Effect Of Different Nitrogen Sources on Growth and Yield of Rice (*Oryza sativa)*

ABSTRACT

The field study was conducted at Chaudhary Charan Singh Haryana Agricultural University, Krishi Vigyan Kendra farm, Fatehabad, (Haryana) during *Kharif* 2020. The experiment was laid down with fourteen treatments, *viz.*T_1 (Control), T_2 (100% RDN (through urea)) + 50% RDN through FYM), T_3 (75% RDN + 25% N through FYM), T_4 (50% RDN + 50% N through FYM), T_5 (25% RDN + 75% N through FYM), T_6 (100% N through FYM), T_7 (75% RDN + 25% N through Vermicompost), T_8 (50% RDN + 50% N through Vermicompost), T_9 (25% RDN + 75% N through Vermicompost), T_{10} (100% N through Vermicompost), T_{11} (75% RDN + 25% N through Poultry manure), T_{12} (50% RDN + 50% N through Poultry manure), T_{13} (25% RDN + 75% N through Poultry manure) and T_{14} (100% N through Poultry manure). Different nitrogen sources affected the yield and yield attributes variably. Highest (56.90, 90.07, 95.42 cm) and lowest (46.63, 77.37, 84.02 cm) plant height was observed in treatments T_2 and T_1 at 30 DAT, 60 DAT and harvest stage, respectively. The number of tillers varied from 166.14 (T_1) to 205.15 (T_2), 213.00 (T_1) to 372.17 (T_2) and 205.90 (T_1) to 364.47 (T_2) m^{-2} among different treatments at 30 DAT, 60 DAT and harvest stage, respectively. Highest grain yield (44.61 q ha^{-1}) was observed in T_2 and lowest (28.55 q ha^{-1}) in T_1. Treatment T_6 and T_1 showed highest and lowest straw yield with 52.28 and 32.93 q ha^{-1}, respectively. Higher biological yield (96.88 q ha^{-1}) was recorded with treatment T_2 while lowest was recorded with treatment T_1 with 61.48 q ha^{-1}. Highest (46.99 %) and lowest (43.18 %) harvest index was observed in T_6 and T_1, respectively. In the treatments where N was applied either through manures alone or in combination with chemical fertilizer (urea), highest growth parameters (plant population and Plant height), yield and yield attributes (number of tillers, test weight) was observed higher in poultry manure as compared to vermicompost and FYM.

Keywords: Nitrogen sources, RDN, FYM, Vermicompost, poultry manure

INTRODUCTION

Rice is cultivated in India and Haryana over an area of 43.66 million ha and 1.44 million ha with a production of 118.87 million tonnes and 4.8 million tonnes with the average productivity of 2.74 tonnes ha^{-1} and 3.33 tonnes ha^{-1}, respectively during the year 2019-2020 (Anonymous, 2021b).

Most of the Indian soils are deficient in primary nutrients (Nitrogen, Phosphorous and Potassium) but at present the deficiency of micronutrients is also found in different parts of the country. During the green revolution the use of inorganic fertilizer started to increase the crop yield. In order to achieve highest yield, the rate of chemical fertilizer use for crop production keep on increasing day by day and indiscriminate use of inorganic fertilizers resulted in the loss of soil water, soil quality, deterioration of soil health. The application of organic sources is important as they supply primary nutrients along with micronutrients, improve soil health by the increase of aeration and microbial activities (Suzuki, 1997). Generally, farmers use higher fertilizer doses than they required to increase the yield but the efficiency of applied fertilizers is relatively low in the rice cropping system because of rapid loss of plant nutrients, especially N, through gaseous volatilization, surface runoff, and leaching (Zhu and Chen, 2002). In submerged rice systems, nitrogen is one of the limiting factors but deficiencies of P and K also play important constraints in increasing the yield for consecutive planting of rice. Due to the increase in the cost of chemical fertilizer, short supply, availability and sustainability issues, there is need to reduce the nutritional dependency only on chemical fertilizers. Therefore, to fulfil the requirement of crops through organic manures like farmyard manure, vermicompost, poultry manure, etc. could be option for sustaining soil fertility and crop productivity along with restoration of overall soil quality as it brings about equilibrium between degenerative and restorative activities in the soil environment. On an average, well-rotted FYM contains 0.5% N, 0.2% P_2O_5 and 0.5% K_2O. Vermicompost is also a nutrient-rich organic fertilizer and works as a soil conditioner. Generally, poultry manure contains more amount of plant nutrients than the FYM and vermicompost. It is widely accepted that neither use of chemical fertilizers alone nor organic manures can achieve the sustainable crop yield under modern intensive farming. Many scientists (Tiwari *et al.,* 2017; Bhatt *et al.*, 2019;) reported that replacement of 50% of nutrients required through the organic sources is the best combination for the growth and yield of rice. Therefore, the integrated use of manures and fertilizers can help sustain soil quality and crop productivity. Kalaiyarasi et al. (2019) reported that application of 75% RDF + Vermicompost @ 2t ha^{-1} + Bio-fertilizer gave significantly higher number of pods per plant (32.73), number of seeds per pod (11.07), seed yield (866 kg ha^{-1}) and stover yield (1976 kg ha^{-1}) in the green gram crop. Shankar *et al.* (2020) studied the effect of different nutrients sources on the growth and yield attributes and found that treatments with 75% RDN+25%

poultry manure and 75% RDN+25% FYM recorded better performance compared to other treatments. The highest grain yield, straw yield and biological yield was observed in treatment 75% RDN+25% RDN through poultry manure and it was statistically at par with 50% RDN+ 50% poultry manure, 100% RDN, 50% RDN+50% FYM and 75% RDN+ 25% FYM. Basnet *et al*. (2021) observed the highest germination percentage (77.00 %), plant height (13.27 cm) and yield (16.55 t ha^{-1}) with treatment 50% recommended N through chemical fertilizer + 50% N through poultry manure while highest leaf numbers (10.40) observed in treatment 50% recommended N through chemical fertilizer + 50% N through vermicompost. Keeping in view the above facts, the present study was conducted to study the effect of different sources of nitrogen on growth, yield and yield attributes of rice crop

MATERIALS AND METHODS

The field study was conducted at Chaudhary Charan Singh Haryana Agricultural University, Krishi Vigyan Kendra farm, Fatehabad, (Haryana) during *Kharif* 2020. The experiment was laid down in Randomized Block Design (RBD) with fourteen treatments, *viz.*T_1 (Control), T_2 (100% RDN (through urea)) + 50% RDN through FYM), T_3 (75% RDN + 25% N through FYM), T_4 (50% RDN + 50% N through FYM), T_5 (25% RDN + 75% N through FYM), T_6 (100% N through FYM), T_7 (75% RDN + 25% N through Vermicompost), T_8 (50% RDN + 50% N through Vermicompost), T_9 (25% RDN + 75% N through Vermicompost), T_{10} (100% N through Vermicompost), T_{11} (75% RDN + 25% N through Poultry manure), T_{12} (50% RDN + 50% N through Poultry manure), T_{13} (25% RDN + 75% N through Poultry manure) and T_{14} (100% N through Poultry manure).The treatments comprised of four sources of nitrogen *viz*., urea, FYM, vermicompost and poultry manure. Fertilizers used as the source of N, P and K were urea, single super phosphate and murate of potash, respectively for the fulfilment of crop requirement. Nitrogen was applied in three split doses 1/3rd as basal dose at the time of transplanting and rest at 21 and 42 DAT while phosphorous and potash were applied in signal basal dose at the time of field preparation. FYM, Vermicompost and poultry manure were used as organic sources which were applied one week before the transplanting and incorporated as per the requirement of treatment plot. Nursery was raised using the seeds (variety PB-1509). Twenty-five days old seedlings were transplanted in the field with one or two seedling per hill at a spacing of 20x15 cm. All the recommended intercultural operation were followed during the experiment period. Irrigation was applied as per the requirement of the crop. Crop was harvested at physiological maturity when plant’s spikelet became yellow in colour and moisture content of grains was about 15 percent. Harvesting was done manually and after sun drying of the crop, threshing was done manually. Plant population per square meter area was recorded at 30 DAT, 60 DAT and at harvest stage using square ring randomly. Plant height was observed at 30 DAT, 60 DAT and at harvest stage by selecting 5 plants randomly from each plot. These plants were marked permanently for further reading. Plants height was measured with meter scale from the ground level to the tip of the top leaf. Number of tillers per meter square was recorded at 30 DAT, 60 DAT and at harvest stage randomly by putting a square ring in each plot and counting of the total number of tillers per meter square was done. After the harvest and threshing of the crop, random samples were collected from the cleaned grains. One thousand grains from each plot were counted. The weights of these grains (at 14% moisture content) were precisely recorded by using an electronic balance. The weight of these1000 grains was recorded in gram (g). It was recorded in kg per plot, after sun drying the above ground part of the produce of and converted in to q ha^{-1}. The weight of total biomass in bundles was recorded with the help of weighing balance. The produce of each plot was threshed manually. Plot wise straw yield was recorded by subtracting the grain weight of each plot separately from the total biomass weight of their respective plot. Thus, the grain and straw yield obtained in kg per plot was multiplied with the conversion factor in order to get the yield in q ha^{-1}. The harvest index (%) was calculated by dividing grain yield by biological (grain + straw) yield.

RESULTS AND DISCUSSION

1.1 Effect of different nitrogen sources on plant population of rice

The data pertaining to the plant population of rice crop recorded at 30, 60 DAT and at harvest stage are presented in Table 3. A perusal of the data revealed that the plant population do not differ significantly in various treatments at 30, 60 DAT and at harvest stage. Plant population at 30 DAT varied from 24.00 (T_1) to 25.67 plants m^{-2} in T_2, T_3, T_7 and T_{11}. In the treatments receiving both chemical fertilizer and manures, highest plant population (25.67 plants m^{-2}) was observed in T_3, T_7 and T_{11} followed by 25.33 plants m^{-2} in T_4, T_8, T_{12} and T_{13}. In the treatments where only manures as N source was applied, highest plant population (24.67 plants m^{-2}) was recorded in the treatment T_{14} followed by T_{10} and T_6. Plant population at 60 DAT ranged from 23.67 (T_1) to 25.33 plants m^{-2} in T_2, T_3, T_7, T_8 and T_{11}. Treatments receiving both chemical fertilizer and manures, highest plant population (25.33 plants m^{-2}) was observed in T_3, T_7, T_8 and T_{11} followed by 25.00 plants m^{-2} in T_{12} and T_{13} and 24.67 plants m^{-2} in T_4 and T_9. In the treatments receiving 100% RDN through manures, highest plant population (24.33 plants m^{-2}) was observed in T_{14} followed by T_{10} and T_6 (24.00 plants m^{-2} each). Similar trend of plant population was observed at harvest stage. More plant population was observed in the treatments where chemical fertilizers were applied either alone or in combination with different manures and it may be due to the better crop stand as result of higher availability of nutrients in plant available form and their easy uptake by plants. Similar findings were observed by Tiwari (2019) & Shankar *et al.* (2020).

1.2 Effect of different nitrogen sources on plant height of rice

The data related to the plant height recorded at 30, 60 DAT and at harvest stage as affected by different nitrogen sources are presented in Table 3. It was observed that the plant height increased initially at faster rates between a period of 30 to 60 DAT but at slower rate from 60 DAT to harvest stage. Highest plant height (56.90 cm) was observed in the treatment T_2 which was found statistically at par with treatment T_3, T_7 and T_{11} while lowest plant height (46.63 cm) was observed in the T_1 (control). In treatments where 100% N was applied only through manures, highest plant height (50.13 cm) was observed in treatmentT_{14} followed byT_{10} (50.10 cm) andT_6 (50.07 cm). In the treatments where both chemical fertilizer and manures as N sources were applied, highest plant height (56.10 cm) was observed in the treatment T_{11} which was statistically at par with T_3, T_4, T_7, T_8 and T_{12} whereas lowest (50.07 cm) was observed in the treatment T_6. Plant height at 60 DAT increased significantly in all the treatments over the control. Highest plant height (90.07 cm) was observed in treatment T_2 which was statistically at par with treatment T_3, T_7 and T_{11}while lowest plant height (77.37cm) was observed in the T_1 (control). In the treatments receiving N through chemical fertilizer and manures, highest plant height (88.43 cm) was observed in the T_{11} which was statistically at par with T_3, T_4, T_7, T_8 and T_{12}. The treatments in which 100%N was applied only through manures, highest plant height (81.37 cm) was observed in treatment receiving T_{14} followed by T_{10} (81.23 cm) and T_6 (81.13). The significantly highest plant height (95.42 cm) was recorded in treatment T_2 which was statistically at par with T_3, T_7 and T_{11}. Lowest plant height (84.02 cm) was observed in T_1 (control). Comparing the treatments receiving 100% N only through manures, highest plant height (87.68 cm) was observed inT_{14} followed by T_{10} (87.50 cm) andT_6 (87.41 cm). In the treatments receiving N through different combination of chemical fertilizer and manures, highest plant height (94.92 cm) was observed in treatment T_{11} which was statistically at par with T_3 and T_7 and lowest (87.41 cm) was observed in T_5. Singh *et al.* (2018) and Shankar *et al.* (2020) also reported significantly higher plant height in treatment where 100% RDN applied through chemical fertilizer as compared to organic sources. This might be due to adequate and increased availability of N through split application of urea at different growth stages which helped in the rapid growth and development of plant cells (Tomar *et al.*, 2018). Treatments received combined application of nitrogen source, increase in plant height observed and it might be due to adequate supply and more availability of nitrogen through inorganic and organic sources to growing plants (Soleimanzadeh and Gooshchi, 2013). Plant height was observed comparatively low in the treatments receiving nitrogen only through manures as the availability of nutrients was less in the soil at early growth stage. The findings of present investigation are in close proximity of those observed by Patel *et al.* (2020) and Sindhuja *et al.* (2021).

1.3 Effect of different nitrogen sources on yield attributes of rice

The data pertaining to the numbers of tillers (m^{-2}) and test weight (g) as influenced by various nitrogen sources are presented in Table 3. The number of tillers increased at faster rate during a period from transplanting to 30 days as compared to period from 30 to 60 DAT and thereafter, a decline in the number of tillers was observed from 60 DAT to harvest stage. It was observed from the data (Table 5) that number of tillers at 30 DAT irrespective to source of N, the numbers of tillers were significantly higher in all the treatments as compared to the control. Highest number of tillers (205.15 m^{-2}) was found in the treatment T_2 which was statistically at par with the treatment T_3, T_7, T_{11} and lowest (166.14 m^{-2}) in T_1 (control). Comparing the various treatment receiving 100% N only through manures, the number of tillers were found highest in treatment T_{14} (178.61 m^{-2}) followed by T_{10} (176.88 m^{-2}) and T_6 (176.40 m^{-2}).In the treatments receiving combined application of chemical fertilizer and manures, highest number of tillers (194.05 m^{-2}) was found in the treatment T_{11} which was significantly higher over the treatments(T_5, T_6, $T_{10}$and T_{14}) and statistically at par with rest of the treatments while lowest number of tillers (180.55 m^{-2})was recorded in the T_5. At 30 DAT, Treatment T_2 recorded highest number of tillers (372.17 m^{-2}) which was statistically at par with the treatment T_3, T_7, T_{11} and lowest (213.00 m^{-2}) in T_1. In the treatments where 100% N was applied only through manures, highest number of tillers (289.57 m^{-2}) were observed in T_{14} followed by T_{10}(280.80 m^{-2}) and T_6(276.00 m^{-2}). The treatments receiving N through both the sources *i.e.*chemical fertilizer and manures, highest number of tillers (364.80 m^{-2}) was found in the treatment T_{11} which was statistically at par with treatment T_3, T_7, T_8 and T_{12} while lowest(292.00 m^{-2}) was observed in T_5. At harvest stage, the highest number of tillers (364.47 m^{-2}) was recorded in the treatment T_2 which was found statistically superior to all other treatments except T_3, T_7 and T_{11}.The lowest number of tillers (205.90 m^{-2}) was recorded in T_1 (control). In the treatments where 100% N was applied through manures, the number of tillers were found highest in T_{14}(282.27 m^{-2}) followed by T_{10} (273.60 m^{-2}) andT_6 (271.20 m^{-2}). In the treatments where both chemical fertilizer and manures as N source was applied, highest number of tillers (357.20 m^{-2}) was found in the treatment T_{11} which was statistically at par with T_3, T_7, T_8 and T_{12} and lowest (284.70 m^{-2}) was recorded in the T_5. The increase in number of tillers in response of 100% RDN through inorganic fertilizer might be primarily due to the supplementary contribution of nitrogen in soil and improved vegetative growth (Arif *et al.*, 2014). Among combined application of both chemical fertilizer and manures, highest number of tillers (m^{-2}) and test weight (g) were observed in treatment T_{11} followed by T_7 and T_3 may be attributed to the higher availability of readily available plant nutrients in these treatments. The combined application of chemical fertilizer and poultry manure improved growth attributes, yield components and productivity (Shankar *et al.*, 2020). In the treatments receiving manures alone, highest number of tillers (m^{-2}) and test weight (g) was observed in poultry manure because nutrient content and its availability in poultry manure is higher as compared to vermicompost and FYM. Higher yield parameters observed in plots amended with poultry manure as compared to other organic sources also reported by Adeleye *et al.* (2010). Similar results were also observed by Surve *et al.* (2019) and Balamurugan *et al.* (2020).

1.4 Effect of different nitrogen sources on yield and harvest index of rice

The data pertaining to the grain, straw, biological yield and harvest index of rice crop as affected by different sources of nitrogen are presented in Table 4. Grain yield of rice crop increased significantly in all the treatments over the T_1 (control). Highest grain yield (44.61 q ha^{-1}) was found in the treatment T_2 which was statistically at par with the treatment T_3, T_7 and T_{11} and found significant over rest of the treatments while lowest grain yield (28.55 q ha^{-1}) was recorded in the control. Further, grain yield was recorded significantly higher in the treatments receiving 100% N through chemical fertilizer as compared to those treatments receiving 100% N through the manures alone. In the treatments in which 100% N was applied through manures only, highest grain yield (32.96 q ha^{-1}) was observed in T_{14} followed by T_{10}(32.75 q ha^{-1}) and T_6(32.54 q ha^{-1}). The treatments receiving N through both the sources *i.e.*, Chemical fertilizer and manures, highest grain yield (43.53 q ha^{-1}) was recorded in the treatment T_{11}which was statistically at par with T_3 and T_7 while lowest grain yield (35.01 q ha^{-1}) was observed in treatment T_5. Highest rice straw yield (52.28 q ha^{-1}) was found in the treatment T_2 which was statistically at par with T_3, T_7, and T_{11} while lowest rice straw yield (32.93 q ha^{-1}) was recorded in T_2. In the treatments where 100% N was applied only through manures, highest straw yield (39.93 q ha^{-1}) was observed in treatment T_{14} followed by T_6 (38.44 q ha^{-1}) and T_6 (36.63 q ha^{-1}). In the treatments receiving N through both chemical fertilizer and manures, highest straw yield (50.36 q ha^{-1}) was observed in treatment T_{11} which was statistically at par with T_3, T_4, T_7, T_8 and T_{12} while significant over rest of the treatments and lowest (40.70 q ha^{-1}) was observed in T_5. Highest biological yield (96.88 q ha^{-1}) was recorded in the treatment T_2 which was found statistically at par with the treatment T_7 and T_{11} while lowest (59.48 q ha^{-1}) was observed in the control. In the treatments receiving N from chemical fertilizer and manures, highest biological yield (50.36 q ha^{-1}) was observed in the treatment T_{11} which was found statistically at par with T_7 and T_3 while lowest (75.72 q ha^{-1}) was recorded in T_5. In the treatments where 100% N was applied through manures alone, highest biological yield (72.89 q ha^{-1}) was observed in T_{14} followed by T_{10} (71.18 q ha^{-1}) and T_6 (69.16 q ha^{-1}), which was also statistically at par with this treatment. Harvest index increased in all the treatments over control but it was found non-significant (Table 6). Highest value of the harvest index (46.99%) was observed in treatment T_6 and lowest (43.11 %) in control. Comparing the treatments receiving 100% N either through chemical fertilizer (urea) or manures (FYM, vermicompost and poultry manure) highest value of harvest index (46.99 %) was observed in treatment T_6 followed by T_2 (46.03 %), T_{10} (45.97 %) and T_{14} (45.19 %). In treatments receiving N through both chemical fertilizer and manures, highest harvest index (46.39 %) was observed in treatment T_{11} followed by T_5 (46.20 %) and T_3 (45.83 %) while lowest (44.62 %) was observed in treatment T_{13}. Treatment T_2 recorded significantly higher grain, straw and biological yield. This result is supported by that of Ayoola and Makinde (2009), who reported highest yield in maize that was fertilized with 100% RDN through inorganic fertilizers as compared to 100% RDN through poultry manure. The grain yield in this treatment was higher due to higher yield attributing characters *viz.* number of tillers (m^{-2}) and test weight (g) as well as higher nutrient uptake by the crop. This might be due to that the grain yield depends on the synthesis and accumulation of photosynthates and their distribution among various plant parts as well as the extent of translocation into sink (grains) and also on plant growth and development during early stages of crop growth which in turn depends on the availability of nutrients, (Sharma *et al.,* 2015; Bharathi *et al.,* 2020). The yield in the treatment T_2 was statistically at par with T_3, T_7 and T_{11} because of the combined application of manures and chemical fertilizer, there was an increase in availability of nutrients which provide higher amount of nutrients to the crop. The increased yield in treatment might be due to the balanced supply of nutrients from poultry manure and chemical fertilizer which enhanced the yield attributes. Among manures, higher grain and straw obtained in treatment receiving N through poultry manure as compared to FYM and vermicompost. Aasif *et al.* (2018) and Kafle *et al.* (2019) also reported higher crop yield in poultry manure treatments. Similar results were also observed by Almaz *et al.* (2017), Surve *et al.* (2019) and Bharathi *et al.* (2020).

Table 1. Initial soil physico-chemical properties of experimental field

Parameters	Contents
Soil composition Sand (%) Silt (%) Clay (%) Textural Class	 30.30 30.60 39.10 Clay Loam
pH	8.00
Electrical conductivity (dS m^{-1})	0.74
Organic Carbon (%)	0.64
Available N (kg ha^{-1})	114.4
Available P (kg ha^{-1})	15.5
Available K (kg ha^{-1})	228.3
Available S (kg ha^{-1})	31.5
DTPA extractable Zn (mg kg^{-1})	1.84
DTPA extractable Fe (mg kg^{-1})	9.22
DTPA extractable Cu (mg kg^{-1})	1.27
DTPA extractable Mn (mg kg^{-1})	5.82

Table 2. Chemical properties of FYM, Vermicompost and Poultry Manure.

Parameters	FYM	Vermicompost	Poultry manure
pH	6.69	6.98	7.18

EC	0.52	0.58	0.64
OC (%)	14.80	27.40	22.90
N (%)	0.63	1.89	2.80
P (%)	0.35	0.62	0.89
K (%)	0.59	0.83	1.18
S (%)	0.13	0.17	0.15
DTPA extractable Fe (mg kg^{-1} soil)	8.77	13.60	8.12
DTPA extractable Zn (mg kg^{-1} soil)	12.32	15.46	10.84
DTPA extractable Mn (mg kg^{-1} soil)	16.59	20.27	14.36
DTPA extractable Cu (mg kg^{-1} soil)	4.24	5.42	3.68

Table 3 Effect of different nitrogen sources on plant population, plant height and yield attributes of rice.

Treatments	Plant population (m^{-2})			Plant Height (cm)			No. of tillers (m^{-2})			Test weight (g)
	30 DAT	60 DAT	(89 DAT)	30 DAT	60 DAT	(89 DAT)	30 DAT	60 DAT	(89 DAT)	
T_1: Control	24.00	23.67	23.67	46.63	77.37	84.02	166.14	213.00	205.90	23.21
T_2: 100% RDN (through urea)	25.67	25.33	25.33	56.90	90.07	95.42	205.15	372.17	364.47	26.78
T_3: 75% RDN + 25% N through FYM	25.67	25.33	25.33	55.70	88.03	94.57	193.01	359.33	351.63	26.24
T_4: 50% RDN + 50% N through FYM	25.33	24.67	24.67	54.17	86.80	92.01	187.10	333.00	325.60	25.54
T_5:25% RDN + 75% N through FYM	24.67	24.33	24.33	52.07	84.17	90.66	180.55	292.00	284.70	25.24
T_6:100% N through FYM	24.33	24.00	24.00	50.07	81.13	87.41	176.40	276.00	271.20	24.11
T_7:75% RDN + 25% N through Vermicompost	25.67	25.33	25.33	55.87	88.33	94.88	193.27	364.47	356.77	26.33
T_8:50% RDN + 50% N through Vermicompost	25.33	25.33	25.33	54.23	86.87	92.16	188.99	347.07	339.47	25.76
T_9: 25% RDN + 75% N through Vermicompost	25.00	24.67	24.67	52.13	84.27	90.85	181.79	300.93	293.53	25.22
T_{10}: 100% N through Vermicompost	24.33	24.00	24.00	50.10	81.23	87.50	176.88	280.80	273.60	24.17
T_{11}: 75% RDN + 25% N through Poultry manure	25.67	25.33	25.33	56.10	88.43	94.92	194.05	364.80	357.20	26.41
T_{12}: 50% RDN + 50% N through Poultry manure	25.33	25.00	25.00	54.50	86.93	92.22	189.49	351.13	344.53	25.88
T_{13}: 25% RDN + 75% N through Poultry manure	25.33	25.00	25.00	52.50	84.33	91.06	186.45	314.13	306.53	25.43
T_{14}: 100% N through Poultry Manure	24.67	24.33	24.33	50.13	81.37	87.68	178.61	289.57	282.27	24.55
SEm±	0.48	0.55	0.55	0.71	0.77	0.74	4.23	6.75	6.72	0.58
CD (P= 0.05)	NS	NS	NS	2.07	2.26	2.16	12.36	19.74	19.64	1.70

Table 4 Effect of different nitrogen sources on yield and harvest index of rice

Treatments	Grain Yield (q/ha)	Straw Yield (q/ha)	Biological Yield (q/ha)	Harvest Index (%)
T_1: Control	28.55	32.93	61.48	43.18
T_2: 100% RDN (through urea)	44.61	52.28	96.88	46.03
T_3: 75% RDN + 25% N through FYM	42.26	49.95	92.21	45.83
T_4: 50% RDN + 50% N through FYM	39.19	47.10	86.29	45.45
T_5: 25% RDN + 75% N through FYM	35.01	40.70	75.72	46.20
T_6: 100% N through FYM	32.54	36.63	69.16	46.99
T_7: 75% RDN + 25% N through Vermicompost	42.53	50.35	92.87	45.78
T_8: 50% RDN + 50% N through Vermicompost	39.34	48.10	87.44	44.99
T_9: 25% RDN + 75% N through Vermicompost	35.93	42.94	78.88	45.52
T_{10}: 100% N through Vermicompost	32.75	38.44	71.18	45.97
T_{11}: 75% RDN + 25% N through Poultry manure	43.53	50.36	93.89	46.39
T_{12}: 50% RDN + 50% N through Poultry manure	40.78	49.60	90.39	45.11
T_{13}: 25% RDN + 75% N through Poultry manure	36.20	44.80	81.06	44.62
T_{14}: 100% N through Poultry Manure	32.96	39.93	72.89	45.19
SEm±	0.91	1.29	1.45	0.92
CD (P= 0.05)	2.67	3.77	4.24	NS

Conclusion

On the basis of the results obtained in present investigation, it may be concluded that 100 % RDN applied through chemical fertilizer was found superior in terms of yield and yield attributes, nutrient content and their uptake. Although in short term, grain yield was recorded highest in chemical fertilizer but it also deteriorates the soil physical, chemical and biological properties, whereas manures help in overall improvement of the soil properties in long term. The results in combined application were at par with chemical fertilizer alone application which shows that regular and balanced application of manures will increase the nutrients status of soil and ultimately the yield.

Reference

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