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Effect of Poultry Manure and Mineral Concentration on Grain Yield and Straw of BR11 Rice Genotypes in Bangladesh

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ABSTRACT

An experiment was conducted to evaluate the residual effect of poultry manure on grain and straw yield and mineral concentration of BR11 rice during the Aman season. To study the residual effect of poultry manure and chemical fertilizers on yield and yield contributing characters of rice. The experiment was laid-out in a Randomize Complete Block Design (RCBD) with three replications assigning 12 treatment combinations comprising 4 levels of poultry manure (@ 0,2.5,5,7.5 t ha-1) and 3 levels of chemical fertilizers (control, half and full recommended dose). Poultry manure was applied during previous crop season. Only chemical fertilizers were applied during this experiment. The recommended full dose of urea, TSP, MOP and gypsum were 150, 100, 60 and 50 kg ha-1, respectively. The residual effect of poultry manure and chemical fertilizers increased plant height, effective tillers hill-1, panicle length, and 1000-grain weight, no. of grains panicle-1, grains and straw yields of BR11 rice. The highest grain yield (5.700 t ha-1) and straw yield (8.930 t ha-1) were obtained by the T12 (PM7.5 N2 P2 K2 S2) treatment. Combined effect of residual poultry manure and chemical fertilizers had significantly positive effect on the availability of nitrogen, phosphorus, potassium, sulphur, copper, zinc, manganese, iron, boron, and protein content in grain and straw of BR11 rice. Nutrient content in grain and straw was lowest at T1 (control) treatment and the highest was at T12 treatment. T12 treatment was the best of all the treatments. It may be concluded from the above study that residual effect of poultry manure and chemical fertilizer showed better performance on yield of BR11 rice and had significant effect on N, K micronutrient (Fe, Zn, Mn and B) and protein contents in rice grain and straw.

Keywords: Mineral, Poultry, Yield, Rice, Fertilizer, Treatment.

INTRODUCTION

Food is the first basic need of humans on earth. The possibility of increasing production through land expansion is practically limited in this country, to achieve self-sufficiency in food, efforts should be made to increase the yield per unit area and improve the quality of the products produced. The most logical way to increase total production from limited

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land resources is to target high yields with high cropping intensity. A sustainable agriculture requires an appropriate combination of organic and inorganic sources of nutrients that will provide food with quality and maintain a good environment.The production of rice in Bangladesh is not sufficient to feed her people. Among the top rice growing countries of the world; position of Bangladesh is forth in terms of total rice area; sixth in yield per hectare [1]. The average yield of rice is quite low (2.76 t ha-1) compared to other leading rice producing countries of the world such as Japan, China and Korean Republic, where per hectare yield is 6.22, 6.06 and 7.00 tons respectively. Higher crop yields naturally have higher nutrient demands and greater stress on the soil for available forms of nutrients. Intensive cropping with modern improved varieties, low use of organic matter and inappropriate soil and crop management practices gradually lead to significant depletion of inherent nutrient reserves. Available data indicate that most of our soil fertility has been degraded over the years, which is responsible for stagnant and in some cases even reduced crop yields. Soil is the principal supplier of plant nutrient. Plants derive 13 essential nutrients out of 16 from the soils. Nutrient stresses in soil of Bangladesh are decreasing day by day. Before 1980 deficiency of N, P, and K were the major problem but thereafter deficiency of S and Zn came up.

Chemical fertilizers are indispensable for the crop production of modern agriculture. Continuous use of chemical fertilizers accelerates the depletion of soil organic matter and impairs physical and chemical properties of soil. Most of the soils of Bangladesh have less than 1.5% and in some cases less than 1% organic matter. This may be due to favorable climatic condition for microbial activities through the year, frequent tillage operations and use of chemical fertilizers with no or very little amount of manures. Depletion of soil fertility has been identified as major constraint for higher crop yield and quality. The soil organic matter and nutrient status of Bangladesh is low and always decreasing day by day. Therefore, improvement and addition of good quantity of poultry manure to crop fields is essential to maintain the fertility and productivity of these soils. Poultry manure is a good source of organic matter and may play a vital role in soil fertility improvement as well as supplying primary, secondary and micronutrients for crop production. The addition of poultry manure is useful in maintaining or increasing the organic substances or nitrogenous compounds in soil, which are decomposed slowly but steadily. Chemical fertilizers are always expensive inputs for crop production. High market price and uncertainly in supplies, limit the application of chemical fertilizers for crop production in Bangladesh. The use of organic manures and their proper management may reduce the need for chemical fertilizers thus allowing the small farmer to save in part the cost of the production. In addition, organic matter improves the physical, chemical and biological properties of soil and thus helps increase and conserves the soil productivity.

Poultry manure and its residual effects are a good source of nutrients and provide long-term plant nutrient uptake. Chicken farming is becoming popular day by day in our country. Unfortunately, the use of poultry manure in agricultural practices is very limited. Poultry manure and its residual effects can play an important role in improving soil health as well as addressing nutrient deficiencies in soil. Hence the use of poultry manure and its residual effects can reduce the need for chemical fertilizers thereby saving smallholder farmers a portion of production costs. Also, global environmental pollution can also be greatly reduced by reducing the use of chemical fertilizers and increasing the use of poultry manure and its residual effects. Hence the present investigation was conducted with the following objectives to study the residual effect of poultry manure and chemical fertilizers on yield and yield contributing characters of BR11 rice to find a suitable combination of poultry manure and chemical fertilizer residual effect and to study rice grain and straw nutrition. Residual effects of poultry manure and chemical fertilizers on material.

METHODS AND MATERIALS

Layout of the experiment

The experiment was carried out in randomized complete block design (RCBD) where the experimental area was divided into three blocks. Each block was divided into 12 unit plots with raised bands according to treatment, thus, the total number of unit plots was 36. Unit plot size was 4m × 2.5m and plots were separated from each other by bands (30cm). Unit blocks are separated from each other by 1m drains. Treatments were randomly distributed within blocks.

Experimental treatments

The experiment comprised of four levels of poultry manure and three levels of chemical fertilizers altogether 12 treatment combination including control.

Manure and chemical fertilizers application

Chicken manure was applied in the previous cropping season. Only chemical fertilizers have been applied in this season. Full amount of TSP, MP and gypsum are applied as

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basal before planting of rice seedlings. Urea was applied in 3 equal splits: one third was applied 15 days after planting. One-third was applied at the active tillering stage (30–35 DAT) and the remaining one-third was applied 5–7 days before the panicle initiation stage (55–60 DAT).

Transplanting of seedling

The healthy seedlings of thirty eight days old were transplanted in the experimental plots on 12th August, 2003. The seedlings were carefully uprooted from the seedbed before transplanting. Plant spacing was maintained 25 cm × 15 cm and three seedlings were transplanted hill-1. The number of row and hills per plot was equal in all plots. Gap filling was done 7 days after transplanting to make uniform plant population density for unit plot.

Intercultural operations

Intercultural operations were done for ensuring and maintaining proper growth and development of the crop.

Irrigation

Necessary irrigations were provided to the plots from deep tube-well as and when required up to the milking stage of the rice plant.

Weeding

The experimental plots were infested with some weeds, which were uprooted two times at 15 and 30 days after transplanting of the seedlings.

Insect diseases and pest control

There was no infestation of disease and insect pest in the field and no control measures were required.

Plant sample

Five hills were randomly selected from each plot at maturity to keep records on yield contributing characters. The selected hills were collected before harvest and necessary information's were recorded accordingly. The grain and straw samples were also kept for chemical analysis.

Harvesting of the crop

The harvested crop of each plot was bundled separately in the threshing floor. Grain and straw yields were recorded plot wise.

Recording of plant data

Plant height

The height of the plant was measured from the ground level to the top of the panicle. From each plot, plants of 5 hills were measured and averaged. Measurement was taken from basal node of the rachis to apex of the panicle.

Panicle length

Measurement was taken from the basal node of the rachis to apex of each panicle. Each observation was a mean of five hills.

Number of effective tillers hill-1

Five hills were taken from each plot randomly and the number of tillers hill-1 was calculated. The number of effective tillers hill-1 was also calculated.

Filled and unfilled grains panicle-1

The filled grains of the sample were counted and the average of which gave the number of filled grains panicle-1 respectively.

1000-grain weight

Thousand grains were taken from each plot and the weight of grains was measured after sun drying in an electric balance.

Grain and straw yields

Grain and straw obtained from each unit plot were sun dried and weighed separately and carefully recorded the grain and straw yield respectively. Grain yield was adjusted to 14% moisture content. Grain and straw yield were then converted to t ha-1.

Collection of post-harvest soil sample and analysis

After harvesting, soil samples were collected from each plot at a depth of 0–15 cm. After removal of weeds and other unwanted matter, the samples were air dried at room temperature in the laboratory of Department of Agricultural Chemistry, Mymensingh, sieved through 10 mesh sieve and placed in polythene bags after proper labeling for chemical analysis.

Soil pH

Soil pH was measured with the help of a glass electrode pH meter, using soil water suspension of 1: 2.5 as described by Jackson (1962).

Organic matter content

Organic carbon of the soil was determined by wet oxidation method of Black (1965). The underlying principal was used to oxidize the organic matter with an excess of 1N $K_2Cr_2O_7$ in presence of concentrated H_2SO_4 and concentrated H_3PO_4 and to titrate the excess $K_2Cr_2O_7$ solution with 1N $FeSO_4$. To obtain the organic matter content, the amount of organic carbon was multiplied by the van bammelen factor 1.73. The result was expressed in percentage.

Total nitrogen content

Total nitrogen of each soil sample was determined by Macro-kjeldahl method outlined by Jackson (1973) through the digestion of organic matter with commercial sulfuric acid (H2SO4) and catalyst mixture (K2SO4: CuSO4 5H2O: Se powder in the ratio 100:10:1) of three distinct steps namely digestion, distillation and titration. The ammonia (40%) involved in distillation step was collected in (4%) boric acid solution and was titrated against 0.135 N (H2SO4).

Available phosphorus content

Available P was extracted from the post-harvest soil following the method of Olsen et al. (1954). The phosphorus in the extract was then determined by developing the blue colour by SnCl2 reduction of phosphomolybdate complex. The absorbance of the molybdophosphate blue color was measured at 660 nm wavelength of light by a spectrophotometer and available phosphorus was calculated with the help of a standard curve.

Exchangeable potassium content

Exchangeable potassium was determined from 1N NH4OAC (pH 7.0) extract of the soil by using flame.

Available sulphur content

Available sulphur of the soil sample was extracted with monocalcium dihydrogen phosphate [Ca (H2PO4)2.H2O] solution (500 ppm P). The turbidity was developed adding acid seed solution (20ppm S as K2SO4 in 2M HCl) to a portion of the extract and then adding BaCl2 to the extract. Turbidity was measured calorimetrically at 420nm wavelength.

Cation exchange capacity

Cation exchange capacity of each soil sample was determined by ammonium acetate saturation method. In this method, soil samples were saturated with 1N sodium acetate (NaOAc) solution. Then the soil samples were washed by 99% isopropyl alcohol. The sodium ions were replaced from saturated samples by NH4OAc solution. Displaced sodium in the solution was then measured by flame photometer.

Available Cu, Zn, Mn

Available copper, zinc and manganese of soil samples were determined by atomic absorption spectrophotometer setting the wavelength at 324.7, 231.9 and 279.5 nm respectively in the Central Laboratory, Bangladesh Agricultural University, Mymensingh. For the extraction of soil samples, 0.04M Na2EDTA was used. In this process, 10g soil was taken in 50 mL centrifuge tube and 25mL Na2EDTA was added. The contents were shaken mechanically for two hours. Thereafter, centrifuged 10 minutes and filtered. The samples were then analyzed for the estimation of Cu, Zn and Mn.

Chemical analysis of grain and straw

Preparation of samples

Grain and straw samples were dried in an oven at 650c for 48 hours and after cooling they were ground by a grinding machine. The prepared samples were then put into paper bags and kept into the desicator till being used.

Digestion of samples with nitric-perchloric acids

Exactly, 1 g of fine plant material was taken in a 250 ml conical flask and 10 ml of di-acid mixture (HN03: HCL04 = 2:1) was added. Then, it was placed on an electric hot plate for heating at 180–2000 C until the solid particles almost disappeared and white fumes emerged from the flask. It was then cooled to room temperature, washed repeatedly with distilled water and filtered through Whatman No. 42 filter paper into a 100 mL volumetric flask and made up to the mark with distilled water. Grain and straw extracts were stored separately in plastic bottles for analysis of different components.

Total nitrogen content

Total nitrogen in grain and straw was determined by the kjeldal method by digesting with conc. H2SO4 and catalyst mixture (K2SO4: CuSO4.5H2O: Se powder =100: 10: 1) and distilling with 40% NaOH followed by titration of the distillate trapped in H3BO3 with 0.01 N (H2SO4).

Phosphorus content

Phosphorus content was determined form the digest by adding ammonium molybdate and SnCl2 solution and measuring the colour with the help of spectrophotometer at 660 nm.

Exchangeable potassium content

Potassium concentration in grain and straw digests were determined directly with the help of flame photometer.

Available sulphur content

Sulphur concentration in the digest of grain and straw were determined by adding acid seed solution and precipitating with BaCl2 crystal and measuring the turbidity with the help of spectrophotometer at 420 nm.

RESULT AND DISCUSSION

Grain yield

Residual effect of poultry manure

The effect was found to be statistically significant at the 1% level of probability. Grain yield varied significantly from 3.06 to 5.37 t ha-1. Treatment T4 gave the highest grain yield of 5.37 t ha-1 and the lowest value of 3.06 t ha-1 in control treatment T1 (Table 1). Poultry manure application works better to increase grain yield and they are in the order of T¬4> T¬3> T¬2> T¬1 treatments. A possible reason for the increase in yield could be the mineralization of concentrated organic fertilizers such as poultry droppings, which could provide sufficient nutrients to plants and ultimately increase yield. Channavasavanna and Biradar [2], observed that grain yield of rice was highest with chicken manure application and lowest with no manure application. Application of poultry manure has been found to be effective in increasing yield of BR11 crops. It was also noted that the yield increased as the amount of chicken manure increased up to the highest level applied in Figure 1.

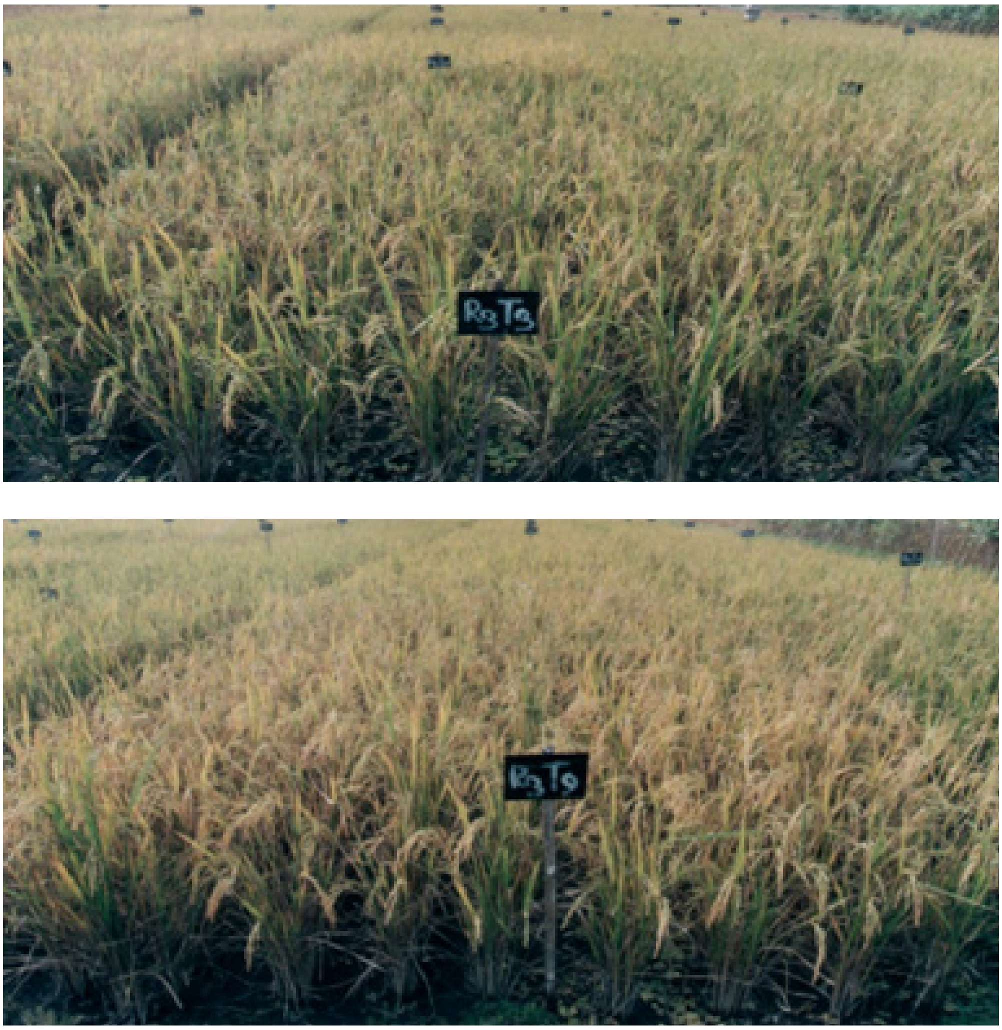

Figure1. Picture showing different plots at maturity stage of BR11 rice

Single effect of chemical fertilizers

The highest yield of rice grain 4.69 t ha-1 was attained in T3 treatment i.e. with full dose of chemical fertilizers. The lowest yield of rice grain 3.80 t ha-1 was attained in T1 control treatment. The highest grain yields obtained from the treatment T3 might be due to sufficient release of nutrients and efficient use of chemical fertilizers. A significant increase in rice grain yield due to the application of chemical fertilizers was also reported by Singh et al. 1998.

Combined effect of residual poultry manure and chemical fertilizers

The combined effect of residual poultry manure and chemical fertilizers on grain yield was significant at 1% level of probability and ranged from 2.40 to 5.70 t ha-1.

The highest grain yield of 5.70 t ha-1 was recorded in T12 treatment. T1 treatment recorded the lowest grain yield of 2.40 t ha-1. Residual chicken manure with and without chemical fertilizers performed better in increasing grain yield of BR11.The application of both poultry manure and chemical fertilizers provides adequate plant nutrients which eventually helps in increasing rice yield. Channabasavanna and Biradar [2], showed that combined application of poultry and inorganic fertilizers increased rice yield. Singh et al. (1996) reported that chicken manure produced significantly higher grain yield of rice. Similar results were also found by Kamiyama et al. 1995.

Table1. Combined effect of residual poultry manure and chemical fertilizers on the yield and yield contributing characters of BR 11 rice

Treatments	Grain Yield ($t\ ha^{-1}$)	Straw Yield ($t\ ha^{-1}$)	Plant Height (cm)	Effective Tillers $Hill^{-1}$(no)	Panicle Length (cm)	Grains $Panicle^{-1}$ (no)	Weight of 1000-Grains (g)
$T_1 = PM_0$ N0 $P_0\ K_0\ S_0$	2.40g	5.01	83.91	4.27	23.78	105.28k	21.10g
$T_2 = PM_{2.5}\ N_0\ P_0\ K_0\ S_0$	3.17f	5.33	89.25	4.93	24.1	111.62j	22.13fg
$T_3 = PM_5\ N_0\ P_0\ K_0\ S_0$	3.62ef	5.83	92.84	5.27	26.05	109.28i	22.43fg
$T_4 = PM_{7.5}\ N_0\ P_0\ K_0\ S_0$	3.80de	6.23	94.44	6.27	25.25	129.82h	22.83ef
$T_5 = PM_0\ N_1\ P_1\ K_1\ S_1$	3.36ef	6.07	93.02	6.26	23.78	120.94i	22.77ef
$T_6 = PM_{2.5}\ N_1\ P_1\ K_1\ S_1$	4.67c	6.93	96.02	6.83	26.25	138.62g	24.80cd
$T_7 = PM_5\ N_1\ P_1\ K_1\ S_1$	4.87bc	7.54	97.35	7.6	26.58	147.28f	25.70bc
$T_8 = PM_{7.5}\ N_1\ P_1\ K_1\ S_1$	4.97bc	7.83	99.45	8.93	27.78	162.62d	25.47bcd
$T_9 = PM_0\ N_2\ P_2\ K_2\ S_2$	4.80bc	7.64	98.25	7.93	26.38	155.95e	24.13de
$T_{10} = PM_{2.5}\ N_2\ P_2\ K_2\ S_2$	4.13d	8.18	101.75	9.6	28.92	172.28c	25.77bc
$T_{11} = PM_5\ N_2\ P_2\ K_2\ S_2$	5.30ab	8.54	103.75	11.27	29.07	182.95b	26.83ab
$T_{12} = PM_{7.5}\ N_2\ P_2\ K_2\ S_2$	5.70a	8.93	105.62	11.93	29.85	191.28a	27.83a
CV (%)	6.72	14.86	3.14	12.7	3.94	1.22	3.34
$\bar{x}$	0.1642	0.6009	1.7473	0.5567	0.603	1.0172	0.4687

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Straw yield

Combined effect of residual poultry manure and chemical fertilizers

Combined effect of residual poultry manure and chemical fertilizer on straw yield ranged from 5.01 to 8.93 t ha-1 which was not significant. The highest straw yield 8.96 t ha-1 was recorded by T12 treatment and the lowest 5.01 t ha-1 was in T1 treatment. Beena and Balachandran (2002) reported that the combined application of organic matter and chemical fertilizer increased straw and grain yield of rice. Similar results were also obtained by Azim, et al. [3].

Combined effect of residual poultry manure and chemical fertilizers

The combined effect of residual poultry manure and chemical fertilizers increased plant height varying from 83.91 to 105.62 cm but was not statistically significant. Maximum plant height of 105.62 cm was recorded by T12 treatment and minimum plant height of 83.91 was recorded in T1 treatment. Babu et al. [4] observed that plant height was significantly affected by addition of organic fertilizers and manure. Islam et al. [5] and Khan et al. [6] also found similar results with organic matter alone or in combination with fertilizers.

Table 2. Combined effect of residual poultry manure and chemical fertilizers on nutrient content in straw of BR 11 rice

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulphur (%)	Iron (ppm)	Zinc (ppm)	Manganese (ppm)	Boron (ppm)	Copper (ppm)	Protein (%)
$T_1 = PM_0\, N_0\, P_0\, K_0\, S_0$	0.54g	0.21	0.78i	0.13	69.42l	39.61g	87.42j	21.37g	18.35	3.56cd
$T_2 = PM_{2.5}\, N_0\, P_0\, K_0\, S_0$	0.55g	0.22	0.85h	0.14	76.34k	41.24ef	99.22i	22.67g	19.35	3.55cd
$T_3 = PM_5\, N_0\, P_0\, K_0\, S_0$	0.58f	0.21	0.90gh	0.15	82.44j	40.67fg	99.32h	24.74f	20.18	3.92abc
$T_4 = PM_{7.5}\, N_0\, P_0\, K_0\, S_0$	0.60e	0.23	0.920g	0.15	89.29h	42.67e	107.35g	25.87f	21.28	3.98abc
$T_5 = PM_0\, N_1\, P_1\, K_1\, S_1$	0.58f	0.23	0.90gg	0.14	86.39i	42.18ef	101.71h	24.57f	20.29	3.80bcd
$T_6 = PM_{2.5}\, N_1\, P_1\, K_1\, S_1$	0.60de	0.24	1.70f	0.16	96.47g	45.31d	112.04f	28.00e	22.08	4.01abc
$T_7 = PM_5\, N_1\, P_1\, K_1\, S_1$	0.60de	0.24	1.12ef	0.17	103.48f	45.54d	127.95d	28.76d	21.85	4.05abc
$T_8 = PM_{7.5}\, N_1\, P_1\, K_1\, S_1$	0.62cd	0.26	1.21d	0.18	110.38d	47.94c	128.05d	30.18cd	23.75	4.06abc
$T_9 = PM_0\, N_2\, P_2\, K_2\, S_2$	0.60e	0.25	1.15e	0.17	106.88e	46.34d	125.22e	28.33e	22.68	3.38d
$T_{10} = PM_{2.5}\, N_2\, P_2\, K_2\, S_2$	0.63c	0.27	1.37c	0.19	117.38c	49.37bc	135.42c	31.30bc	24.86	4.16ab
$T_{11} = PM_5\, N_2\, P_2\, K_2\, S_2$	0.65b	0.29	1.46b	0.2	124.37b	50.71b	144.42b	32.84ab	25.46	4.25ab
$T_{12} = PM_{7.5}\, N_2\, P_2\, K_2\, S_2$	0.67a	0.3	1.53a	0.2	130.78a	52.41a	152.42a	34.48a	26.55	4.38a
CV (%)	2.33	6.22	2.19	9.48	1.47	1.97	1.28	3.53	4.81	7.16
$\bar{x}$	0.0081	0.0088	0.014	0.009	0.8462	0.5149	0.8704	0.5656	0.6195	0.1685

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Nutrient content in rice grains

Nitrogen content

Residual effect of poultry manure

The highest N content (1.28%) was observed in T4 and the lowest total N content (1.12%) was in T1 treatment. Residual effect of poultry manure performed better in increasing N content and they were in the order T4> T3> T2> T1. Verma (1991) reported that from a crop rotation with FYM the concentration of N in paddy grain increased significantly.

Phosphorus content

Residual effect of poultry manure

The highest phosphorus content (0.48%) was observed in T4 and the lowest available phosphorus content (0.38%) in T1 treatment. Deshpande et al. (1983) reported that addition of FYM increased P concentration in rice grains.

Sulphur content

Residual effect of poultry manure

The effect was found statistically significant at 1% level of probability. The highest value of sulphur content (0.16%) was found in treatment T12 and the lowest value of sulphur content (0.22%) was found in control treatment (Table 2).

Iron content

Residual effect of poultry manure

The residual effect of poultry manure on iron content in rice grain was also significant at 1% level of probability. The highest value of iron content (110.28ppm) was found in T4 treatment and the lowest iron content (66.96ppm) was found in T1 treatment (Table 2).

Zinc content

Residual effect of poultry manure

The application of poultry manure increased zinc content in rice grain as compared to no use of poultry manure. The highest zinc content (30.22ppm) was found in T4 treatment and the lowest zinc content (21.79ppm) was found in T1 treatment (Table 2).

Copper content

Residual effect of poultry manure

The highest copper content (19.97ppm) was recorded in T4 treatment and the lowest content (12.37ppm) was recorded in T¬1 treatment.

Protein content

Residual effect of poultry manure

It can be found that residual effect of poultry manure alone on protein content in rice grain was significant at 1% level of probability. The highest protein content (8.20%) was found in T4 treatment and the lowest (6.82%) was found in T1 treatment (Table 2). Dixit and Gupta (2000) reported that grain protein content increased due to application of FYM.

Nitrogen content

Residual effect of poultry manure

The residual effect of poultry manure on N content was significant at the 1% level of probability. The highest N content (0.65%) was observed in T4 treatment and the lowest N content (0.55%) was in T1 treatment (Table 2). The residual effect of poultry manure was better in increasing N content and they were in the order T4>T3>T2>T1. Verma (1991) reported that incorporation of FYM significantly increased N concentration in rice straw.

Phosphorus content

Residual effect of poultry manure

It can be found that residual effect of poultry manure on phosphorus concentration in rice straw was significant at 1% level. The highest phosphorus content (0.28%) was observed in T4 treatment and the lowest phosphorus content (0.21%) was observed in T1 treatment (Table 2). Deshpande et al. (1983) reported that P concentration increased in rice grain by addition of FYM.

Potassium content

Residual effect of poultry manure

The residual effect of poultry manure on potassium content in rice straw was significant at 1% level of probability. The application of poultry manure increased the potassium content compared to no use of poultry manure. The highest potassium content (1.45%) was observed in T4 treatment and the lowest (0.84%) was observed in T1 treatment (Table 2). Verma et al. (1991) reported that incorporation of FYM significantly increased the concentration of K in paddy straw.

Sulphur content

Residual effect of poultry manure

It was found that residual effect of poultry manure influenced sulphur content in rice straw. The effect was found statistically significant at 1% level of probability. The highest sulphur content (0.19%) was found in treatment T4 and the lowest (0.14%) was found in T1 treatment (Table 2) [7-27].

CONCLUSION

Treatment T4 gave the highest grain yield (5.37 t ha-1) and the lowest value (3.06 t ha-1) was recorded in treatment T1. Maximum rice yield of 4.69 t ha-1 was achieved in T3 treatment i.e. full dose of chemical fertilizers. The combined effect of residual poultry manure and chemical fertilizers on grain yield ranged from 2.40 to 5.70 t ha-1 which was significant. The highest grain yield of 5.70 t ha-1 was recorded in T12 treatment. T1 treatment recorded the lowest grain yield of 2.40 t ha-1. The residual effect of poultry manure on straw yield ranged from 5.39 to 8.55 t ha-1 and treatment T4 gave the highest straw yield of 8.55 t ha-1. T1 treatment showed the lowest straw yield of 5.39 t ha-1. The effect of chemical fertilizers on straw yield ranged from 6.74 to 7.33 t ha-1 which was not significant. The combined effect of residual poultry manure and chemical fertilizers was not significant. Straw yield ranged from 5.01 to 8.93 t ha-1. T12 treatment recorded the highest straw yield (8.93 t ha-1) and T1 treatment recorded the lowest (5.01 t ha-1). The residual effect of poultry manure on micronutrients (Fe, Cu, Zn, Mn and B) content of rice grain and straw was also significant. The residual effect of poultry manure on Fe content of rice grain and straw was statistically significant. The highest and lowest values were recorded in T1 and T4 treatments respectively. Similarly, residual effect of poultry manure on Cu, Zn, Mn and B contents of rice grain and straw was statistically significant. The highest and lowest values were recorded in T4 and T1 treatments respectively. The effect of chemical fertilizers on micronutrients (Fe, Cu, Zn, Mn and B) in rice grain was statistically significant while the effect of Cu in straw was not significant. The combined residual effects of poultry manure and chemical fertilizers on micronutrient (Fe, Cu, Zn, Mn and B) content of rice grain and straw were statistically significant except for Cu content in straw. From the above study it can be concluded that the residual effect of chicken manure and chemical fertilizer showed better performance on BR11 rice yield and significant effect on N, K micronutrients (Fe, Zn, Mn and B) and protein content of rice grain and straw.

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