2O_5 @ 105g + K_2O @ 105g plant^{-1}, T_8 =VC @ 7.5 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_9 = VC @ 7.5 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_{10} =VC @ 15 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_{11} =VC @ 15 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_{12} =VC @ 15 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, DAT = Days after transplanting

Table 4: Response of the *Ficus carica* node and shoot number to different combination of manure and fertilizer

Treatment	Node number			Date mean	Shoot number			Date mean
	30 DAT	60 DAT	90DAT		30 DAT	60 DAT	90 DAT	
T_0	11.67 h	29.67 h	52.67 g	31.34 G	1.33 b	3.00 b-d	4.00 b-d	2.78 B
T_1	13.67 gh	36.33 g	58.00 f	36 F	2.00 ab	3.67 ab	4.67 ab	3.45 B
T_2	16.33 e-g	38.33 fg	59.00 ef	37.89 F	1.33 b	3.67 ab	4.67 ab	3.22 B
T_3	17.67 d-f	42.33 de	61.33 de	40.44 E	1.33 b	2.00 d	3.00 d	2.11C
T_4	17.00 d-f	47.00 bc	59.00 ef	41D E	2.00 ab	3.33 bc	4.33 bc	3.22 B
T_5	18.00 d-f	48.67 ab	62.00 de	42.89 D	1.67 ab	2.33 cd	3.33 cd	2.44 C
T_6	19.00 c-e	49.67 ab	64.00 d	44.22 C	2.00 ab	2.33 cd	3.33 cd	2.55 C
T_7	15.00 fg	40.00 ef	69.00 c	41.33 D	2.67 a	4.67 a	5.67 a	4.33 A
T_8	16.67 e-g	44.00 cd	70.33 bc	43.67 C	2.00 ab	3.33 bc	3.67 b-d	3.00 B
T_9	21.33 a-c	47.00 bc	70.00 bc	46.11 BC	1.67 ab	3.00 b-d	4.00 b-d	2.89 B
T_{10}	20.00 b-d	44.00 cd	71.33 bc	45.11 C	1.67 ab	2.67 b-d	3.67 b-d	2.67 C
T_{11}	22.67 ab	48.33 ab	73.00 ab	48 B	1.00 b	2.00 d	3.00 d	2.00 C
T_{12}	24.33 a	51.00 a	75.67 a	50.33 A	1.00 b	2.00 d	3.00 d	2.00 C
Treatment mean	**17.95 *C***	**43.56 *B***	**65.03 *A***		**1.67 *C***	**2.92 *B***	**3.87 *A***	

* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Tukeys's Honest Significant Difference (HSD) Test. HSD (*P*d"0.01) for node number: comparison of date at each level of treatment=1.92, comparison of treatment at each level of date = 3.30; for shoot number: comparison of date at each level of treatment =0.73, comparison of treatment at each level of date =1.25T_0 = Control, T_1 = Farm Yard Manure (FYM) @ 12.5kg + N @ 160g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_2 = FYM @ 12.5kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130g plant^{-1}, T_3 =FYM @ 12.5kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_4 = FYM @ 25 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_5 = FYM @ 25 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_6 = FYM @ 25 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_7 = Vermicompost (VC) @ 7.5kg + N @ 160g + P_2O_5 @ 105g + K_2O @ 105g plant^{-1}, T_8 =VC @ 7.5 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_9 = VC @ 7.5 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_{10} =VC @ 15 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_{11} =VC @ 15 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_{12} =VC @ 15 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, DAT = Days after transplanting

(Table 5). In all growth parameters control showed lowest values.

Plots, where higher doses of NPK[@ 200, 130 and 160 g plant^{-1}were applied (T_{12})], resulted about 0.93 time lower height and 0.71 time lower girth than the plants receiving the lower doses of these fertilizers in T_7 (Table 5). Similarly, lower number of nodes and shoots were also recorded in the plants receiving higher doses of fertilizers (Table 4).Excessive P significantly affects leaf growth and chlorophyll concentration (Shi *et al*., 2020) and excess K found to be inhibitory to growth and root development by Xu *et al*.(2020).

The leaf and node formation might be increased by high dose of fertilizer but shorter internodes lowered the plant height. Similar findings were reported by Sun *et al*. (2020); Shi *et al*. (2020) and Xu, *et al*. (2020). High P in high soil p^H (>6.5; Table 2) induces micronutrient deficiencies which results leaf dwarfing. Besides, high rate of nitrogen significantly decreases phosphorus and potassium availability along with lowering glutamine synthesized activity (Sun *et al*., 2020). The applied NPK and nitrogen fixing bacteria from vermicompost, might have improved the fertility, aeration, water holding capacity, mineral uptake and synthesis of growth hormones (Mengel *et al*., 2001).

Yield performance of *F. carica* to different combination of manure and fertilize

Earlier fruit set occurred in plants (6.33 to 27.33 days earlier) receiving lower doses of VC and NPK in T_7 (VC @ 7.5 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g) than rest of the fertilizer combinations followed by T_1 (72.33 DAT) where lowest dose of NPK (N160g+$P_2O_5$105g+K_2O105g plant^{-1}) was applied with only 12.5 kg FYM. Most delayed fruit set (93.33 DAT) was resulted from

Table 5: Response of the *Ficus carica* plant height and plant girth to different combination of manure and fertilizer

Treatment	Plant height (cm)			Date mean	Plant girth (cm)			Date mean
	30 DAT	**60 DAT**	**90 DAT**		**30 DAT**	**60 DAT**	**90 DAT**	
T_0	16.33 g	41.33 f	81.67 e	46.44 E	5.17	7.17	9.57	7.30 CDE
T_1	18.33 fg	43.33 ef	83.33 de	48.33 E	5.97	7.73	10.07	7.92 C
T_2	19.33 e-g	44.67 d-f	84.67 de	49.56 D	5.50	7.57	9.77	7.61CD
T_3	20.67 d-f	45.67 c-e	85.93 cd	50.76 D	5.27	7.30	9.57	7.38 CDE
T_4	22.00 c-e	47.00 cd	86.67 cd	51.89 CD	5.87	7.90	9.90	7.89 C
T_5	23.00 cd	49.00 c	89.23 c	53.74 C	5.83	7.90	10.53	8.09 BC
T_6	24.67 c	48.33 c	88.33 c	53.78 C	5.23	7.30	9.50	7.34 CDE
T_7	33.00 ab	58.33 ab	105.00 a	65.44 A	7.00	9.27	11.63	9.30 A
T_8	35.00 a	60.00 a	98.67 b	64.56 A	6.80	8.86	11.07	8.91 AB
T_9	32.00 ab	57.00 ab	97.13 b	62.04 B	6.87	8.83	11.07	8.92 AB
T_{10}	34.00 ab	59.00 ab	98.83 b	63.94 AB	5.43	7.70	10.10	7.74 C
T_{11}	31.67 ab	56.67 ab	96.17 b	61.50 B	4.77	6.57	8.80	6.71 DE
T_{12}	31.00 b	56.00 b	96.47 b	61.16 B	4.67	6.40	8.67	6.58 E
Treatment mean	**26.23 *C***	**51.26 *B***	**91.70 *A***		**5.72 *C***	**7.73 *B***	**10.02 *A***	

* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Tukeys's Honest Significant Difference (HSD) Test. HSD ($P \leq 0.01$) for plant height: comparison of date at each level of treatment=2.08, comparison of treatment at each level of date = 3.57; for plant girth: comparison of date at each level of treatment =0.26, comparison of treatment at each level of date =0.92T_0 = Control, T_1 = Farm Yard Manure (FYM) @ 12.5kg + N @ 160g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_2 = FYM @ 12.5kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130g plant^{-1}, T_3 =FYM @ 12.5kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_4 = FYM @ 25 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_5 = FYM @ 25 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_6 = FYM @ 25 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_7 = Vermicompost (VC) @ 7.5kg + N @ 160g + P_2O_5 @ 105g + K_2O @ 105g plant^{-1}, T_8 =VC @ 7.5 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_9 = VC @ 7.5 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, T_{10} =VC @ 15 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1}, T_{11} =VC @ 15 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g plant^{-1}, T_{12} =VC @ 15 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g plant^{-1}, DAT = Days after transplanting

the plants applied with higher doses of FYM and NPK fertilizers in T_6 (25kg FYM+ 240 g N+160g P_2O_5+ 160g K_2O plant^{-1}) followed by T_5 (90.33 DAT) and T_{12} (higher doses of VC and NPK) (90.33 DAT) (Table 6).

Number of fruiting shoot (3.00) and fruit number (31.67) was also highest in the plants treated with T_7 which was about three times more than control (T_0) (1.33 and 11.67 respectively). Second highest fruiting shoot (2.00) was found in T_1, T_4 and T_8 and they are statistically analogous to T_0 (1.33), T_2 (1.33), T_9 (1.67) and T_{10} (1.67). Lowest number of fruit per plant was produced by T_3 (9.33) (Table 6).

Organic manure improves soil physical properties by increasing soil porosity and decreasing soil bulk density (Shah *et al*., 2023) which ultimately improves root environment, nutrient uptake and vigorous growth resulted highest number of fruits per plant (Rabindra *et al*., 2021). Shamsuddin *et al*. (2020) also reported higher yield with higher rate of organic manure.

Largest fruits were produced in T_7 in respect of fruit length (61.33 mm), fruit diameter (55.00 mm) and fruit girth (168.90 mm) followed by T_{10} (length 56.67mm, diameter 51.33 mm and girth 148.03 mm). The lowest reading was in the fruits harvested from T_6 (36.67mm, 32.67 mm and 94.43 mm, respectively). The treatment T_7 showed superiority for fruit weight (57.00 g) over all other fertilizer compositions followed by T_{10} (51.67 g) and T_9 (45.33 g). Average fruit weight from T_7 was recorded as 57.00 g i.e. 5.33g to 27.00g more than fruit weight produced by other treatments. Total harvested fruit per plant (1.81 kg plant^{-1}) and yield per hectare (4.53 ton ha^{-1}) were also highest in T_7 followed by T_{10} (1.18 kg plant^{-1} and 2.94 ton ha^{-1}) (Table 6).

Higher leaf length and width formed from organic fertilizer (vermicompost or FYM) in

Table 6: Response of the yield parameters of *Ficus carica* to different combination of manure and fertilizer

Treatment	Days to fruit set	Number of fruiting shoot	Number of fruit	Fruit length (mm)	Fruit diameter (mm)	Fruit girth (mm)	Days to fruit maturity	Average fruit weight (g)	Total fruit per plant (kg)	yield per hectare (ton)	Cost benefit ratio
T_0	75.00 g	1.33 bc	11.67 e	42.00 e	39 .00 de	122.37 cd	58.00 de	33.00 de	0.38 d	0.96 d	1.23 cd
T_1	72.33 h	2.00 b	21.33 bc	47.00 d	50.67 ab	155.33 b	60.00 cd	41.00 c	0.88 c	2.19 c	2.16 b
T_2	79.00 ef	1.33 bc	12.00 e	41.00 ef	38.00 ef	116.50 de	65.33 b	30.00 e	0.36 d	0.89 d	0.87 de
T_3	83.00 d	1.00 c	9.33 e	39.33 ef	34.33 fg	106.77 ef	68.33 a	31.00 e	0.29 d	0.72 d	0.69 e
T_4	76.33 g	2.00 b	24.00 b	38.00 ef	34.00 fg	104.53 ef	59.33 cde	32.67 de	0.79 c	1.97 c	1.53 c
T_5	90.33 b	1.00 c	11.67 e	38.33 ef	34.33 fg	103.30 f	67.00 ab	33.67 de	0.39 d	0.98 d	0.75 e
T_6	93.33 a	1.00 c	10.00 e	36.67 f	32.67 g	94.43 f	68.00 a	31.67 de	0.32 d	0.79 d	0.61 e
T_7	66.00 i	3.00 a	31.67 a	61.33 a	55.00 a	168.90 a	54.00 f	57.00 a	1.81 a	4.53 a	3.95 a
T_8	79.67 e	2.00 b	16.33 d	49.67 d	43.00 cd	130.63 c	57.67 e	44.33 c	0.71 c	1.79 c	1.50 c
T_9	82.33 d	1.67 bc	10.33 e	48.67 d	42.00 cde	131.30 c	61.00 c	45.33 bc	0.47 d	1.67 d	1.01 de
T_{10}	77.00 fg	1.67 bc	23.00 b	56.67 b	51.33 ab	148.03 b	59.33 cde	51.67 ab	1.18 b	2.94 b	1.99 b
T_{11}	87.67 c	1.00 c	19.00 cd	54.33 bc	49.33 b	132.17 c	65.33 b	44.33 c	0.85 c	2.12 c	1.43 c
T_{12}	90.33 b	1.00 c	11.67 e	50.33 cd	44.67 c	131.00 c	67.33 ab	38.33 cd	0.45 d	1.13 d	0.75 e
HSD	2.48	0.97	3.53	4.37	4.34	12.45	2.32	7.03	0.21	0.52	0.42

* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Tukeys's Honest Significant Difference (HSD) Test.T_0 = Control, T_1 = Farm Yard Manure (FYM) @ 12.5kg + N @ 160g + P_2O_5 @ 105 g + K_2O @ 105 g $plant^{-1}$, T_2 = FYM) @ 12.5kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g $plant^{-1}$, T_3 =FYM @ 12.5kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g $plant^{-1}$, T_4 = FYM @ 25 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g $plant^{-1}$, T_5 = FYM @ 25 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g $plant^{-1}$, T_6 = FYM @ 25 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g $plant^{-1}$, T_7 = Vermicompost (VC) @ 7.5kg + N @ 160g + P_2O_5 @ 105g + K_2O @ 105g $plant^{-1}$, T_8 =VC @ 7.5 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g $plant^{-1}$, T_9 = VC @ 7.5 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g $plant^{-1}$, T_{10} =VC @ 15 kg + N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g $plant^{-1}$, T_{11} =VC @ 15 kg + N @ 200 g + P_2O_5 @ 130 g + K_2O @ 130 g $plant^{-1}$, T_{12} =VC @ 15 kg + N @ 240 g + P_2O_5 @ 160 g + K_2O @ 160 g $plant^{-1}$

combination with lower rates of NPK fertilizers which enlarged the photosynthetic area and photosynthete accumulation that yielded larger fruit with higher weight and ultimately triggered the yield hectare^{-1}. Kurubar *et al*. (2017) also inferred that superior fruit characters were found in fig when both organic and inorganic fertilizers were applied together. Choudhury *et al*. (2020) also reported significant positive effect of organic manure (FYM, vermicompost and mustard cake) on yield and quality of sapota.

It is pivotal for any commodity to ensure that the particular product is marketable at the right time. Plants that received 7.5 kg vermicompost with 160g N, 105g P and 105g K (T_7) showed 3.67 to 14.33 days early maturity of fruit than rest of the treatments followed by T_8 (57.67 DAT) without significant difference with T_0 (58 DAT), T_4 (59.33 DAT) and T_{10} (59.33 DAT).Most delayed maturity was observed in T_3 (68.33 DAS) followed by T_6 (68 DAT),where maximum chemical fertilizer was used along with FYM. Statistically similar result was exhibited by T_{12} (67.33 DAT) where highest dose of vermicompost (15 kg) along with highest amount of NPK were used (Table 6). Naik (2005) also recorded delayed flowering and maturity in the high nitrogen treated capsicum plants.

Benefit cost ratio (BCR)

Maximum benefit cost ratio (3.95) was also observed in T_7 followed by T_1 (2.16) and T_{10} (1.99). The ratio derived from T_7 was about three times more than that of control. Lowest ratio was resulted from T_3 (Table 6). Due to increased rate of fertilizer, plant growth and yield might be inhibited. Moreover, increased fertilizer incurred higher production cost with lower harvest. Lokappa *et al*. (2018) reported that the investment in fig orchard will be economically viable with a benefit cost ratio of > 3. The difference is that, they measured the payback for three years and in the current study output from the orchard was measured for only 8 months from planting the saplings.

CONCLUSION

Common fig (*Ficus carica*) is not very fertilizer loving plant. It can produce fruits even in control in Bangladesh but a combination of vermicompost with a low level of NPK can yield best. Among all treatments, 7.5 kg vermicompost with N @ 160 g + P_2O_5 @ 105 g + K_2O @ 105 g plant^{-1} performed as the best combination in respect of better yield and economic return.

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