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Feasibility of Replacing Chemical Fertilizer by Using Organic Fertilizer in Wheat (*Triticum aestivum*) Considering Dry Matter Content and Estimatimation of Different Growth Parameters

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Abstract: An experiment was conducted at the experimental field of Sher-e-Bangla Agricultural University, Dhaka during the period from October 2010 to March 2011 to study the feasibility of replacing chemical fertilizer by using organic fertilizer in wheat. The experiment comprised of 10 treatments, such as T_0: Control condition; T_1: All chemical fertilizer as recommended dose; T_2: Cowdung as recommended dose; T_3: Compost as recommended dose; T_4: ½ Cowdung + ½ Compost; T_5: Cowdung + Compost; T_6: Cowdung + ½ Chemical fertilizer; T_7: Compost + ½ Chemical fertilizer; T_8: Cowdung + Compost +½ Chemical fertilizer and T_9: ½ Cowdung + ½ Compost + ½ Chemical fertilizer. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. At 30, 50, 70, 90 and 110 (Days After Sowing) DAS, the highest dry matter content plant^{-1} was recorded from T_1 (0.30 g, 3.87 g, 8.84 g, 19.58 g and 30.18 g), whereas the lowest weight from T_0 (0.18 g, 2.49 g, 6.50 g, 11.80 g and 18.08 g). At 30-50 DAS, the highest (Crop Growth Rate) CGR was found from T_1 (5.35 g m^{-2}day^{-1}), while the lowest CGR from T_0 (3.46 g m^{-2}day^{-1}). At 50-70 DAS, the highest CGR was found from T_7 (8.34 g m^{-2}day^{-1}), while the lowest CGR from T_0 (6.70 g m^{-2}day^{-1}). At 70-90 DAS, the highest CGR was found from T_1 (17.89 g m^{-2}day^{-1}), while the lowest CGR from T_0 (8.83 g m^{-2}day^{-1}). At 90-110 DAS, the highest CGR was found from T_8 (18.69 g m^{-2}day^{-1}), while the lowest CGR from T_0 (10.47 g m^{-2}day^{-1}). At 30-50 DAS, the highest RGR was found from T_3 (0.134 g g^{-1} day^{-1}) and the lowest RGR from T_5 and T_8 (0.127 g g^{-1} day^{-1}). At 50-70 DAS, the highest RGR was found from T_3 (0.049 g g^{-1} day^{-1}) and the lowest RGR from T_9 (0.041 g g^{-1} day^{-1}). At 70-90 DAS, the highest RGR was found from T_3 (0.040 g g^{-1} day^{-1}) and the lowest RGR from T_0 (0.030 g g^{-1} day^{-1}). At 90-110 DAS, the highest (Relative Growth Rate) RGR was found from T_3 (0.026 g g^{-1} day^{-1}) and the lowest RGR from T_0 (0.021 g g^{-1} day^{-1}). The longest spike (19.86 cm), highest grain yield (3.71 t ha^{-1}) and highest straw yield (5.78 t ha^{-1}) was attained from T_1 and the shortest spike (14.33 cm), lowest grain yield (2.06 t ha^{-1}) and lowest straw yield (4.49 t ha^{-1}) from T_0.

Key words: Wheat, chemical fertilizer, Organic fertilizer, Dry matter and growth parameter.

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops and it is as well as a staple food and shaws the large acreage among all the field crops in the world (FAO, 2010). About two third of the total world's population consume wheat as staple food (Majumder, 1991). The crop is grown under different environmental condition ranging from humid to arid, subtropical to temperate zone. Dubin and Ginkel (1991) reported that the largest area of wheat cultivation in the warmer climates exists in the South-East Asia including Bangladesh, India and Nepal. Wheat is the second most important cereal crops in Bangladesh that contribute to the national economy by reducing the volume of import of cereals for fulfilling our this food requirements of the country (Razzaque *et al.*, 1992). Wheat grain is rich in food value containing 69.60% carbohydrate, 12.00% protein, 1.72% fat 17.20% and minerals (BARI, 2006). Wheat cultivation has been increased manifolds to meet up the food shortage in the country. The area, production and yield of wheat have been increasing dramatically during the last two decades, but its present yield is too low in comparison to that of some developed countries like Japan, France, Germany and UK producing 3.76, 7.12, 7.28, and 8.00 t ha^{-1}, respectively (FAO, 2000). In Bangladesh, the position of wheat is second in respect of total area (0.80 million hectares) and production (2.80 million ton) after rice and the average yield is only 3.44 t ha^{-1} (BBS, 2010) but it can be increased up to 6.8 t ha^{-1} (RARS, 2010).To increase yield of wheat, care should be taken to improve crop growth rate as well as its relative growth rate crop growth and relative growth rate.

Application of both chemical and organic fertilizers is need for the improvement of soil physical properties and quick supply of essential plant nutrients for higher yield. The combined effect of organic manure and inorganic fertilizer on crop yield was also reported by many workers (Davarynejad *et al*., 2004; Singh and Singh, 2000). Therefore the present work was undertaken to study feasibility of replacing chemical fertilizer by using organic fertilizer in wheat (*triticum aestivum*) considering dry matter content, and estimatimation of different growth parameters.

Materials and Methods

The experiment was conducted to study the feasibility of replacing chemical fertilizer by using organic fertilizer in wheat during the period from October 2010 to March 2011. The experiment comprised the 10 treatments i.e., T_0: Control (without manure and fertilizer); T_1: All chemical fertilizers as recommended dose; T_2: Cowdung as recommended dose; T_3: Compost as recommended dose; T_4: ½ Cowdung + ½ Compost; T_5: Cowdung + Compost; T_6: Cowdung + ½ Chemical fertilizer; T_7: Compost + ½ Chemical fertilizer; T_8: Cowdung + Compost +½ Chemical fertilizer and T_9: ½ Cowdung + ½ Compost + ½ Chemical fertilizer. Recommended dose of chemical fertilizer, cowdung and compost for this experiment were Urea: 220 kg ha^{-1}, TSP: 180 kg ha^{-1}, MP: 50kg ha^{-1}, Gypsum: 120 kg ha^{-1}, Zinc oxide: 5 kg ha^{-1}, Boric acid: 6 kg ha^{-1}, Cowdung: 8 ton ha^{-1} and compost: 8 ton ha^{-1}. CGR and RGR were calculated using formulas as described by Hunt (1971).

$$\text{CGR} = \frac{\text{In}W_2 - \text{In}\,W_1}{T_2 - T_1} \quad g\ m^{-2}\ day^{-1}$$

CGR is the dry matter production per unit of time per ground area.

$$\text{RGR} = \frac{DM_2 - DM_1}{T_2 - T_1} \quad g\ g^{-1}\ day^{-1}$$

RGR is the dry matter production per unit of time per plant.

The data obtained for different characters were statistically analyzed to observe the significant difference among the treatment. The mean values of all the characters were calculated and analyses of variance were performed. The significance of the difference among the treatment means was estimated by the Duncan Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

Results and Discussion

Different chemical and organic fertilizers and their combinations showed significant variation for dry matter content $plant^{-1}$ at 30, 50, 70, 90 and 110 DAS (Table 1). At 30 DAS, the highest dry matter content $plant^{-1}$ was recorded from T_1 (0.30 g), which was statistically similar with T_8, T_9, T_5 and T_7 (0.29 g, 0.28 g, 0.25 g and 0.25 g, respectively) and closely followed by T_6 (0.24 g), whereas the lowest from T_0 (0.18 g), which was statistically similar with T_2, T_3, and T_4 (0.20 g, 0.20 g and 0.22 g, respectively). At 50 DAS, the highest dry matter content $plant^{-1}$ was observed from T_1 (3.87 g), which was statistically similar with T_8 and T_9 (3.71 g and 3.67 g, respectively) and followed by T_7 (3.30 g), whereas the lowest from T_0 (2.49 g). At 70 DAS, the highest dry matter content $plant^{-1}$ was obtained from T_1 (8.84 g), which was statistically identical with T_8, T_9, T_7, T_6 and T_3 (8.71 g, 8.37 g, 8.30 g, 8.11 g and 7.95 g, respectively), while the lowest from T_0 (6.50 g). At 90 DAS, the highest dry matter content $plant^{-1}$ was recorded from T_1 (19.58 g), which was statistically similar with T_8 (17.90 g) and closely followed by T_7, T_6 and T_5 (17.03 g, 16.38 g and 16.07 g, respectively) and that of lowest from T_0 (11.80 g). At harvest, the highest dry matter content $plant^{-1}$ was attained in T_1 (30.18 g), which was statistically similar with T_8, T_9 and T_7 (29.11 g, 28.01 g and 27.61 g, respectively) and closely followed by T_6 and T_5 (26.82 g and 26.74 g, respectively), again the lowest T_0 (18.08 g). Application of all chemical fertilizer in recommended doses gave the highest dry matter accumulation followed by the combination of cowdung, compost and chemical fertilizers half in recommended doses.

Table 1. Effect of chemical and organic fertilizers and their combinations on dry matter $plant^{-1}$ of wheat

Treatment	Dry matter $plant^{-1}$ (g) at				
	30 DAS	50 DAS	70 DAS	90 DAS	110 DAS
T_0	0.18 d	2.49 d	6.50 d	11.80 e	18.08 d
T_1	0.30 a	3.87 a	8.84 a	19.58 a	30.18 a
T_2	0.20 cd	2.91 c	7.53 c	15.34 d	25.67 c
T_3	0.20 cd	2.98 c	7.95 a-c	15.47 d	25.86 c
T_4	0.22 cd	3.05 c	7.86 bc	15.82 cd	25.99 c
T_5	0.25 a-c	3.15 c	7.76 bc	16.07 b-d	26.74 bc
T_6	0.24 b-d	3.17 c	8.11 a-c	16.38 b-d	26.82 bc
T_7	0.25 a-c	3.30 bc	8.30 a-c	17.03 b-d	27.61 a-c
T_8	0.29 ab	3.71 a	8.71 ab	17.90 ab	29.11 ab
T_9	0.28 ab	3.67 ab	8.37 a-c	17.62 bc	28.01 a-c
SE	0.018	0.132	0.291	0.616	0.885
CV(%)	10.24	7.06	6.30	6.55	5.80

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of significance. CV= Co-efficient of variance.

CGR varied significantly for different chemical and organic fertilizers and their combinations at 30-50, 50-70, 70-90 and 90-110 (Table 2). At 30-50 DAS, the highest CGR was found in T_1 (5.35 g m^{-2} day^{-1}), while the lowest CGR was recorded in T_0 (3.46 g $m^{-2}day^{-1}$). At 50-70 DAS, the highest CGR was found in T_7 (8.34 g $m^{-2}day^{-1}$), while the lowest CGR was recorded in T_0 (6.70 g $m^{-2}day^{-1}$). At 70-90 DAS, the highest CGR was found in T_1 (17.89 g $m^{-2}day^{-1}$), while the lowest CGR was recorded in T_0 (8.83 g m^{-2} day^{-1}). At 90-110 DAS, the highest CGR was found in T_8 (18.69 g $m^{-2}day^{-1}$), while the lowest CGR was recorded in T_0 (10.47 g $m^{-2}day^{-1}$).

Table 2. Effect of chemical and organic fertilizers and their combinations on Crop Growth Rate (CGR) of wheat

Treatment	Crop Growth Rate (g $m^{-2}day^{-1}$) at			
	30-50 DAS	50-70 DAS	70-90 DAS	90-110 DAS
T_0	3.46 d	6.70 b	8.83 c	10.47 b
T_1	5.35 a	8.29 a	17.89 a	17.67 a
T_2	4.07 c	7.69 a	13.03 b	17.21 a
T_3	4.17 c	8.28 a	12.53 b	16.32 a
T_4	4.25 c	8.02 a	13.26 b	17.94 a
T_5	4.35 c	7.70 a	13.84 b	17.79 a
T_6	4.39 c	8.24 a	13.78 b	17.41 a
T_7	4.56 bc	8.34 a	14.55 b	17.63 a
T_8	5.13 ab	8.32 a	15.32 ab	18.69 a
T_9	5.09 ab	7.82 a	15.43 ab	17.31 a
SE	0.197	0.243	0.859	0.838
CV(%)	7.60	5.29	10.74	8.62

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of significance. CV= Co-efficient of variance.

RGR showed significant variation for different chemical and organic fertilizers and their combinations at 30-50, 50-70, 70-90 and 90-110 (Table 3). At 30-50 DAS, the highest RGR was found in T_3 (0.134 g g^{-1} day^{-1}) and the lowest RGR was recorded in T_5 and T_8 (0.127 g g^{-1} day^{-1}). At 50-70 DAS, the highest RGR was found in T_3 (0.049 g g^{-1} day^{-1}) and the lowest RGR was recorded in T_9 (0.041 g g^{-1} day^{-1}). At 70-90 DAS, the highest RGR was found in T_3 (0.040 g g^{-1} day^{-1}) and the lowest RGR was recorded in T_0 (0.030 g g^{-1} day^{-1}). At 90-110 DAS, the highest RGR was found in T_3 (0.026 g g^{-1} day^{-1}) and the lowest RGR was recorded in T_0 (0.021 g g^{-1} day^{-1}).

Table 3. Effect of chemical and organic fertilizers and their combinations on Relative Growth Rate (RGR) of wheat

Treatment	Relative growth rate (g g^{-1} day^{-1}) at			
	30-50 DAS	50-70 DAS	70-90 DAS	90-110 DAS
T_0	0.131 ab	0.048 ab	0.030 c	0.021 e
T_1	0.128 ab	0.042 cd	0.040 a	0.022 de
T_2	0.133 a	0.047 a-c	0.036 ab	0.026 a
T_3	0.134 a	0.049 a	0.033 bc	0.025 ab
T_4	0.132 ab	0.047 a-c	0.035 a-c	0.025 a-c
T_5	0.127 b	0.045 a-d	0.036 ab	0.025 ab
T_6	0.130 ab	0.047 a-d	0.035 a-c	0.025 a-c
T_7	0.128 ab	0.046 a-d	0.036 ab	0.024 bc
T_8	0.127 b	0.043 b-d	0.036 ab	0.024 a-c
T_9	0.129 ab	0.041 d	0.037 ab	0.023 cd
SE	0.002	0.002	0.002	0.001
CV(%)	7.60	6.06	8.16	6.15

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of significance. CV= Co-efficient of variance.

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