Effect of different Nutrient Management Practices on Phonological Characters, Yield and Economics of Hybrid Rice

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A B S T R A C T

A field experiment was conducted during kharif season of 2018 in Alfisols to study grain yield of hybrid rice varieties as influenced by different nutrient management practices. Results revealed that the variety IRH-103 (V1) was recorded significantly higher grain yield q ha⁻¹, straw yield q ha⁻¹, harvest index (%), gross income, net income and B: C ratio than the variety IRH-111 (V2). However, in case of different nutrient management practices treatment 150% RDF through inorganic (N5) recorded significantly highest grain yield q ha⁻¹, straw yield q ha⁻¹, gross income, net income and B: C ratio among all treatments.

Keywords
Organic and inorganic, Hybrid rice, Vermicompost

Introduction

Rice (Oryza sativa L.) is one of the vital cereal crop of the world as it is most likely food grain of over half of the globe population and more than 70% people obtained energy from rice (Bamangaonkar et al., 2009). Rice has the distribution of being the most extensively cultivated crop in the world and important staple food of more than 60% of the world. Rice supplies 20% and 31% of the total energy required by world and Indian population, respectively (Singh et al., 2018). World’s 90% rice is grown and consumed in Asia region in the world (Dekhane et al., 2014). In India, rice occupies an area of 43.39 m ha with production and productivity of 104.32 mt and 2.4 t ha⁻¹, respectively and In Chhattisgarh, rice occupies an area of 3.84 m ha with production and productivity of 6.09 mt and 1.5 t/ha, respectively (Ministry of agriculture & farmers welfare, 2016). To achieve food security, hybrid rice can be one of the most possible options to increase 15% to 20% of food production (Peng et al., 1999, Siddiq, 1996). Rice yield and biomass increased
rapidly due to increased use of chemical fertilizers. Imbalanced nutrient management under intensive cropping system and it reduces soil organic carbon is the key factors responsible for decline in soil quality (Kang *et al.*, 2005).

Under such situation organic nutrient management has significant role in improving productivity of crop and soil fertility (Tiwari *et al.*, 2017).

**Materials and Methods**

The experiment was conducted in Instructional cum Research Farm of SG College of Agriculture and Research Station, Jagdalpur, Chhattisgarh. The experiment was laid out in Split plot design with 2 main plot viz. V1- IRH 103, and V2- IRH 111 and subplot treatment was in 5 level i.e. 100% RDF through inorganic (N1), 75% RDF through inorganic + organic (N2), 100% RDF through inorganic + organic (N3), 150% RDF through inorganic + organic (N4) and 150% RDF through inorganic (N5) which was replicated in thrice three. Treatment N2, N3 and N4 and 2 q ha\(^{-1}\) Vermicompost + 25 kg ha\(^{-1}\) DAP were applied at 25-30 DAT. The recommended dose of fertilizer was 120:60:40 kg N: P: K ha\(^{-1}\) applied as per treatment. The soil of the experimental site was characterized as silty loam (*Alfisols*) which is locally known as *Mal*. It comes under midland situation of landscape of Bastar and soil was slightly acidic in reaction with high to medium in fertility level. A total 1085 mm rainfall was received during the cropping season. During the experimentation maximum and minimum temperature was recorded ranges between 26.8 and 37.2\(^{\circ}\)C and 8.7 to 24.3\(^{\circ}\)C.

**Results and Discussion**

The variety V\(_1\) produced significantly highest number of effective tillers than V\(_2\) at harvest. However, in case of different nutrient management practices, treatment N\(_5\) recorded significantly taller plant among all the treatment but it was found at par with treatment N\(_1\) at 60, 90 DAT and at harvest. The smaller plant height recorded with treatment N\(_2\) at all growth stages of observation. The plant height was more it may be due to 150% RDF through inorganic produce more nutrient to the plant and had vigorous plant root and taller plant and uptake more nutrients. Similar result had recorded by Maiti, *et al.*, (2006) he observed the taller plant when the crop received 125% recommended doses of fertilizer along with 5 tonnes of FYM ha\(^{-1}\). Hossaen *et al.*, (2011) also observed the taller plant was found with 70% NPKS +2.4 t poultry manure ha\(^{-1}\) at all growth stages of observation and the lowest was observed from control treatment.

The variety V\(_1\) produce significantly taller plant than V\(_2\) at 60, 90 DAT and at harvest. However, in case of different nutrient management practices, treatment N\(_5\) recorded significantly taller plant among all the treatment but it was found at par with treatment N\(_1\) at 60, 90 DAT and at harvest. The smaller plant height recorded with treatment N\(_2\) at all growth stages of observation. The plant height was more it may be due to 150% RDF through inorganic produce more nutrient to the plant and had vigorous plant root and taller plant and uptake more nutrients. Similar result had recorded by Maiti, *et al.*, (2006) he observed the taller plant when the crop received 125% recommended doses of fertilizer along with 5 tonnes of FYM ha\(^{-1}\). Hossaen *et al.*, (2011) also observed the taller plant was found with 70% NPKS +2.4 t poultry manure ha\(^{-1}\) at all growth stages of observation and the lowest was observed from control treatment.
The variety $V_2$ produced significantly highest dry matter hill$^{-1}$ than $V_1$ at 60 DAT. However, in case of different nutrient management practices treatment $N_5$ observed significantly highest dry matter hill$^{-1}$ among all treatment but it was significantly at par with treatment $N_1$ at 60, 90 DAT and at harvest, while the lowest dry matter hill$^{-1}$ was recorded with treatment $N_2$ at all the growth stages. Variety IRH- 111 and 150% RDF through inorganic produced higher dry matter accumulation, more number of tillers and leaves because more assimilation due to 150% RDF through inorganic. Similar result was found by Naseer and Bali (2007) he reported that significant increased dry matter accumulation with application of N up to 90 kg ha$^{-1}$. Maiti, et al., (2006) also observed the maximum dry matter accumulation and LAI when the crop received 125% recommended doses of fertilizer along with 5 tons of FYM ha$^{-1}$.

The crop growth rate increased from 30-60 to 60-90 and thereafter, it declined at 90 to at harvest. The significantly highest crop growth rate was observed in $V_2$ treatment than $V_1$ at 60 DAT. However, in case of different nutrient management practices all treatments shows no significant effect on crop growth rate but numerically highest crop growth rate was observed in treatment $N_5$ and the lowest was recorded with treatment $N_2$ at all growth stages of observation. The treatment 150% RDF through inorganic observed highest crop growth rate, it may be due to highest dry matter accumulation and more assimilation in 150% RDF through inorganic.

The relative growth rate declined with advancement of crop age. The treatment $V_1$ and $V_2$ shows no significant effect on relative growth rate but numerically highest relative growth rate was noticed in $N_2$ treatment at 30-60 and 60-90 DAT.

The net assimilation rate declined with advancement of crop age. The treatment $V_1$ and $V_2$ shows no significant effect on net assimilation rate but numerically highest net assimilation rate was observed in treatment $V_2$ than $V_1$ at 30-60 DAT and 90-at harvest. However, in case of different nutrient management practices all treatments recorded no significant effect on net assimilation rate but numerically highest net assimilation rate was noticed in treatment $N_2$ at 30-60 and 60-90 DAT.

The Leaf area index increased with advancement of crop age. The data reveals that the treatment $V_1$ and $V_2$ shows no significant effect on leaf area index but numerically highest LAI was observed in treatment $V_2$ than $V_1$ at 30 and 60 DAT but at 90 DAT and at harvest highest LAI was noticed in treatment $V_1$ than $V_2$. However, in different nutrient management practices, it was found no significant effect on leaf area index among all treatment but numerically highest LAI was noticed in treatment $N_5$ among all treatments, while the lowest LAI was recorded with treatment $N_2$ at all growth. The treatment 150% RDF through inorganic produced higher leaf area index, it may be due to more number of tillers and leaves because more assimilation in 150% RDF through inorganic.

The variety $V_1$ produced significantly highest grain yield than $V_2$. However, in case of different nutrient management practices, treatment $N_5$ recorded significantly highest grain yield among all the treatments and lowest grain yield was recorded in treatment $N_3$. It was due to increased number of grain panicle$^{-1}$, number of effective tiller hill$^{-1}$ and test weight (Table 1–7).
**Table 1** Effect of different nutrient management practices on Plant height of hybrid rice

| Treatment                  | Plant Height (cm) |   |   |   |   |
|----------------------------|-------------------|---|---|---|---|
|                            | 30 DAT            | 60 DAT | 90 DAT | At harvest |
| **Varieties**              |                   |       |       |             |
| V1                         | 51.09             | 86.76  | 104.11 | 106.88      |
| V2                         | 49.80             | 75.95  | 93.77  | 97.74       |
| **SEm±**                   | 0.77              | 1.41   | 2.18   | 1.69        |
| **CD at 5%**               | NS                | 9.22   | 6.40   | 4.57        |
| **CV %**                   | 5.93              | 6.70   | 8.55   | 6.43        |
| **Nutrient management practices** |                   |       |       |             |
| N1                         | 51.30             | 82.77  | 100.40 | 103.42      |
| N2                         | 47.45             | 76.97  | 95.47  | 98.82       |
| N3                         | 48.93             | 79.47  | 96.60  | 100.79      |
| N4                         | 50.68             | 81.33  | 98.47  | 101.73      |
| N5                         | 53.87             | 86.23  | 103.77 | 106.79      |
| **SEm±**                   | 1.45              | 1.95   | 1.85   | 2.18        |
| **CD at 5%**               | NS                | 5.90   | 5.60   | 4.84        |
| **CV %**                   | 7.02              | 5.88   | 4.58   | 5.23        |

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)
Table 2: Effect of different nutrient management practices on no. of effective tillers plant\(^{-1}\) of hybrid rice

| Treatment                                | Number of Tillers Plant\(^{-1}\) | 30 DAT | 60 DAT | 90 DAT | At harvest |
|------------------------------------------|----------------------------------|--------|--------|--------|------------|
| Varieties                                |                                  |        |        |        |            |
| V1                                       | 7.72                             | 10.68  | 7.60   | 9.16   |            |
| V2                                       | 8.92                             | 13.49  | 6.49   | 8.18   |            |
| SEM±                                     | 0.26                             | 0.54   | 0.28   | 0.12   |            |
| CD at 5%                                  | NS                               | NS     | NS     | 0.79   |            |
| CV %                                     | 12.16                            | 17.35  | 15.53  | 5.37   |            |
| Nutrient management practices            |                                  |        |        |        |            |
| N1                                       | 9.13                             | 11.13  | 7.59   | 9.4    |            |
| N2                                       | 6.87                             | 10.17  | 6.08   | 7.33   |            |
| N3                                       | 7.40                             | 11.67  | 6.42   | 7.78   |            |
| N4                                       | 8.17                             | 12.83  | 6.87   | 8.53   |            |
| N5                                       | 10.03                            | 14.63  | 8.26   | 10.3   |            |
| SEM±                                     | 0.54                             | 0.48   | 0.45   | 0.61   |            |
| CD at 5%                                  | 1.64                             | 1.45   | 1.36   | 1.85   |            |
| CV %                                     | 15.9                             | 9.68   | 15.60  | 17.3   |            |

V1-IRH 103, V2-IRH 111, N1-100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4-150% RDF (Organic + inorganic), N5-150% RDF (Inorganic)
Table 3: Effect of different nutrient management practices on dry matter accumulation of hybrid rice

| Treatment                      | Dry Matter Accumulation hill$^{-1}$ (g) |         |         |         |         |
|-------------------------------|----------------------------------------|---------|---------|---------|---------|
|                               |                                        | 30 DAT  | 60 DAT  | 90 DAT  | At harvest |
| Varieties                     |                                        |         |         |         |         |
| V1                            |                                        | 3.00    | 26.27   | 51.09   | 56.33   |
| V2                            |                                        | 3.47    | 28.67   | 48.88   | 56.41   |
| SEm±                          |                                        | 0.11    | 0.15    | 2.00    | 0.90    |
| CD at 5%                      |                                        | NS      | 0.98    | NS      | NS      |
| CV %                          |                                        | 12.88   | 6.65    | 15.53   | 6.18    |
| Nutrient management practices |                                        |         |         |         |         |
| N1                            |                                        | 3.57    | 28.71   | 51.17   | 57.78   |
| N2                            |                                        | 2.43    | 24.28   | 47.0    | 52.01   |
| N3                            |                                        | 2.64    | 25.93   | 48.72   | 55.23   |
| N4                            |                                        | 3.23    | 27.2    | 49.42   | 57.03   |
| N5                            |                                        | 4.34    | 31.2    | 53.3    | 59.78   |
| SEm±                          |                                        | 0.23    | 1.24    | 1.03    | 1.20    |
| CD at 5%                      |                                        | 0.70    | 3.76    | 3.10    | 3.62    |
| CV %                          |                                        | 17.54   | 11.07   | 5.02    | 5.21    |

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)
Table 4: Effect of different nutrient management practices on CGR of different growth stages of hybrid rice

| Treatment | Crop Growth Rate (g hill⁻¹d⁻¹) |
|-----------|---------------------------------|
|           | 30-60 DAT | 60-90 DAT | 90- At harvest |
| Varieties |          |          |               |
| V1        | 0.78      | 0.83     | 0.18          |
| V2        | 0.84      | 0.67     | 0.25          |
| SEm±      | 0.008     | 0.07     | 0.04          |
| CD at 5%  | 0.06      | NS       | NS            |
| CV %      | 12.38     | 8.32     | 20.49         |
| Nutrient management practices |          |          |               |
| N1        | 0.84      | 0.75     | 0.22          |
| N2        | 0.73      | 0.76     | 0.17          |
| N3        | 0.78      | 0.76     | 0.22          |
| N4        | 0.80      | 0.74     | 0.24          |
| N5        | 0.90      | 0.71     | 0.22          |
| SEm±      | 0.05      | 0.06     | 0.02          |
| CD at 5%  | NS        | NS       | NS            |
| CV %      | 14.12     | 19.3     | 6.65          |

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)
**Table 5** Effect of different nutrient management practices on RGR of different growth stages of hybrid rice

| Treatment                                   | Relative Growth Rate (g \(^{\text{g}}\) hill\(^{-1}\)d\(^{-1}\)) | 30-60 DAT | 60-90 DAT | 90- At harvest |
|---------------------------------------------|---------------------------------------------------------------|------------|------------|----------------|
| Varieties                                   |                                                               |            |            |                |
| V1                                          |                                                               | 0.032      | 0.010      | 0.001          |
| V2                                          |                                                               | 0.031      | 0.008      | 0.002          |
| SEm±                                        |                                                               | 0.001      | 0.01       | 0.001          |
| CD at 5%                                     |                                                               | NS         | NS         | NS             |
| CV %                                        |                                                               | 10.04      | 11.44      | 18.12          |
| Nutrient management practices                |                                                               |            |            |                |
| N1                                          |                                                               | 0.030      | 0.008      | 0.002          |
| N2                                          |                                                               | 0.034      | 0.010      | 0.001          |
| N3                                          |                                                               | 0.033      | 0.009      | 0.002          |
| N4                                          |                                                               | 0.031      | 0.009      | 0.002          |
| N5                                          |                                                               | 0.029      | 0.008      | 0.002          |
| SEm±                                        |                                                               | 0.001      | 0.01       | 0.001          |
| CD at 5%                                     |                                                               | NS         | NS         | NS             |
| CV %                                        |                                                               | 10.04      | 11.44      | 18.12          |

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)
**Table 6** Effect of different nutrient management practices on NAR of different growth stages of hybrid rice

| Treatment                        | Net assimilation rate (g hill\(^{-1}\)d\(^{-1}\)) | 30-60 DAT | 60-90 DAT | 90- At harvest |
|----------------------------------|---------------------------------------------------|-----------|-----------|---------------|
| **Varieties**                    |                                                   |           |           |               |
| V1                               |                                                   | 0.014     | 0.009     | 0.001         |
| V2                               |                                                   | 0.015     | 0.007     | 0.002         |
| SEM±                             |                                                   | 0.001     | 0.001     | 0.001         |
| CD at 5%                         |                                                   | NS        | NS        | NS            |
| CV %                             |                                                   | 6.76      | 4.0       | 6.17          |
| **Nutrient management practices**|                                                   |           |           |               |
| N1                               |                                                   | 0.015     | 0.008     | 0.002         |
| N2                               |                                                   | 0.015     | 0.009     | 0.001         |
| N3                               |                                                   | 0.015     | 0.008     | 0.002         |
| N4                               |                                                   | 0.015     | 0.008     | 0.002         |
| N5                               |                                                   | 0.014     | 0.007     | 0.001         |
| SEM±                             |                                                   | 0.001     | 0.001     | 0.001         |
| CD at 5%                         |                                                   | NS        | NS        | NS            |
| CV %                             |                                                   | 6.76      | 4.0       | 6.17          |

V1-IRH 103, V2-IRH 111, N1-100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4-150% RDF (Organic + inorganic), N5-150% RDF (Inorganic)
### Table 7 Effect of different nutrient management practices on LAI of hybrid rice

| Treatment | Leaf Area Index | 30 DAT | 60 DAT | 90 DAT | At harvest |
|-----------|----------------|--------|--------|--------|------------|
| Varieties |                |        |        |        |            |
| V1        |                | 0.90   | 2.463  | 2.71   | 2.97       |
| V2        |                | 0.97   | 2.511  | 2.56   | 2.66       |
| SEm±      |                | 0.12   | 0.22   | 0.08   | 0.16       |
| CD at 5%  |                | NS     | NS     | NS     | NS         |
| CV %      |                | 15.17  | 34.84  | 11.23  | 22.54      |
| Nutrient management practices | | | | | |
| N1        |                | 1.06   | 2.43   | 2.65   | 3.00       |
| N2        |                | 0.73   | 2.14   | 2.44   | 2.37       |
| N3        |                | 0.80   | 2.41   | 2.48   | 2.53       |
| N4        |                | 0.99   | 2.50   | 2.71   | 2.71       |
| N5        |                | 1.10   | 2.95   | 2.89   | 3.45       |
| SEm±      |                | 0.11   | 0.22   | 0.20   | 0.28       |
| CD at 5%  |                | NS     | NS     | NS     | NS         |
| CV %      |                | 9.11   | 21.27  | 18.34  | 24.49      |

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)
Similarly, Dixit and Gupta (2000) stated that the grain yield and straw yields of rice increased significantly with increasing levels of NPK fertilizers. Singh et al., (2004) also observed the highest grain and straw yield with the highest level of N nutrition (180 kg ha\(^{-1}\)), through the differences between successive N levels were only significant up to 120 kg N ha\(^{-1}\). Similarly Manzoor et al., (2006) reported that the application of fertilizer where 175 kg nitrogen ha\(^{-1}\) was applied produced a maximum (4.24 t ha\(^{-1}\)) of paddy yield which was statistically similar with that obtained in 150, 200, and 225 kg ha\(^{-1}\) nitrogen application.

The variety V\(_1\) recorded significantly highest straw yield than V\(_2\). Where, in case of different nutrient management practices, treatment N\(_5\) recorded significantly highest straw yield among all the treatments and lowest straw yield was recorded in treatment N\(_2\). Increased number of tillers hill\(^{-1}\), number of leaves and plant height inward straw yield in V\(_1\) and N\(_5\) during experimentation.

The treatment V\(_1\) recorded significantly higher gross and net return than V\(_2\). While, in case of different nutrient management practices, treatment N\(_5\) was noticed significantly highest gross return and net return and lowest economic return was observed in treatment N\(_3\) among all treatment.

The variety V\(_1\) recorded significantly higher B: C ratio than V\(_2\). However, in case of different nutrient management practices, treatment N\(_2\) was noticed significantly highest B: C ratio but it was at par with N\(_2\) and N\(_4\) treatment and lowest was observed in N\(_3\) treatment among all treatment. Similar result found by Usman et al., (2003) reveals that highest value of benefit cost ratio was observed in case of combined application of organic manure in form of poultry manure @ 20 t ha\(^{-1}\) along with same amount of mineral fertilizers. Tiwari et al., (2017) also recorded the maximum gross and net returns and the lowest cost of cultivation under 50% recommended NPK through fertilizer + 50% N (FYM) than other treatments.

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