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Performance of Wheat As Influenced By Integrated Nutrient Management

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Abstract

The experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barisal during Rabi season of 2016-2017 and 2017-18 to find out the suitable combination of inorganic fertilizers and organic fertilizers with proper planting technique in a randomized complete block design. Nine treatments viz.T_1=100%of RF+Bio-slurry 0 tha^{-1},T_2= 100% of RF+Bio-slurry 5 tha^{-1},T_3=100% of RF+Bio-slurry10tha^{-1},T_4=50% of RF+ Bio-slurry 0 tha^{-1},T_5=50%of RF+Bio-slurry 5tha^{-1},T_6=50% of RF+Bio-slurry10tha^{-1},T_7=75% of RF +Bio-slurry 0tha^{-1},T_8=75% of RF+Bio-slurry 5tha^{-1},T_9=75% of RF + Bio-slurry 10tha^{-1}. The result revealed that when 100% recommended dose of fertilizers was used with 10 tha^{-1} of bio-slurry gave the highestyield (3.96 and 3.86 tha^{-1}) which was statistically similar to the yield (3.91 and 3.84tha^{-1}) in T_9 treatment where 10tha^{-1} of bio-slurry was applied with 75% of recommended fertilizers.

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Introduction

Wheat (*Triticumaestivum*) belongs to the Graminae family, is one of the most important grain crops in Bangladesh. In Bangladesh, per annum demand for wheat is 7.70 m tons, but its production is only 1.15 m tons. The average production per hectare is only 3.38 tons (BBS, 2017). Hence, the production is much lower than demand. This lower yield is due to a lack of balanced fertilizers as well as rice-based cropping patterns. The soil fertility status of Bangladesh soil is degraded day by day. More than 60% of our cultivated soil contains organic matter at a low level (<1.7%) (FRG, 2012). According to an appraisal report of Bangladesh soil resources, soils of about 6.10 m ha contain very low (less than 1%) organic matter, 2.15 m ha contain low (1-2%) organic matter and the remaining 0.90 ha contain more than 2 % organic matter (Mondal, 2000).Maintenance of soil fertility is a must for long-term sustainable crop production.Soil fertility and nutrient availability are closely connected to the soil's organic matter content and its mineralization (Zech, 1996). Soil chemical, physical and biological properties are also altered by manure applications and it seems possible that long-term manure applications could change nutrient release patterns significantly (Haynes and Naidu 1998). So, the application of organic matter is essential for maintaining soil fertility. Wheat is sensitive to nutrient stress. Bio-slurry is one of the organic sources which have been obtained as a by-product of fermented biogas generated through the anaerobic decomposition of various organic materials that can be used for crop production (Abubakar, 2012; Haque *etal.*,2015). Very little research work on bio-slurry was conducted in the world. Therefore, the present study was undertaken to study the suitable combination of inorganic and organic fertilizers for higher yield and economic return.

Materials and methods

Experimental site

A field experiment was conducted at the Regional Agricultural Research Station, Rahmatpur, Barisal during rabi 2016-2017 and 2017-18. The soil of the plot was sandy loam in texture having pH 7.5, total N, available P and K were 0.08%, 16.8 µg g^{-1} soil and 0.09 meq per 100 g of soil, respectively.

Treatments and experimental design

BARI Gom 26 was used as the test crop. The experiment was comprised of nine treatments i.e. T_1=100% of RF + Bio-slurry 0 tha^{-1}, T_2= 100% of RF + Bio-slurry 5 tha^{-1}, T_3= 100% of RF + Bio-slurry 10 tha^{-1}, T_4= 50% of RF + Bio-slurry 0 tha^{-1}, T_5= 50% of RF + Bio-slurry 5 tha^{-1}, T_6= 50% of RF + Bio-slurry10 tha^{-1}, T_7= 75% of RF + Bio-slurry 0 tha^{-1}, T_8= 75% of RF + Bio-slurry 5 tha^{-1}, T_9= 75% of RF + Bio-slurry 10 tha^{-1}.

The experiment was laid out in a randomized complete block design with 3 replications and spacing of 30 cm between rows and 20 cm between plants. Unit plot size was (4 X 3) m^2.

Fertilizer and bio-slurry application

Fertilizer was applied according to treatment specifications. Nutrients were calculated on an IPNS basis and just the necessary amount of fertilizer was applied. Except for Urea, all other fertilizers and bio-slurry were applied in whole amounts during the final land preparation. Urea was applied at 25 DAS and 50 DAS as a split dose.

Cultivation practices

The seeds were sown on 19 November 2016 and 21 November 2017. Irrigation was given at 35 DAS and 55 DAS for both seasons. Weeding was done as and when necessary.

The crop was always kept under careful observation until it was harvested. Wheat seeds were cured for 6 days in the sun at 14% moisture before storing in an ordinary room. Ten plants were selected at random from each plot for the collection of data.

Data collection

Data on the following parameters were recorded during the period of the experiment as Plant height (cm), No. of plants m^{-2}, Spikes m^{-2}, Length of spike (cm), Grains $spike^{-1}$, 1000-seedweight (g), yield (tha^{-1}).

Statistical analysis

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique and the mean differences were adjudged by LSD test using the statistical computer package program, Statistics 10 (Gomez and Gomez, 1984).

Results

Wheat responded positively to bio-slurry. The combined effect of inorganic fertilizers and bio-slurry on wheat yield was significant. Plant height is an important character of a variety as taller plants lodges down and create a shed for other plants. Plant height in this study varied significantly. The highest plant height was recorded in T_3 treatment (95.70 cm in 2016-17 and 97.00 cm in 2017-18) and the lowest was noticed in T_4 treatment (87.67 cm in 2016-17 and 86.67 cm in 2017-18). No. of plants m^{-2}, spikes m^{-2}, length of spike,grain spike^{-1}and 1000-seed weightare theindicator of yield. Except number of plants m^{-2}all the yield and yield contributing characters significantly varied from treatment to treatment.

Significantly the highest spike length (11.53 and 11.20cm) was recorded in T_3 treatment in both years and the lowest was observed in T_4 treatment (8.33and 8.80 cm).The highest no. of spikes m^{-2} (331 and 331.67) was recorded in T_3 treatment in both seasons which was identical with T_2 treatment (316.33 and 318.00).

Table 1. Growth, yield and yield attributes as affected by bio-slurry at 2016-17.

Treatment	Plant height (cm)	No. of plants m^{-2}	Spikes m^{-2}	Length of spike (cm)	Grains spike^{-1}	1000-seed weight (g)	Yield (tha^{-1})
T_1	88.60 c	21.67	293.30 cd	9.40 cd	40.93 d	43.16 d	3.45 c
T_2	92.56 ab	23.00	316.33 ab	10.23 bc	50.13 a	47.16 a-c	3.71 b
T_3	95.70 a	24.33	331.00 a	11.53 a	52.26 a	48.53 ab	3.96 a
T_4	87.67 c	22.00	260.00 f	8.33 d	33.83 e	42.03 d	2.89 e
T_5	88.26 c	22.67	271.00 ef	8.96 d	37.03 de	44.83 b-d	3.25 d
T_6	89.96 bc	24.00	285.67 de	9.56 cd	43.50 bc	47.60 a-c	3.42 cd
T_7	87.86 c	23.67	284.00 de	9.06 d	38.93 c-e	44.63 cd	3.06 e
T_8	90.60 bc	25.00	289.67 d	9.67 cd	42.30 c	47.00 a-c	3.50 c
T_9	93.33 ab	25.33	308.00 bc	10.90 ab	48.23 ab	50.23 a	3.91 a
$LSD_{(0.05)}$	1.97	Ns	16.41	0.59	3.95	2.89	0.18
CV (%)	2.35	12.37	3.23	6.45	6.89	4.66	3.02

Values followed by the same letter(s) did not differ significantly at the 5% level of probability.

The lowest no. of spikes m^{-2} (260 and 259.33) was recorded in T_4 treatment.In 2016-17 the maximum number of grains per spike (52.26) was observed in T_3 treatment which was statistically similar to that of T_2 (50.13) and T_9 treatments (48.23) and in 2017-18, the maximum number was observed in T_3 treatment (53.67) which was also similar with T_2 (51.00) and T_9 (49.12) treatments.

Table 2. Growth, yield and yield attributes as affected by bio-slurry at 2017-18.

Treatment	Plant height (cm)	No. of plants m^{-2}	Spikes m^{-2}	Length of spike (cm)	Grains spike^{-1}	1000-seed weight (g)	Yield (tha^{-1})
T_1	89.93 de	22.33	285.00 c	9.73 cd	43.47 c	45.33 cd	3.61 c
T_2	93.63 bc	23.67	318.00 ab	10.33 bc	51.00 a	48.33 bc	3.54 b
T_3	97.00 a	24.00	331.67 a	11.20 a	53.67 a	49.67 ab	3.86 a
T_4	86.67 f	22.67	259.33 d	8.80 e	31.87 e	44.00 d	2.61 e
T_5	88.73 ef	21.33	274.00 cd	9.03 e	40.33 cd	46.00 bcd	3.13 d
T_6	90.67 de	24.67	287.33 c	9.87 cd	44.53 bc	49.00 abc	3.28 cd
T_7	89.03 e	23.33	284.33 c	9.37 de	38.00 de	46.33 bcd	3.14 e
T_8	91.47 cd	26.33	289.67 c	9.80 cd	43.97 c	48.67 abc	3.51 c
T_9	93.97 b	24.33	311.67 b	10.53 b	49.12 ab	52.33 a	3.84 a
$LSD_{(0.05)}$	2.36	NS	14.47	0.64	4.95	3.89	0.20
CV (%)	1.50	12.99	3.23	3.76	6.46	4.71	2.95

Values followed by the same letter(s) did not differ significantly atthe 5% level of probability.

T_1 = 100% of RF+Bio-slurry 0 tha^{-1}
T_2 = 100% of RF+Bio-slurry 5 tha^{-1}
T_3 = 100% of RF+Bio-slurry10 tha^{-1}
T_4 = 50% of RF+Bio-slurry 0 tha^{-1}
T_5 = 50%of RF+Bio-slurry 5 tha^{-1}
T_6 = 50% of RF+Bio-slurry10 tha^{-1}
T_7 = 75% of RF+Bio-slurry 0 tha^{-1}
T_8 = 75% of RF+Bio-slurry 5 tha^{-1}
T_9 = 75% of RF+Bio-slurry10 tha^{-1}

The minimumnumber of grains per spike (33.83 and 31.87) was observed in T_4 treatment in both years.1000 seed weight was found highest (50.23 g and 52.33 g) in T_9 treatment in both years, respectively and lowest (42.03 g and 44.0 g) was found at T_4 treatment. The highest yield (3.96 and 3.86 tha^{-1}) was found in T_3 treatment which was statistically similar to that of T_9 (3.91 and 3.84 tha^{-1}) treatment, respectively in both years. All the parameters were found lowest in T_4 treatment where no bio-slurry was applied, but only 50% of the recommended doses of fertilizers were applied (Table 1 and Table 2).

Discussion

Due to the decomposition and breakdown of parts of its organic content, digested slurry provides fast-acting nutrients that easily enter into the soil solution, thus becoming immediately available to plants (Gaur *et al.*, 1984).From the study, it was found that bio-slurry along with chemical fertilizers enhances plants phenotypic as well as reproductive growth compared to plots treated with only chemical fertilizers. This might be due to higher nitrogen use efficiency, availability of nutrients in the root zone over the whole growing period because nutrients in bio-slurry, especially nitrogen, are more readily available than in manure, leading to a larger short term fertilization effect (Bonten *et al.* 2014).The use of bio-slurry along with chemical fertilizers changes to soil organic matter, nitrogen content,cation exchange capacity and bulk density (Zebider Alemneh,2011) and ultimately increasesnutrient use efficiency (Akanbi*et al.*,2010).Bio-slurry also makes macro and micronutrients available to plants.As a result, more assimilates were transformed from source to sync (root, shoot, seed).It may have a positive impact on plant growth for future crops; these are found to be agreed with those ofCaravaca *et al.* (1999).

Conclusion

Bio-slurry is an important organic fertilizer that helps in quality crop production and enhances soil quality. As it is digested anaerobically, it supplies more nutrients than cowdung. Results from the study showed that bio-slurry along with chemical fertilizer increased the yield and quality of wheat. Yield is higher in T_3 treatment where 100% recommended fertilizers were applied with 10 tha^{-1}bio-slurry. So, farmers can use bio-slurry along with chemical fertilizers for improving yield and quality.

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