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FERTILIZER RECOMMENDATION FOR MAIZE CULTIVATION IN KARATOA BANGALI FLOODPLAIN SOILS OF BANGLADESH

M. R. A. Mollah[1]*, M. A. Islam[1], M. S. Alam[1], M. R. Khatun[2] and T. Hasan[1]
[1]On-Farm Research Division, BARI, Chalopara, Bogura-5800
[2]Soil Science Division, Bangladesh Agricultural Research Institute, Gazipur-1701
***Corresponding author's email: rmollah67@yahoo.com

ABSTRACT

The trial was conducted in the farmers' field of Multilocation Testing Site, Sherpur, Bogura during Rabi season of 2020-21 to develop a suitable fertilizer recommendation for maize in Maize- T. Aus- T. Aman rice cropping pattern. For the first crop (maize), the treatments were T_1: STB dose, T_2: T_1 + 25% extra NPK, T_3: T_1 + 50% extra NK, T_4: IPNS based on T_1 @5 tha^{-1} of cowdung and T_5: IPNS based on T_3 @5 tha^{-1} of cowdung. According to the treatment specifications, the STB and other doses were estimated. Treatments were assigned randomly, and fertilizer doses were applied accordingly following RCB design. Maximum grain yield (8.56 tha^{-1}) was recorded from T_3 treatment that was statistically similar to T_2 and T_5 and the minimum (6.92 t ha^{-1}) from T_4 treatment. Similar trend was observed for stover yield also. The highest gross return (Tk. 182750 ha^{-1}) was amounted from T_3 treatment against the cultivation cost of Tk. 110454 ha^{-1} that together led to the higher gross margin amounting Tk. 72256 ha^{-1}. Lower gross return (Tk. 147640 ha^{-1}) as well as gross margin (Tk. 38768 ha^{-1}) was obtained from the T_4 treatment.

Key words: Fertilizer, maize, inorganic, organic. Karatoa Bangali Floodplain.

Introduction

Bangladesh is a densely populated (1008 per sq. km.) country of the world with an area of 1,47,570 sq. km and the present population is about 170 million, with an increase annually at the rate of about 1.42% per year (BBS 2018). The major challenge for the agriculture sector of Bangladesh is to increase and sustain crop yield and production. This is possible through cropping intensification with high yielding varieties of balanced fertilizer and proper soil fertility management. The present soil fertility status of Bangladesh is alarming. Use of Organic manures to meet the nutrient requirements of the crop would be an inevitable practice in the years to come for sustainable agriculture since organic manures not only improve the soil physical, chemical, and biological properties (Nambiar *et al*., 2011). Fertilizers, manures, and other amendments either alone or in combinations could be used to develop a nutrient supplying capacity of the soil (Madhvi and Deepa Sharma, 2020). Several studies indicated that combined use of chemical fertilizer with manure could increase yield and economic returns compared with fertilizer or manure alone (Zhang *et al*., 2012). The application of poultry manure increasing the pH, P, K, Ca, Mg, and Mn, in the soil, more effectively when compared to other animal manures. In rice-based cropping system Maize-T. Aus-Taman is one of the major cropping patterns in Sherpur Upazila of Bogura which cover around 1330 hectare of land. The present cropping intensity of Sherpur is 251% by improving the present cropping pattern. Sustainable crop production in Bangladesh through the improvement of cropping patterns in rice-based cropping systems is regarded as increasingly important in national issues such as food security, poverty alleviation, and creation of job opportunities. Thus, it is necessary to find out the optimum fertilizer dose for maize in Maize-T.Aus-T.Aman cropping pattern in the Bogura region. Hence the program was undertaken to find out a suitable and economic fertilizer dose for sustainable crop productivity and soil fertility for maize in Maize-T. Aus-T. Aman cropping pattern and increase the productivity and income of the farmers.

Materials and Methods

The trial was conducted in the farmers' field of Multilocation Testing Site, Sherpur, Bogura situated in the Karatoa Banglali Floodplain (AEZ-4) during *Rabi* season of 2020-21 to develop a suitable fertilizer

recommendation for maize in Maize- T. Aus- T. Aman rice cropping pattern. The experiment was laid out in a randomized complete block design with three replications. There were five treatments for each crop. The soils belong to the AEZ-4 (Karatoa Banglali Floodplain). Initially the soil samples were collected from different points of the experimental field and analyzed to determine the nutrient status of the soils. Nutrient status of the soils presented in the Table 1. Based on soil test values, fertilizer doses for respective treatment were estimated. For the subsequent crops i.e., T. Aus and T. Aman rice, fertilizer doses to be rationalized based on the doses applied for the first crop maize.

Operations related to Maize cultivation: After selection of land and subsequent collection of soil samples and analysis, the land was well prepared through tillage followed by laddering. Then borders alongside the ages of the 15 plots were made leaving water channels in between the plots. Then fertilizer doses for each treatment were calculated based of soil test report. For the first crop (maize), the treatments were T_1: STB dose, T_2: T_1 + 25% extra NPK, T_3: T_1 + 50% extra NK, T_4: IPNS based on T_1 @5 tha^{-1} of cowdung and T_5: IPNS based on T_3 @5 tha^{-1} of cowdung. According to the treatment specifications, the STB and other doses were estimated as T_1 = N-P-K-S-Zn-B @ 238.07-72.74-68.93-32.32-4.68-1.20 $kgha^{-1}$; T_2 = N-P-K-S-Zn-B @ 297.59-72.74-86.17-32.32-4.68-1.20 $kgha^{-1}$; T_3 = N-P-K-S-Zn-B @ 297.59-90.93-86.17-32.32-4.68-1.20 $kgha^{-1}$; T_4 = CD-N-P-K-S-Zn-B @ 5000-213.07-65.24-57.43-32.32-4.68-1.20 $kgha^{-1}$; T_5 = CD-N-P-K-S-Zn-B @ 5000-272.59-83.43-74.67-32.32-4.68-1.20 $kgha^{-1}$ respectively. Before sowing of seed, all the fertilizers except urea were applied as basal thoroughly mixed with the soils. Treatments were assigned randomly, and fertilizer doses were applied accordingly following RCB design. The unit plot size was 40 m^2. Seeds of BARI Hybrid Maize (BHM-9) @ 25 kg ha^{-1} were sown on 26 November 2020 following a spacing of 60cm ×20cm. At the final stage of land preparation, one third of the approved urea and all other fertilizers was broadcast followed by tilling and leveling. The remaining urea was applied in equal 2 installments. The first installment was applied at 35 days after seed germination (8-10 leaf stage) and the second installment at 60-65 days after seed germination (male flowering stage). Excess seedlings were removed from the land within 30 days of seedling emergence. The land was kept weed free till the seedlings were one month old. Four irrigations were provided at 30, 45, 70 and 90 DAS respectively to facilitate necessary soil moisture essential for plant growth and development. Fertilizer Recommended Guide (BARC, 2018) along with the application methods was followed for rationalizing the treatments in order to support the normal growth of the crops. Initially, Spodoptera pheromone @ 40 traps/ha was set to control common cutworm. The crop was then sprayed with Proclaim 5 SG @1g/L at 7-10 days interval to control Fall Armyworm. In some cases, leaf blight was observed and Rovral 50wp @ 2g/L was sprayed to control blight. The crop was harvested on 13 May 2020. The economic indices i.e. gross return, gross margin and cultivation cost were also calculated based on prevailing market price of the commodities. Relevant data were taken and analyzed statistically.

Table 1. Average nutrient status of initial soil (0-15 and 15-30 cm depth) of the experimental fields

Matter	pH	OM (%)	Total N (%)	K (meq $100g^{-1}$ soil)	P	S	Zn	B
					μg g^{-1} soil			
Value	5.95	1.55	0.085	0.172	8.254	17.145	0.321	0.263
Interpretation	N	L	L	M	L	L	VL	L

N= Neutral, M=Medium, L=Low, VL=Very low

Results and Discussion

Yield and yield contributing parameters presented in the Table 2. All the parameters were varied significantly among the treatments. Maize plants responded better with the higher amount of fertilizer applied to the field. Higher yield and yield contributing characters were associated with higher amount of fertilizer. Higher plant height (175.36 cm) was recorded from T_3 treatment which was identical with T_2 and T_5 treatments and the lower (161.48 cm) from T_4 treatment. Extra N-P-K applied to the T_2, T_3 and T_5 treatments might be helpful for better plant growth and development. On the contrary, plants under T_1 and T_5 showed slightly stunting in nature as N-P-K were applied in less amount in the said treatments. Healthy plants produced longer cobs than those of

stunted one. Cob length was maximum (17.24 cm) in T_4 treatment which is statistically identical to T_2 and T_5 and the minimum (15.10 cm) was recorded in T_4 treatment which was like T_1. Maximum number of grain cob^{-1} (460.23) was obtained from T_3 treatment followed by T_2 treatment (450.67) and the minimum (402.15) from T_4 treatment. Similar trend was observed for hundred grain weight. Hundred grain weight was almost identical in all the treatments. However, it was ranged from 22.21 g in T_4 to 26.65 g in T_3 treatment. It was observed that higher grain weight was associated with the boldness of the seeds. Higher yield contributing characters resulted in higher yield for the respective treatments. Maximum grain yield (8.56 tha^{-1}) was recorded from T_3 treatment that was statistically similar to T_2 and T_5 and the minimum (6.92 t ha^{-1}) from T_4 treatment. More or less similar trend was observed for stover yield of the maize. Stover yield was ranged from 6.16 t ha^{-1} in T_4 to 7.70 t ha^{-1} in T_3 treatment. Priya *et al* (2014) reported that the yield advantage was observed in the combination of inorganic fertilizers with the application of bio-fertilizers and green manuring. Shanwad *et al* (2010) also noted that the enhancement in maize productivity with the combined application of nutrients through organic and inorganic resources. Similar findings have also been reported that the increase in maize yield with the combined application through organic and inorganic resources of nutrients (Singh *et al* 2018). The combination of organic and inorganic nutrient sources proved better in soil fertility in the long run. Parbati *et al* (2022) reported that the combined applications of organic manures and chemical fertilizer have proved superior and contributed to the soil properties and the performance of maize.

Cost and return related information were presented in the Table 3. From the presented data, it was observed that maximum yield provided maximum return and vice versa. The highest gross return (Tk. 182750 ha^{-1}) was amounted from T_3 treatment against the cultivation cost of Tk. 110454 ha^{-1} that together led to the higher gross margin amounting Tk. 72256 ha^{-1}. T_2 scored the second position regarding cost and return. Lower gross return (Tk. 147640 ha^{-1}) as well as gross margin (Tk. 38768 ha^{-1}) was obtained from the T_4 treatment. Though, higher doses in T_1 and T_2 treatments coexisted with higher cultivation cost, the higher return from the higher yield resulted in higher gross margin in said treatments.

Table 2. Yield parameter and yield of maize as influenced by different nutrient treatment combinations in MLT site, Sherpur, Bogura during 2020-21 cropping season

Treatment	Plant height (cm)	Cob length (cm)	No of grain/cob	100 grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	165.72 b	15.12 b	408.82 b	22.67 b	7.15 b	6.31 b
T_2	172.57 a	16.78 a	450.67 a	24.59 ab	8.34 ab	7.52 a
T_3	175.36 a	17.24 a	460.23 a	26.65 a	8.56 a	7.70 a
T_4	161.48 c	15.10 b	402.15 b	22.21 b	6.92 c	6.16 b
T_5	171.25 ab	16.95 a	438.54 ab	24.42 ab	7.85 ab	7.13 ab
CV%	8.34	5.61	4.68	4.72	6.17	7.38

Table 3. Cost and return of maize as influenced by different nutrient treatment combinations in MLT site, Sherpur, Bogura during 2020-21 cropping season (Average data)

Treatment	Gross return (Tk. ha^{-1})			Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
	Grain	Stover	Total		
T_1	143000	9465	152465	105910	46555
T_2	166800	11280	178080	108493	69587
T_3	171200	11550	182750	110494	72256
T_4	138400	9240	147640	108872	38768
T_5	157000	10695	167695	113456	54239

Input Price (Tk/kg); Urea: 16; TSP: 22; MoP: 15; Gysum: 10; $ZnSO_4$: 150; Boric acid: 150; Cowdung: 1 Output price (Tk/kg): Maize grain: 20; Stover: 1.5

Conclusion

Considering the yield and economic return, T_2, T_3 and T_5 were found suitable for maize cultivation. Extra application of N, P and K essential nutrient element was found suitable for better plant growth and development and consequently for higher grain yield of maize. Despite of having a slightly higher cultivation cost due to use of higher rate of fertilizers, treatments T_2, T_3 and T_5 were found profitable for higher grain yield. Therefore, it could be recommended that farmers may apply 25% NPK or 25% NK as extra with the STB dose for higher yield and return from maize cultivation.

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