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# Effect of integrated nutrient management on yield and yield attributes of rice (*Oryza sativa* L.)

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**Abstract**
The present study conducted to evaluate the suitable proportion of organic manures and inorganic fertilizers along with biofertilizer to maximize growth and dry matter accumulation of rice on alkaline soils of Uttar Pradesh, India. The experiment consisting twelve treatments viz., $T_1$ (control), $T_2$ (75% RDF), $T_3$ (100% RDF), $T_4$ (125% RDF), $T_5$ (100% RDF + FYM 6 t/ha), $T_6$ (100% RDF V. C.3 t/ha), $T_7$ (100% RDF + BGA @ 10 kg/ha), $T_8$ (100% RDF + neem cake 6 q/ha), $T_9$ (75% RDF + FYM 6 t/ha) k $T_{10}$ (75% RDF + V.C.3 t/ha), $T_{11}$ (75% RDF + BGA 10 kg/ha) and $T_{12}$ (75% RDF + neem cake 6 q/ha) were tested in Randomized Block replicated as thrice. The maximum yield and yield attributes of rice crop was recorded under nutrient management module of 100% RDF + 3 tonne vermi compost closely followed by 100% RDF + 6 tonne FYM. Significantly higher grain and straw yield was recorded under treatment having 100% RDF + 3 tonne vermi compost over all the treatment except treatment $T_4$, $T_5$, $T_7$ and $T_8$ $T_{12}$ which was recorded at par.

**Keywords:** Integrated nutrient management, rice, yield, yield attributes

## Introduction
Rice (*Oryza sativa* (L.)) is one of the most important staple food crops in the world. In Asia, more than two billion people are getting 60-70 percent of their energy requirement from rice and its derived products.

Rice is the bulk of food security of the global population. In 21st century there will be the need of about 250 million tons of food grains to feed the rapidly increasing population. The global requirement of rice by 2050 AD world by 800 million tones, which is 26% higher than the present level of production.

Utter Pradesh is an important rice growing state is the country. The area and production of rice in this state is about 13.84 million hectare and 14.00 million tonnes respectively with productivity of 2358 kg per hectare (Anonymous, 2013) [1]. The role of fertilizer in boosting crop production has already been proved and they have become so essential that the cultivation of present day rice crop without them in rather a dream. The cost of chemical fertilizer is very high. However, fertilizer alone cannot sustain the productivity of rice under such condition integration of various sources of nutrients (organic and inorganic) are more suitable because it reduce the application of chemical fertilizer and the cost of cultivation.

Nitrogen is one of the most important elements and has more pronounced effect on growth, and development as well as on quality of rice than other elements, however, excess quantity of nitrogen lowers the quality. Integrated nutrient management involves conjunctive use of nitrogenous chemical fertilizer and organic manures which have the great significance for increasing the productivity, quality and sustainability of rice as they supply all macro and micro nutrients in balanced and required proportion as far as the crops need. Integrated nitrogen management not only economizes the use of chemical fertilizers but also sustain the soil health by improving physico–chemical and biological conditions of rhizospheric soil for longer period than inorganic nitrogen alone (Krishana *et al.*, 2005) [5]. The objective of present study to know the effect of Integrated nutrient management on growth attributes of rice.

Several long-term experiments conducted all over India indicated a decrease in rice productivity due to continuous use of chemical fertilizers Yadav (2006) [10]. Integrated nutrient management (INM) aims to improve soil health and sustain high level of productivity and production.

## Materials and Methods

The field experiment was conducted during *Kharif* 2014 and 2015 at Agronomy Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.). The experimental site located at Kumarganj is situated 42 km away from Faizabad city on Faizabad-Raibarely road.

**Table 1:** Treatments detail

| | |
|---|---|
| $T_1$ | Control |
| $T_2$- | 75% RDF |
| $T_3$- | 100% RDF |
| $T_4$ | 125% RDF |
| $T_5$ | 100% RDF + FYM 6 t/ha |
| $T_6$ | 100% RDF V. C.3 t/ha |
| $T_7$ | 100% RDF + BGA @10 kg/ha |
| $T_8$ | 100% RDF + neem cake 6 q/ha |
| $T_9$ | 75% RDF + FYM 6 t/ha |
| $T_{10}$ | 75% RDF + V.C.3 t/ha |
| $T_{11}$ | 75% RDF + BGA 10 kg/ha |
| $T_{12}$ | 75% RDF + neem cake 6 q/ha |

### Yield attributes and yield

### Panicles ($m^2$)

The number of panicles was counted from randomly selected four places of one running meter method in each plot and the total of all four places were taken and divided by four to express as panicles $m^{-2}$.

### Panicle length (cm)

Five panicles sampled randomly from each plot and their length was measured from base to tip of panicle and average values were recorded.

### Spikelets panicle$^{-1}$

After taking weight of the selected panicles, the spikelets were counted from each panicle and mean number of spikelets panicle$^{-1}$ were computed.

### Grains panicle$^{-1}$

After counting the spikelets of selected panicles, the grains were counted and mean values were taken as grains panicle$^{-1}$.

### Chuffy grain panicle$^{-1}$

After counting the grains of selected panicles, the chaffy grains were counted and mean values were taken as chaffy grains panicle$^{-1}$.

### Grains weight panicle$^{-1}$

The grain of five panicles taken for recording grains per panicle were weighed and mean values were taken.

### 1000-grain weight (g)

A composite sample of grains was collected from the clean grains of each plot after drying and cleaning. 1000-grains were counted from each sample separately and their weights were recorded to express test weight (1000 grain weight).

### Yield (q/ha$^{-1}$)

### Grain Yield (q ha$^{-1}$)

After taking the weight of biomass, the produce of each net plot was threshed separately and clean grains were sun dried to maintain 14% moisture. The grain yield was recorded in kg plot$^{-1}$ and finally the values were converted to q ha$^{-1}$.

### Straw yield (q ha$^{-1}$)

Straw yield was obtained by subtracting the weight of grains from the weight of total harvested produce of each net plot. The straw yield thus obtained in kg plot$^{-1}$ was converted in q ha$^{-1}$.

### Harvest Index (%)

Harvest index of each experimental plot was calculated with the help of following formula:

$$\text{H.I. (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

## Result and Discussion

The highest number of panicles $m^{-2}$, panicle length, spikelets panicle$^{-1}$ and number of grains panicle$^{-1}$ are the most important yield contributing characters. These attributes were recorded highest under the treatment $T_6$ 100% RDF + VC 3 t/ha. All the treatments were found significantly superior over treatment $T_1$ (Control) alone. The maximum increase in panicle length, spikelets panicle$^{-1}$ and number of grains panicles$^{-1}$ were observed in $T_6$ followed by $T_5$. The superiority of the treatment be explained on the basis of balanced nutrient supply which enhances cell division, photosynthesis and reproductive phases resulted more panicle length, and number of grains panicles$^{-1}$. This might be because of improved physical condition of soil, thereby improving the efficiency and utilization of native as well as applied nutrients. The result also corroborates with the finding of Reddy and Kumar (2006) [7], Shankar and Laware (2011) [9] and Barik *et al.* (2006) [2].

Data pertaining to the effect of Integrated Nutrient Management modules on test weight revealed that the highest 1000 grain weight was found under the treatment $T_6$ having 100% RDF + VC 3 t/ha followed by $T_5$ 100% RDF + FYM 6 t/ha while the lowest 1000 grain weight was recorded in control. Increased 1000 grain weight under treatment $T_6$ might be due to relatively more nutrient supply in available farm which enhanced the plant growth behaviors increased in 1000 grain weight. The minimum chuffy grains recorded with application of 75% RDF + neem cake 6 q/ha it was significantly less that unfertilized treatment. This might be due to the proper and better availability of the nutrients. While the highest grain weight of recorded with the application of 100% RDF + VC 3 t/ha. It might be due to better nutrients supplement with organic sources. Similar findings were also reported by Khursheed *et al.* (2013) and Reddy and Kumar (2006) [7].

### Grain and straw yield and harvest index

The grain and straw yield and harvest index of rice were significantly influenced by various integrated nutrient management modules. The maximum increment in grain, straw and harvest index were observed with the treatment supplied 100% RDF + VS 3 t/ha followed by $T_5$ 100% RDF + FYM 6 t/ha. The increase in grain, straw yield and harvest index were affected with the supplement of, supplied the nutrient in combination through organic, neem cake, biofertilizer and inorganic fertilizers. Thereby improving the efficiency in utilization of nutrient as well as applied nutrients which

ultimately improved the yield attributing characters and yield of crop. These results are also corroborate with the findings of Khairnar and Thakur (2011) [3], Khursheed *et al.* (2013) [4], and Swarup and Yaduvanshi (2013) [8].

**Table 1:** Effect of integrated nutrient management on growth attributes of rice crop.

| Treatment | | Panicles $m^{-2}$ | | Panicle length (cm) | | Spikelets $panicle^{-1}$ | | Grain $panicle^{-1}$ | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 |
| $T_1$ | Control | 270 | 273 | 15.39 | 15.04 | 35.94 | 37.14 | 125.80 | 130.00 |
| $T_2$ | 75% RDF | 295 | 296 | 21.75 | 21.98 | 46.26 | 48.23 | 161.90 | 168.80 |
| $T_3$ | 100% RDF | 321 | 324 | 23.77 | 24.03 | 50.60 | 52.97 | 177.10 | 185.40 |
| $T_4$ | 125% RDF | 351 | 354 | 24.58 | 24.85 | 52.31 | 54.51 | 183.10 | 190.80 |
| $T_5$ | 100% RDF + FYM 6 t/ha | 360 | 362 | 25.53 | 25.81 | 54.33 | 56.63 | 190.15 | 198.20 |
| $T_6$ | 100% RDF V. C.3 t/ha | 364 | 367 | 25.80 | 26.08 | 54.91 | 57.23 | 192.20 | 200.30 |
| $T_7$ | 100% RDF + BGA @10 kg/ha | 357 | 360 | 23.89 | 24.15 | 50.84 | 53.00 | 177.95 | 185.50 |
| $T_8$ | 100% RDF + neam cake 6 q/ha | 354 | 357 | 23.70 | 23.95 | 50.29 | 51.71 | 176.00 | 181.00 |
| $T_9$ | 75% RDF + FYM 6 t/ha | 332 | 353 | 23.70 | 23.94 | 50.17 | 52.14 | 176.60 | 183.50 |
| $T_{10}$ | 75% RDF + V.C.3 t/ha | 335 | 338 | 23.76 | 24.05 | 49.71 | 51.71 | 175.00 | 185.00 |
| $T_{11}$ | 75% RDF + BGA 10 kg/ha | 330 | 333 | 23.72 | 23.90 | 49.23 | 51.14 | 173.30 | 180.00 |
| $T_{12}$ | 75% RDF + neam cake 6 q/ha | 327 | 330 | 23.68 | 23.88 | 48.94 | 50.86 | 172.30 | 180.00 |
| | SEm± | 17.15 | 7.21 | 0.82 | 0.83 | 1.79 | 1.86 | 7.34 | 7.42 |
| | CD at 5% | 48.50 | 19.10 | 2.39 | 2.44 | 5.26 | 5.47 | 21.52 | 21.76 |

**Table 2:** Effect of integrated nutrient management on yield attributes of rice crop

| Treatment | | Unfilled grain $panicle^{-1}$ | | Grain weight (g) $panicle^{-1}$ | | 1000 grain weight (g) | |
|---|---|---|---|---|---|---|---|
| | | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 |
| $T_1$ | Control | 21.50 | 22.33 | 3.01 | 3.01 | 22.62 | 22.85 |
| $T_2$ | 75% RDF | 16.19 | 16.88 | 3.49 | 3.63 | 23.20 | 23.32 |
| $T_3$ | 100% RDF | 17.71 | 18.54 | 3.05 | 3.75 | 23.56 | 23.78 |
| $T_4$ | 125% RDF | 19.22 | 20.03 | 3.81 | 3.93 | 24.00 | 24.23 |
| $T_5$ | 100% RDF + FYM 6 t/ha | 18.87 | 19.50 | 3.84 | 3.94 | 24.30 | 24.53 |
| $T_6$ | 100% RDF V. C.3 t/ha | 18.31 | 19.08 | 3.90 | 3.99 | 24.50 | 24.72 |
| $T_7$ | 100% RDF + BGA @10 kg/ha | 17.80 | 18.55 | 3.69 | 3.89 | 23.62 | 23.84 |
| $T_8$ | 100% RDF + neam cake 6 q/ha | 17.60 | 18.10 | 3.69 | 3.81 | 23.46 | 23.69 |
| $T_9$ | 75% RDF + FYM 6 t/ha | 16.16 | 16.85 | 3.56 | 3.60 | 23.22 | 23.45 |
| $T_{10}$ | 75% RDF + V.C.3 t/ha | 16.00 | 16.70 | 3.47 | 3.65 | 23.14 | 23.36 |
| $T_{11}$ | 75% RDF + BGA 10 kg/ha | 15.83 | 16.50 | 3.49 | 3.60 | 23.08 | 23.30 |
| $T_{12}$ | 75% RDF + neam cake 6 q/ha | 15.73 | 16.40 | 3.53 | 3.57 | 23.03 | 23.25 |
| | SEm± | 0.77 | 0.75 | 0.08 | 0.08 | 0.79 | 0.97 |
| | CD at 5% | 2.27 | 2.20 | 0.23 | 0.22 | 1.29 | 1.38 |

**Table 3:** Effect of integrated nutrient management on grain and straw yields, harvest index of rice crop

| Treatment | | Grain yield (q $ha^{-1}$) | | Straw yield (q $ha^{-1}$) | | Harvest index (%) | |
|---|---|---|---|---|---|---|---|
| | | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 |
| $T_1$ | Control | 22.75 | 23.45 | 32.31 | 33.30 | 0.41 | 0.41 |
| $T_2$ | 75% RDF | 35.62 | 36.45 | 50.22 | 51.39 | 0.41 | 0.41 |
| $T_3$ | 100% RDF | 46.71 | 45.41 | 65.86 | 64.03 | 0.41 | 0.41 |
| $T_4$ | 125% RDF | 51.37 | 52.43 | 71.92 | 73.40 | 0.42 | 0.42 |
| $T_5$ | 100% RDF + FYM 6 t/ha | 53.91 | 54.19 | 74.93 | 75.32 | 0.42 | 0.42 |
| $T_6$ | 100% RDF V. C.3 t/ha | 55.8 | 56.45 | 75.33 | 76.21 | 0.43 | 0.43 |
| $T_7$ | 100% RDF + BGA @10 kg/ha | 52.27 | 53.45 | 72.13 | 73.76 | 0.42 | 0.42 |
| $T_8$ | 100% RDF + neam cake 6 q/ha | 51.21 | 52.44 | 70.67 | 72.37 | 0.42 | 0.42 |
| $T_9$ | 75% RDF + FYM 6 t/ha | 47.85 | 46.65 | 65.55 | 63.91 | 0.42 | 0.42 |
| $T_{10}$ | 75% RDF + V.C.3 t/ha | 48.81 | 47.12 | 68.33 | 65.97 | 0.42 | 0.42 |
| $T_{11}$ | 75% RDF + BGA 10 kg/ha | 46.01 | 45.91 | 63.03 | 62.90 | 0.42 | 0.42 |
| $T_{12}$ | 75% RDF + neam cake 6 q/ha | 45.32 | 46.25 | 61.18 | 62.44 | 0.43 | 0.43 |
| | SEm± | 1.79 | 2.09 | 2.27 | 2.67 | 1.30 | 1.51 |
| | CD at 5% | 6.26 | 7.02 | 6.66 | 7.82 | 3.80 | 4.43 |

## Summary and Conclusions

The yield attributes *viz.*, panicle $m^{-2}$, panicle length (cm), spikelets $panicle^{-1}$, grains $panicle^{-1}$, chuffy grain $panicle^{-1}$, grain weight $panicle^{-1}$ and 1000-grain weight were increased with the application of nutrient managemenbt modules. The maximum yield attributes were recorded with the application of 100% RDF + 3 t vermicompost $ha^{-1}$ followed by 100% RDF + FYM 6 t/ha. On the basis of present investigation, it can be concluded that the $T_6$ -100% RDF + VC 3 t/ha found most effective in increasing the yield and yield attributes of rice.

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