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Effect of irrigation and fertilizer, manure on the yield of boro rice

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Abstract
The experiment was conducted in the farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to study the effect of various organic manures and inorganic fertilizers with different water management on the growth and yield of Boro rice. BRRI dhan29 was used as the test crop in the experiment. The experiment consists of 2 factors (i) Irrigation and (ii) fertilizer plus manure. Two levels of irrigations (I_1= Continuous flooding and I_2= Saturated Condition) were used with 8 levels of fertilizer plus manure, as T_0: Control, T_1: 100% ($N_{120}P_{25}K_{60}S_{20}Zn_2$) Recommended dose of Fertilizer, T_2: 50% NPKSZn + 5 ton cow-dung ha^{-1}, T_3: 70% NPKSZn + 3 ton cow-dung ha^{-1}, T_4: 50% NPKSZn + 5 ton compost ha^{-1}, T_5: 70% NPKSZn + 3 ton compost ha^{-1}, T_6: 50% NPKSZn + 3.5 ton poultry manure ha^{-1} and T_7: 70% NPKSZn + 2.1 ton poultry manure ha^{-1}, with 16 treatment combinations and 3 replications. The yield parameters and yields were significantly affected by fertilizer and manure. The highest grain yield (7.40 ton/ha) was found from T_7 (70% NPKSZn + 2.1 ton poultry manure ha^{-1}) treatment which was closely similar to T_6 (50% NPKSZn + 3.5 ton poultry manure ha^{-1}) treatment and lowest yield was obtained from T_0 treatment. The higher grain yields were found by the application of organic plus inorganic fertilizers compared to the use of chemical fertilizer alone. The yield parameters were not significantly influenced by combined application of irrigation and fertilizer and the highest grain yields (7.51 ton/ha) were recorded from I_1T_1 (Continuous flooding + 100% (Recommended dose of Fertilizer) which was closely similar with the yield of I_1T_7 (Continuous flooding + 70% NPKSZn + 2.1 ton poultry manure ha^{-1}) and lowest (3.69 ton/ha) from I_2T_0 (Saturated Condition + control treatment) treatment combination.

Keywords: Effect of irrigation, yield of boro rice, fertilizer

1. Introduction
Rice (*Oryza sativa*) is one of the major crops of the world. Rice is a semi aquatic annual grass plant and is the most important cereal crop in the developing world. Rice is the major staple food of nearly half of the world's population, and is particularly important in Asia, where approximately 90% of world's rice is produced and consumed. Since the introduction of high yielding semi-dwarf varieties in 1960s by the International Rice Research Institute (IRRI) more than 1000 modern rice varieties have been released to farmers in many Asian countries, resulting in a rapid increase in rice yields and global rice production. Global production dropped sharply at the beginning of the 21st Century, from 410 million tons in 2000 to 378 million tons in 2003 bec*aus*e of severe droughts in parts of Asia, but has recovered by growing 50 million tons between 2005 and 2011 (Rejesus *et al*., 2012) [1]. Rice is intensively cultivated in Bangladesh which covered about 80% of the total cultivable land. But the population density is higher that can't provide them their whole requirements. The main thing is that in Bangladesh the yield of rice is low compare to the other rice growing countries like Japan, South Korea where the average yield is 6.22 and 7.00 ton per hectare chronologically (Islam *et al*., 2013) [2] and the demand is increasing day by day in Bangladesh. Statistically total area under Boro crop has been estimated at 47.70 lac hectares in 2010-11, 48.10 lac hectares in 2011-12, and 47.60 lac hectares in 2012-13. So compared to 2010-11 and 2011-12, the harvested area has increased by 0.83%. But compared to 2011-12 and 2012-13, the harvested area has decreased by 1.04%. (Hossain, 2013) [3] (Source: Bangladesh Bureau of Statistics).

According to DAE field service wing, over 99 percent of boro paddy at the national level has already been harvested by the farmers with good production of the crop. The government had set a target of boro cultivation acreage at 47.80 lakh hectares of land with production target of 18,916,000 tons for 2013-14 boro season. The growers have actually cultivated boro paddy on some 48.03 lac hectares during the current 2013-14 crop year, with extra 23,000 hectares of land under boro cultivation, (Source: DAE field service wing director Md. Abdul Mannan).

For that reason scientists are trying to improve the production systems with the help of combination of organic and inorganic sources of nutrients. The improvement of soil physico-chemical properties by using both chemical and organic fertilizers are supply for essential plant nutrient for higher yield. The application of different levels of irrigation in boro rice affect the yield and boro rice quality. Organic manure can supply a good amount of plant nutrients thus can contribute to crop yields. Thus, it is necessary to use fertilizer and manure in an integrated way in order to obtain sustainable crop yield without affecting soil fertility. The integrated approach by using the organic and inorganic sources of nutrients helps to improve the efficiency of nutrients. Mineralization and immobilization are biochemical in nature and are mediated through the activities of microorganisms. The rate and extent of mineralization determines crop availability of nutrients.

Considering the present situation the present study was undertaken to: develop a suitable integrated dose of inorganic fertilizers combined with different manures for Boro rice; evaluate the effects of inorganic and organic fertilizer with different water management on the yield and yield components of Boro rice.

This detailed study was under taken with the following objectives:

i. To develop a suitable integrated dose of inorganic fertilizers combined with different manures for Boro rice.
ii. To evaluate the effects of combined application of inorganic and organic fertilizer with different water management on the yield, yield components and quality of Boro rice.

2. Materials and Methods

The experiment was conducted in the Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from December 2012 to July 2013 to study the effect of various organic manure and inorganic fertilizer with different water management on the growth, yield of Boro rice and nutrient availability in soil during rice growing period.

2.1. Experimental Site and Soil

The experiment was conducted in typical rice growing silt loam soil at the Sher-e-Bangla Agricultural University Farm, Dhaka during the *Boro* season of 2012-13. The morphological, physical and chemical characteristics of the soil are shown in the Table 1 and 2.

Table 1: Morphological Characteristics of the Experimental Field

Morphology	Characteristics
Location	SAU Farm, Dhaka
Agro-ecological zone	Madhupur Tract (AEZ- 28)
General Soil Type	Deep Red Brown Terrace Soil
Parent material	Madhupur clay
Topography	Fairly level
Drainage	Well drained
Flood level	Above flood level

Table 2: Initial Physical and Chemical Characteristics of the Soil

Characteristics		Value
Mechanical fractions:	% Sand (2.0-0.02 mm)	22.26
	% Silt (0.02-0.002 mm)	56.72
	% Clay (<0.002 mm)	20.75
Textural class		Silt Loam
pH (1: 2.5 soil- water)		5.9
Organic Matter (%)		1.09
Total N (%)		0.06
Available K (ppm)		15.63
Available P (ppm)		10.99
Available S (ppm)		6.07

2.2. Climate

The climate of the experimental area is characterized by high temperature, high humidity and medium rainfall with occasional gusty winds during the *kharif* season (March-September) and a scanty rainfall associated with moderately low temperature in the R*abi* season (October-March).

2.3. Planting Material

BRRI dhan 29 was used as the test crop in this experiment. This variety was developed at the Bangladesh Rice Research Institute from the cross between BG 90-2 and BR51-46-5 in 1994.

2.4. Land Preparation

The land was first opened by a tractor and prepared thoroughly by ploughing and cross ploughing with a power tiller followed by country plough. Laddering helped breaking the clods and leveling the land followed every ploughing.

2.5. Experimental Design and Layout
The experiment was laid out in a split plot design (SPD) with three replications (Fig-2). In each sub-plot a 30 cm diameter and 40 cm long PVC pipe was installed in the centre of the Sub-Plot.

2.6. Treatments
The experiment consists of 2 factors (i) irrigation and (ii) fertilizer plus manure. Details of factors and their combinations are presented below:

Factor A: 2 Level of Irrigation in the Main Plot
I_1= Continuous flooding
I_2= Saturated condition

Factor B: 8 Fertilizer, Manure Treatment in the Sub Plot
T_0: Control
T_1: 100% ($N_{120}P_{25}K_{60}S_{20}Zn_2$) Recommended dose of Fertilizer
T_2: 50% NPKSZn + 5 ton cowdung ha^{-1}
T_3: 70% NPKSZn + 3 ton cowdung ha^{-1}
T_4: 50% NPKSZn + 5 ton compost ha^{-1}
T_5: 70% NPKSZn + 3 ton compost ha^{-1}
T_6: 50% NPKSZn + 3.5 ton poultry manure ha^{-1}
T_7: 70% NPKSZn + 2.1 ton poultry manure ha^{-1}

Treatment Combination
I_1T_0 = (Continuous flooding + Control)
I_1T_1 = Continuous flooding + 100% ($N_{120}P_{25}K_{60}S_{20}Zn_2$) (Recommended dose)
I_1T_2 = (Continuous flooding + 50% NPKSZn + 5 ton cowdung ha^{-1})
I_1T_3 = (Continuous flooding + 70% NPKSZn + 3 ton cowdung ha^{-1})
I_1T_4 = (Continuous flooding + 50% NPKSZn + 5 ton compost ha^{-1})
I_1T_5 = (Continuous flooding + 70% NPKSZn + 3 ton compost ha^{-1})
I_1T_6 = (Continuous flooding + 50% NPKSZn + 3.5 ton poultry manure ha^{-1})
I_1T_7 = (Continuous flooding + 70% NPKSZn + 2.1 ton poultry manure ha^{-1})
I_2T_0 = (Saturated condition + Control)
I_2T_1 = Saturated condition + 100% ($N_{120}P_{25}K_{60}S_{20}Zn_2$) (Recommended dose)
I_2T_2 = (Saturated condition + 50% NPKSZn + 5 ton cowdung ha^{-1})
I_2T_3 = (Saturated condition + 70% NPKSZn + 3 ton cowdung ha^{-1})
I_2T_4 = (Saturated condition + 50% NPKSZn + 5 ton compost ha^{-1})
I_2T_5 = (Saturated condition + 70% NPKSZn + 3 ton compost ha^{-1})
I_2T_6 = (Saturated condition + 50% NPKSZn + 3.5 ton poultry manure ha^{-1})
I_2T_7 = (Saturated condition + 70% NPKSZn + 2.1 ton poultry manure ha^{-1})

2.7. Fertilizer Application
The amounts of N, P, K, S and Zn fertilizers required per plot were calculated as per the treatments. Full amounts of TSP, MP, Gypsum and Zinc sulphate were applied as basal dose before transplanting of rice seedlings. Urea were applied in 3 equal splits: one third was applied at basal before transplanting, one third at active tillering stage (30 DAT) and the remaining one third was applied at 5 days before panicle initiation stage (55 DAT). Fertilizers were applied into the core and outside the core during final land preparation.

2.8. Organic Manure Incorporation
Three different types of organic manure *viz*. cow-dung, poultry manure and compost were used. The rates of manure as 5 & 3, 3.5& 2.1 and 5 & 3 tons per ha for cow-dung, poultry manure and compost per plot were calculated as per the treatments, respectively. Cow-dung, compost and poultry manure were applied before four days of final land preparation. Chemical compositions of the manures used have been presented in Table 3.

Table 3: Chemical Compositions of the Cow-dung, Poultry Manure and Compost (Oven dry basis)

Sources of organic manure	Nutrient content			
	N (%)	P (%)	K (%)	S (%)
Cow-dung	1.46	0.29	0.74	0.24
Poultry manure	2.2	1.99	0.82	0.29
Compost	1.49	0.28	1.60	0.32

2.9. Raising of Seedlings
The seedlings of rice were raised wet-bed methods. Seeds (95% germination) @ 5 kg per ha were soaked and incubated for 48 hour and sown on a well-prepared seedbed. During seedling growing, no fertilizers were used. Proper water and pest management practices were followed whenever required.

2.10. Transplanting
Forty days old seedlings of BRRI dhan29 were carefully uprooted from the seedling nursery and transplanted in 18 January, 2013 in well puddle plot. Two seedlings per hill were used following a spacing of 20 cm × 15 cm. After one week of transplanting all plots were checked for any missing hill, which was filled up with extra seedlings whenever required.

2.11. Intercultural Operations
Irrigation and weeding were done. There was no infestation of diseases in the field but leaf roller (*Chaphalocrocis medinalis*, Pyralidae, Lepidoptera) was observed in the field and used Malathion @ 1.12 Liter per ha.

2.12. Crop Harvest
The crop was harvested at full maturity when 80-90% of the grains were turned into straw colored on June, 2013. The crop was cut at the ground level and plot wise crop was bundled separately and brought to the threshing floor. Ten hills of rice plant were selected randomly from the plants for measuring yield contributing characters.

2.13. Yield Components
Following data were collected for the yield calculation.
a) Total Number of Effective Tiller per Hill
b) Total Number of Non Effective Tiller per Hill
c) Plant Height
d) Length of Panicle (cm)
e) Number of Unfilled and Filled Grain per Panicle
f) Weight of 1000 Seeds (gram)
g) Straw Weight (kg)
h) Grain Yield (kg)

2.14. Collection and Preparation of Plant Samples

Grain and straw samples were collected after threshing for N, P, K and S analyses. The plant samples were dried in an oven at 70 ^{0}C for 72 hours and then ground by a grinding machine (Wiley-mill) to pass through a 20-mesh sieve. The samples were stored in plastic vial for analyses of N, P, K and S. The grain and straw samples were analyzed for determination of N, P, K and S concentrations.

2.15. Statistical Analysis

The significance of the difference among the treatment means was estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez *et. al.*, 1984) [5].

3. Results and discussion

3.1. Effect of Irrigation and Fertilizer on the Growth and Yield of Boro Rice

The number of effective tillers hill^{-1}, plant height, panicle length and filled grains per panicle were not significantly affected by irrigation but significantly influenced by fertilizer and manure application. Between the two levels of irrigation, I_1 (Continuous flooding) showed highest number of effective tillers/hill (10.59) and I_2 (Saturated condition) showed lower number of effective tillers/hill (9.99). I_1 (Continuous flooding) showed lower plant height (83.31 cm) and I_2 (Saturated condition) showed higher plant height (85.03 cm). I_1 (Continuous flooding) showed lower panicle length (24.72 cm) and I_2 (Saturated condition) showed higher panicle length (25.21 cm). I_1 (Continuous flooding) showed lower filled grain per panicle (133) and I_2 (Saturated condition) showed higher filled grain per panicle (135). The 1000 grain weight, grain and straw yields were not significantly influenced by irrigation treatments. I_1 (Continuous flooding) showed 1000 seed weight (21.50 g) and I_2 (Saturated condition) showed 1000 seed weight (21.33 g). I_1 (Continuous flooding) showed higher straw yield (7.31ton/ha) and I_2 (Saturated condition) showed lower yield (7.00 ton/ha). I_1 (Continuous flooding) showed higher grain yield (6.76 ton/ha) and I_2 (Saturated condition) showed lower grain yield (6.61 ton/ha) (Table 4).

Table 4: Effect of Irrigation on the Growth and Yield Parameter of Boro Rice

	Plant Height (cm)	Panicle length (cm)	Filled grain/panicle	1000 seed weight (g)	No of effective tiller/hill	Straw yield (ton/ha)	Grain yield (ton/ha)
I_1	83.31	24.72	133	21.5	10.59	7.31	6.76
I_2	85.03	25.21	135	21.33	9.99	7	6.61

3.2. Effect of Fertilizer and Manure on the Yield Parameters and Yield of Boro Rice in Different Treatment

Among the different fertilizer treatments, T_5 (70% NPKSZn + 3 ton compost/ha) showed the highest number of effective tillers/hill (11.1) which was statistically similar to all other treatments except T_0 (Table 5). The T_7 (70% NPKSZn + 2.1 ton poultry manure/ha) treatment showed the highest plant height (87.8 cm) which was statistically similar to all other treatment except control. Similarly, the highest panicle length was obtained in T_3 treatment and the control (T_0) treatment gave the lowest number of effective tillers/hill, plant height, panicle length and filled grains panicle^{-} [1].

The application of fertilizers and manure had a positive effect on the grain and straw yield of boro rice (Table 4.1). Among the different doses of fertilizers, T_7 (70% NPKSZn + 2.1 ton poultry manure/ha) showed the highest grain yield (7.40 t/ha) which was statistically similar to T_1, T_2, T_3, T_5 & T_6 treatments and the lowest grain yield/plot (3.95 t/ha) was observed with T_0 where no fertilizer was applied. Similarly, the highest straw yield (8.00 t ha^{-1}) was obtained in T_7 (70% NPKS + 2.1 ton poultry manure/ha) treatment which was statistically similar to T_1, T_3. And T_6 treatments respectively and the lowest straw yield was obtained in T_0 treatment.

Table 5: Effect of Fertilizer and Manure on the Yield Parameter and Yield of Boro Rice

Treatments	Number of effective tillers/hill	Plant height (cm)	Panicle length (cm)	Number of filled grain/ panicle	Straw yield (ton/ha)	Grain yield (ton/ha)
T_0	8.2b	72.48b	22.38b	103	4.57d	3.95c
T_1	10.0a	85.68a	25.14a	144	7.78ab	7.25a
T_2	10.4a	84.91a	25.01a	142	7.01c	7.07ab
T_3	11.0a	87.08a	25.97a	130	7.54abc	6.83ab
T_4	10.2a	83.43a	25.14a	140	7.11bc	6.51b
T_5	11.1a	84.67a	25.41a	137	7.03c	7.08ab
T_6	10.8a	87.34a	25.26a	138	7.18a	7.38a
T_7	10.7a	87.77a	25.42a	138	8.00a	7.40a
SE (±)	0.46	1.52	0.32	4.68	0.19	0.21

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT at 5% level of significance.

3.3. Combined effects of irrigation and fertilizer on the growth and yield of Boro rice

The combined effects of different doses of fertilizer and irrigation on the yield parameters and yield of Boro rice were not significantly different (Table 6). The highest number of effective tiller per hill of rice (11.3) was recorded with the treatment combination I_1T_6 (continuous flooded + 50% NPKSZn + 3.5 ton compost/ha) & I_2T_3 (Saturated condition + 70% NPKSZn + 3 ton cowdung ha^{-1}) which was almost similar to I_1T_5, I_1T_7 and I_2T_5 treatment combinations and the lowest number of effective tiller of rice (7.6) was found in I_2T_0 (saturated condition + control treatment) treatment combination.

The highest number of plant height was (90.15 cm) recorded with the treatment combination I_2T_6 (Saturated condition + 50% NPKSZn + 3.5 ton poultry manure ha^{-1}) which was similar to I_1T_7 and I_2T_7 treatment combinations and the lowest number of plant height was 72.16 cm found in I_1T_0 (Continuous flooding + Control) treatment combination.

The highest number of panicle length was (26.14 cm) recorded with the treatment combination I_2T_3 (Saturated condition + 70% NPKSZn + 3 ton cowdung ha^{-1}) which was similar to I_2T_6 and I_2T_7 treatment combinations and the lowest number of panicle length was 22.23 cm found in I_1T_0 (Continuous flooding + Control) treatment combination.

The highest number of filled grains per panicle was (149) recorded with the treatment combination I_2T_7 (Saturated condition + 70% NPKSZn + 2.1 ton poultry manure ha^{-1}) which was similar to I_1T_1, I_1T_2, I_1T_4, I_2T_1 and I_2T_6 treatment combinations and the lowest number of filled grain per panicle was 102 found in I_2T_0 (Saturated condition + Control) treatment combination.

The highest number of 1000 seed weight was (22.5 gm) recorded with the treatment combination I_2T_3 (Saturated condition + 70% NPKSZn + 3 ton cowdung ha^{-1}) which was similar to I_1T_2 and I_1T_4 treatment combinations and the lowest number of 1000 seed weight was 20.33 gm found in I_2T_0 (Saturated condition + Control) treatment combination.

The highest straw yield of rice was (8.26 ton/ha) recorded with the treatment combination I_1T_6 (continuous flooded + 50% NPKSZn + 3.5 ton compost/ha) which was similar to I_1T_1, I_1T_7, I_2T_6 and I_2T_7 treatment combinations and the lowest straw yield was 4.21 ton/ha found in I_2T_0 (saturated condition + control treatment) treatment combination.

The highest grain yield of rice was (7.51 ton/ha) recorded with the treatment combination I_1T_1 (continuous flooded condition + 100% recommended dose of fertilizer) which was closely similar to I_1T_5, I_1T_6, I_1T_7, I_2T_6, I_2T_7 treatment combinations and the lowest grain yield was 3.69 ton/ha found in I_2T_0 (saturated condition + control treatment) treatment combination.

Table 6: Interaction effect of fertilizer and irrigation on the growth and yield of Boro rice

Treatments	Number of effective tiller	Plant height (cm)	Panicle length (cm)	Number of Filled grain/panicle	1000 seed weight (g)	Straw yield (t/ha)	Grain yield (t/ha)
I_1T_0	8.7	72.16	22.23	104	20.5	4.93	4.2
I_1T_1	10.4	85.99	25.24	146	21.5	8.06	7.51
I_1T_2	10.9	83.59	24.6	145	22.33	7.04	7.11
I_1T_3	10.7	87.23	25.8	123	21.5	7.73	6.58
I_1T_4	10.4	82.1	25.14	147	22.17	6.97	6.51
I_1T_5	11.1	82.87	25.35	137	21.5	7.46	7.45
I_1T_6	11.3	84.53	24.64	135	21	8.26	7.33
I_1T_7	11.1	88.01	24.79	127	21.5	8.07	7.38
I_2T_0	7.6	72.8	22.53	102	20.33	4.21	3.69
I_2T_1	9.7	85.37	25.03	143	21.5	7.51	6.99
I_2T_2	9.9	86.24	25.42	139	21.33	6.99	7.03
I_2T_3	11.3	86.93	26.14	137	22.5	7.36	7.08
I_2T_4	10.1	84.77	25.13	133	21.17	7.26	6.51
I_2T_5	11	86.48	25.47	136	21.17	6.6	6.71
I_2T_6	10.2	90.15	25.87	142	21.17	8.1	7.42
I_2T_7	10.2	87.53	26.05	149	21.5	7.93	7.41
SE (±)	NS	NS	NS	NS	NS	NS	NS

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT at 5% level of significance.

3.4. Effect of irrigation and fertilizer on N, P, K and S concentration in Boro rice grain and straw

Insignificant variation was observed in N, P, K and S concentration in grain and straw of boro rice when the field was irrigated with two different irrigations. The grain and straw N and S concentrations were significantly influenced by fertilizer and manure treatments. The highest grain N concentration (1.31%) was found in T_5 treatment which was closely similar to T_1, T_2, T_3 and T_7 treatments. Similarly the highest P concentration (0.272%) in T_3 treatment and S concentration (0.091%) was found in T_2 treatment where organic plus inorganic fertilizers were used (Table 7).

The highest straw N concentration (0.730%) was recorded in T_1, straw P concentration (0.140%) was recorded in T_2 (50% NPKSZn + 5 ton cowdung/ha), K (1.63%) in T_3 and highest S(0.052%) concentration was recorded in T_6 (50% NPKSZn + 3.5 ton poultry manure/ha) treatment and in all cases the lowest concentration was found from T_0 treatment (Table 8). Higher levels of N, P, K and S were accumulated in combined application of organic plus inorganic fertilizer. The grain N, P, K, S and straw P, K, S concentrations were not influenced by interaction effect of irrigation and fertilizer. The straw N concentration was significantly influenced by interaction effect of irrigation and fertilizer. Similarly the highest straw N concentration (0.64%) was obtained from T_3 70% (NPKSZn + 3 ton cowdung ha^{-1}) treatment.

Table 7: Effect of fertilizer and manure on NPKS concentration of Boro rice grain

Treatment	Concentration (%) in grain			
	N	P	K	S
T_0	1.16bc	0.229	0.167	0.065cd
T_1	1.28a	0.235	0.195	0.086b
T_2	1.27ab	0.239	0.195	0.091a
T_3	1.29a	0.272	0.167	0.087ab
T_4	1.13c	0.23	0.195	0.063d
T_5	1.31a	0.21	0.195	0.087ab
T_6	1.16bc	0.239	0.167	0.087ab
T_7	1.28a	0.204	0.195	0.067c
SE (±)	0.034	NS	NS	0.006

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT at 5% level of significance.

Table 8: Effect of fertilizer and manure on NPKS concentration of Boro rice straw

Treatment	Concentration (%) in straw			
	N	P	K	S
T_0	0.530bc	0.049	1.31	0.035de
T_1	0.627ab	0.053	1.5	0.038cd
T_2	0.730a	0.057	1.46	0.044b
T_3	0.640ab	0.048	1.63	0.031e
T_4	0.467c	0.053	1.61	0.051a
T_5	0.553bc	0.054	1.59	0.037d
T_6	0.510c	0.055	1.39	0.052a
T_7	0.543bc	0.053	1.46	0.041b
SE (±)	0.031	NS	NS	0.004

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT at 5% level of significance.

4. Conclusion

From the above discussion it can be concluded that irrigation had significant effect on yield and yield contributing characters and continuous flooding is preferable than saturated irrigation. The application of inorganic fertilizer plus manure performed better compared to inorganic fertilizer. The application of 100% ($N_{120}P_{25}K_{60}S_{20}Zn_2$) Recommended dose of Fertilizer and continuous flooding was most favorable for improving yield and yield contributing characters of Boro (BRRI dhan 29) rice.

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