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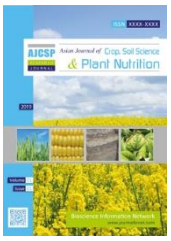

# Evaluation of organic fertilizer on cabbage production at Mymensingh and Jamalpur, Bangladesh

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***ABSTRACT***

*Organic fertilizer (OF) has positive effects on soil, especially soil fertility and productivity. Two experiments were conducted at the farmer's field of Mymensingh and Jamalpur to observe the effect of organic fertilizer on cabbage production during rabi season 2018. There were seven fertilizer treatments viz: $T_1$: RCF ($N_{150}$ $P_{40}$ $K_{100}$ $S_{16}$ Kg $ha^{-1}$), $T_2$: 85% RCF, $T_3$: 70% RCF, $T_4$: 85% RCF + 3 t $ha^{-1}$ OF, $T_5$: 85% RCF + 1 t $ha^{-1}$ OF, $T_6$: 70% RCF + 3 t $ha^{-1}$ OF and $T_7$: 70% RCF + 1 t $ha^{-1}$ OF. The experiments were laid out in a RCBD (Randomized Complete Block Design) with three replications. The average fresh yield at Mymensingh ranged from 34.5 to 60.0 t $ha^{-1}$ with the highest yield of 60.0 t $ha^{-1}$ from treatment $T_4$ (85% RCF + 3 t $ha^{-1}$ OF). At Jamalpur, the average yield ranged from 31.5 to 56.3 t $ha^{-1}$ and the highest yield of 56.3 t $ha^{-1}$ was recorded from treatment $T_4$ (85% RCF + 3 t $ha^{-1}$ OF). The lowest yield was found from treatment $T_3$ in both locations. The percent fresh yield increased over control ($T_1$), was 42.85 and 40.04 in Mymensingh and Jamalpur, respectively. The highest gross margin is Tk. 534507, which was obtained from treatment $T_4$ (85% RCF + 3 t $ha^{-1}$ organic fertilizer). The highest MBCR 3.05 (average of two locations) was obtained from the same treatment $T_4$ (85% RCF + 1 t $ha^{-1}$ organic fertilizer). The result indicated that applying organic fertilizer and 85% recommended dose of chemical fertilizer is more profitable than applying chemical fertilizers only.*

***Key Words:*** *Organic fertilizer, Cabbage and Higher yield*

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## I. Introduction

The primary way of increasing the production of any crop depends on the soil conditions and improved production technology. Crop yield per unit area in Bangladesh is either stagnating or declining state.

Less use of organic matter, intensive cropping pattern, nutrient depletion of soil, imbalanced fertilizer application and improper management practices are the leading causes. Indeed, only chemical fertilizer use cannot maintain sustainable crop production and similarly, it is not possible to get higher crop yield by using organic fertilizer alone (Bair, 1990). Sustainable crop production can be achieved by integrated use of organic and chemical fertilizers. Karim et al. (1994) stated that Bangladesh's soil organic matter depleted by 9 to 45% during the period from 1969 to 1990. The organic matter content and the nutrient status of Bangladesh soils are low and always declining day by day. The application of organic manure increases crop production significantly (Saleque et al., 2004). The importance of organic manuring for increasing soil productivity has been recognized early times. Incorporation of organic manure into soil has been shown to increase organic carbon, total nitrogen and crop yield (Chakraboty et al., 2001).

Cabbage, one of the most popular vegetables grown in Bangladesh, contains low fat, high dietary fibre, vitamin B, C, potassium, and calcium with high nutritional value, which can help protect from many diseases (Krish et al., 2007). The average area under cabbage production in Bangladesh was 45,681 acres and the average yield was 3,11,650 tons with an average yield of 6.82 t/ha during 2016-2017 year, which was very low (BBS, 2017). Agricultural soil should have 3-5% organic matter, but the organic matter content of Bangladesh soil is below 1.5% and mostly, it is less than 1% (BARC, 2005) which is alarmingly low for total agricultural production. It is essential to apply balanced fertilizer with organic matter to soil based on soil analysis to the sustenance of soil fertility and crop productivity. Therefore the present study has been taken to evaluate the effect of organic fertilizer on cabbage production.

## II. Materials and Methods

### Experiment site and design

To determine the effect of organic fertilizers on cabbage production during rabi season 2018, field experiments were conducted at farmer's fields of Mymensingh and Jamalpur. The experiments comprised of seven treatments (Table 01). With three replications, the experiments were laid out in RCBD (Randomized Complete Block Design). The unit plot size of the experiment was 5×4 $m^2$. The lands were prepared properly as per crop requirements before setting up of the experiments. Organic fertilizers were applied before final land preparation. Applications of fertilizers were made as per treatments. One-third urea and all TSP, MP and Gypsum were applied during final land preparation and thoroughly incorporated into the soil. Urea was applied in two equal splits. Both of these instalments were applied as broadcast and incorporated with soil. Intercultural operations were done whenever necessary and fresh cabbage was harvested at maturity. Economic analysis was done using standard procedure.

### Chemical Analysis

The initial soil status of the experimental sites shown in Table 02. The initial soils of the experimental fields were collected and analyzed following standard methods (pH, Organic matter, nitrogen, phosphorus, potassium and sulphur). Soil pH was measured with a glass electrode pH meter, the soil-water ratio being 1:2.5 as described by Jackson (1962). The organic carbon content of soil was determined following the wet oxidation method (Page et al., 1982). Total N content in soil was determined by the Kjeldahl method. Available P content was extracted from soil with 0.5M $NaHCO_3$ solution at a pH 8.5 (Olsen et al., 1954). Exchangeable K content of soil was determined by extraction with 1M $NH_4OAc$, pH 7.0 solution followed by measurement of extractable K by flame photometer (Page et al., 1982). Available S content was determined by extracting soil sample with $CaCl_2$ (0.15%) solution as described by Page et al. (1982). The S content in the extract was determined turbidimetrically and the turbid was measured by spectrophotometer at 420 nm wavelength.

**Table 01. Treatments detail of organic fertilizer for Cabbage production**

| Treatments | Detail |
|---|---|
| $T_1$ | Recommended chemical fertilizer (RCF) ($N_{150}$ $P_{40}$ $K_{100}$ $S_{16}$) |
| $T_2$ | 85% RCF |
| $T_3$ | 70% RCF |
| $T_4$ | 85% RCF + 3 t $ha^{-1}$ OF |
| $T_5$ | 85% RCF + 1t $ha^{-1}$ OF |
| $T_6$ | 70% RCF + 3 t $ha^{-1}$ OF |
| $T_7$ | 70% RCF + 1t $ha^{-1}$ OF |


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**Table 02. Initial soil status of the experimental sites**

| Locations | pH | OM (%) | Nitrogen (%) | Phosphorus (ppm) | Potassium (meq%) | Sulphur (ppm) |
|---|---|---|---|---|---|---|
| Farmer's field Mymensingh | 6.9 | 1.21 | 0.11 | 14.1 | 0.19 | 18.1 |
| Farmer's field Jamalpur | 7.1 | 1.23 | 0.10 | 15.3 | 0.21 | 17.6 |

**Data Analysis**

The analysis of variance for various crop characters and yield was done following the principle of F-statistics. Mean comparisons of the treatments were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

## III. Results and Discussion

**Effect on yield**

The fresh yields of cabbage for different treatments at both locations are presented in Table 03. In both of the locations, the yield was increased significantly due to the treatments. All the organic fertilizer treated plots produced higher yield over chemical fertilizer treated plots except $T_7$ (70% RCF +1 t ha$^{-1}$ OF) because 1 ton organic fertilizer cannot recover nutrients that of 30% chemical fertilizer has been reduced in that treatment. The average yield at Mymensingh ranged from 34.5 to 60.0 t ha$^{-1}$ with the highest yield of 60.0 t ha$^{-1}$ from treatment $T_4$ (85% RCF + 3 t ha$^{-1}$ OF) followed by treatment $T_5$ (85% RCF +1 t ha$^{-1}$ OF) which produced 51.2 t ha$^{-1}$. The lowest yield (34.5 t ha$^{-1}$) was obtained from treatment $T_3$ (70% RCF). The percent increase in fresh yield over $T_1$ was 42.85 at Mymensingh.

At Jamalpur, the average yield ranged from 31.5 to 56.3 t ha$^{-1}$ and the highest yield of 56.3 t ha$^{-1}$ was recorded from treatment $T_4$ (85% RCF + 3 t ha$^{-1}$ OF) followed by treatment $T_5$ (85% RCF +1 t ha$^{-1}$ OF) which produced 47.2 t ha$^{-1}$. The lowest yield (31.5 t ha$^{-1}$) was obtained by the treatment $T_3$ (70% RCF). The percent increase in yield over $T_1$ was 40.04. From the different treatments of organic fertilizer with recommended chemical fertilizer packages, the results demonstrated that the highest cabbage yield was obtained from the treatment $T_4$ (85% RCF + 3 t ha$^{-1}$ OF).

Organic fertilizers application improves the soil health and increases the microbial activity in soil, increasing the nutrient availability for cabbage production and finally increasing the yield of cabbage compared to the application of chemical fertilizers alone. However, it was recorded that, without chemical fertilizers, organic fertilizers could not give a better yield. Our result is an agreement with Batsai et al. (1997), Noor et al. (2005) and Reza et al. (2016).

**Table 03. Effect of organic fertilizer on cabbage production (t ha$^{-1}$) at Mymensingh and Jamalpur**

| Treatments | Cabbage yield (t ha$^{-1}$) | | Yield increase over control ($T_1$) (%) | |
|---|---|---|---|---|
| | Mymensingh | Jamalpur | Mymensingh | Jamalpur |
| $T_1$: RCF ($N_{150}$ $P_{40}$ $K_{100}$ $S_{16}$) | 42.0bc | 40.2bc | - | - |
| $T_2$: 85% RCF | 38.2c | 36.6c | - | - |
| $T_3$: 70% RCF | 34.5cd | 31.5cd | - | - |
| $T_4$: 85% RCF + 3 t ha$^{-1}$ OF | 60.0a | 56.3a | 42.85 | 40.04 |
| $T_5$: 85% RCF + 1 t ha$^{-1}$ OF | 51.2ab | 47.2ab | 21.90 | 17.41 |
| $T_6$: 70% RCF + 3 t ha$^{-1}$ OF | 48.8abc | 44.7bc | 16.19 | 11.19 |
| $T_7$: 70% RCF + 1 t ha$^{-1}$ OF | 41.3bc | 39.3bc | - | - |
| CV (%) | 12.32 | 11.73 | - | - |

Figure in a column, having common letter (s) do not differ significantly at 5% level of probability.

**Economic analysis**

The estimated gross return, variable cost, gross margin and marginal benefit cost ratio (MBCR) are presented in Table 04. The integration of chemical and organic fertilizer increased the gross margin in all the treatments. The highest gross margin is Tk. 534507/- obtained from treatment $T_4$ (85% RCF + 3 t ha$^{-1}$ organic fertilizer) followed by treatment $T_5$ (85% RCF + 1 t ha$^{-1}$ OF). The highest MBCR 3.05 (average of two locations) was obtained from treatment $T_4$ and the second highest MBCR 2.47 was found from treatment $T_5$ (85% RCF + 1 t ha$^{-1}$ OF). The result indicated that applying organic fertilizer and 85% recommended dose of chemical fertilizer is more profitable than applying chemical fertilizers only.

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**Table 04. Cost benefit ratio of organic fertilizer on cabbage (average of two locations)**

| Treatments | Yield (t/ha) | Gross return (Tk./ha/yr.) | Variable cost (Tk./ha/yr.) | Gross Margin (Tk./ha/yr.) | MBCR |
|---|---|---|---|---|---|
| $T_1$: RCF ($N_{150}$ $P_{40}$ $K_{100}$ $S_{16}$) | 41.1 | 411000/- | 19907/- | 391093/- | - |
| $T_2$: 85% RCF | 37.4 | 374000/- | 16993/- | 357007/- | - |
| $T_3$: 70% RCF | 33.0 | 330000/- | 14877/- | 315123/- | - |
| $T_4$: 85% RCF + 3 t $ha^{-1}$ OF | 58.2 | 581500/- | 46993/- | 534507/- | 3.05 |
| $T_5$: 85% RCF + 1 t $ha^{-1}$ OF | 49.2 | 492000/- | 26993/- | 465007/- | 2.47 |
| $T_6$: 70% RCF + 3 t $ha^{-1}$ OF | 47.5 | 475000/- | 44877/- | 430123/- | 0.87 |
| $T_7$: 70% RCF + 1 t $ha^{-1}$ OF | 40.3 | 403000/- | 24877/- | 378123/- | - |

* Chemical fertilizer @ $N_{150}P_{40}K_{100}S_{16}$ kg $ha^{-1}$ at Mymensingh & Jamalpur. Cabbage = Tk 15 $kg^{-1}$, Urea =Tk 16 $kg^{-1}$, TSP= Tk 22 $kg^{-1}$, MP= Tk 15 $kg^{-1}$, Gypsum= Tk 10 $kg^{-1}$, Organic fertilizer =Tk 10 $kg^{-1}$.

## V. Conclusion

In both locations, treatment $T_4$ (85% recommended chemical fertilizer + 3 t $ha^{-1}$ organic fertilizer) has produced the highest yield. The highest marginal benefit cost ratio was obtained from treatment $T_4$ as well and this treatment is found economically cost effective. From the result, it might be concluded that treatment $T_4$ (85% recommended chemical fertilizer + 3 t $ha^{-1}$ organic fertilizer) is the best treatment for cabbage production. There is ample scope for increasing the yield of cabbage through the use of organic fertilizer.

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