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Effect of Organic and Inorganic Fertilizers on Growth and Yield Performance of Sweet Corn (*Zea mays*) at BAPARD Agricultural Farm

Mohammad Tojammel Haq & Md. Shamim Ahmed

Abstract

An experiment was conducted at Bangabandhu Academy for Poverty Alleviation and Rural Development (BAPARD) Agricultural Farm, Kotalipara, Gopalganj during 01 January, 2021 to 20 May, 2021 to find out the vegetative growth and yield performance of sweet corn at different combinations of organic and chemical fertilizers. Five treatments were selected where T_0 was only cowdung (Control), T_1 was Cowdung+ Urea+ TSP+ MoP, T_2 was Cowdung+ Urea+ TSP+ MoP+ Gypsam, T_3 was Cowdung+ Urea+ TSP+ MoP+ Gypsam+ Zinc sulphate and T_4 was Cowdung+ Urea+ TSP+ MoP + Gypsam+ Zinc sulphate+ Boric acid. Plant height and number of leaves at 25 DAS, 50 DAS, 75 DAS and 100 DAS were significantly increased except number of leaves/plant at 25 DAS. Maximum stalk weight per plant (186.90gm), stalk yield (12.46 t/ha), ear height (84.47cm), weight per cob (111.62gm), Cob length (18.52cm), number of rows of seeds per cob (15.27), number of grain per cob (421.80), grain weight per cob(79.17gm) and 100 seed weight (18.77gm) were found in T_4. But maximum shelling percentage (75.06) was found in T_3. The highest grain yield and Stover yield were found were 5.28 t/ha and 14.32 t/ha respectively in T_4. Maximum 233.63% yield was increased over control in case of using organic and inorganic fertilizers at optimum dose. However, it was evident from the present study that using of organic and inorganic fertilizers maximizes the vegetative growth and yield of sweet corn at experimental area of Gopalganj district in Bangladesh.

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Introduction

Maize (*Zea mays L.*) is one of the most widely distributed crops of the world belongs to the family Gramineae (Kaul *et. al.,* 2011). It is one of the most important cereal crops used in the human diet in large part of the world and it is an important feed component for livestock. This crop is the highest yielding cereal crop in the world and has a significant importance to fulfill the demand of staple food. Maize is the third most important cereal crop in the world after wheat and rice (Bukhsh *et. al.,* 2011). About 60% produced in the developed countries, particularly by the United States of America. China produces 27% of the world's maize and the rest is grown in countries of Africa, Latin America and southern Asia with a large proportion being produced in the tropical and subtropical countries (Bushra *et. al.,* 2019). Maize crop has been used in the crop diversification and intensive cropping programs (Kaul and Rahman, 1983). The area coverage of maize cultivation in Bangladesh was about 472,064.78 hectare and the production of maize in Bangladesh was 4,015,000.00 metric tons in 2018-2019 (BBS, 2020). The production of maize was 750,000.00 tons in 2009-2010. The present demand of maize is 54.00 lac metric tons in Bangladesh. The highest production observed in Rangpur division in Bangladesh. The nutritional content of maize is 66.2% starch, 11.1% protein, 7.12% oil and 1.5% minerals. 100 gram maize grains contain 90 mg carotene, 1.8 mg niacin, 0.8 mg thiamin and 0.1 mg riboflavin (Chowdhury and Islam, 1993). Maize has various health benefits. The B-Complex vitamins in maize are good for skin, hair, heart and proper digestion. In many countries of the world such as India, China, Spain, France and Greece, it is used to treat kidney stone, urinary tract infections. Maize oil is used as the best quality edible oil and soap making component. Green parts of the plant and grain are used as the feed of livestock and poultry. Stover and dry leaves are used as good fuel (Ahmed, 1994). The important industrial use of maize includes in the manufacture of starch and other products such as glucose, high fructose sugar, maize oil, alcohols, baby foods and breakfast cereals (Kaul, 1985). Maize starch is especially famous in pharmaceutical industries as diluents and also used in cosmetics. It's stem used for paper manufacturing. Small scale farmers are engaged with maize forming because of its highly nutritional value and affordable source of vitamins and minerals for people living in rural areas. This crop has much higher grain protein content than rice. In Bangladesh, the cultivation of maize was started in the late 19th century but the cultivation has started to gain the momentum as requirements of maize grain are being increased as poultry industry in Bangladesh. For its higher yield per hectare, versatile uses, almost year round growing ability maize is called the queen of cereals. In case of present study different combinations of fertilizers are used along with cowdung. Chemical fertilizers are beneficial for the growth and yield of crop. Moreover chemical fertilizer works very quickly and can fulfill the demand of essential plant nutrients. The application of nutrients such as nitrogen, phosphorus, sulfur, and boron improves the grain and biological yield of maize crops (Shiferaw *et. al*., 2018) But it has negative effect on environment such as destruction of physical structure of soil, change the pH of soil, interrupt the activity of microorganisms, destruct the eco-friendly insects, pollution of water resources, crop susceptibility to disease attack etc. On the other hand organic manure improves the soil structure, soil aeration, soil water holding capacity and patronizes the activity of micro-organisms in the soil that make plant nutrients readily available (Choudhary and Bailey, 1994). Application of humic substance (HS) signifcantly increased the soil fertility and micronutrient uptake (Kazemi, R., *et. al*., 2016). Besides that, application of compost manure signifcantly improved the grain yield of maize (Gomaa, 2016). Combined application of organic with inorganic fertilizer increased yield as compared with using inorganic fertilizer alone (Körschens, M. *et al*., 2013). The yield and growth performance is very much related to the macro nutrient such as nitrogen, phosphorus, potassium and micro nutrient such as sulphur, boron, zinc etc. For this reason, it could be helpful to study the effect of application of organic manure combined with chemical fertilizers by using integrated nutrient management system, which has been the

research focus all over the world (Reganold, 1995). In the view of this fact the study was conducted with the following objectives of this research work: 1) To observe vegetative growth of sweet corn at different combinations of organic and inorganic fertilizers, 2) To find out the effect of organic and inorganic fertilizers on the yield performance of sweet corn and 3) To extension of maize cultivation in this local area.

Materials and Methods

The field experiment was conducted at Bangabandhu Academy for Poverty Alleviation and Rural Development (BAPARD) Agricultural Farm, Kotalipara, Gopalgonj during 01 January 2021 to 20 May 2021. The location of the site is between 21°51´and 23°10´ north latitude and between 89°56´ and 90°10´ east longitude. The topography of the farm area was medium high land and the soil is sandy loam type. The average temperature of this location varies from 12.1°C to 36.1 °C. Heavy rainfall occurs during rainy season. BARI Sweet Corn-1 was used for the experiment and it was developed by Bangladesh Agricultural Research Institute (BARI). Seed was collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The seeds were sown in the plot on 01 January, 2021. Before sowing seeds were soaked in water for 24 hours. The size of the experiment field was (23m×8m) 184m^2. The 4 cross ploughing were done and raised beds were prepared. The size of the plot was (4m×2m) 8m^2 and 0.5m drain was kept between two plots. Total number of plot was 15. The row to row and plant to plant distance was 60cm and 25cm respectively. Randomized Completely Block Design (RCBD) was used with 3 replications and 5 treatments. Treatments are-

T_0= Only cowdung (Control)
T_1= Cowdung+ Urea+ TSP+ MoP
T_2= Cowdung+ Urea+ TSP+ MoP+ Gypsam
T_3= Cowdung+ Urea+ TSP+ MoP+ Gypsam+ Zinc sulphate
T_4= Cowdung+ Urea+ TSP+ MoP + Gypsam+ Zinc sulphate+ Boric acid.

Fertilizer was used as the recommendation of BARI Krishi Projukti Hatboi, 2019. The organic and inorganic fertilizer doses were Cow dung 100 ton/ha, Urea 400 kg/ha, TSP 200 kg/ha, MoP 200 kg/ha, gypsum 190 kg/ha, Zinc sulphate 10 kg/ha and boric acid 9 kg/ha. Equal amount of cowdung was used in each plot. 1/3 of Urea splits in 35 DAS (Days after Sowing) and 1/3 of urea apply in 65 DAS. Rest of all fertilizers and 1/3 urea were given as basal dose during land preparation. Seed germination was started after 7 DAS. Weak, injured and dead seedlings were removed and gap filling will be done within 25 days of sowing. Weeding was done when necessary. Irrigation was very important for maize. Irrigation was given a 3 leaf stage, 10 leaf stage, tasseling stage, flowering stage and during grain setting stage. Maize leaf eating caterpillar was found on few plants and these are finally controlled by spraying Virtako @ 2gm in 10L of water for 5 decimal. Data were recorded on the following parameters: Height of plant and number of leaves at 25 DAS, 50 DAS, 75 DAS and 100 DAS, Ear height, Stover yield, Stalk weight, Stalk yield, Weight/cob, Cob length, Number of rows of seeds/cob, Number of seeds/cob, Weight of grain/cob, 100 seed weight, Shelling percentage and Percentage of yield increased over control. All data were taken carefully at proper time.

Result and Discussion

Plant Height

Height of plant at 25 DAS was observed from 20.66cm to 28.55cm (Table-1). Maximum plant height at 25 DAS was recorded with T_4 (28.55cm) which was statistically similar with T_1 T_2 and T_3 and the minimum plant height at 25 DAS was recorded with T_0 (20.66cm). The plant needs more macro nutrient in initial vegetative stage and the effect of micronutrient cannot detect in initial vegetative stage and so plant height at 25 DAS are almost similar in T_1, T_2, T_3 and T_4. Plant height at 50 DAS was varied from 65.74cm to 105.65cm (Table-1). Maximum plant height

at 50 DAS was recorded with T_4 (105.65cm) which was statistically similar with T_1, T_2 and T_3 and the minimum plant height at 50 DAS was recorded with T_0 (65.74cm). At 75 DAS and 100 DAS plant height was observed from 133.70cm to 185.47cm and 155.43cm to 200.73cm (Table-1). Maximum plant height at 75 DAS and 100 DAS was recorded with T_4 (185.47cm, 200.73cm) which was statistically similar with T_1, T_2 and T_3 and minimum plant height at 75 DAS and 100 DAS was recorded with T_0 (133.70cm, 155.43cm). This variation of plant height was also observed by Eltelib *et. al.,* 2006 and Agba *et. al*., 2005.

Table: 1. Plant height (cm), Number of leaves/plant

Treatment	Plant height (cm) 25 DAS	Plant height (cm) 50 DAS	Plant height (cm) 75 DAS	Plant height (cm) 100 DAS	Number of leaves/plant at 25 DAS	Number of leaves/plant at 50 DAS	Number of leaves/plant at 75 DAS	Number of leaves/plant at 100 DAS
T_0	20.66b	65.74b	133.70b	155.43b	5.27	8.80b	10.75b	10.75b
T_1	26.63a	95.54a	175.13a	194.47a	5.60	11.07a	13.27a	13.27a
T_2	28.33a	101.12a	180.80a	195.40a	5.73	11.13a	13.40a	13.40a
T_3	28.39a	104.75a	182.53a	196.87a	5.87	11.47a	13.67a	13.67a
T_4	28.55a	105.65a	185.47a	200.73a	5.93	11.53a	13.93a	13.93a
F-test	*	*	*	*	NS	*	*	*
CV (%)	8.00	9.21	8.04	6.89	6.08	8.84	5.64	5.64

In a column, figure with same letter do not differ significantly; *Significant at 5% level of significance; NS= Non Significant
Source: Data was collected from research field and data was analyzed by using STAR (Statistical Tool for Agricultural Research)

Number of leaves per plant

Number of leaves per plant at 25 DAS observed from 5.27 to 5.93 (Table-1). Maximum and minimum number of leaves per plant at 25 DAS was recorded with T_4 (5.93) and T_0 (5.27) which were statistically identical. As a result the number of leaves at 25 DAS of all treatments was almost similar. Number of leaves at 50 DAS was observed from 8.80 to 11.53 (Table-1). Maximum number of leaves at 50 DAS was recorded with T_4 (11.53) which was statistically similar with T_1, T_2 and T_3 and the minimum number of leaves at 50 DAS was recorded with T_0 (8.80). Number of leaves per plant at 75 DAS and 100 DAS was observed from 10.75 to 13.93 (Table-1). Maximum number of leaves at 75 DAS and 100 DAS was recorded with T_4 (13.93) which was statistically similar with T_1, T_2 and T_3. Minimum number of leaves at 75 DAS and 100 DAS was recorded with T_0 (10.75). As a result the number of leaves per plant of sweet corn at 25 DAS, 50 DAS and 75 DAS was comparatively lower when we did not use any chemical fertilizers. Therefore, number of leaves per plant at 75 DAS and 100 DAS was same. So, we found that the new leaf did not appear at reproductive stage of the sweet corn.

Ear height

Ear height was varied significantly from 50.23cm to 84.47cm (Table-2). Maximum ear height was recorded with T_4 (84.47cm) which was statistically similar with T_1, T_2 and T_3 and the minimum ear height was recorded with T_0 (50.23cm).

Stalk weight

Stalk weight was taken without cob after drying the plant. The stalk weight was observed from 59.09gm to 186.90gm (Table 2). Maximum stalk weight was recorded with T_4 (186.90gm) which was statistically similar with T_1, T_2 and T_3 and the minimum stalk weight was recorded with T_0 (59.09). As a result, the T_1, T_2, T_3 and T_4 treatments of the sweet corn was given comparatively higher fodder weight than when we did not use any chemical fertilizers.

Stalk yield

The stalk yield was observed from 3.94t/ha to 12.46t/ha (Table-2). Maximum stalk yield was recorded with T_4 (12.46 t/ha) which was statistically similar with T_1, T_2, T_3 and the minimum stalk yield was recorded with T_0 (3.94 t/ha). As a result the T_1, T_2, T_3 and T_4 treatments of the

sweet corn was given comparatively higher dry matter than when we did not use any chemical fertilizers.

Table: 2. Ear height, Stalk weight, Stalk yield, Weight/cob, Cob length, Number of rows of seeds/cob, Number of seeds/cob

Treatment	Ear height (cm)	Stalk weight (gm/plant)	Stalk yield (t/ha)	Weight/cob (gm)	Cob length (cm)	Number of rows of seeds/cob	Number of seeds/cob
T_0	50.23b	59.09b	3.94b	55.26b	12.60b	12.23c	196.07c
T_1	73.40a	165.59a	11.04a	73.92b	14.63ab	13.63b	306.90b
T_2	78.73a	171.68a	11.45a	100.82a	16.77a	14.53ab	395.93a
T_3	82.97a	182.39a	12.16a	101.23a	16.81a	14.80ab	410.93a
T_4	84.47a	186.90a	12.46a	111.62a	18.52a	15.27a	421.80a
F-test	*	*	*	*	*	*	*
CV (%)	14.47	13.98	13.98	14.24	16.14	4.63	17.46

In a column, figure with same letter do not differ significantly; *Significant at 5% level of significance; NS= Non Significant
Source: Data was collected from research field and data was analyzed by using STAR (Statistical Tool for Agricultural Research)

Weight/cob

Weight of per cob was varied from 55.26gm to 111.62gm (Table 2). Maximum weight of per cob was recorded with T_4 (111.62gm) which was statistically similar with T_2 and T_3 and the minimum weight of per cob was recorded with T_0 (45.26gm) which was statistically similar with T_1 (73.92).

Cob length

Cob length was observed from 12.60cm to 18.52cm (Table 2). Maximum cob length was recorded with T_4 (18.52cm) which was statistically similar with T_2 and T_3 and minimum cob length was recorded with T_0 (12.60cm) which are statistically similar with T_1 (14.63cm). This result was supported by Agba *et. al.,* 2005; Hassan 2005; Oktem and Oktem, 2005 who observed the similar result.

Number of rows of seeds/cob

Number of rows of seeds per cob was observed from 12.23 to 15.27 (Table 2). Maximum number of rows of seeds per cob was recorded with T_4 (15.27) which was statistically similar with T_2 and T_3 and the minimum number of rows of seeds per cob was recorded with T_0 (12.23). As a result the number of rows of seeds per cob was comparatively lower when we did not use any inorganic fertilizers. The highest number of grain rows was obtained 15.62 and the lowest number of grain rows was recorded 14.25 by NN Shahinur, 2013.

Number of seeds/cob

Number of seeds per cob was significantly varied from 196.07 to 421.80 (Table 2). Maximum number of seeds per cob was recorded with T_4 (421.80) which was statistically similar with T_2 and T_3 and the minimum number of seeds per cob was recorded with T_0 (196.07). As a result the number of seeds per cob was gradually increased when we applied the combination of organic and inorganic fertilizers. Similar findings were reported by Hassan (2005), Oktem and Oktem (2005) and Ogunlela et. al. (1998).

Weight of grain per cob

Weight of grain per cob was observed from 33.92gm to 79.17gm (Table 3). Maximum weight of grain per cob was recorded with T4 (79.17gm) which was statistically similar with T1, T2 and T3. The minimum weight of grain per cob was recorded with T0 (33.92gm) which was statistically similar with T1 (54.75gm).

Table: 3. Weight of grain/cob, 100 seed weight, Shelling percentage, Matured grain Yield, Stover yield, Percent yield increased over control

Treatment	Weight of grain/cob (gm)	100 seed weight (gm)	Shelling percentage	Matured grain Yield (t/ha)	Stover yield (t/ha)	Percent yield increased over control
T_0	33.92b	17.30	61.38b	2.26c	5.36b	100b
T_1	54.75ab	17.84	74.07a	3.65b	12.32a	161.50ab
T_2	73.72a	18.49	73.12a	4.92a	13.13a	217.70a
T_3	75.98a	18.62	75.06a	5.07a	14.27a	224.33a
T_4	79.17a	18.77	70.93a	5.28a	14.32a	233.63a
F-test	*	NS	*	*	*	*
CV (%)	23.99	10.26	14.14	23.99	10.96	24.85

In a column, figure with same letter do not differ significantly; *Significant at 5% level of significance; NS= Non Significant
Source: Data was collected from research field and data was analyzed by using STAR (Statistical Tool for Agricultural Research)

100 seed weight

100 seed weight was observed from 17.30gm to 18.77gm (Table 3). Maximum weight of 100 seed was recorded with T_0 (18.77gm) and minimum weight of 100 seed was recorded with T_0 (17.30gm) which were statistically identical.

Shelling percentage

Shelling percentage is the ratio of weight of grain per cob and the weight of whole cob. It was observed from 61.38% to 75.06% (Table 3). Maximum was recorded with T_3 (75.06%) which was statistically similar with T_1, T_2 and T_4. The minimum shelling percentage was recorded with T_0 (61.38%).

Matured grain yield (t/ha)

Matured grain yield was observed from 2.26 t/ha to 5.28t/ha (Table 3). Maximum and minimum grain yield was recorded with T_4 (5.28 t/ha) and T_0 (2.26 t/ha), which was significantly increase over control. As a result gradually increase of grain yield by combined application of organic and inorganic fertilizer.

Stover yield

Stover yield was observed from 5.36 t/ha to 14.32 t/ha (Table 3). Maximum Stover yield was recorded with T_4 (14.32 t/ha) which was statistically similar with T_1, T_2 and T_3. The minimum Stover yield was recorded with T_0 (5.36 t/ha). This result was supported by NN Shahinur (2013) who was found that the Stover yield of maize was found 4.94 t/ha when use only organic fertilizer and 13.97 t/ha when use inorganic fertilizers.

Percent yield increased over control

It was observed that highest and lowest percentage of yield increased over control was T_4 (233.63) and T_1 (161.50). As a result it was proved that combined application of organic and inorganic fertilizer increased grain yield.

Conclusion

The vegetative growth of the sweet corn was reduced when only cowdung was used. In vegetative stage plant uses more macronutrient and so the number of leaves and plant height did not vary in case of inorganic fertilizers used. But finally we showed that the highest yield was given by using both macro and micronutrients that means the highest performance was found by using the combination of cowdung, urea, TSP, MoP, Gypsum, Zinc sulphate and Boric acid at optimum dose. We advise that the combination of organic and inorganic fertilizers at optimum doses is more beneficial when applied at farmer field.

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