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Organic Amendments with Poultry Manure and Cow Dung Influence the Yield and Status of Nutrient Uptake in Wheat (*Triticum aestivum*)

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Abstract

The field experiment cultivating wheat during the winter season from November 2014 to March 2015 was conducted in the "North Eastern Barind Tract Soils" at Kushadaha, Nawabganj, Dinajpur in Bangladesh. The wheat variety BARI Gom 26 was selected in focusing to evaluate the effects of organic amendments using poultry manure (PM) and cow dung (CD) on the growth, yield and nutrient uptake by the plant. The texture of the field soil was clay with acidic nature (pH 5.61). The trials comprise three treatments following a randomized complete block design (RCBD) replicated thrice. Results showed that significantly greater plant height, number of tillers per hill and straw yield were 98.10 cm, 3.66 and 5425 kg/ha respectively in receiving the treatment T_2 than T_3 (95.66 cm, 3.38 and 4483 kg/ha) and T_1 (control). Spike length, 1000 grain weight and grain yield were 9.23 cm, 39.81 kg/ha and 3100 kg/ha respectively also higher in T_2 treatment than T_3 (8.76 cm, 38.51 kg/ha, 3091 kg/ha) with no statistical differences among them. Therefore, the treatment T_2 (PM) comprised of poultry manure and NPK exhibited as the best treatment for producing the highest in all growth and yield parameters of wheat. In wheat grain, the content of N, P, K, S, Mg, Zn and B ranged from 1.080% to 1.380% N, 0.390% to 0.398% P, 0.780% to 0.840% K, 0.079% to 0.111% S, 0.181% to 0.187% Mg, 25.56 to 29.77 ppm Zn and 10.12 to 12.54 ppm B. Similarly in straw, nutrients content ranged from 0.220 to 0.300% N, 0.045% to 0.074% P, 0.970% to 1.250% K, 0.152% to 0.191% S, 0.097% to 0.101% Mg, 10.78 to 13.23 ppm Zn and 27.98 to 2989 ppm B. Therefore, organic amendment with 5-ton cow dung (CD) ha^{-1} with a recommended dose of NPK significantly increased the content of N, S, Mg, Zn and B in the grain and straw of wheat. Alternatively, the poultry manure treatment with NPK significantly increased the content of P and K in the grain and straw of wheat.

However, results revealed that the treatments T_2 and T_3 comprising a recommended dose of NPK with poultry manure and cow dung respectively could increase the content of N, P, K, S, Mg, Zn and B in wheat. The overall results expressed that the poultry manure treatment with NPK (T_2) exposed as superior for producing the top growth and yield attributes of wheat in the studied area.

Keywords

Wheat Cultivation, Poultry Manure, Cow Dung, Chemical Fertilizers, Micronutrients, Straw and Grain Yield

1. Introduction

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 to rice and can play a vital role to feed the teeming millions of hungry people in Bangladesh. It is superior to rice for its higher protein content, vitamins and minerals. The annual production of wheat grain in 2010-2011 in Bangladesh was 0.901 million metric tons obtained from 0.374 million hectares of land with an average yield of 970 kg/ac [1]. 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.

Soil fertility deterioration has become a major constraint to higher crop production in Bangladesh. The increasing land use intensity without adequate and balanced use of chemical fertilizers and with little or no use of organic manures have caused severe fertility deterioration of our soils resulting in stagnating or even declining crop productivity. Sustainable production of crops cannot be maintained by using only chemical fertilizers and similarly it is not possible to obtain higher crop yield by using organic manure alone [2]. The soils of Bangladesh are already depleted in many essential nutrients mainly because of intensive cultivation having no return from organic recycling. Inorganic fertilizers today hold the key to the success of the crop production systems of Bangladesh agriculture, being responsible for about 50% of the total production [3].

The soil fertility status is gradually declining in the yield of major crops in the country is now becoming a very alarming issue for scientists and policymakers [4]. Amendment of organic materials such as, animal manures, and cow dung to soils directly affect soil organic matter content, soil fertility, soil physical characteristics, and augmentation of microbial activities, amelioration of metal toxicity. In recent years, poultry farms of different sizes have been established all over the country. Poultry excreta/manure is a relatively cheap source of rich in nutrients and it contains a higher concentration of secondary and micronutrients compared to cow dung. As the poultry excreta are not used as fuel, these can be a good source of manure for field crops [5].

Cow dung is common organic manure in Bangladesh, and can play a vital role in soil fertility improvement as well as in supplying most of the secondary and micronutrients. Cow dung has long been recognized as perhaps the most desirable animal manure because of its high nutrient and organic matter content. The addition of cow dung increases the organic carbon content of degraded soil which may lead to the increasing activity of beneficial soil microorganisms as well as the fertility status of soil by increasing the availability of nutrients for the plants from the soil. Cow dung significantly increased the growth and yield of plants [6] [7] [8]. Application of cow dung @ 5 $t \cdot ha^{-1} \cdot yr^{-1}$ improved productivity as well as prevented the soil resources from degradation [4]. Judicious application of manures and fertilizers can increase the crop yield per unit area and minimize the nutrient imbalance in the soil.

Proper soil fertility management, therefore, is of prime importance in an endeavor to increase crop productivity. The farmers of Bangladesh are very poor and illiterate. The emergence of secondary and micronutrient deficiency can properly be mitigated with the organic amendments program. Considering the above points in view, the experiment was conducted to investigate the effect of organic amendments with poultry manure & cow dung on the yield and yield contributing characters of wheat producing BARI Gom 26 at North Eastern Barind Tract.

2. Materials and Methods

2.1. Experimental Soil, Design, Treatments and Agronomic Management

The field experiment was conducted from November 2014 to March 2015 at Kushadaha, Nawabganj in Dinajpur district of Bangladesh situated between 25˚62'N and 88˚63'E at 38.20 meters above the sea level. The soil is characterized by heavy clays in texture having pH 5.61, organic matter 1.58%, total N 0.10%, available P 7.03 ppm, exchangeable K 0.11 meq/100g, available S 2.57 ppm, exchangeable Mg 0.55 meq/100g, available Zn 1.30 ppm and available B 0.08 ppm [9]. Cow dung contained 24.03%, 1.05%, 0.35%, 0.45%, 0.24%, 0.16% and 0.015% organic C, total N, P, K, S, Ca and Mg, respectively [10].

The chemical composition of poultry manure characterized by different nutrient elements as N 4.50%, P_2O_5 2.50%, K_2O 2.00%, CaO 2.00% MgO 1.00%, S 0.50%, Fe 0.04%, Mn 0.09% and Zn 0.09% [11].

A modern high yielding variety of wheat "BARI Gom 26" was selected and cultivated applying three treatments with three replications laid out in a randomized complete block design (RCBD). The three treatments consisting of NPK, poultry manure (PM) and cow dung (CD) were in combination with one control in receiving the recommended dose of N, P and K denoted as T_1 = NPK; T_2 = NPK + PM (poultry manure) and T_3 = NPK + CD (cow dung). The recommended dose of urea, TSP and MP fertilizers were used to supply 100 kg N/ha, 30 kg P/ha and 70 kg K/ha respectively to all the experimental plots of wheat as basal dose, cow dung (CD) and poultry manure (PM) were applied at the rate of 5 tons PM ha^{-1} and 5 tons CD ha^{-1} (dry weight basis as per FRG 2012). Total numbers of cultivated plots were 9, the unit plot size was 4 m × 3 m, the distance between two unit plots was 0.3 m and between blocks 0.7 m.

Recommended cultivation practices were followed to grow the wheat crop sown on 15^{th} November 2014 and harvesting was performed on 29^{th} March 2015. All data on plant height (cm), tillers/hill, spike length (cm), 1000-seed weight (g), grain and straw yield (kg/ha) were taken at the full maturity of the crop. The parameters plant height, spike length and 1000-grain weight (g) were collected from 10 (ten) randomly selected plants taken from each plot. The yield of grain and straw were measured plot-wise on the basis of sundry (12% moisture basis).

2.2. Estimation of Different Mineral Nutrient Elements

Plant samples of grain and straw from all plots were dried at 65˚C for about 48 hours with aeration until reaching a constant weight. Dried samples were grained using a stainless steel grinder to pass through a 20-mesh sieve to make samples ready for analysis.

2.2.1. Estimation of Nitrogen (N)

At first dried samples were digested to prepare plant extract with concentrated sulphuric acid and then perchloric acid for the determination of total nitrogen (N) contents by Kjeldahl method [12].

2.2.2. Estimation of P, K, S, Mg, Zn and B

By using wet oxidation method with nitric-perchloric acid plant samples were digested for the determination of phosphorus, potassium, sulphur, magnesium, zinc and boron. All these elements *i.e.* P, K, S, Mg, Zn and B except N were determined from this single digest extracted sample. Sulphur was measured in the digest by the acid seed turbid metric procedure improved by Hunter, A.H. [13].

In the acid digest system, P concentration was estimated colorimetrically using molybdovanadate solution yellow colour method [14]. By using flame photometer K concentration in the extract was determined directly [14]. The concentration of both Mg and Zn were determined directly by atomic absorption spectrophotometer [14]. With the help of acid digest system S content was determined using $BaCl_2$ by turbidity method [15]. By the method of Azomethine-H [16] using spectrophotometer at 420 nm Boron concentration of the extract was determined.

2.3. Statistical Analysis

Data on growth parameters, yield and yield contributing characters, content of different nutrients uptaken by (in grain and straw) wheat were analyzed statistically [17] using F-test to examine various treatment effects. The mean comparisons of treatments were evaluated by the Duncan's Multiple Range Test (DMRT), and a computer package programme "MSTATC" was used for the analyses of variance (ANOVA) for different treatment parameters.

3. Results and Discussion

3.1. Effect of Organic Amendments on Growth and Yield Components of Wheat

The treatments combined with organic manures viz. poultry manure and cow dung with NPK significantly affected on the cultivation of wheat. The organic amendments with poultry manure and cow dung both could supply the required other essential elements, especially beneficial micro nutrients. The components of the cultivated wheat crop as affected by different organic amendments are presented in **Table 1** shows the growth and yield parameters viz. plant height, tillers $hill^{-1}$, spike length, weight of 1000-grain, yield of grain and straw of wheat. Different growth parameters along with grain and straw yields of wheat increased in receiving different treatments over control. Grain yield was measured on 12% (approx.) moisture basis.

The most of the parameters of growth and yield components of wheat were significantly affected by poultry manure and cow dung treatments compare to those of control. Significantly greater plant height 98.10 cm, number of tillers per hill 3.66 and straw yield 5425 kg/ha were noted by applying poultry manure treatment T_2 than cow dung T_3 (95.66 cm, 3.38 and 4483 kg/ha) treatment and control T_1. Alternatively 1000 grain weight, grain yield and spike length were 39.81 kg/ha, 3100 kg/ha and 9.23 cm respectively also higher in receiving the poultry manure treatment than cow dung (38.51 kg/ha, 3091 kg/ha and 8.76 cm), though there were no identical differences among the treatments. However, the T_2 treatment incorporating PM was exposed as producing the highest in all growth and yield contributing parameters of wheat followed by the T_3 (CD) treatment and the lowest were identified in control T_1. Poultry manure is very high in nitrogen and also contains a good amount of potassium and phosphorus.

Table 1. Effect of different treatments on growth and yield parameters of wheat.

Treatments	Plant height (cm)	Tillers/ hill (no.)	Spike Length (cm)	1000 grain weight (g)	Grain yield ($Kg \cdot ha^{-1}$)	Straw yield ($Kg \cdot ha^{-1}$)
T_1 NPK (Control)	91.83 c	2.92 b	8.50 a	38.94 a	2596 b	3602 c
T_2 NPK + Poultry manure (PM)	98.10 a	3.66 a	9.23 a	39.81 a	3100 a	5425 a
T_3 NPK + Cow dung (CD)	95.66 b	3.38 ab	8.76 a	38.51 a	3091 a	4483 b
CV (%)	**4.16**	**2.78**	**3.97**	**3.39**	**3.14**	**1.18**
S. E. (±)	**0.54**	**0.10**	**0.41**	**1.13**	**21.60**	**55.44**
Significance	*	**	NS	NS	**	*

The figures having common letter in a column are not significantly different at 5% level by DMRT; S. E. (M) = Standard error of mean, CV = Co-efficient of Variation, NS = Non-significant, ** = Significant at 1% level, * = Significant at 5% level.

The high nitrogen and balanced nutrients are the reason that poultry manure compost is the best kind of manure to use. Ojo *et al.* [18] reported that among the different feedstocks, poultry manure effluent (PM, RRB: PM, SRB: PM and BRB: PM) contained higher amount of TOC, N, P, K, Fe and Zn compared to effluent of rice bran and cow dung. The application of poultry manure markedly influenced the plant height of wheat, which is in agreement with this result [19]. Similar results were reported by Ranwa and Singh [20].

Farid *et al.* [5] recommended that poultry manure performed better in producing more plant height in combination with the chemical fertilizers (70% FRD) as compared to cow dung. Rajni *et al.* [21] found increased number of effective tiller per hill with the integrated use of poultry manure and nitrogenous fertilizers. Ahmed and Rahman [22] observed that application of poultry manure and chemical fertilizers (NPK) elevated the spike/panicle length. Rajni *et al.* [21] and Haque *et al.* [23] found that the superior position of grain yield was resulted by combined using of poultry manure with recommended dose of NPK are in agreement with our findings. Islam [24] and Khan [25] found significant better effects of poultry manures and fertilizers on straw yield.

3.2. Different Nutrient Contents in Grain and Straw of Wheat

Wheat grain and straw samples were analyzed for N, P, K, S, Mg, Zn, and B contents as influenced by the application of inorganic fertilizers, poultry manures and cow dung along with NPK fertilizers.

3.3. Nitrogen (N) in Grain and Straw of Wheat

The concentration of N in the grain was significantly influenced by using different organic treatments (**Table 2**). Nitrogen content in grain of wheat ranged from 1.080% to 1.380%, and the significantly highest content was obtained from the cow dung treatment (T_3: 1.380%) followed by the poultry manure (T_2: 1.330%) treatment. The same trend of result was appeared for up taking N in wheat straw.

Table 2. Effect of different treatments on basic nutrient contents of wheat.

Treatment	Grain			Straw		
	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
T_1 NPK (Control)	1.080 c	0.390 a	0.780 b	0.220 b	0.045 c	0.970 c
T_2 NPK + Poultry manure (PM)	1.330 ab	0.398 a	0.840 a	0.290 a	0.074 a	1.250 a
T_3 NPK + Cow dung(CD)	1.380 a	0.392 a	0.830 a	0.300 a	0.056 b	1.160 b
CV (%)	**3.630**	**5.150**	**2.660**	**6.110**	**5.700**	**4.870**
S. E. (±)	**0.050**	**0.023**	**0.021**	**0.007**	**0.713**	**0.046**
Significance	*	NS	**	**	*	*

The figures having common letter in a column are not statistically significant at 5% level by DMRT; S. E. (M) = Standard error of mean, CV = Co-efficient of Variation, NS = Non-significant, ** = Significant at 1% level, * = Significant at 5% level.

Little higher content of N was absorbed in straw by cow dung (T_3: 0.300%) than that of poultry manure (T_2: 0.290%) where these two values were statistically similar. Significantly lowest values of N were observed in control (T_1) for both grain (1.080%) and straw (0.220%). The analytical results of N in wheat grain by the cow dung treatment (T_3: 1.380%) is in partial agreement with those found by Timsina *et al.* [26]. Mathew and Nair [27] showed that the cattle manure applied alone or in combination with NPK fertilizers had increased the total N in rice soils. The increasing N rate increases uptake of macronutrients (P, K, Ca, Mg, and S) provided that these elements are present in sufficient amount in soil.

3.4. Phosphorus (P) in Grain and Straw of Wheat

The concentration of P in wheat grain was not significantly influenced by the treatments (**Table 2**) and it's ranged from 0.390% to 0.398%. Though treatments did not show any significant effect among each other, a little increment occurred in P content with different treatments as compared to the control (T_1). The higher content of P in grain obtained from T_2 (0.398%) than T_3 treatment (0.392%) and the optimum range (0.20% - 0.40%) was closer to the results of T_2 treatment which was in accordance with the results of Jones *et al.* [12].

Combined application of NPK and manures showed the significant effect on P content in straw of wheat (**Table 2**) ranged from 0.045% to 0.074%. The significantly highest content was recorded in T_2 treatment (0.074%) which was statistically different from T_3 (0.056%) and T_1 (0.045%) treatments. This result is in agreement with Kadu *et al.* [28] who observed that PM treatment showed the highest P content in wheat straw.

3.5. Potassium Content in Grain and Straw of Wheat

The combined application of NPK with different manures significantly influence on the concentration of K in wheat grain and straw shown in **Table 2** ranging from 0.780% to 0.840% in grain and 0.970% to 1.250% in straw. The highest K content in grain was observed in T_2 (0.840%) and the lowest 0.780% was recorded in T_1 (control), where as T_3 (0.083%) was identically similar with T_2. The highest content of K in straw was recorded 1.250% in T_2 (PM) treatment and the lowest 0.970% was recorded in T_1. The results of Jones *et al.* [12] with wheat grain and straw are similar to the findings of this study. The content of K in grain is little bit higher than those obtained by Timsina *et al.* [26].

3.6. Sulphur Content in Grain and Straw of Wheat

The results presented in **Table 3** indicated that the application of poultry manure and cow dung with NPK had significant effect on S concentration in grain and straw of wheat. Sulphur content in wheat grain ranged from 0.079% to 0.111% with the highest content of S (0.111%) owing in the treatment T_3 (CD)

Table 3. Effect of different treatments on S and Mg content in grain and straw of wheat.

Treatments	Grain		Straw	
	S (%)	Mg (%)	S (%)	Mg (%)
T_1 NPK (Control)	0.079b	0.181a	0.152c	0.097a
T_2 NPK + Poultry manure (PM)	0.106a	0.185a	0.191a	0.102a
T_3 NPK + Cow dung (CD)	0.111a	0.187a	0.171b	0.102a
CV (%)	**2.460**	**5.970**	**1.110**	**3.210**
S. E. (±)	**0.525**	**0.079**	**0.698**	**0.508**
Significance	**	NS	*	NS

The figures having common letter in a column are not statistically significant at 5% level by DMRT; S. E. (M) = Standard error of mean, CV = Co-efficient of Variation, NS = Non-significant, ** = Significant at 1% level, * = Significant at 5% level.

statistically similar with T_2 (PM) treatment and the lowest (0.079%) was in T_1 (control).

Sulphur content in wheat straw was also significantly affected by these two treatment combinations (Table 3). The concentration of S in wheat straw ranged from 0.152% to 0.191% noting with the significantly highest content in straw (0.191%) in the treatment T_2 followed by T_3 and the lowest (0.152%) was in T_1 (control). The obtaining results with the treatment T_2 using poultry manure was in agreement with the results found by Jones *et al.* [12] and Timsina *et al.* [26].

3.7. Magnesium Content in Grain and Straw of Wheat

Table 3 indicated that the application of different treatments did not show any significant effect on Mg concentration in the grain and straw of wheat. The presence of Mg in wheat grain ranged from 0.181% to 0.187% with an increasing tendency belong the treatments consisted of PM and CD as compared to the control (T_1). The greater content of Mg was found from the treatment T_3 comprising the addition of cow dung with NPK.

In wheat straw, the presence of Mg showed the same identical affects by the combinations of different treatment (Table 3). Magnesium content in wheat straw ranged from 0.097% to 0.102% exposing the same highest content 0.102% Mg in wheat straw from the two treatments T_2 and T_3. The lowest (0.097%) was found in control T_1. According to Jones *et al.* [12], the optimum Mg range in wheat plant should be 0.15% - 0.50% at GS 3-10 those are in partial agreement with our results.

3.8. Micro Nutrients Concentration in Wheat (BARI Gom 26)

Zinc and boron content in grain and straw of wheat was significantly influenced by the direct application of various treatments.

3.9. Zinc Content in Grain and Straw of Wheat

Table 4 indicated that the application of different treatments with PM and CD

Table 4. Effect of different treatments on Zn and B content in grain and straw of wheat.

Treatment	Grain		Straw	
	Zn (ppm)	B (ppm)	Zn (ppm)	B (ppm)
T_1 NPK (Control)	25.56 b	10.12 b	10.78 b	27.98 b
T_2 NPK + Poultry manure (PM)	28.04 ab	10.66 b	12.08 a	29.47 a
T_3 NPK + Cow dung (CD)	29.77 a	12.54 a	13.23 a	29.89 a
CV (%)	**4.68**	**1.81**	**6.24**	**3.752**
S. E. (±)	**1.10**	**0.85**	**0.40**	**0.69**
Significance	**	**	**	**

The figures having common letter in a column are not statistically significant at 5% level by DMRT; S. E. (M) = Standard error of mean, CV = Co-efficient of Variation, NS = Non-significant, ** = Significant at 1% level, * = Significant at 5% level.

had significant effect on Zn concentration in the grain and straw of wheat. The presence of Zn in wheat grain ranged from 25.56 to 29.77 ppm and the significantly higher content was found with cow dung (CD) treatment (T_3) than poultry manure (T_2), and the lowest in T_1 (control) treatment. It was clear that Zn content in wheat grain with organic amendments/treatments was higher than the control T_1 where using only NPK as basal dose. Brennan [29] observed that Zn content in wheat grain increased by the application of treatments combining PM and CD containing with the micronutrient element Zn.

The application of organic amendments denoted as different treatments shown significantly better effect on Zn concentration in wheat straw than the control. Zinc content in wheat straw ranged from 10.78 to 13.23 ppm. The highest Zn 13.23 ppm was found in T_3 which was identically similar to that of T_2, and the lowest 10.78 ppm was in T_1 (control) treatment. Jones *et al.* [12] described the optimum range of Zn concentration in wheat as 15 - 70 $\mu g \cdot g^{-1}$ those are in agreement with the findings of our results.

3.10. Boron Content in Grain and Straw of Wheat

Table 4 exposed that the application of different treatments had significant effect on B concentration in the grain and straw of wheat. The ranges of B in wheat grain from 10.12 to 12.54 ppm obtained from different treatments. Significantly higher content of B was found in T_3 than T_1 and T_2, and the lowest 10.12 ppm was recorded in T_1 (control) treatment. The overall results amended by organic manures evaluated that B content of wheat grain was higher in T_3 than those of other treatments. Abedin *et al.* [30] observed that N and B content in grain increased by adding organic manures to the soil.

The influence of combined treatments with organic manures impacted significantly on boron content in wheat straw over the control T_1 and it ranged from 27.98 to 29.89 ppm, the lowest 27.98 ppm was noted in T_1 (control) treatment. The highest content of B 29.89 ppm was found in T_3 treatment which was statistically similar to T_2 (29.47 ppm) and these findings are similar to those results found by Rerkasem *et al.* [31] [32].

4. Conclusions

Grain and straw yield of wheat responded significantly by applying organic amendments to wheat crops. The grain and straw yield of wheat varied from 2596 kg to 3100 kg·ha^{-1}, and 3602 kg·ha^{-1} to 5425 kg·ha^{-1} respectively. The highest yield of grain and straw was found in T_2 (PM) and the lowest in T_1 (control). The treatment of T_2 (PM) combined with a recommended dose of NPK and poultry manure resulted in the top yield of grain and straw of wheat.

The nutrient content (N, P, K, S, Mg, Zn and B) in grain and straw of wheat were significantly influenced due to application of different treatments. In wheat grain, the content of N, P, K, S, Mg, Zn and B ranged from 1.080% to 1.380% N, 0.390% to 0.398% P, 0.780% to 0.840% K, 0.079% to 0.111% S, 0.181% to 0.187% Mg, 25.56 to 29.77 ppm Zn and 10.12 to 12.54 ppm B. Similarly in straw, nutrients content ranged from 0.220% to 0.300% N, 0.045% to 0.074% P, 0.970 to 1.250% K, 0.152% to 0.191% S, 0.097% to 0.101% Mg, 10.78 to 13.23 ppm Zn and 27.98 to 2989 ppm B.

The main finding of this experiment was the application of organic amendments influenced wheat (BARI Gom 26) production. However, the recommended dose of NPK and organic amendment with 5-ton cow dung (CD) ha^{-1} significantly increased N, S, Mg, Zn and B content in the grain and straw of wheat as well as other micronutrients might be supplemented from the cow dung (CD) that helps to get the satisfactory level of grain and straw yield of wheat. Alternatively, the poultry manure treatment with NPK significantly increased the content of P and K in the grain and straw of wheat.

It may be concluded that obtaining a satisfactory yield of wheat (BARI Gom 26) by the application of recommended NPK, along with either cow dung (CD) or poultry manure (PM) could be an efficient practice for achieving sustainable soil fertility and crop yield in the "North Eastern Barind Tract" soil.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] BBS (2013) Pocket Book of Statistics of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka.

[2] Bair, W. (1990) Characterization of the Environment for Sustainable Agriculture: Issues, Perspectives and Prospects in Semi-Arid Tropics. Indian Society of Agronomy, Hyderabad, 1, 90-128.

[3] FRG (2012) Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council, Farmgate, Dhaka.

[4] Bhuiyan, N.I. (1994) Crop Production Trends and Need of Sustainability in Agri-

culture. *The Workshop on Integrated Nutrient Management for Sustainable Agriculture*, Dhaka, 26-28 June 1994.

[5] Farid, M.S., Mamun, M.A.A., Matin, M.A. and Jahiruddin, M. (2011) Combined Effect of Cow Dung, Poultry Manure, Dhaincha and Fertilizers on the Growth and Yield of Rice. *Journal of Agroforestry and Environment*, **5**, 51-54.

[6] Gudugi, I.A.S. (2013) Effect of Cow Dung and Variety on the Growth and Yield of Okra (*Abelmoschus esculentus* L.). *European Journal of Experimental Biology*, **3**, 495-498.

[7] Akande, M.O., Oluwatoyinbo, F.I., Kayode, C.O. and Olowokere, F.A. (2006) Response of Maize (*Zea mays*) and Okra (*Abelmoschus esculentus*) Intercrop Relayed with Cowpea (*Vigna unguiculata*) to Different Levels of Cow Dung Amended Phosphate Rock. *World Journal of Agricultural Science*, **2**, 119.

[8] Mehedi, T.A., Siddique, M.A. and Shahid, S.B. (2012) Effect of Urea and Cow Dung on Growth and Yield of Carrot. *Journal of Bangladesh Agricultural University*, **10**, 9-13. https://doi.org/10.3329/jbau.v10i1.12012

[9] Azad, M.A.K., Ahmed, T., Eaton, T.E.J., Hossain, M.M., Haque, M.K. and Soren, E.B. (2021) Yield of Wheat (*Triticum aestivum*) and Nutrient Uptake in Grain and Straw as Influenced by Some Macro (S & Mg) and Micro (B & Zn) Nutrients. *Natural Science*, **13**, 381-391. https://doi.org/10.4236/ns.2021.139030

[10] Zaman, M.M., Chowdhury, T., Nahar K. and Chowdhury, M.A.H. (2017) Effect of Cow Dung as Organic Manure on the Growth, Leaf Biomass Yield of *Stevia rebaudiana* and Post Harvest Soil Fertility. *Journal of Bangladesh Agricultural University*, **15**, 206-211. https://doi.org/10.3329/jbau.v15i2.35064

[11] Almaz, M.G., Halim, R.A. and Martini, M.Y. (2017) Effect of Combined Application of Poultry Manure and Inorganic Fertiliser on Yield and Yield Components of Maize Intercropped with Soybean. *Pertanika Journal of Tropical Agricultural Science*, **40**, 173-184. http://www.pertanika.upm.edu.my

[12] Jones, J.B.Jr., Wolf, B. and Mills, H.A. (1991) Plant Analysis Handbook: A Practical Sampling, Preparation, Analysis, and Interpretation Guide. Micro-Macro Inc., Athens.

[13] Hunter, A.H. (1984) Soil Fertility Analytical Services in Bangladesh. Consultancy Report, BARC, Dhaka.

[14] Yoshida, S.D., Forno, A., Cock, J.H. and Gomez, K.A. (1976) Laboratory Manual for Physiological Studies of Rice. 3rd Edition, International Rice Research Institute, Manila, 14-22.

[15] Chapman, C.A. and Pratt, P.F. (1964) Methods of Analysis for Soil, Plant and Water. Division of Agricultural Science, University of California, Berkeley.

[16] Page, A.L, Miller, R.H. and Keeney, D.R. (1982) Methods of Soil Analysis Part 2. 2nd Edition, American Society of Agronomy Inc.

[17] Gomez, K.A. and Gomez, A.A. (1984) Statistical Procedure for Agricultural Research. 2nd Edition, International Rice Research Institute, Los Banos, 207-215.

[18] Ojo, O., Ogunwande, G., Adesanwo, O. and Olatoberu, F. (2021) Effect of Effluent from Biodigestion of Pre-Treated Rice Bran and Animal Manure on the Dry Matter Yield and Nutrient Uptake of *Amaranthus viridis*. *Food and Nutrition Sciences*, **12**, 1255-1268. https://doi.org/10.4236/fns.2021.1212092

[19] BARI (Bangladesh Agricultural Research Institute) (1997) Effect of Organic Manure in Wheat-Rice Cropping System. Annual Report (1996-97), Joydebpur, 15.

[20] Ranwa, R.S. and Singh, K.P. (1999) Effect of Integrated Nutrient Management with Vermicompost on Productivity of Wheat. *Indian Journal of Agronomy*, **44**, 554-559.

[21] Rajni, R., Srivastava, O.P. and Rani, R. (2001) Effect of Integrated Use of Organics

with Fertilizer N on Rice and N Uptake. *Fertilizer News*, **46**, 63-65.

[22] Ahmed, M. and Rahman, S. (1991) Influence of Organic Matter on the Yield and Mineral Nutrition of Modern Rice and Soil Properties. *Bangladesh Rice Journal*, **2**, 107-112.

[23] Haque, M.Q., Rahman, M.H., Fokrul, I., Jan Rijpma and Kadir, M.M. (2001) Integrated Nutrient Management in Relation of Soil Fertility and Yield Sustainability under Wheat-Mung-T.aman Cropping Pattern. *Online Journal of Biological Science*, **1**, 731-734. https://doi.org/10.3923/jbs.2001.731.734

[24] Islam, M.R. and Bhuiya, Z.H. (1997) Effect of Nitrogen and Phosphorus on the Growth, Yield and Nutrient Uptake of Deep Water Rice. *Bangladesh Journal of Agricultural Science*, **24**, 93-96.

[25] Khan, M.M.R. (1998) Effect of Cow Dung, Poultry Manure and Urea-N on the Growth and Yield of BRRI Dhan 29. M.S. Thesis, Dept. Soil Sci., BAU, Mymensingh.

[26] Timsina, J., Humphreys, E., Quayyum, M.A., Saleque, M.A., Panuallah, G.M., Haq, F. and Connor, D.J. (2002) Nutrient and Water Management for Sustainable Rice-Wheat Cropping Pattern Systems in Bangladesh and Australia. Final Report, ACIAR-UM-CSIRO-BARI-BRRI Project # 9432 (July, 2002).

[27] Mathew, T. and Nair, S.S. (1997) Physical and Chemical Properties of Rice Soil as Influenced by Organic and Inorganic Sources of Nutrients. *Indian Journal of Agricultural Research*, **31**, 257-261.

[28] Kadu, P.B., Bhoyar, V.S. and Thakare, R.S. (1991) Effect of NPK-FYM Blended Manuring Mixtures on Performance of Rice. *Journal of Soils Crops*, **1**, 172-174.

[29] Brennan, R.F. (1996) Availability of Previous and Current Applications of Zinc Fertilizer Using Single Super Phosphate for the Grain Production of Wheat on South Western Australia. *Journal of Plant Nutrition*, **19**, 109-115. https://doi.org/10.1080/01904169609365183

[30] Abedin, M.J., Jahiruddin, M., Hoque, M.S., Islam, M.R. and Ahmed, M.U. (1994) Application of Boron for Improving Grain Yield of Wheat. *Progressive Agriculture*, **5**, 75-79.

[31] Rerkasem, B. and Lordkaew, S. (1992) Predicting Grain Set Failure with Tissue Boron Analysis. In: Mann, C.E. and Rerkasem, B., Eds., *Boron Deficiency in Wheat*, Wheat Special Report No. 11, CIMMYT, Mexico, 9-14.

[32] Rerkasem, B. and Loneragan, J.F. (1994) Boron Deficiency in Two Wheat Genotypes in a Warm Subtropical Region. *Agronomy Journal*, **86**, 887-890. https://doi.org/10.2134/agronj1994.00021962008600050024x