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# Effect of integrated nutrient management on soil property and nutrients uptake by Rice (*Oryza sativa* L.)

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**Abstract**
The present investigation entitled "Effect of integrated nutrient management on soil property and nutrients uptake by Rice (*Oryza sativa* L.)" was conducted at Genetics and Plant Breeding Research Farm of Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya, during Kharif season 2018. The results revealed that among the INM practices application of 100% RDF alone significantly improve the protein content, N, P, K uptake by rice crop and maximum increase in soil properties like available nitrogen (115.40 to 126.30 kg/ha.), phosphorus (15.60 to 16.80 kg /ha.), potassium (240.0 to 258.00 kg/ha.). There is significantly decline in pH (9.0 to 8.70), Electrical conductivity (0.96 to 0.83 $dSm^{1}$) and maximum build-up of organic carbon (0.23 to 0.30%), of soil in combined application of 50% RDF + 50% N through green manure (Dhaincha).

**Keywords:** Protein content, soil property, organic carbon, uptake, fertilizer, manure

## Introduction
Among the cereals, rice (*Oryza sativa* L.) is the major source of calories for 40% of the world population. It is a staple food crop in South, South-East and East Asia. The area and production of rice in U.P. is about 5.95 million hectares and 13.27 million tonnes, respectively with productivity of 2230 kg per hectare (Agricultural Statistics at a Glance, 2018) [1]. Rice supplies 20% and 31% of the total calories required by world and Indian population, respectively Imbalanced nutrient management under intensive cropping system and decreased soil organic matter are the key factors responsible for decline in soil quality parameters (Kang *et al.*, 2005) [6] such as deterioration of the physical, chemical and biological health of soils, and declined factor productivity, due to much higher annual removal of nutrients by crops and cropping systems than the amount added through fertilizers and resulted negative nutrient balance. In recent past, Indian farmers showed tendency to apply more nitrogenous fertilizers to maximize rice yield. High nitrogen application without appropriate balance with phosphorus, potassium and other nutrients resulted negative effect on soil (Kumar *et al.*, 2011) [8]. INM approach is flexible and minimizes use of chemicals but maximize use efficiency and improve the soil health. Change in cropping sequence with respect to availability of resources, the integrated approach of nutrient supply through inorganic and organic has become very much promising in building soil health and quality of produce. The integrated nutrient supply system is the most logical concept for managing long-term soil fertility and productivity (Ramesh *et al.*, 2009) [13]. Use of chemical fertilizers and organic manures has been found promising in arresting the decline trend in soil-health and productivity through the correction of marginal deficiencies of some secondary and micro-nutrients, micro-flora and fauna and their beneficial influence on physical and biological properties of soil. Integrated nutrient management system can bring about equilibrium between degenerative and restorative activities in the soil eco-system (Upadhyay *et al.*, 2011) [22]. Green manuring has twin benefits of soil quality and fertility enhancement while meeting a part of nutrient needs of crop. Organic manures provide regulate supply of N by releasing it slowly resulting in increased yield of rice and nutrient use efficiency (Sharma 2002) [15]. Crop residues have potential for improving the soil and water conservation, sustaining soil productivity and enhancing crop

yields (Das *et al.*, 2003) [4]. Integrated use of inorganic fertilizers, organic manures, green manures and crop residue are the only alternatives which may help in improving soil health and sustained productivity. Keeping the above facts in view, Keeping the above aspect in view, a study was undertaken to determine the effectiveness of INM practices on soil property and nutrients uptake by Rice.

## Materials and Methods

A field experiment was conducted to evaluate effectiveness of INM practices on soil property and nutrients uptake by Rice (*Oryza sativa* L.) During kharif season of 2018 at Genetics and Plant Breeding Research Farm of Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya. The experimental soil having silty loam in texture, pH (1:2.5) 9.0, electrical conductivity (EC) 0.96 dS $m^{-1}$, organic carbon 0.23%, available N 115.40 $kgha^{-1}$, P 15.60 $kgha^{-1}$ and K 240.0 kg $ha^{-1}$. All treatments were randomly allocated and replicated three times in a randomized block design was adopted for the experimentation. The experiment was comprised with eight treatments viz. $T_1$ –Control, $T_2$ - RDF(150:60:60 kg $ha^{-1}$ $N:P_2O_5:K_2O$), $T_3$ -75% RDF+25%N substitution through press mud, $T_4$ -75%RDF+25%N substitution through GM (Dhaincha), $T_5$ -75%RDF+25% N substitution through crop residues, $T_6$ -50%RDF+50% N substitution through press mud, $T_7$ - 50%RDF+50% N substitution through GM (Dhaincha), $T_8$ -50%RDF+50% N substitution through crop residues. The recommended dose of NPK was applied through urea, DAP and muriate of potash, respectively. The rice variety Sarju-52 was taken as a test crop. To assess the various treatment effects, soil sample were collected after harvest of the crop from each plots. Soil pH and EC were determined by following Chopra and Kanwar (1991) [3]. Soil organic carbon was determined by Walkley and Black (1934) [33] rapid titration procedure. Soil available N was determined following Subbiah and Asija (1956) [20]. Available P was determined by Olsen *et al.* (1954) method. Available K was determined by following Jackson (1973) [5]. N content in plant samples was determined by micro Kjeldahl method (Piper 1966). Di-acid extract was prepared as per the method outlined by Jackson (1973) [5]. It was carried out using a 9:4 mixture of $HNO_3$:$HClO_4$. The predigestion of sample was done by using 10ml of $HNO_3$ $g^{-1}$ sample. This di-acid extract was used to determine P and K content in the plant and grain samples. Phosphorus was determined spectrophotometrically by vanadomolybdate phosphoric acid yellow color method as described by Jackson (1973) [5] from di-acid extract. Potassium was estimated from di-acid extract by using flame photometer (Jackson 1973) [5]. From the chemical analytical data, uptake of the each nutrient was calculated as shown below:

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{Nutrient\ content\ (\%) \times dry\ weight\ in\ per\ kg\ ha}{100}$$

The data recorded on various parameters were subjected to statistical analysis following analysis of variance technique and were tested at 5% level of significance to interpret the significant differences.

## Result and Discussion

### Effect of INM on quality of Crop

Data represented in the Table-1 clearly shows that the maximum protein content in grains was recorded with treatment $T_2$ (100% RDF) followed by $T_4$ (75% RDF + 25% N through Dhaincha) and which was statistically superior over control. The improvement in quality parameters due to sole organic and integrated nutrient treatment might be due to fact that organic manure improves organic carbon status of soil which is most important component of soil. Organic carbon will help to increase microbial as well as enzymatic activities of soil which improve the availability of macro and micro nutrients of the soil which ultimately help to improve the quality parameter of rice. The result is in close conformity with the findings of Singh *et al.* (2000) [16], Singh *et al.* (2006) [17], Yadav *et al.* (2005) [24] and Pandey *et al.* (2007) [12].

### Effect of INM nutrients uptake by Crop

Data depicted in the Table- 2 clearly revealed the maximum N, P and K contents in grain and straw were found under treatment $T_2$ (100% RDF) followed by $T_4$ (75% RDF + 25% N through Dhaincha) and which were statistically superior over control, Similar response was observed by Sultana *et al.* (2015). The uptake of nitrogen, phosphorus and potassium were recorded significantly higher with the treatment $T_2$ (100% RDF). This result is closely related with finding of Imade *et al.* (2015), Pandey *et al.* (2007) [12]. The application of Press mud, GM and Crop residue might have modified the physical conditions of the soil and helped in absorption and translocation of nutrients from soil. The application of fertilizer in combination with organic manure is known to improve various physico-chemical properties resulting in enhanced nutrient absorption and uptake. This result was closely justified with report of Sharma *et al.* (2001), Laxminarayana and Ram *et al.* (2006) [10], Kumar *et al.* (2007) [9], Shrivastava and Singh (2017) [19], and Singh *et al.* (2011) [18].

### Effect of INM on soil property and nutrients availability

Integrated Nutrient Management combinations showed (Table-3) non-significant effect on soil pH after harvest of the crop. But the integration of organic manures, green manures (Dhaincha) with inorganic fertilizers decreases the soil ph. The nutrient combination had significant effect on EC, organic carbon content and availability of N and P in the soil. It might be because the addition of organic manure improves the availability of organic matter to microbes which causes optimum activity of micro-organism, activity of soil enzymes by which the availability of N, P and K in the soil is increased. Maximum availability of N, P and K in the soil after harvest of the crop was recorded by T4 (75% RDF + 25% N through Dhaincha) followed by $T_7$ (50% RDF + 50% N through Dhaincha) and $T_3$ (75% RDF + 25% N through press mud). The minimum availability was recorded in the Control. The result exhibited that the integrated application through inorganic fertilizer and organic manure used in a suitable combination improved the soil fertility. These results are in conformity with the findings of Thulasi *et al.* (2016) [21], Saha *et al.* (2007) [14], Laxminarayana and Ram *et al.* (2006) [10], Kumar *et al.* (2012), Kharche *et al.* (2013) [7] and Bora *et al.* (2008) [2].

## Conclusion

It can be concluded that application of 100% RDF alone significantly improve the protein content as well as N, P, K content and increase availability of nitrogen, phosphorus, potassium as compared to other treatments, but maximum reduction in soil pH and EC and maximum organic carbon content observed in combined application of 50% RDF + 50% N through green manure (Dhaincha) so, the integrated use of

50% RDF + 50% N through green manure (Dhaincha) can be used as better alternative for inorganic inputs to maintain soil health for sustainable development and the most of the characters may be best treatment in next year as the organic materials take time to decompose.

**Table 1:** Effect of Integrated Nutrient Management practices on quality of Crop

| Treatments | | N Content (%) | | | P Content (%) | | K Content (%) | |
|---|---|---|---|---|---|---|---|---|
| | | Grain | Straw | Protein content in Grain (%) | Grain | Straw | Grain | Straw |
| $T_1$ | Control | 1.15 | 0.46 | 7.19 | 0.21 | 0.09 | 0.26 | 1.57 |
| $T_2$ | 100% RDF (150:60:60)N:$P_2O_5$:$K_2O$ | 1.28 | 0.55 | 8.00 | 0.29 | 0.13 | 0.35 | 2.21 |
| $T_3$ | 75% RDF + 25% N through press mud | 1.24 | 0.53 | 7.75 | 0.29 | 0.13 | 0.34 | 2.19 |
| $T_4$ | 75% RDF + 25% N through green manure(Dhaincha) | 1.26 | 0.54 | 7.88 | 0.29 | 0.13 | 0.35 | 2.17 |
| $T_5$ | 75% RDF + 25% N through crop residue(Oat) | 1.25 | 0.54 | 7.81 | 0.29 | 0.13 | 0.34 | 2.15 |
| $T_6$ | 50% RDF + 50% N through press mud | 1.21 | 0.52 | 7.56 | 0.28 | 0.13 | 0.33 | 2.08 |
| $T_7$ | 50% RDF + 50% N through green manure (Dhaincha) | 1.24 | 0.53 | 7.75 | 0.29 | 0.13 | 0.34 | 2.13 |
| $T_8$ | 50% RDF + 50% N through crop residue (Oat) | 1.23 | 0.53 | 7.69 | 0.28 | 0.13 | 0.34 | 2.11 |
| | S.Em± | 0.028 | 0.012 | 0.176 | 0.006 | 0.003 | 0.007 | 0.046 |
| | CD at 5% | 0.084 | 0.037 | 0.535 | 0.019 | 0.008 | 0.022 | 0.140 |

**Table 2:** Effect of Integrated Nutrient Management practices on nutrient uptake by Grain and Straw

| Treatments | | N uptake (kg/ha) | | | P uptake (kg/ha) | | | K uptake (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grain | Straw | Total | Grain | Straw | Total | Grain | Straw | Total |
| $T_1$ | Control | 20.09 | 12.16 | 32.25 | 3.63 | 2.45 | 6.08 | 4.52 | 41.37 | 45.89 |
| $T_2$ | 100%RDF (150:60:60)N:$P_2O_5$:$K_2O$ | 52.74 | 29.99 | 82.73 | 12.10 | 7.25 | 19.35 | 14.55 | 120.45 | 135.00 |
| $T_3$ | 75% RDF + 25% N through press mud | 41.64 | 24.27 | 65.91 | 9.57 | 5.85 | 15.42 | 11.50 | 100.03 | 111.52 |
| $T_4$ | 75% RDF + 25% N through green manure(Dhaincha) | 50.55 | 28.72 | 79.27 | 11.63 | 6.91 | 18.55 | 13.98 | 115.80 | 129.78 |
| $T_5$ | 75% RDF + 25% N through crop residue(Oat) | 39.68 | 24.26 | 63.94 | 9.11 | 5.84 | 14.95 | 10.97 | 97.42 | 108.39 |
| $T_6$ | 50% RDF + 50% N through press mud | 37.92 | 23.25 | 61.18 | 8.72 | 5.60 | 14.32 | 10.47 | 93.35 | 103.82 |
| $T_7$ | 50% RDF + 50% N through green manure (Dhaincha) | 40.82 | 24.72 | 65.55 | 9.38 | 5.93 | 15.30 | 11.23 | 99.03 | 110.27 |
| $T_8$ | 50% RDF + 50% N through crop residue (Oat) | 36.66 | 23.10 | 59.76 | 8.43 | 5.54 | 13.97 | 10.10 | 91.95 | 102.05 |
| | S.Em± | 1.460 | 1.076 | 2.201 | 0.357 | 0.270 | 0.466 | 0.617 | 5.865 | 6.278 |
| | CD at 5% | 4.427 | 3.265 | 6.677 | 1.082 | 0.820 | 1.412 | 1.870 | 17.791 | 19.042 |

**Table 3:** Effect of Integrated Nutrient Management practices on soil property and nutrient availability

| Treatments | | Soil property | | | Available Nutrients (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | pH | EC($dSm^{-1}$) | OC (%) | Nitrogen | Phosphorus | Potassium |
| $T_1$ | Control | 9.00 | 0.96 | 0.23 | 118.20 | 15.80 | 243.00 |
| $T_2$ | 100% RDF (150:60:60)N:$P_2O_5$:$K_2O$ | 8.92 | 0.92 | 0.24 | 126.30 | 16.80 | 258.00 |
| $T_3$ | 75% RDF + 25% N through press mud | 8.84 | 0.89 | 0.26 | 128.60 | 17.30 | 264.00 |
| $T_4$ | 75% RDF + 25% N through green manure(Dhaincha) | 8.75 | 0.85 | 0.28 | 134.80 | 17.90 | 270.00 |
| $T_5$ | 75% RDF + 25% N through crop residue(Oat) | 8.85 | 0.90 | 0.25 | 126.50 | 16.80 | 260.00 |
| $T_6$ | 50% RDF + 50% N through press mud | 8.80 | 0.89 | 0.28 | 126.90 | 17.00 | 263.00 |
| $T_7$ | 50% RDF + 50% N through green manure (Dhaincha) | 8.70 | 0.83 | 0.30 | 134.60 | 17.40 | 266.00 |
| $T_8$ | 50% RDF + 50% N through crop residue (Oat) | 8.82 | 0.89 | 0.27 | 125.40 | 16.70 | 256.00 |
| | S.Em± | 0.329 | 0.019 | 0.009 | 2.887 | 0.75 | 12.68 |
| | CD at 5% | NS | 0.057 | 0.029 | 8.756 | 1.61 | NS |

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