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# Effect of integrated nutrient management on physico-chemical properties and yield of wheat crop under *Inceptisol*

**Basant Kumar Sahu, RN Singh, SS Sengar and Mahanand Sahu**

**Abstract**
A field experiment was carried out during *Rabi* season of 2018-19 and 2019-20 in the Instructional-cum-Research Farm, I.G.K.V, Raipur, Chhattisgarh, to study the effect of integrated nutrient management on physico-chemical properties and yield of wheat crop under *Inceptisol.* The experiment was laid out in randomized block design with three replications and consisted fourteen treatments namely Control ($T_1$), 25% RDN ($T_2$), 50% RDN ($T_3$), 75% RDN ($T_4$), 100% RDN ($T_5$), 25% N –RDN + 75% N through vermicompost ($T_6$), 25% N-RDN + 75% N through FYM ($T_7$), 25% N-RDN+75% N through poultry manure ($T_8$), 50% RDF+50% N through vermicompost ($T_9$), 50% RDN+50% N through FYM ($T_{10}$), 50% RDN+50% N through poultry manure ($T_{11}$), 75% RDN+25% N through vermicompost ($T_{12}$), 75% RDN+25% N through FYM ($T_{13}$) and 75% RDN+25% N through poultry manure ($T_{14}$). Recommended dose of P and K where applied as basal in all treatments. Various soil physical, chemical and biological properties were observed at various depths and different stages of wheat crop. The result revealed that different INM treatments could not produce any significant difference in pH and EC of soil after wheat harvest. The integration of organic and inorganic fertilizers had significantly increased soil organic carbon from its initial value. The higher grain and straw yield of wheat was recorded in treatment 75% N - RDN + 25% N through vermicompost ($T_{12}$), during both the years.

**Keywords:** pH, EC, yield, FYM, vermicompost, poultry manure, INM and *Inceptisol*

## Introduction

Wheat (*Triticum* Spp.) has been described as "king of cereals" and is one of the most important staple food crops in India. Wheat has its own outstanding importance as human food. In India, the wheat production is about 107.6 million tonnes from an area of around 314.5 million hectares, and productivity 3421 kg ha$^{-1}$. Department of Agriculture, Cooperative & Farmer' Welfare (Annual Report 2019-20). In Chhattisgarh wheat occupies an area around 181.60 million hectares with the production of 207.28 million tonnes and productivity 1141 kg ha$^{-1}$. Annual administrative report 2019-20 (Bhu Abhilekh C.G.). The basic concept underlying the principles of integrated nutrient management (INM) is the maintenance and possibly improvement of soil fertility for sustaining crop productivity on long term basis. This may be achieved through combine use of all possible sources of nutrients and their scientific management for optimum growth, yield and quality of different crops and cropping systems. Use of organic manures like farm yard manure, poultry manures and vermicompost should be encouraged as it supplies plant nutrient, improve the physical, chemical and biological properties of the soil and thereby increase the fertility and productivity of the soil. Singh *et al.* (2017) [5] reported that soil organic carbon, available N, P and K were recorded under integrated use of 75% NPK + 10t FYM ha$^{-1}$ addition of inorganic fertilizer along with organic manures helps in mineralization which resulted in conversion of organically bound form of nutrients to inorganic form. Kafle *et al.* (2019) [8] found that plots receiving 50% RDNPK through inorganic fertilizers and remaining 50% RDN through poultry manure registered the highest available N, P and K status in the soil. Ahmad *et al.* (2022) [3] found that plots receiving 50% RDF through inorganic fertilizers + 50% N through vermicompost registered the highest pH, EC, Organic carbon, available N, P and K status in the soil. Bilkis *et al.* (2017) [4] recorded a higher grain 8.3-33.8% and 2.9-18.3% and straw yields with an integrated use of inorganic and organic sources of nutrients (IPNM) in both Boro and Aman rice, respectively as compared to sole use inorganic fertilizers. Patel *et al.* (2017) [12] reported that supplementation of 75% RDF along with 10 t FYM ha$^{-1}$ registered highest wheat grain and straw (4093 kg ha$^{-1}$) and (6103 kg/ha$^{-1}$) yield which was 24.74 and 42.29% over 100% NPK applied through chemical fertilizer, respectively.

Tiwari *et al.* (2017) [22] studied the effect of integrated nutrient management (INM) on soil properties, yield and economics of rice. The results revealed that application of (50% RDF + 50% FYM) was found significantly best with all parameters of yield i.e., maximum grain (5459 kg/ha) & straw (7042 kg/ha) yield. Raman *et al*. (2018) [14] Among the INM practices, RDF 100% + press mud compost @ 5 t $ha^{-1}$ ($T_5$) significantly resulted in the grain and stover yield of 6830.19 kg $ha^{-1}$, 9031.08 kg $ha^{-1}$ respectively. Singh *et al.* (2018) [10] results revealed that grain yield (48.45 q /$ha^{-1}$), straw yield (62.62 q/$ha^{-1}$) and biological yield (111.07 q/$ha^{-1}$) was recorded with the application of 100% RDF + vermicompost @ 2 t $ha^{-1}$ + PSB gave best results in respect to all parameters and second best treatment is $T_5$ -75% RDF + vermicompost @ 2 t $ha^{-1}$ + PSB.

## Materials and Methods

A field experiment was conducted on the *Inceptisol* at Instructional cum Research Farm College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, and Chhattisgarh. Raipur is situated at21$^o$4$'$ North Latitude and 76$^o$ 3$'$ East Longitude with an altitude of 293 meter above mean sea level. The Research farm is situated on National highway No. 6 in eastern part of Raipur city and located between 20$^o$4$'$ North Latitude and 81$^o$ 39 East Longitude with an altitude of 293 m above mean sea level. The region comes under sub-humid climate and the general climate if this region is dry moist, sub humid and region receives 1200-1400 mm rainfall annually, out of which about 88 percent is received during rainy season (June to September) and 8 % during winter season (October to February). The soil of the experimental field was *Inceptisol*, which was locally called Matasi soil and are considered to be immature soil with poor soil profile features having lighter texture and shallow to moderate depth. The all experiment was conducted on the Research farm I.G.K.V, Raipur (C.G.) in the presently year of 2018-19 and 2019-20 on *Rabi* season. The experimental crop was wheat (*Triticum arstivum* L.), variety GW-366. In the Experimental design RBD (Randomized Block Design) used included 14 number of treatment with 3 replications. The lot size of the field 6m x 3m and spacing between row to row and plant to plant 20cmx10cm respectively. Treatment details are Control ($T_1$), 25% RDN ($T_2$), 50% RDN ($T_3$), 75% RDN ($T_4$), 100% RDN ($T_5$), 25% N –RDN + 75% N through vermicompost ($T_6$), 25% N-RDN + 75% N through FYM ($T_7$), 25% N-RDN+75% N through poultry manure ($T_8$), 50% RDF+50% N through vermicompost ($T_9$), 50% RDN+50% N through FYM ($T_{10}$), 50% RDN+50% N through poultry manure ($T_{11}$), 75% RDN+25% N through vermicompost ($T_{12}$), 75% RDN+25% N through FYM ($T_{13}$) and 75% RDN+25% N through poultry manure ($T_{14}$). The experimental field was ploughed by tractor drawn MB plough, followed by harrowing. The individual plot was prepared. In wheat, total amount of P and K were applied as basal dose through SSP and MOP respectively. Three split doses of N were applied through urea. The required quantity of basal doses of farmyard manure, poultry manure, vermicompost were broadcasted in the field before sowing.

## Result and Discussion

### Soil reaction (pH)

Soil pH is an intrinsic property which is decided by the exchangeable cations on clay surface and taken large time to get change. The data on pH in the soil after harvest of wheat are presented in Table 1. The application of different levels of inorganic fertilizer supplemented with FYM, vermicompost and poultry manure did not showed on soil pH significantly. The pH was not significantly influenced by different treatments during both years (2018-19 and 2019-20). The pH ranged from 7.11 to 7.25 among different treatments. A slight decrease in pH was recorded in all treatments as compared to the initial pooled value (7.25) may be due to the formation of organic acids during decomposition of organics manures. This was supported by the findings of Parvathi *et al.* (2013) [11], Sharma *et al*. (2013) [15] and Gawde *et al.* (2017) [5].

### Electrical conductivity (EC)

The data on electrical conductivity (EC) of soil after harvest of wheat crop presented in Table 2 in both the years 2018-19 and 2019-20 during *Rabi* season. The data indicated that, application of different dose of manures and fertilizers caused slight increase in the EC of soil irrespective of initial value (0.22 d $Sm^{-1}$). The effect of applied organic and inorganic fertilizer on EC of the soil was statistically non-significant in both the years. The EC of the soil ranged from (0.20 to 0.30 $dSm^{-1}$). The highest EC (0.30 $dSm^{-1}$) was recorded in ($T_{14}$) 75% N – RDN + 25% N - poultry manure, followed by rest of the treatments. The trends of variation in EC of soil between the different treatments almost negligible and non- significant (Table 4.2). The different treatments did not influence the EC of the soil and the value was almost constant.

**Table 1:** Effect of integrated nutrient management practices on pH of soil during two years

| Soil pH | | | | |
|---|---|---|---|---|
| Treatments | | Wheat | | |
| | | 2018-19 | 2019-20 | Pooled mean |
| T1 | Control | 7.26 | 7.23 | 7.25 |
| T2 | 25% RDN | 7.24 | 7.25 | 7.25 |
| T3 | 50% RDN | 7.23 | 7.22 | 7.23 |
| T4 | 75% RDN | 7.24 | 7.26 | 7.25 |
| T5 | 100% RDN | 7.23 | 7.24 | 7.24 |
| T6 | 25% N -RDN+75% N -Vermicompost | 7.12 | 7.10 | 7.11 |
| T7 | 25% N- RDN+75% N -FYM | 7.14 | 7.12 | 7.13 |
| T8 | 25% N- RDN+75% N- Poultry manure | 7.16 | 7.13 | 7.14 |
| T9 | 50% N- RDN+50% N- Vermicompost | 7.19 | 7.17 | 7.18 |
| T10 | 50% N -RDN+50% N- FYM | 7.21 | 7.19 | 7.20 |
| T11 | 50% N - RDN+50% N- Poultry manure | 7.23 | 7.21 | 7.22 |
| T12 | 75% N -RDN+25% N-Vermicompost | 7.24 | 7.22 | 7.23 |
| T13 | 75% N -RDN+25% N- FYM | 7.23 | 7.21 | 7.22 |
| T14 | 75% N -RDN+25% N -Poultry manure | 7.24 | 7.22 | 7.23 |
| | Initial | 7.25 | | |
| | SEm± | 0.04 | 0.03 | 0.03 |
| | CD (p = 0.05%) | NS | NS | NS |

Similar finding was also reported by Urkurkar *et al.* (2010) [24]. This was supported by several workers (Gawde *et al.* 2017) [5]. Singh *et al.* (2018) [10] reported that the soil pH and EC did not changed significantly with the application of organic and inorganic sources of nutrients. Application of FYM and fertilizers reduced the electrical conductivity of soil. This could be attributed to increase of cation exchange capacity by addition of FYM and fertilizers were observed by (Rajani *et al.* 2019) [13].

**Soil organic carbon**

Soil organic carbon (SOC) is an important soil property to assess the health of soil. The data relating the effects of different treatments on organic carbon at different depth are presented in Table 3. Among the practices, significantly highest organic carbon (6.21 g $kg^{-1}$ and 6.27g $kg^{-1}$) and (5.64 $gkg^{-1}$ and 5.68g $kg^{-1}$) was recorded under treatment ($T_6$) 25% N–RDN + 75% N through vermicompost, being statistically at par with treatments 25% N–RDN+75% N through FYM, and 25% N –RDN +7 5% N through poultry manure at 0-10 and 10-20 cm soil depths in both the years 2018-19 and 2019-20, respectively. The lowest OC (5.10 g $kg^{-1}$ and 5.08 g $kg^{-1}$) and (4.85 g $kg^{-1}$ and 4.83g $kg^{-1}$) at 0-10 and 10-20cm soil depths in both the years 2018-19 and 2019-20, respectively was noticed under control ($T_1$). The higher pooled OC was recorded in the surface 0-10 cm layer (5.09 to 6.24 g $kg^{-1}$) and lower in the sub surface 10-20 cm layer (4.84 to 5.66 g $kg^{-1}$) in both the years under different treatments. The mean value of OC content has registered a decreasing trend (6.24 to 5.66 g $kg^{-1}$) with increasing from 0-20 cm soil depths.

**Table 2:** Effect of integrated nutrient management practices on electrical conductivity (d $Sm^{-1}$) of soil during two years

| Soil EC ($dSm^{-1}$) | | | | |
|---|---|---|---|---|
| Treatments | | Wheat | | |
| | | 2018-19 | 2019-20 | Pooled mean |
| T1 | Control | 0.29 | 0.26 | 0.28 |
| T2 | 25% RDN | 0.24 | 0.23 | 0.23 |
| T3 | 50% RDN | 0.20 | 0.21 | 0.21 |
| T4 | 75% RDN | 0.22 | 0.24 | 0.23 |
| T5 | 100% RDN | 0.25 | 0.22 | 0.24 |
| T6 | 25% N -RDN+75% N -Vermicompost | 0.23 | 0.21 | 0.22 |
| T7 | 25% N- RDN+75% N -FYM | 0.24 | 0.24 | 0.24 |
| T8 | 25% N- RDN+75% N- Poultry manure | 0.26 | 0.25 | 0.25 |
| T9 | 50% N- RDN+50% N- Vermicompost | 0.22 | 0.23 | 0.23 |
| T10 | 50% N -RDN+50% N- FYM | 0.25 | 0.24 | 0.25 |
| T11 | 50% N - RDN+50% N- Poultry manure | 0.27 | 0.25 | 0.26 |
| T12 | 75% N -RDN+25% N-Vermicompost | 0.26 | 0.27 | 0.26 |
| T13 | 75% N -RDN+25% N- FYM | 0.28 | 0.28 | 0.28 |
| T14 | 75% N -RDN+25% N -Poultry manure | 0.30 | 0.29 | 0.30 |
| | Initial | 0.22 | | |
| | SEm± | 0.02 | 0.02 | 0.01 |
| | CD (p = 0.05%) | NS | NS | NS |

The pooled OC was recorded highest (6.24g $kg^{-1}$) both levels at 0-10 cm and (5.66 g $kg^{-1}$) levels at 10-20 cm depth under treatment ($T_6$) 25% N –RDN+75% N through vermicompost, which was statistically at par with 25% N –RDN + 75% N through FYM ($T_7$) and 25% N – RDN+75% N through poultry manure ($T_8$). The lowest mean value of OC (5.09 g $kg^{-1}$) both levels at 0-10 cm and (4.84 g $kg^{-1}$) at 10-20 cm depths in both the years 2018-19 and 2019-20, respectively was noticed under control ($T_1$). The mean value of organic carbon content generally decreased trend (6.24 to 4.84 g $kg^{-1}$) with increasing soil depths from 0-20 cm soil depths. These results corroborate with observation taken by Thakur *et al.* (2010) [21]. The soil fertility is intimately linked with its organic matter which has an influenced on physical, chemical and biological property of the soil.

**Available soil nitrogen**

The fertilizer and manure application exhibited a significant effect of available nitrogen of the soil. The results pertaining to status of available nitrogen after harvest of wheat 2018-19 and 2019-20 in both the years. The data on available soil nitrogen was showed in Table 4. The data subjected to statistically affect by the different INM applied with the combination of different doses of fertilizers (RDN) as compared to sole application of chemical fertilizer during experimental periods. Among the treatments, plots ($T_{12}$) received with 75% N-RDN inorganic + 25% N through vermicompost (VC) was significantly recorded the highest post-harvest available soil nitrogen of 233.51 and 236.37 kg $ha^{-1}$ during 2018-19 and 2019-20, respectively and ($T_{14}$) 75% N-RDN inorganic + 25% N through poultry manure (PM), ($T_{13}$) 75% N– RDN inorganic+ 25% N through farm yard manure (FYM) and ($T_9$) 50% N- RDN+ 50% N through vermicompost (VC), Which was at par with each other and highly significantly over 100% RDN. The minimum available N was recorded in treatment ($T_1$) consisting of control after harvest of wheat crop 197.39 and 198.16 kg/ha during 2018-19 and 2019-20 respectively. Soil available nitrogen was increased over control in all treatments. The increase in available nitrogen might be attributed to the enhanced multiplication of microbes by the incorporation of manures for the conversion of organically bound N to inorganic form.

Addition of nitrogenous fertilizer along with vermicompost helps in narrowing down of C: N ratio and thus increased mineralization resulted in rapid conversion of organically bound N to inorganic form (Singh *et al.* 2006) [19].

These results are in line with findings of Singh *et al.* (2009) [17] were also observed that available N content in soil increased with the use of recommended dose of fertilizer in combination with manure. The favorable soil condition under organic manure application might have facilitated the mineralization of soil N leading to build-up of higher available N. (Kumar and Singh, 2010) [6].

## Available soil phosphorus

The data on available phosphorus content in soil after harvest of wheat crop is presented in Table 5. The result showed that the available soil phosphorus influenced significantly by different INM applied with the combination of different doses of fertilizers (RDF) as compared to sole application of chemical fertilizer and control ($T_1$) during 2018-19 and 2019-20 respectively. Among the treatments, plots ($T_6$) received with 25% N- RDN through inorganic + 75% N through vermicompost (VC) was significantly recorded the highest post-harvest available soil phosphorus of 16.81 and 17.65 kg ha$^{-1}$ during 2018-19 and 2019-20, respectively, which was significantly superior over all the treatments and statistically at par with ($T_7$), ($T_8$), ($T_9$) and ($T_{11}$). Increase in available soil P with the application of NPK fertilizer conjunction with organics might be due to the release of organic acids during decomposition which in turn helped in releasing phosphorus through solubilizing action of native phosphorus in soil (Urkurkar *et al.* 2010 and Singh *et al.* 2007) [24, 16].

**Table 3:** Effect of integrated nutrient management on soil organic carbon (%) during two years

| Treatments | | Soil organic carbon (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0-10 cm | | | 10-20 cm | | |
| | | 2018-19 | 2019-20 | Pooled | 2018-19 | 2019-20 | Pooled |
| T1 | Control | 5.1$^{g}$ | 5.08$^{g}$ | 5.09$^{f}$ | 4.85$^{g}$ | 4.83$^{f}$ | 4.84$^{f}$ |
| T2 | 25% RDN | 5.14$^{g}$ | 5.12$^{g}$ | 5.13$^{f}$ | 4.94$^{fg}$ | 4.98$^{ef}$ | 4.96$^{ef}$ |
| T3 | 50% RDN | 5.15$^{g}$ | 5.16$^{g}$ | 5.16$^{f}$ | 4.97$^{efg}$ | 5.05$^{def}$ | 5.01$^{def}$ |
| T4 | 75%RDN | 5.27$^{fg}$ | 5.3$^{fg}$ | 5.28$^{ef}$ | 5.11$^{defg}$ | 5.12$^{cde}$ | 5.11$^{def}$ |
| T5 | 100%RDN | 5.41$^{efg}$ | 5.43$^{ef}$ | 5.42$^{de}$ | 5.12$^{defg}$ | 5.14$^{cde}$ | 5.13$^{def}$ |
| T6 | 25% N-RDN + 75% N –VC | 6.21$^{a}$ | 6.27$^{a}$ | 6.24$^{a}$ | 5.64$^{a}$ | 5.68$^{a}$ | 5.66$^{a}$ |
| T7 | 25% N-RDN + 75% N – FYM | 6.13$^{a}$ | 6.18$^{a}$ | 6.16$^{a}$ | 5.53$^{ab}$ | 5.59$^{a}$ | 5.56$^{ab}$ |
| T8 | 25% N-RDN + 75% N- PM | 6.06$^{ab}$ | 6.11$^{a}$ | 6.09$^{a}$ | 5.51$^{abc}$ | 5.52$^{ab}$ | 5.52$^{abc}$ |
| T9 | 50% N -RDN + 50% N – VC | 5.81$^{bc}$ | 5.85$^{b}$ | 5.83$^{b}$ | 5.32$^{bcd}$ | 5.34$^{bc}$ | 5.33$^{bcd}$ |
| T10 | 50% N -RDN + 50% N –FYM | 5.72$^{cde}$ | 5.76$^{bcd}$ | 5.74$^{b}$ | 5.28$^{bcde}$ | 5.3$^{bcd}$ | 5.29$^{bcde}$ |
| T11 | 50% N -RDN + 50% N – PM | 5.78$^{bcd}$ | 5.81$^{bc}$ | 5.8$^{b}$ | 5.23$^{bcdef}$ | 5.28$^{bcd}$ | 5.26$^{bcde}$ |
| T12 | 75% N -RDN + 25% N – VC | 5.64$^{cde}$ | 5.68$^{bcde}$ | 5.66$^{bc}$ | 5.21$^{bcdef}$ | 5.22$^{cde}$ | 5.21$^{cde}$ |
| T13 | 75% N- RDN+ 25% N – FYM | 5.48$^{def}$ | 5.51$^{def}$ | 5.5$^{cd}$ | 5.19$^{cdefg}$ | 5.17$^{cde}$ | 5.18$^{def}$ |
| T14 | 75% N-RDN + 25% N-PM | 5.51$^{cdef}$ | 5.56$^{cde}$ | 5.54$^{cd}$ | 5.16$^{defg}$ | 5.18$^{cde}$ | 5.17$^{def}$ |
| | Initial | 5.24 | | | 5.04 | | |
| | SEm± | 0.11 | 0.09 | 0.06 | 0.13 | 0.12 | 0.08 |
| | CD (0.05%) | 0.31 | 0.26 | 0.18 | 0.38 | 0.34 | 0.25 |

**Table 4:** Effect of integrated nutrient management on available nitrogen (kg ha$^{-1}$) of soil during two years

| Soil Available Nitrogen (kg ha$^{-1}$) | | | | |
|---|---|---|---|---|
| Treatments | | Wheat | | |
| | | 2018-19 | 2019-20 | Pooled mean |
| T1 | Control | 197.39$^{h}$ | 198.16$^{g}$ | 197.78$^{h}$ |
| T2 | 25% RDN | 204.46$^{gh}$ | 206.02$^{g}$ | 205.24$^{g}$ |
| T3 | 50% RDN | 211.21$^{fg}$ | 215.33$^{f}$ | 213.27$^{f}$ |
| T4 | 75% RDN | 218.8$^{def}$ | 221.49$^{def}$ | 220.15$^{de}$ |
| T5 | 100% RDN | 223.08$^{bcde}$ | 225.41$^{cde}$ | 224.25$^{cd}$ |
| T6 | 25% N -RDN+75% N -Vermicompost | 214.69$^{ef}$ | 219.36$^{ef}$ | 217.03$^{ef}$ |
| T7 | 25% N- RDN+75% N –FYM | 211.41$^{fg}$ | 216.15$^{f}$ | 213.78$^{f}$ |
| T8 | 25% N- RDN+75% N- Poultry manure | 212.25$^{fg}$ | 218.24$^{ef}$ | 215.24$^{ef}$ |
| T9 | 50% N- RDN+50% N- Vermicompost | 226.14$^{abcd}$ | 230.75$^{abc}$ | 228.45$^{bc}$ |
| T10 | 50% N -RDN+50% N- FYM | 221.31$^{cde}$ | 227.33$^{bcd}$ | 224.32$^{cd}$ |
| T11 | 50% N - RDN+50% N- Poultry manure | 224.18$^{bcd}$ | 229.25$^{abcd}$ | 226.71$^{bc}$ |
| T12 | 75% N -RDN+25% N-Vermicompost | 233.51$^{a}$ | 236.37$^{a}$ | 234.94$^{a}$ |
| T13 | 75% N -RDN+25% N- FYM | 229.86$^{abc}$ | 232.48$^{abc}$ | 231.17$^{ab}$ |
| T14 | 75% N -RDN+25% N -Poultry manure | 231.23$^{ab}$ | 234.19$^{ab}$ | 232.71$^{ab}$ |
| | Initial | 208.41 | | |
| | SEm± | 2.77 | 2.53 | 1.96 |
| | CD (p = 0.05%) | 8.13 | 7.43 | 5.75 |

**Table 5:** Effect of integrated nutrient management on phosphorus (kg ha$^{-1}$) of soil during two years

| Available Phosphorus (kg ha$^{-1}$) | | | | |
|---|---|---|---|---|
| Treatments | | Wheat | | |
| | | 2018-19 | 2019-20 | Pooled mean |
| T1 | Control | 10.45$^{e}$ | 10.86$^{d}$ | 10.66$^{f}$ |
| T2 | 25% RDN | 11.14$^{e}$ | 11.24$^{d}$ | 11.19$^{ef}$ |
| T3 | 50% RDN | 11.86$^{de}$ | 11.98$^{cd}$ | 11.92$^{ef}$ |
| T4 | 75% RDN | 12.24$^{de}$ | 12.36$^{cd}$ | 12.3$^{e}$ |
| T5 | 100% RDN | 13.32$^{cd}$ | 13.57$^{bc}$ | 13.45$^{d}$ |

| | | | | |
|---|---|---|---|---|
| T6 | 25% N -RDN+75% N -Vermicompost | 16.81$^{a}$ | 17.65$^{a}$ | 17.23$^{a}$ |
| T7 | 25% N- RDN+75% N -FYM | 15.79$^{ab}$ | 16.54$^{a}$ | 16.17$^{ab}$ |
| T8 | 25% N- RDN+75% N- Poultry manure | 16.52$^{a}$ | 17.32$^{a}$ | 16.92$^{a}$ |
| T9 | 50% N- RDN+50% N- Vermicompost | 15.73$^{ab}$ | 16.45$^{a}$ | 16.09$^{ab}$ |
| T10 | 50% N -RDN+50% N- FYM | 14.61$^{bc}$ | 15.27$^{b}$ | 14.94$^{bc}$ |
| T11 | 50% N - RDN+50% N- Poultry manure | 15.38$^{ab}$ | 16.24$^{a}$ | 15.81$^{abc}$ |
| T12 | 75% N -RDN+25% N-Vermicompost | 14.72$^{bc}$ | 15.41$^{b}$ | 15.16$^{bc}$ |
| T13 | 75% N -RDN+25% N- FYM | 14.21$^{bc}$ | 14.89$^{b}$ | 14.7$^{c}$ |
| T14 | 75% N -RDN+25% N -Poultry manure | 14.52$^{bc}$ | 15.23$^{b}$ | 14.98$^{bc}$ |
| | Mean | 12.36 | | |
| | SEm± | 0.52 | 0.54 | 0.41 |
| | CD (p = 0.05%) | 1.54 | 1.63 | 1.20 |

**Soil available potassium**

The fertility status of soil in terms of available potassium as affected by INM treatments after harvest of wheat crop have been shown in Table 6. Among the treatments, plot ($T_6$) received with 25% N-RDN through inorganic + 75% N through vermicompost (VC) was significantly recorded the highest post-harvest available soil potassium 341.62 and 357.52 kg ha$^{-1}$ during 2018-19 and 2019-20, respectively which was statistically at par with ($T_7$) 25% N- RDN through inorganic + 75% N through FYM, and ($T_8$) 25% N - RDN through inorganic + 75% N through poultry manure (PM) both the years and significantly superior over control and rest of the treatments.

Increase in available soil potassium due to addition of organic manures may be ascribed to the reduction of K fixation and release of potassium due to interaction of organic matter with clay, besides the direct K addition of the pool of soil. The present findings are conformity with Kumar (2014) [7]. FYM incorporation along with N, P and K fertilizers increased the organic C status of soil which consequently caused higher availability of N, P and K in soil was reported by Gawde *et al.* (2017) [5]. Kafle *et al.* (2019) [8] also reported that the plots receiving 50% RDNPK through inorganic and remaining 50% RDN through poultry manure registered the highest available N, P and K status in the soil and it was closely followed by the plots receiving 50% RDN through VC and FYM, but was markedly higher than those of the plots receiving 100% RDNPK through chemical fertilizer only.

**Table 6:** Effect of integrated nutrient management practices on potassium (kg ha$^{-1}$) of soil during two years

| Available Potassium (kg ha$^{-1}$) | | | | |
|---|---|---|---|---|
| Treatments | | Wheat | | |
| | | 2018-19 | 2019-20 | Pooled mean |
| T1 | Control | 308.85$^{g}$ | 310.16$^{f}$ | 309.5$^{g}$ |
| T2 | 25% RDN | 314.25$^{fg}$ | 318.29$^{ef}$ | 316.27$^{fg}$ |
| T3 | 50% RDN | 316.37$^{fg}$ | 321.41$^{de}$ | 318.89$^{ef}$ |
| T4 | 75% RDN | 319.49$^{ef}$ | 324.26$^{de}$ | 321.87$^{ef}$ |
| T5 | 100% RDN | 321.16$^{def}$ | 329.34$^{d}$ | 325.25$^{e}$ |
| T6 | 25% N -RDN+75% N -Vermicompost | 341.62$^{a}$ | 357.52$^{a}$ | 349.57$^{a}$ |
| T7 | 25% N- RDN+75% N -FYM | 334.43$^{abc}$ | 351.48$^{ab}$ | 342.95$^{ab}$ |
| T8 | 25% N- RDN+75% N- Poultry manure | 337.52$^{ab}$ | 348.97$^{abc}$ | 343.24$^{ab}$ |
| T9 | 50% N- RDN+50% N- Vermicompost | 332.57$^{bc}$ | 350.16$^{abc}$ | 341.36$^{bc}$ |
| T10 | 50% N -RDN+50% N- FYM | 327.31$^{cde}$ | 342.75$^{bc}$ | 335.03$^{cd}$ |
| T11 | 50% N - RDN+50% N- Poultry manure | 330.49$^{bc}$ | 346.21$^{bc}$ | 338.35$^{bcd}$ |
| T12 | 75% N -RDN+25% N-Vermicompost | 331.22$^{bc}$ | 347.64$^{bc}$ | 339.43$^{bcd}$ |
| T13 | 75% N -RDN+25% N- FYM | 326.53$^{cde}$ | 340.65$^{c}$ | 333.59$^{d}$ |
| T14 | 75% N -RDN+25% N -Poultry manure | 329.84$^{bcd}$ | 343.32$^{bc}$ | 336.58$^{bcd}$ |
| | Initial | 320.17 | | |
| | SEm± | 2.81 | 3.08 | 2.22 |
| | CD (p = 0.05%) | 8.23 | 9.04 | 6.51 |

**Grain and straw yield of wheat**

The data on grain and straw yields of wheat during both the years 2018-19 and 2019-20 are presented in Table 7. The grain and straw yield of wheat was significantly affected by different integrated nutrient management treatments. Data indicate that the various treatments recorded significantly increase in the grain and straw yield of wheat over control. As regards to grain and straw yield of wheat significantly higher yield was recorded in treatment 75% N – RDN + 25% N through vermicompost ($T_{12}$). The significant effect of different treatments was observed during study. The treatment 75% N -RDN + 25% N through vermicompost ($T_{12}$) recorded higher grain yields of wheat (33.85 and 36.52 qha$^{-1}$) during both the years i.e. 2018-19 and 2019-20 respectively. The grain yield of wheat ranged between 12.14 to 33.85 and 10.32 to 36.52q ha$^{-1}$during 2018 and 2019, respectively. The minimum grain yield was recorded in control plot ($T_1$). The results of both the years of experiment showed that highest grain yield was recorded with treatment ($T_{12}$) 75% N -RDN + 25% N through vermicompost, which was at par with treatments ($T_5$), ($T_9$), ($T_{13}$) and ($T_{14}$). The highest pooled mean of grain yields of both the years was recorded in ($T_{12}$) 75% N -RDN + 25% N through vermicompost (35.18 q ha$^{-1}$) followed by 75% N -RDN + 25% N -poultry manure ($T_{14}$), 75% N -RDN + 25% N through FYM ($T_{12}$) and 100% RDF treatment ($T_5$). The lowest (11.23qha$^{-1}$) was noticed in control ($T_1$). The treatments combination of organic manures with chemical fertilizer increased grain yield as compared to inorganic fertilizers respective 100% RDF application. Results on wheat straw yield presented in Table 7, its varied ranges from 15.79 to 45.69 q $ha^{-1}$ and 13.93 to 50.75 q $ha^{-1}$ was recorded during both the years. The higher straw yield was recorded in ($T_{12}$) 75% N -RDN + 25% N through vermicompost, while the minimum wheat straw yield was recorded in control ($T_1$). The data presented in Table 4.11 revealed that the highest pooled mean of wheat straw yield (48.22 q $ha^{-1}$) was noticed under treatment ($T_{12}$) 75% N -RDN + 25% N through vermicompost, which was at par with treatments ($T_5$), ($T_{12}$) and ($T_{14}$). The highest pooled mean of straw yields (48.55 q $ha^{-1}$) of both the years was recorded under treatment ($T_{12}$) 75% N -RDN + 25% N through vermicompost followed by ($T_{14}$) 75% N -RDN + 25% N through poultry manure, ($T_{12}$) 75% N -RDN + 25% N through FYM and ($T_5$) 100% RDF. The lowest straw yield (14.86 q $ha^{-1}$) was recorded in control ($T_1$). The combination of fertilizer application with organic manures showed a significant increase in yield by wheat straw. The increase in grain and straw yield of wheat in chemical fertilizers with organic manures treated plots might be due to colonization of mycorrhizal fungi, the activity of beneficial microbes and enzymes activities increased, which play an important role in mobilization of nutrients and thereby leading to better availability and balanced proportions of nutrients supplied to the crop as per need during the growth period resulting in favorable increase in yield attributing characters which ultimately lead towards an increase in economic yield. Improved physical, chemical and biological properties of the soil through the application of chemical fertilizer with organic manures *viz.* (Vermicompost, FYM and Poultry Manure) might be the other possible reason for higher productivity. Mohanty *et al.* (2013) [9] found that application of chemical fertilizer, FYM and bio-fertilizer produced significantly higher no. of tillers and highest no. of grains/panicle as compared to 100% RDF and control.

The growth attributes like plant height, no of effective tillers, grain and straw yield of rice was found highest with the application of 75% N – RDN from chemical fertilizer + 25% N through green manure, which was at par with 100% RDN from chemical fertilizer reported by Mandal *et al.* (2018) [10]. Similar results have been reported by Tummala *et al.* (2018) [23]. Singh *et al.*, (2017) [5] found that the growth, yield attributes and yield of grain and straw were maximum with the application of 75% NPK + 2t vermicompost$ha^{-1}$closely followed by 100% NPK alone.

## Conclusion

The highest grain yield and straw yield of wheat was obtained under ($T_{12}$) 75% N-RDN + 25% N through vermicompost, which was also found comparable with ($T_5$) 100% NPK, ($T_9$) 50% N -RDN + 50% N through vermicompost. ($T_{13}$) 25% N -RDN + 75% N through FYM and ($T_{14}$) 75% N -RDN + 25% N through poultry manure.

**Table 7:** Effect of integrated nutrient management on grain & straw yield (q $ha^{-1}$) of wheat during two years

| | | Grain yield (q $ha^{-1}$) | | | Straw yield (q $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|
| | **Treatments** | **2018-19** | **2019-20** | **Pooled mean** | **2018-19** | **2019-20** | **Pooled mean** |
| T1 | Control | $12.14^{g}$ | $10.32^{i}$ | $11.23^{i}$ | $15.79^{f}$ | $13.93^{i}$ | $14.86^{i}$ |
| T2 | 25% RDN | $15.47^{g}$ | $18.25^{h}$ | $16.86^{h}$ | $20.12^{f}$ | $24.09^{hi}$ | $22.1^{i}$ |
| T3 | 50% RDN | $19.59^{f}$ | $21.11^{gh}$ | $20.35^{g}$ | $26.45^{e}$ | $28.92^{gh}$ | $27.68^{h}$ |
| T4 | 75% RDN | $25.27^{de}$ | $27.24^{de}$ | $26.25^{e}$ | $35.63^{cd}$ | $37.86^{def}$ | $36.74^{ef}$ |
| T5 | 100% RDN | $30.35^{abc}$ | $33.45^{ab}$ | $31.9^{ab}$ | $41.88^{abc}$ | $46.5^{abc}$ | $44.19^{bc}$ |
| T6 | 25% N -RDN+75% N -Vermicompost | $23.04^{ef}$ | $25.81^{ef}$ | $24.42^{ef}$ | $30.87^{de}$ | $35.11^{efg}$ | $32.99^{fg}$ |
| T7 | 25% N- RDN+75% N -FYM | $21.34^{ef}$ | $23.21^{fg}$ | $22.27^{fg}$ | $27.95^{e}$ | $30.63^{g}$ | $29.29^{gh}$ |
| T8 | 25% N- RDN+75% N- Poultry manure | $22.18^{ef}$ | $24.46^{efg}$ | $23.32^{f}$ | $29.49^{e}$ | $33.02^{fg}$ | $31.26^{gh}$ |
| T9 | 50% N- RDN+50% N- Vermicompost | $29.35^{bc}$ | $32.14^{bc}$ | $30.74^{cd}$ | $41.38^{abc}$ | $44.35^{bc}$ | $42.87^{bcd}$ |
| T10 | 50% N -RDN+50% N- FYM | $27.93^{cd}$ | $29.68^{cd}$ | $28.81^{d}$ | $38.27^{bc}$ | $40.08^{cde}$ | $39.17^{de}$ |
| T11 | 50% N - RDN+50% N- Poultry manure | $28.79^{bcd}$ | $31.87^{bc}$ | $30.33^{cd}$ | $40.02^{bc}$ | $43.66^{bcd}$ | $41.84^{cd}$ |
| T12 | 75% N -RDN+25% N-Vermicompost | $33.85^{a}$ | $36.52^{a}$ | $35.18^{a}$ | $45.69^{a}$ | $50.75^{a}$ | $48.22^{a}$ |
| T13 | 75% N -RDN+25% N- FYM | $31.71^{abc}$ | $33.88^{ab}$ | $32.8^{abc}$ | $43.76^{ab}$ | $46.42^{abc}$ | $45.09^{abc}$ |
| T14 | 75% N -RDN+25% N -Poultry manure | $32.63^{ab}$ | $35.29^{ab}$ | $33.96^{ab}$ | $44.7^{ab}$ | $49.16^{ab}$ | $46.93^{ab}$ |
| | SEm± | 1.33 | 1.41 | 1.14 | 1.80 | 1.91 | 1.33 |
| | CD (P =0.05) | 3.90 | 4.13 | 3.34 | 5.27 | 5.59 | 3.91 |

## References


1. Anonymous. Department of Agriculture, Cooperative & Farmer' Welfare; c2029-20.
2. Anonymous. Annual administrative report 2019-20 (Bhu Abhilekh C.G.); c2019-20.
3. Ahmad Meraj, Tripathi SK. Effect of Integrated use of Vermicompost, FYM and Chemical Fertilizers on Soil Properties and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial Soil. The Journal of Phytophamacology. 2022;11(2):101-106.
4. Bilkis S, Iqbal MR, Jhiruddin M, Rahaman MM. Integrated use of manure and fertilizers increase rice yield, nutrient uptake and soil fertility in the boro-fallow-t. Aman rice cropping pattern. SAARC Journal of Agriculture. 2017;15(2):147-161.
5. Gawde Neha, Singh Anup Kumar, Agrawal SK, Rahul Kumar. Long-term effect of integrated nutrient management on soil nutrient status under rice- wheat cropping system in Inceptisols. International Journal of Chemical Studies. 2017;5(4):1050-1057.
6. Kumar, Singh AP. Integrated nutrient management in rice (*Oryza sativa* L.) wheat *(Triticum aestivum* L.*)* cropping system. Bhartiya vaigyanik evam audyogik anusandhan patrika. 2010;15(1):34-43.
7. Kumar A, Meenam RN, Yadav L, Gilotiya YK. Effect of organic and inorganic sources of nutrient on yield, yield attributes and nutrient uptake of rice cv. PRH-10. International Journal of Environmental Science. 2014;9:595-597.
8. Kafle Kishor, Shrivastava Chandeshwer Prasad, Marasini Madan. Influence of Integrated Nutrient Management Practices on Soil Properties and Yield of Potato (*Solanum tuberosum* L.) in an Inceptisol of Khajura, Banke. International Journal of Applied Sciences and

Biotechnology (IJASBT). 2019;7(3):365-369.

9. Mohanty M, Nanda SS, Barik AK. Effect of integrated nutrient management on growth, yield and nutrient uptake and economics of wet season rice (*Oryza sativa* L.) in Odisha. Indian Journal of Agricultural Sciences. 2013;83(6):599-604.
10. Mandal Nakul, Barik Arun Kumar, Singha Roy, Ashis Kumar, Ghosh Pritam, Saha Biswajit. Studies on Integrated Nutrient Management in Hybrid Rice (*Oryza sativa* L.) under Old Alluvial Zone of West Bengal, India. International Journal of Bio-resource and Stress Management. 2018;9(6):713-717.
11. Parvathi E, Venkaiah K, Munaswamy V, Naidu MVS, Giridhara Krishna T, Prasad TNVKV. Long-term effect of manure and fertilizers on the physical and chemical properties of an alfisol under semi-arid rainfed conditions. International Journal of Agricultural Sciences. 2013;3(4):500-505.
12. Patel Tejalben G, Khushvadan C, Patel, Patel Vimal N. Effect of integrated nutrient management on yield attributes and yield of wheat (*Triticum aestivum* L.) International Journal of Chemical Studies 2017;5(4):1366-1369.
13. Rajani, AV, Wediya SP, Jadeja AS, Hirpara DV. Long term effect of balanced nutrients managements on dynamics of important chemical properties of a calcareous soil. Journal of Pharmacognosy and Phytochemistry. 2019;8(5):238-241.
14. Raman R, Suganya K. Effect of Integrated Nutrient Management on the Growth and Yield of Hybrid Maize. Journal of Agricultural Research. ISSN: 2474-8846. 2018;3(2):000156.
15. Sharma GD, Thakur R, Raj Som, Kauraw DL, Kulhare PS. Impact of integrated nutrient management on yield, nutrient uptake, protein content of wheat (*Triticum astivum* L.) and soil fertility in a Typic Haplustert. The Bioscan an International Quarterly Journal of Life Sciences. 2013;8(4):1159-1164.
16. Singh G, Jalota SK, Singh Y. Manuring and residue management effects on physical properties of a soil under the rice wheat system in Punjab, India. Soil and Tillage Research. 2007;94:229-238.
17. Singh D, Nepalia V. Influence of integrated nutrient management on quality protein maize (*Zea mays*) productivity and soils of southern Rajasthan. Indian Journal of Agricultural Sciences. 2009;79(12):1020-22.
18. Singh Guruvinder, Kumar Santosh, Sindhu Gurjagdeep Singh, Kaur Ramandeep. Effect of integrated nutrient management on yield of wheat (*Triticum aestivum* L.) under irrigated condition. International Journal of Chemical Studies. 2018;6(2):904-907.
19. Singh S, Singh RN, Prasad J, Singh BP. Effect of nutrient management on yield and uptake of nutrients by rice and soil fertility in rain fed uplands. Journal of the Indian Society of Soil Science. 2006;54:327-330.
20. Singh S, Bohra JS, Singh YV, Upadhyay AK, Verma S, Mishra PK, *et al*. Effect of integrated nutrient management on growth and development stages of rice under Rice-Wheat Ecosystem. International Journal of Current Microbiology and Applied Science. 2017;6(7):2032-2042.
21. Thakur R, Sawarkar D, Kauraw DL, Singh M. Effect of inorganic and organic sources on nutrients availability in a Vertisol. Agropedology. 2010;20(1):53-59.
22. Tiwari Abhishek, Tiwari Ankit, Singh NB, Kumar Arvind. Effect of integrated nutrient management (INM) on soil properties, yield and economics of rice (*Oryza sativa* L.). Res. Environ. Life Sci. 2017;10(7):640-644.
23. Tummalal K Reddy, Pawar RB, Patil DS. Effect of Integrated Nutrient Management on Growth, Yield and Economics of Wheat (*Triticum aestivum* L.) in Inceptisol. International Journal of Current Microbiology and Applied Sciences. 2018;7(10):1892-1902.
24. Urkurkar JS, Tiwari A, Shrikant C, Bajpai RK. Influence of long-term use of inorganic and organic manures on soil fertility and sustainable productivity of rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.) in Inceptisols. Indian Journal of Agricultural Sciences. 2010;80(3):208-212.