Effect of some secondary and micro nutrients along with organic amendments on wheat at AEZ 3

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Abstract: The field experiment was conducted in the "Tista Meander Floodplain Soils" at BINA (Bangladesh Institute of Nuclear Agriculture) sub-station farm. Tajhat,Rangpur, during the Rabi season 2002-2003 with wheat (Kanchan) grown in an objective of evaluating the effects of secondary nutrients (S & Mg), micro nutrients and organic amendments(PM and CD) on the growth, yields and nutrients uptake by crops. The surface soil was sandy loam texture. The experiment wasdesigned with eight treatments laid out in a randomized complete block design with three replications.The growth and yield contributing characters were significantly influenced by treatments. The grain and straw yields of wheat significantly influenced due to application of secondary nutrients, micronutrients and organic amendments though the different treatments. The grain yield of wheat varied from 3650 kg to 4100 kg ha^{-1}, the highest yield recorded T_8: N P K+ (CD) treatment and the lowest yield in control. There were significant positive effects of the treatment T_8: NPK + (CD) on wheat.Secondary nutrients and micronutrients along with NPK fertilizer showed less response than those of organic amendments plus NPK fertilizers. The overall results express that organic amendments with NPK is essential to obtain satisfactory yield of wheat in the experiment soil.

Key words: Secondary and micro nutrients, organic amendments, wheat, AEZ.

Introduction

Wheat is the second stable cereal food in Bangladesh. Wheat (*Triticum aestivum*) is the second most important crop and about two-thirds of the world's population lives on wheat grains. It can be a good supplement of rice and can play a vital role to feed the teeming millions of hungry people in this country. It is superior to rice for its higher protein content, vitamins and minerals. The annual production of wheat grain in 2001-2002 was 0.17 million metric tons obtained from 0.78 million hectare of land with an average yield of 876 kg/ac (BBS Pocket Book, 2011). It plays a vital role in national economy to reduce gap between food production and import of food. The urgent need of the crop sector of Bangladesh Agriculture at this moment is to produce more food to feed the country's ever growing population. To attain self-sufficiency in food, efforts must be made to enhance the yield per unit area and improve the quality of the produce. Targeting high yield with a higher cropping intensity is the most logical way to raise the total area from the total production from the limited land resource. The practice of intensive cropping with modern improved variety is a major endeavor of crop production in Bangladesh. This in turn causes a marked depletion of inherent reserves in soils. Before 1980's deficiency of NPK was a major problem but thereafter NPK, deficiency along with secondary and micronutritents (S and Zn). Boron deficiency is also reported on some soils and crops (Mondal, 2000; Jahiruddin, 1993; Islam *et al*.,1998). Sulphur deficiency has been recognized in many area of Bangladesh, which roughly covers 44% of the total cropped area (Hussain, 1990).

The farmers of this country use only about 102 kg nutrients ha^{-1} (70 kg N, 24 kg P_20_5, 6 kg K_20, 2 kg S + Zn) annually, while the crop removal is nearly 200 kg ha^{-1} (Islam *et al.,* 1998). The intensive cropping with modern varieties**,** nutrient leaching with monsoon rains and light textured soils are also favouring the emergence of micronutrient deficiency in this soil. Consequently, Zn and B deficiency are frequently reported on some soils and crops (Jahiruddin *et al.*, 1995).

The soil fertility status are gradually declining or stagnating trend in the yield of major crops of the country is now becoming a very alarming issue for the scientists and policy makers (Bhuiyan, 1995). Cowdung a common manure in Bangladesh, can play a vital role in soil fertility improvement as well as in supplying most of the secondary and micronutrients. In the recent years poultry farms of the different sizes have been established all over the country. Poultry farm holders use concentrated feeds to feed their poultry birds. As a result the poultry excreta are rich in nutrients. As the poultry, excreta are not used as fuel these can be the good source of nutrients for field crops. Poultry manure contains high amount of secondary and micronutrients.

The farmers of Bangladesh are so poor and illiterate. Therefore, it is rigid that they don't know how to use properly secondary and micro nutrients adding from organic and inorganic sources. The intensive cropping with modern varieties, nutrients leaching with monsoon rains and light textured soil favorer emergence of secondary and micronutrient deficiency in those soils limiting secondary and micronutrients in properly blanched fertilization and organic amendments programmed should be taken into sequentially sustainable agricultural practices considerations keeping the above points in view, an experiment was conducted in BINA substation, Rangpur to investigate the effect of secondary nutrients, micronutrients and organic amendments on Tista Meander Floodplain Soils in achieving yield of T.aman-wheat cropping sequence to study some physiological parameters which effect on growthand yield of wheat; to study the effect of secondary nutrients (S & Mg) micronutrients (B, Zn & Mo) and organic amendments (Poultry Manure &Cowdung) on the yield and yield contributing characters of wheat; and to predict the effective doses of inorganic and organic fertilizers in wheat cropping at Tista Meander Floodplain Soils.

Materials and Methods

The experiment was set up at the BINA (Bangladesh Institute of Nuclear Agriculture) sub-station farm, Tajhat, Rangpur with wheat (cv. Kanchan) grown in under some selected treatments during the years 2002-2003.The experimental site belongs to the Gangachara Soil Series of Tista Meander Floodplain soil. (AEZ-3) having Non-calcareous Brown Floodplain soil. The land was medium

high with sandy loam texture having pH 6.34, OM 1.24%, available N, P, S, Ca, Zn, B, Fe, Mn sequentially 0.11, 24.4, 6.62, 0.45, 0.17, 31.92, 5.13and exchangeable K, Mg 0.05, 1.37.The experiment was laid out in a randomized complete block design in 8 treatments with three replications. The size of unit plot was 4.0 m × 3.00 m. Spacing of 0.70 m and 0.30 m were maintained in between the replications and unit plot, respectively.There were eight treatments consisting of S, Mg, Zn, B, Mo, poultry manure (PM) and cow dung (CD) in combinations including one control (receiving N, P, and K), the treatments are T_1 = N P K (Control),T_2 = N P K + S, T_3 = N P K + Mg + S, T_4 = N P K + Mg + S + Zn, T_5 = N P K + Mg + S + Zn + B, T_6 = N P K + Mg + S + Zn + B + Mo, T_7 = NPK + PM (Poultry Manure), T_8 = NPK + CD (Cow dung).

The amounts of N, P, K, S, Mg, Zn, B, Mo required for each unit plot were calculated as per their rates of applications are N, P, K, S, Mg, Zn, B, Mo, 80 , 20, 30, 30, 15, 5, 2, 1.5 kg ha^{-1} CD and PM were 5 t ha^{-1} respectively. The full dose of TSP, MoP, Gypsum, magnesium oxide, zinc oxide, borax, Ammonium molybdate and 1/3 urea were applied at the time of final land preparation. The full amount of each TSP and MP were added as broadcast during final land preparation for wheat and urea was applied in three equal splits, the first split during final land preparation, the second split after 30 days of sowing and third split after 55 days of sowing (booting) of wheat seeds.The land was prepared by cross plough with power tiller before layout. After plot prepare it would be final prepared by spade and wheat seed (cv. Kanchan) were sown on 20thNovember 2002 at the rate of 120 kg/ha in sequentially .Seeds were sown in 20 cm apart lines continuously.

Intercultural operations were done to ensure normal growth of the crop weeding and irrigation were done twice during the whole growth period, given after 30 and 55 days of sowing. Top dressing of urea was done in the following day of irrigation. Harvesting of wheat crop was done 15th April 2003. The harvested crop of each plot was bundled separately and brought threshing floor for threshing. The crops were threshed, cleaned and processed. The grain and straw yields were recorded plot-wise on both crops (12%-14% moisture basis). Agronomical characters were recorded as Plant height (cm), effective tillers/ hill, Panicle /spike length (cm),1000-seed weight(g), Grain yield (kg/ha) and Straw yield (kg/ha).The initial and post harvest soil sample was analyzed for soil texture, pH, organic matter, total N and available/ exchangeable P, K, S, Mg, Zn, B, Fe and Mn content. Soils were collected at a depth of 0-15 cm from several spots of the land. The samples were air dried ground and sieved through 2 mm (8 mesh) sieve. The composite sample was stored in a clean plastic container for physical and chemical analyses in standard methods.

Plant samples collected from the field experiment were analyzed for N, P, K, S, Mg, Zn, B, Mn and Mo contents. Grain and straw samples were prepared through standard method and procedure. Prepare extract sample for analyzing and Calculation nutrient uptake sum of straw and grain through nutrient concentration.

The analysis of variance for every crop characters, for the nutrient content and nutrient uptake by the plant was done following the principle of F-statistics and the mean results in case of significant F-value were adjusted by the Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

The field experiment was carried out to evaluate the immediate effect of secondary nutrients, micronutrients and organic amendments on yield, yield contributing characters and nutrient concentration of wheat and uptake by wheat crop. There was significant effect of all treatments applied recommended dose on wheat (Kanchan). The data on yield components of the crop as affected by different fertilizer treatments are presented in (Table 1). The yield components comprise plant height, tillers/hill, and panicle length and 1000-grain weight. The results are discussed below:

Table 1. Effect of secondary nutrients, micronutrients and organic amendments on yield and yield components of wheat (Kanchan)

Treatment	Plant height (cm)	Tillers/hill	Spike Length (cm)	1000 grain wt. (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)
T_1 NPK (control)	92.73 c	2.99 b	8.60 a	39.38 a	3650 e	4583 e
T_2 NPK+S	94.80 bc	3.36 ab	8.98 a	39.84 a	3992 b	5342 b
T_3 NPK+S+Mg	95.03 bc	3.14 b	9.02 a	39.54 a	3908 c	5092 c
T_4 NPK+S+Mg+Zn	94.36 c	3.08b	8.72 a	40.88 a	3708 e	4750 d
T_5 NPK+S+Mg+Zn+B	94.80 bc	3.31ab	9.15 a	39.68 a	3808 d	5108 c
T_6 NPK+S+Mg+Zn+B+Mo	96.73 b	3.11 b	10.00 a	42.32a	3835 d	4773 d
T_7NPK+Poultrymanure(PM	98.10 a	3.66 a	9.25 a	42.72 a	4091 a	6425 a
T_8 NPK+Cow dung(CD)	96.66 b	3.36ab	8.78 a	43.08 a	4100 a	5483 b
CV(%)	5.75	3.95	4.03	4.07	4.22	1.57
S.E.(±)	0.85	0.14	0.62	1.50	32.50	66.58

Common letter in a column are not significantly different at 5% level by DMRT.

Plant height: The plant height of wheat was significantly affected due to the application of different treatment combinations (Table 1). The highest plant height of wheat was 98.10cm recorded in T_7 (PM) treatment, which was statistically different from all of other treatments and the lowest in T_1.However, it is clear that the PM, CD and all nutrients having treatments gave highest value of plant height. BARI (1997) also reported that the application of poultry manure was markedly influenced the plant of wheat, which is in agreement with this result.

Tillers hill^{-1}: Tillers hill^{-1} of wheat significantly affected by different treatments (Table 1). The highest number of tillers hill^{-1}was found in T_7 (PM) 3.66 and lowest 2.99 in T_1 (control) treatment. The statistical relationship between grain yield and tillers hill^{-1}has been calculated and found positively correlated (Fig. 1).

Spike length: Spike length of wheat was statistically unaffected due to different treatments (Table 1). However, treatments did not show any significant effect among each other but increasing with different treatments as compared to control (T_1) treatment.

1000-grains weight: The 1000 grain weight of wheat was unaffected due to the application of different treatment combinations (Table 1) and ranged from 39.38 to 43.08 g. The highest value of 1000-grain weight found in T_8 and lowest in T_1 (control) treatment.

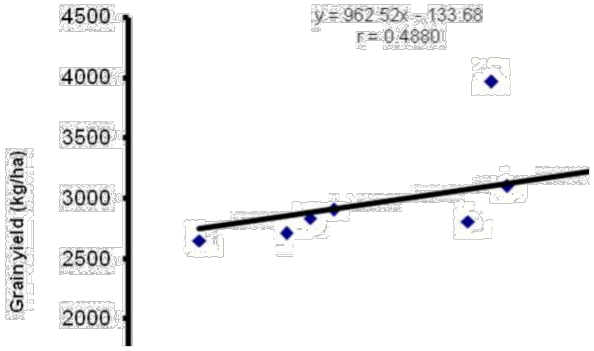

Fig. 1. Relationship between grain yield and tillers/hill of wheat (Kanchan)

Effect of secondary nutrients, micronutrients and organicamendments on the yields of wheat

The data of grain and straw yields of the crop was significantly affected by the different treatments are presented in Table 1. Grain and straw yields increased over control due to various treatments. Grain yield data are determined on 12 to 14% (approx.) moisture basis. The results are discussed below:

Grain yield of wheat: The grain yield of wheat responded significantly due to the added of different treatment combinations on wheat. The grain yield varied 3650 to 4100 kg/ha. The highest grain yield 3100 kg/ha was in T_8 (CD) and lowest 3650 kg/ha in T_1 (control) treatment (Table 1). The second highest grain yield 4091kg ha^{-1} was observed in the treatment T_7 (PM), which was statistically identical with T_8 treatment. The treatment may be ranked in order $T_8>T_7>T_2>T_3>T_6>T_5>T_4>T_1$. The treatment T_1 produce significantly lower grain yield of 3650 kg/ha. BARI (1997) initiated an experiment in 1995-96 on wheat grown season at Dinajpur and found that wheat grain yield of wheat responded significantly due to addition of poultry manure as compared to 100 % NPKS fertilizers. The statistical relationship between grain and straw yield has been calculated and found positively correlated (Fig. 2).

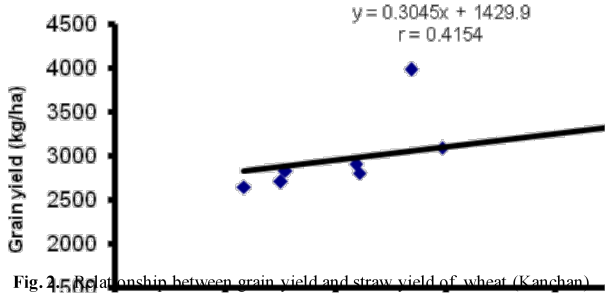

Fig. 2. Relationship between grain yield and straw yield of wheat (Kanchan)

Straw yield: Thestraw yield of wheat was significantly influenced due to the nutrient application in wheat crop. The highest yield varied from 4583 to 6425 kg/ha (Table 1). The highest straw yield was found in T_7 (PM) treatment and the lowest was found in T_1 (control) treatment, both of value were statistically different from all of other treatments. The second highest straw yield of wheat found in cow dung bearing treatment, which was statistically similar to S containing treatment. However, it is clear that the organic amendments gave higher straw yield of wheat by the application of different treatment combinations (Fig. 2).

Nutrient uptake by wheat straw and grain: Nutrient uptake by wheat grain and straw was calculated from the yield data and concentration of nutrient elements. Total uptake is the sum of grain and strawsecondary and micronutrients uptake. The data have been presented in (Table 2)

Secondary nutrient uptake by wheat: Results presented in Table 2 indicated that there was significant variation in S and Mg uptake by grain and straw due to different treatments.

Total Sulphur uptake by wheat: The total S uptake by grain and straw of wheat was significant. The total S uptake ranged from 8.84 to 15.580 kg ha^{-1} (Table 2). The highest total S uptake (15.580 kg ha^{-1}) was observed in T_7 (PM) treatment, which was statistically different from all other treatments. The second total highest S uptake was found in T_8 (CD); which was statistically similar to T_2, T_3, T_4, T_5, and T_6 treatments. The lowest total S uptake was found (8.84 kg/ha) in T_1 (control) treatment.

Total magnesium uptake by wheat: The total Mg uptake of grain and straw as affected by different treatments combinations ranged from 9.27 to 12.27 kg ha^{-1} (Table 2). The highest total Mg uptake (12.27 kg ha^{-1}) was observed in T_7 (PM) treatment, which was statistically different from all other treatments. The lowest total Mg uptake was found (9.27 kg/ha) in T_1 (control) treatment, which was also different from all other treatments.

Micro nutrients uptake by wheat: Result presented in Table 2, showed a significant variation in Zinc uptake by grain and straw and total uptake of zinc due to various treatments.

Total zinc uptake by wheat: The total Zn uptake by grain and straw were significantly affected by different treatment combinations. The total Zn uptake by wheat grain and straw ranged from 0.119 to 0.216 kg ha^{-1} (Table 2). The highest total Zn uptake (0.216 kg/ha) was observed in T_5 treatment, which was not statistically identical of all other treatments. The second highest total Zn uptake was noted in T_6 followed by T_4 which were statistically different from all other treatments. The lowest total Zn uptake (0.119 kg/ha) was found in T_1 (control) treatment, which was statistically different from all other treatments. However, Zn-uptake by wheat was increased due to application of Zn, which is supported by Awad *et al.,* (1996).

Total boron uptake by wheat: The total B uptake (grain plus straw) were positively affected by the treatment combinations (Table 2). The total B uptake by grain and ranged from 0.159 to 0.233 kg/ha (Table 2). The highest

total B uptake (0.233 kg ha^{-1}) was observed in T_5 treatment, which was statistically identical to T_6 treatment and different from of all other treatments. The lowest total B uptake (0.159 kg/ha) was observed in T_1 (control) treatment. Which was statistically different from other treatments & B uptake by the crop was closely associated with the grain and straw yields of wheat (Table 2).

Table 2. Effect of secondary nutrients, micronutrients and organic amendments on S , Mg, Zn and B uptake grain and straw of wheat (Kanchan)

Treatment	Total Uptake			
	S (kg/ha)	Mg (kg/ha)	Zn (kg/ha)	B (kg/ha)
T_1 NPK(control)	8.845 c	9.275 e	0.119 f	0.159 f
T_2 NPK+ S	12.02 b	10.96 bc	0.155 e	0.193 d
T_3 NPK+ S+ Mg	12.75 b	10.74 cd	0.156 e	0.185 e
T_4 NPK+S+ Mg+ Zn	11.89 b	10.46 d	0.187 c	0.184 e
T_5 NPK+ S+ Mg+ Zn+ B	12.04 b	10.58 cd	0.216 a	0.233 a
T_6NPK+S+ Mg+ Zn+ B+Mo	11.76 b	11.01 bc	0.209b	0.228ab
T_7NPK+poultry manure(PM)	15.58 a	12.27 a	0.164d	0.225 b
T_8NPK+cow dung (CD)	12.81 b	11.38 b	0.16d	0.201 c
CV (%)	4.510	2.380	3.920	5.360
S.E.(±)	0.453	0.211	0.816	0.186

Grain and straw yield of wheat responded significantly to added some secondary nutrients (S & Mg) micronutrients (Zn, B & Mo) and organic amendments applied on wheat crops. The grain yield of wheat varied from 2650 kg to 3100 kg ha^{-1}. The highest in T_8 (CD) and lowest in T_1 (control). The treatment T_8 (CD) receiving the recommended rate of direct CD in highest yield of wheat.The straw yield of wheat varied from 4583 kg ha^{-1} to 6425 kg ha^{-1} highest in T_7 (PM) and lowest in T_1 (control) was recorded in control.In wheat the content of S, Mg, Zn and B in grain ranged from 0.089% to 0.111% S, 0.182% to 0.191% Mg, 26.17 ppm to 34.08 ppm Zn and 10.03 ppm to 15.05 ppm B, respectively. Similarly in straw, nutrients content ranged from 0.230% to 0.300% N, 0.043% to 0.074% P, 0.950% to 1.250% K, 0.108 %to 0.191% S, 0.098% to 0.117% Mg, 10.93 to 23.59 ppm Zn and 28.84 to 38.88 ppm B, respectively. In wheat (second crop) nutrient uptake of S, Mg, Zn and B by wheat grain ranged from 2.36 to 3.43 kg S ha^{-1}, 4.83 to 5.80 kg Mg ha^{-1}, 0.069 to 0.096 kg Zn ha^{-1} and 0.026 to 0.042 kg B ha^{-1}, respectively. The nutrient uptake of straw ranged from 6.47 to 12.29 kg S ha^{-1}, 4.44 to 6.55 kg Mg ha^{-1}, 0.050 to 0.121 kg Zn ha^{-1} and 0.132 to 0.192 kg B ha^{-1}, respectively. The total (grain plus straw) uptake of S, Mg, Zn and B by wheat plant ranged from 8.84 to 15.58 kg S ha^{-1}, 9.27 to 12.27 kg Mg ha^{-1}, 0.119 to 0.216 kg Zn ha^{-1} and 0.159 to 0.233 kg B ha^{-1}, respectively. It observed that there were significant and positive relationships between biological yield and total S, Mg, Zn and B uptake by the wheat crop.

The main finding of these experiments were that application of secondary nutrients (S & Mg), micronutrients (Zn & B) and organic amendments onwheat crop. Based on one year result it may be concluded that to obtain satisfactory yield of wheat crop application of recommended N, P and K containing fertilizers along with either CD or PM (5t ha^{-1}) is needed for the sustainable crop production at "Tista Meander Floodplain Soil."

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