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# Influence of Different Establishment Methods and Nutrient Management Practices on Growth Attributes of Rice (*Oryza sativa* L.)

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## ABSTRACT

**Background:** Rice is most important staple meal for more than half of the world's population. The conventional method of rice production uses a lot of water, requires a lot of labor and has a negative impact on soil and environmental health. Besides, unbalanced nutrient supply leads to low growth and development of plant, soil deterioration and poor environmental health.

**Methods:** The field experiment was conducted with rice variety PR-121 using 4 establishment methods (transplanting, system of rice intensification, direct seeded rice and wet-direct seeded rice) and 5 nutrient management practices (100% RDF, 75% RDF+FYM (equiv. to 25% N), 150% RDF, RDF (LCC based N application) and RDF+5 t FYM) in split plot design with three replication.

**Result:** Results revealed that the highest value of plant height was recorded under transplanting method while the maximum value of number of tillers $m^{-2}$, dry matter accumulation crop and relative growth rate was found under direct seeded method of rice establishment over other establishment methods at all the stages of crop growth during both the years of study. Application of 150% RDF recorded the highest value of plant height, number of tillers $m^{-2}$, dry matter accumulation, crop growth rate and relative growth rate on most of the crop growth stages during both the years of study compared to remaining nutrient management practices but found statistically on par with application of RDF+5 t FYM.

**Key words:** Establishment method, Growth attributes, Nutrient management practices, Rice.

## INTRODUCTION

Rice is recognized as the world's most valuable commodity since it provides life, culture, tradition and a source of income for millions of people. It is a significant staple meal for more than half of the world's population (Singh *et al*., 2017). The current situation indicates that research on rice crop establishment methods and management techniques are getting more emphasis. This is mostly due to differences in crop establishment methods in terms of energy requirements, resource use and potential to operate as a climate change mitigation technique, which may have far-reaching ramifications in terms of yield and revenue for farmers, as well as environmental health. Furthermore, novel crop establishment methods and management strategies are becoming increasingly important to address concerns such as natural resource degradation and the rising cost of chemical and agronomic treatments or resources (Shahane *et al*., 2020).

In India, majority farmers prefer conventional (transplanting) system of rice production because they don't want any type of risk with new technology. However, we know that conventional rice production uses a lot of water, requires a lot of labor and has a negative impact on soil and environmental health. As a result, in order to maintain long-term rice production, we need more efficient alternative rice producing methods (Saharawat *et al*., 2010) like system of rice intensification which saves 22 to 38% of water compared to conventional rice-growing methods (Singh *et al*., 2015). Another method of crop establishment that may assure improves plant population and staggered labor usage is direct sowing of rice seeds or presprouted seeds (Mankotia *et al*., 2009). Dry seeding (sowing dry seeds into dry soil), wet seeding (sowing pre-germinated seeds over wet puddle soils) and water seeding are the three main ways for establishing direct seeded rice (DSR) (seeds sown into standing water). However, as water scarcity worsens, the motivation to develop and implement dry-DSR has increased. In irrigated regions, dry-DSR output is minimal,

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but it is done in rainfed upland ecosystems in most Asian nations (Joshi *et al.,* 2013).

Nutrient management strategies have a significant impact on rice crop growth and development. Different nutrients have their own specific roles in growth and development of plant. The nutrients from the organic and inorganic sources differ in their relative availability for crop. Chemical fertilizers are plentiful in nutrients and are a rapid source of nutrient delivery and readily available to plant because most fertilizers are water soluble. Furthermore, the continued use of chemical fertilizers results in a considerable decrease in cereal crop production after only a few years of cropping (Singh *et al*., 2019). On the other hand, farmyard manure, is an easy and complete source of most nutrients (Nanda *et al*., 2016) and become available for crop uptake for a longer period of time due to their low nutrient content, bulky nature, slow decomposition and gradual release of nutrients into the labile pool. Furthermore, organic nutrition sources enhance soil physical qualities by reducing bulk density, increasing water holding capacity and enhancing penetration rates (Joshi *et al*., 2019). As a result, an integrated approach involving the use of organic and inorganic fertilizers is necessary to ensure that crops receive all of the needed nutrients in appropriate levels and that the nutrients are easily available during crop growth (Das *et al*., 2014).

Therefore, the present investigation was undertaken with the objective to assess growth performance of rice under different establishment methods and nutrient management practices.

## MATERIALS AND METHODS

A field experiment on rice was conducted in the Rice Agronomy $A_2$ Block at the N.E. Borlaug Crop Research Centre, G.B. Pant university of Agriculture and Technology, Pantnagar, Uttarakhand during *Kharif* 2018 and 2019. The geographical reference of the study area is 290 N latitude and 79.290 E longitude, with a height of 243.84 meters above mean sea level. The climate is humid subtropical and the mean annual rainfall of this region is 1450 mm. Soil of experimental area was silty loam having pH value of 7.6; organic carbon (0.87%), available nitrogen (227 kg $ha^{-1}$), available phosphorus (19.6 kg $ha^{-1}$) and potassium (202 kg $ha^{-1}$). The experiment was laid out with rice variety PR-121 in a split plot design (SPD) with three replications and 20 treatments comprising four establishment methods (transplanted rice (TPR), system of rice intensification (SRI), direct seeded rice (DSR) and wet-direct seeded rice (WDSR)) and five nutrient management practices (120:60:40 NPK (100% RDF), 75% inorganic+FYM (equiv. to 25% N), 180:90:60 NPK (150% RDF), LCC based nitrogen application (having 3 shade as crucial for N application of 20-25 kg $ha^{-1}$) and 100% RDF+5 tonns FYM (Farmer's practice). Prior to sowing, a full dose of phosphorus and potassium, as well as 50% nitrogen was applied as a basal in all rice-established plots using urea (46% N), NPK fertilizer (12:32:16) and murate of potash (60% $K_2O$), respectively and incorporated into the soil as needed in each treatment. The remaining nitrogen was administered in two split doses, one at tillering (50% in direct seeded and moist direct seeded plots and 25% in transplanted rice plots) and the other at panicle initiation (25% N was applied in all plots as per the treatment). Prior to sowing or transplanting, FYM was applied as per treatment on required sub-plots and thoroughly incorporated into the top 15 cm soil with the help of spade manually. Gap filling and thinning were done wherever necessary to maintain optimum plant population. Plant protection measures were taken to prevent infestation of insects, weeds and diseases.

Plant height (cm), number of tillers $m^{-2}$, dry matter accumulation ($m^{-2}$), crop growth rate and relative growth rate were measured at 30 60, 90 DAS/DAT and at harvest during both the years of experimentation. On both sides of the direct seeded plot, one meter row length of crop in the third row was marked from north to south for recording observations on plant height, number of tillers and dry matter accumulation, leaving the two rows as borders. Also, in the wet-direct seeded plot, a 0.5m×0.5m area in each corner was demarcated for recording the aforementioned observations after leaving a 0.5m boundary on both sides of the plot. In SRI and transplanted rice plots total 16 hills, 4 from each corner in third and fourth row were marked for observations on growth attributes of rice.

Data on growth attributes of rice were analyzed following standard statistical analysis of variance procedure as suggested by Gomez and Gomez (1984). Wherever the interaction between establishment methods and nutrient management practices found significant were presented in separate two way tables.

## RESULTS AND DISCUSSION

### Plant height

#### Establishment method

The height of rice plant was increased progressively as the age of crop advanced (Table 1). Significantly higher plant height was recorded under TPR followed by SRI and WDSR during both the years of study at 30 and 60 DAS/DAT stages. At 90 DAS/DAT, the maximum plant height was found under TPR which is statistically at par with SRI followed by DSR during both the years of study. The highest plant height at harvest was recorded with TPR and SRI for 2018 and 2019, respectively but both were comparable. Greater plant height in TPR was because of less competition for nutrients, between the crop and weed for space and sunlight compared to direct seeded and wet direct seeded method of rice cultivation. In addition, the rice seedlings were transplanted at a specific distance in the transplanting method, which allowed the rice crop to take advantage of maximum solar radiation and more area for better root growth and penetration, resulting in efficient use of uptaken nutrients, whereas in the direct seeded rice and wet-direct seeded

rice methods, the appropriate plant to plant distance was not maintained because seeds were either drilled or sown directly. These findings are consistent with those of Kumhar *et al.* (2016); Ali *et al.* (2012) and Yadav *et al.* (2009).

**Nutrient management practices**

The maximum plant height was observed under 150% RDF at all the crop growth stage of rice during 2018 and 2019 (Table 1). The increase in plant height with application of 150% RDF might be due to additional supply of nutrients which might have increased nutrient uptake and better translocation which would have increased the cell division, elongation and photosynthesis. The results confirm the findings of Manzoor *et al.* (2006); Mirza *et al.* (2010) and Sowmyalatha *et al.* (2012).

**Number of tillers**

**Establishment method**

At 30 DAS/DAT, DSR recorded 12.3 and 6.4% more tillers $m^{-2}$ during 2018 and 2019, respectively over TPR. At 60 and 90 DAS/DAT stage, DSR gave significantly higher number of tillers $m^{-2}$ which was significantly superior over other methods of rice cultivation in year 2018 and 2019 (Table 2). Tillers were much higher in DSR compared to other rice establishment methods at all the phases of crop growth. This might be attributed to the direct seeded method's

**Table 1:** Effect of establishment methods and nutrient management practices on plant heightat different stages of rice.

| | Plant height (cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 DAS/ DAT | | 60 DAS/ DAT | | 90 DAS/ DAT | | At harvest | |
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| **Establishment method** | | | | | | | | |
| TPR | 49.7 | 53.0 | 73.6 | 76.7 | 90.2 | 96.0 | 101.3 | 103.9 |
| SRI | 41.2 | 44.1 | 68.9 | 73.3 | 88.5 | 94.0 | 98.3 | 106.0 |
| DSR | 30.3 | 38.9 | 51.6 | 57.9 | 81.4 | 81.4 | 94.9 | 99.4 |
| WDSR | 32.7 | 39.4 | 52.1 | 59.9 | 81.2 | 79.8 | 93.7 | 97.2 |
| SEm± | 1.6 | 1.1 | 1.1 | 1.3 | 1.4 | 2.0 | 1.5 | 1.5 |
| CD(P=0.05) | 5.4 | 3.6 | 3.6 | 4.6 | 2.4 | 6.9 | 5.3 | 5.2 |
| **Nutrtient management practices** | | | | | | | | |
| 100% RDF | 37.6 | 43.8 | 60.5 | 63.1 | 80.6 | 85.3 | 95.4 | 101.1 |
| 75% RDF+FYM (equiv. to 25% N) | 39.3 | 43.7 | 60.7 | 68.3 | 84.8 | 86.9 | 96.7 | 101.6 |
| 150% RDF | 39.6 | 44.1 | 63.6 | 70.0 | 89.9 | 91.0 | 99.2 | 102.8 |
| RDF(LCC based N) | 37.4 | 43.3 | 59.6 | 66.1 | 83.6 | 86.4 | 95.4 | 100.5 |
| RDF+5 t FYM | 38.3 | 44.5 | 63.4 | 67.4 | 87.5 | 89.3 | 98.5 | 102.2 |
| SEm± | 0.7 | 0.7 | 1.0 | 1.2 | 1.0 | 1.4 | 0.9 | 0.9 |
| CD(P=0.05) | 1.9 | NS | 3.0 | 3.4 | 2.8 | 3.9 | 2.5 | NS |

**Table 2:** Effect of establishment methods and nutrient management practices on number of tillers $m^{-2}$ at different stages of rice.

| | Number of tillers ($m^{-2}$) | | | | | |
|---|---|---|---|---|---|---|
| | 30 DAS/ DAT | | 60 DAS/ DAT | | 90 DAS/ DAT | |
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| **Establishment method** | | | | | | |
| TPR | 154 | 172 | 286 | 302 | 234 | 250 |
| SRI | 139 | 147 | 249 | 275 | 211 | 232 |
| DSR | 173 | 183 | 410 | 432 | 379 | 394 |
| WDSR | 159 | 167 | 329 | 358 | 320 | 327 |
| SEm± | 7 | 6 | 9 | 8 | 8 | 6 |
| CD(*P*=0.05) | NS | 22 | 29 | 28 | 26 | 22 |
| **Nutrient management practices** | | | | | | |
| 100% RDF | 133 | 135 | 246 | 302 | 238 | 274 |
| 75% RDF+FYM (equiv. to 25% N) | 161 | 169 | 319 | 322 | 287 | 293 |
| 150% RDF | 167 | 185 | 361 | 377 | 312 | 325 |
| RDF(LCC based N) | 158 | 163 | 315 | 348 | 291 | 299 |
| RDF+5 t FYM | 162 | 183 | 353 | 361 | 302 | 313 |
| SEm± | 6 | 7 | 9 | 5 | 8 | 5 |
| CD(P=0.05) | 19 | 20 | 26 | 15 | 23 | 15 |

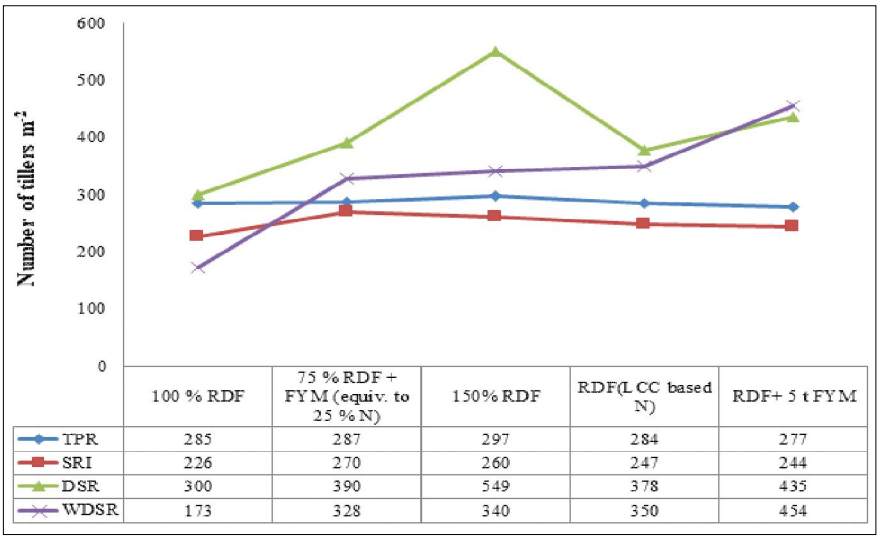
slighter plant to plant distance as compared to the transplanted and system of rice intensification methods, which caused higher number of tillers. These findings are consistent with those of Thakur *et al.* (2004) and Rashid *et al.* (2009). Conversely, in transplanted method root damage due to nursery uprooting and transplanting trauma reduced early growth and vigour in transplanted method (Ishfaq *et al.*, 2020).

**Nutrient management practices**

The highest number of tillers $m^{-2}$ was noted under 150% RDF as compared to remaining nutrient management practices at 30, 60 and 90 DAS/DAT stages of 2018 and 2019. Higher number of tillers with application of 150% RDF might be due to the fact that the inorganic fertilization has quick, adequate and easy nutrient supplying capacity to the crop which cop up with the demand of crop resulting improved number of tillers and dry matter accumulation. Similar results were reported by Songyikhangsuthor *et al.* (2014) and Joshi *et al.* (2019).

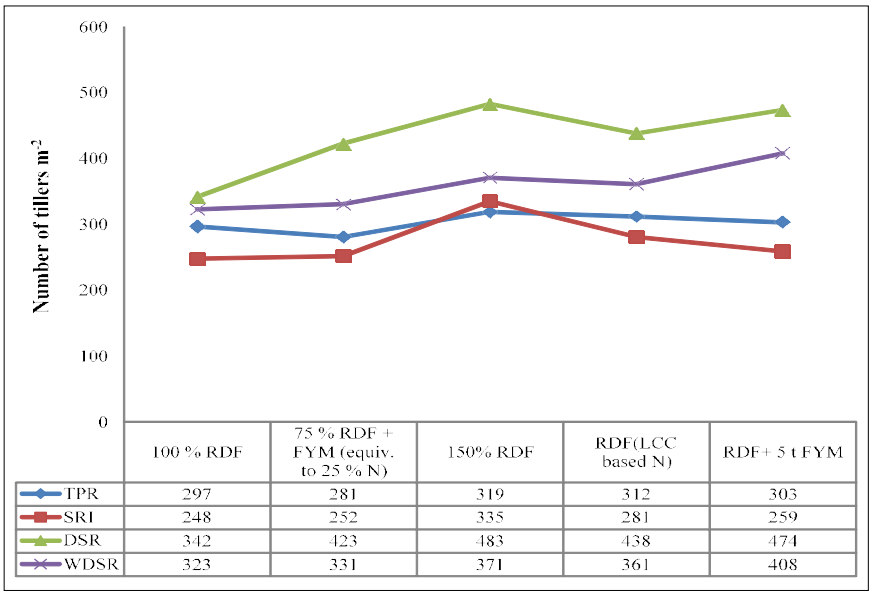
**Interaction effect**

The interaction effect of different establishment method and nutrient management practices found to be significant at 60 DAS/DAT stage of rice crop during both the years. DSR with application of 150% RDF gave the highest number of tllers $m^{-2}$ during 2018 (Fig 1) and 2019 which is significantly superior over all other treatment combination during 2018 and 2019 except DSR with application of RDF+5 t FYM (Fig 2).




| | 100 % RDF | 75 % RDF + FYM (equiv. to 25 % N) | 150% RDF | RDF(LCC based N) | RDF+ 5 t FYM |
|---|---|---|---|---|---|
| TPR | 285 | 287 | 297 | 284 | 277 |
| SRI | 226 | 270 | 260 | 247 | 244 |
| DSR | 300 | 390 | 549 | 378 | 435 |
| WDSR | 173 | 328 | 340 | 350 | 454 |

**Fig 1:** Interaction effect of different establishment methods and nutrient management practices on plant height of rice at 60 DAS/DAT during 2018.




| | 100 % RDF | 75 % RDF + FYM (equiv. to 25 % N) | 150% RDF | RDF(LCC based N) | RDF+ 5 t FYM |
|---|---|---|---|---|---|
| TPR | 297 | 281 | 319 | 312 | 303 |
| SRI | 248 | 252 | 335 | 281 | 259 |
| DSR | 342 | 423 | 483 | 438 | 474 |
| WDSR | 323 | 331 | 371 | 361 | 408 |

**Fig 2:** Interaction effect of different establishment methods and nutrient management practices on plant height of rice at 60 DAS/DAT during 2019.

## Dry matter accumulation

### Establishment method

Data presented in Table 3 showed that dry matter accumulation (DMA) increased with increasing crop age till maturity under various rice growing methods. At 30 DAS/ DAT stage, the highest dry matter was recorded under TPR which is superior over all the other rice establishment methods. At 60, 90 DAS/DAT and at harvest stages, DSR gave the highest DMA which was significantly superior over other establishment methods followed by TPR during both the year of study. Higher DMA with DSR as compared to other establishment methods was due to higher number of effective tillers and vigorous vegetative growth. Similar findings have been made by Gill *et al.* (2006 a and b) and Sharma *et al.* (2016).

### Nutrient management practices

Maximum DMA was recorded in RDF+5 t FYM at 30 DAS/ DAT. However at 60 and 90 DAS/DAT and at harvest stage, 150% RDF recorded the maximum DMA (Table 3). Application of 150% RDF resulted in a larger amount of dry matter buildup might be due to the fact that inorganic fertilization provides a rapid, adequate and easy nutrient-supply capacity for the crop, which enhances crop dry matter accumulation. Furthermore, a larger nitrogen supply may have aided in the maintenance of a better condition for photosynthetic activity in the leaves. In addition, enough

**Table 3:** Effect of establishment methods and nutrient management practiceson dry matter accumulation $m^{-2}$ at different stages of rice.

| | Dry matter accumulation (g $m^{-2}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 DAS/ DAT | | 60 DAS/ DAT | | 90 DAS/ DAT | | At Harvest | |
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| **Establishment method** | | | | | | | | |
| TPR | 49.5 | 56.4 | 504.3 | 526.4 | 890.1 | 898.3 | 1190.1 | 1191.2 |
| SRI | 41.4 | 46.0 | 450.4 | 483.1 | 841.6 | 863.1 | 1146.6 | 1160.4 |
| DSR | 39.5 | 42.4 | 520.1 | 536.5 | 942.2 | 964.5 | 1242.2 | 1277.8 |
| WDSR | 37.9 | 40.3 | 449.7 | 437.9 | 862.7 | 887.1 | 1162.7 | 1180.3 |
| SEm± | 1.9 | 1.6 | 13.1 | 9.7 | 13.7 | 18.4 | 16.7 | 16.5 |
| CD(*P*=0.05) | 6.9 | 5.6 | 45.3 | 33.5 | 47.6 | 39.1 | 57.8 | 57.2 |
| **Nutrient management practices** | | | | | | | | |
| 100% RDF | 40.2 | 42.2 | 441.6 | 452.5 | 843.2 | 863.2 | 1145.7 | 1156.5 |
| 75% RDF+FYM (equiv. to 25% N) | 44.3 | 47.7 | 471.3 | 496.0 | 891.7 | 904.0 | 1191.7 | 1212.2 |
| 150% RDF | 43.5 | 51.0 | 518.5 | 532.4 | 913.9 | 939.3 | 1218.0 | 1230.1 |
| RDF(LCC based N) | 37.9 | 39.3 | 475.8 | 486.8 | 875.0 | 888.4 | 1175.0 | 1194.5 |
| RDF+5t FYM | 44.8 | 51.1 | 498.3 | 512.3 | 896.8 | 921.3 | 1196.8 | 1218.9 |
| SEm± | 1.7 | 1.7 | 13.5 | 8.3 | 10.8 | 13.6 | 12.3 | 15.9 |
| CD (P=0.05) | 4.8 | 5.0 | 38.9 | 23.9 | 31.1 | 39.1 | 35.5 | 45.7 |

**Table 4:** Effect of establishment methods and nutrient management on crop growth rate at different stages of rice.

| | CGR (g $m^{-2}$ $day^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | 30-60 DAS/ DAT | | 60-90 DAS/ DAT | | 90 DAS/ DAT- At harvest | |
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| **Establishment method** | | | | | | |
| TPR | 15.16 | 15.67 | 12.86 | 12.40 | 10.00 | 9.76 |
| SRI | 13.63 | 14.57 | 13.03 | 12.67 | 10.18 | 9.92 |
| DSR | 16.02 | 16.47 | 14.07 | 14.27 | 10.00 | 10.45 |
| WDSR | 13.73 | 13.25 | 13.77 | 14.97 | 10.91 | 9.77 |
| SEm± | 0.47 | 0.35 | 0.56 | 0.45 | 0.29 | 0.90 |
| CD (*P*=0.05) | 1.62 | 1.19 | NS | 1.56 | NS | NS |
| **Nutrient management practices** | | | | | | |
| 100% RDF | 13.38 | 13.67 | 13.39 | 13.69 | 10.08 | 9.78 |
| 75% RDF+FYM (equiv. to 25% N) | 14.24 | 14.94 | 14.01 | 13.60 | 10.00 | 10.27 |
| 150% RDF | 15.84 | 16.05 | 13.18 | 13.56 | 10.14 | 9.69 |
| RDF (LCC based N) | 14.60 | 14.92 | 13.31 | 13.39 | 10.00 | 10.20 |
| RDF+5 t FYM | 15.11 | 15.37 | 13.28 | 13.64 | 10.00 | 9.92 |
| SEm± | 0.45 | 0.29 | 0.47 | 0.52 | 0.38 | 0.58 |
| CD (P=0.05) | 1.31 | 0.85 | NS | NS | NS | NS |

**Table 5:** Effect of establishment methods and nutrient management on relative growth rate at different stages of rice.

| | RGR (g $g^{-1}$ $day^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | 30-60 DAS/ DAT | | 60-90DAS/ DAT | | 90 DAS/ DAT- At harvest | |
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| **Establishment method** | | | | | | |
| TPR | 2.64 | 2.66 | 2.86 | 2.86 | 2.98 | 2.98 |
| SRI | 2.60 | 2.63 | 2.84 | 2.85 | 2.96 | 2.97 |
| DSR | 2.66 | 2.67 | 2.88 | 2.89 | 2.99 | 3.01 |
| WDSR | 2.60 | 2.58 | 2.85 | 2.86 | 2.97 | 2.97 |
| SEm± | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| CD (*P*=0.05) | 0.04 | 0.03 | 0.02 | 0.03 | 0.02 | 0.02 |
| **Nutrient management practices** | | | | | | |
| 100% RDF | 2.59 | 2.59 | 2.84 | 2.85 | 2.96 | 2.96 |
| 75% RDF+FYM (equiv. to 25% N) | 2.61 | 2.64 | 2.86 | 2.87 | 2.98 | 2.99 |
| 150% RDF | 2.66 | 2.67 | 2.87 | 2.88 | 2.99 | 3.00 |
| RDF (LCC based N) | 2.62 | 2.63 | 2.85 | 2.86 | 2.97 | 2.98 |
| RDF+ 5 t FYM | 2.64 | 2.65 | 2.86 | 2.87 | 2.98 | 2.99 |
| SEm± | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| CD (*P*=0.05) | 0.04 | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 |

nitrogen delivery aids in cell elongation and multiplication, which increased the growth characteristics of rice plants grown under nutrient management practices of 150% RDF. These findings are similar to those of Sowmyalatha *et al.* (2012); Songyikhangsuthor *et al.* (2014) and Joshi *et al.* (2019).

**Crop growth rate (g $m^{-2}$ $day^{-1}$)**

**Establishment method**

During both the years, DSR had higher crop growth rate (CGR) than other establishement methods at all the observations except 60- 90 DAS/DAT stage during 2019 and 90 DAS/DAT- At harvest stage during 2018 (Table 4). The variable trends in CGR at different observations were due to the variation in accumulated dry matter per day.

**Nutrient management practices**

Different nutrient management practices had a significant influence on CGR of rice at 30-60 DAS/DAT stage only during both the years of study (Table 4). During both the years of study, greater CGR was seen under 150% RDF over other practices at 30-60 DAS/DAT stage. However, the nutrient management practices had no significant influence on crop growth rate at 60-90 DAS/DAT and 90 DAS/DAT to harvest stage of rice during both the year of study.

**Relative growth rate (g $g^{-1}$ $day^{-1}$)**

**Establishment method**

Data pertaining to relative growth rate (RGR) of rice at 30-60, 60-90 DAS/DAT and 90 DAS/DAT to harvest varied significantly due to differennt establishment methods during both the year of study (Table-5). The maximum RGR was noted under DSR at all the stages of rice growth which was due to higher dry matter accumulation in this treatment except 30 DAS/DAT. Ishfaq *et al.* (2020) also reported that DSR achieved higher relative growth rate than TPR, as observed in our study.

**Nutrient management practices**

The highest RGR was recorded in 150% RDF over other nutrient management practices but statistically at par with RDF+5 t FYM at all the crop growth stages during both the years (Table 5). The lowest value of relative growth rate was observed under 100% RDF at all the stage of crop growth stages during both the years of study. As dry matter production was the highest with 150% RDF, so RGR was higher with this treament. The results are supported by the findings of Dissanayke *et al.* (2014) and Jeyajothi and Durairaj (2015).

## CONCLUSION

On the basis of present investigation it may concluded that the direct seeded method of rice establishment and RDF+5 t FYM nutrient management was found most effective for enhancing the growth attributes of rice over remaining treatments.

**Conflict of interest:** None.

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