Studies on Effect of Age of Seedling and Levels of Nitrogen on Performance of Hybrid Rice (Oryza sativa L.)

Govinda Kumar¹, Shivasankar Acharya¹*, S. K. Pathak¹, Sunil Kumar², Fozia Homa³ and Arun Kumar⁴

¹Dept. of Agronomy, ²Dept. of Soil Science and Agricultural Chemistry, ³Dept. of SMCA, ⁴Dept. of Seed Science and Technology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar (813 210), India

Abstract

A field experiment was conducted during kharif season of 2018 at Bihar Agricultural College Farm, Sabour, Bhagalpur, Bihar, to study the effect of age of seedling and levels of nitrogen on performance of hybrid rice (Oryza sativa L.) variety Arize-6444 Gold. The experiment was laid out in a split-plot design, replicated thrice with main plot assigned to three levels of age of seedling and subplot with four nitrogen levels. The result revealed highest grain yield (5374 kg ha⁻¹) recorded with 15 days seedling, being at par with 20 days seedling (5216 kg ha⁻¹), but differed significantly with 25 days seedling (4934 kg ha⁻¹). Among the nitrogen levels, significant difference in grain yield and harvest index was found with 150 kg N ha⁻¹ with values of 6050 kg ha⁻¹ and 45.21% respectively, being at par with 180 kg N ha⁻¹, whereas the highest straw yield (7439 kg ha⁻¹) was recorded with 180 kg N ha⁻¹, being at par with 150 kg N ha⁻¹. The highest net return (Rs. 60,850 ha⁻¹) was obtained with 15 days seedling, which was found at par with 20 days but differed significantly from 25 days seedling. Nitrogen levels significantly influenced the net return and B:C ratio, with the highest net return (Rs.73014 ha⁻¹) and B:C ratio (1.67) obtained with 150 kg N ha⁻¹ respectively, being at par with 180 kg N ha⁻¹ with net return and B:C ratio of Rs. 69,139 ha⁻¹ and 1.56 respectively, differing significantly from 120 kg N ha⁻¹ and no nitrogen plot.

Keywords: Age of seedling, nitrogen, hybrid rice, yield, economics

1. Introduction

Rice (Oryza sativa L.), also known as global grain, is a major cereal crop and most important staple primary food source for more than 60% of the world’s population (Prasad et al., 2010). India has the largest area under rice cultivation with an area of 43.19 mha., accounting for 29.40% of the global rice area. However, production of rice in India is 110.15 mt, with a national productivity of rice is 2.55 t ha⁻¹ (Anonymous, 2019). The current world population of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100 (World Population Prospects: The 2017 Revision). The yield of high yielding varieties of rice is plateauing and is rather difficult to achieve the target with the present day varieties. Therefore, to sustain self-sufficiency in rice, among the available technological options to enhance rice production and productivity, hybrid rice is the most practically feasible and readily adoptable technology. Hybrid rice technology has been identified as...
one of the alternative means to meet the challenge of food security for the increasing population (Islam et al., 2009). The success of hybrid rice cultivation depends on the exploitation of the full potential of the hybrids with improved package of practices such as suitable genotype, optimum plant population and optimum nutrition. The use of appropriate aged seedlings for transplantation and its timely planting are important non-cash inputs for attaining the higher yield of rice. Transplanting of younger aged seedlings utilizes phyllochronic potential to produce significantly higher grain yield of rice (Shukla et al., 2014). Hybrid rice crop is a heavy feeder of fertilizers and in addition to other nutrients; nitrogen is key nutrient of increased production, which directly influences the growth, development, yield and economics of hybrid rice. Nitrogen fertilization has a vital role in determining the percentage nitrogen in the rice grains and nitrogen uptake by the rice plants. Insufficient or inappropriate fertilizer nitrogen management may account for one-half to two-third of the gap between actual and potential irrigated rice yield. Thus, keeping in view of above facts into consideration, one experiment entitled “Studies on effect of age of seedling and levels of nitrogen on performance of hybrid rice (Oryza sativa L.)” was conducted with the objectives to study the effect of age of seedling and nitrogen level on growth, yield attributes, yield and economics of hybrid rice.

2. Materials and Methods

The present experiment was conducted at Bihar Agricultural College Farm, Sabour, Bihar Agricultural University, Sabour, during kharif season of 2018, which comes under Agro-climatic Zone III A of Bihar and Middle Gangetic plain region of India, situated at 25°50’ N latitude and 87°19’ E longitude with an altitude of 52.73 meters above mean sea-level. The monthly mean temperature during the crop growth period ranged from 29.6 °C in the month of November, 2018 to 35.5 °C in the month of June, 2018, whereas the monthly mean minimum temperature ranged from 12.9 °C in the month of November to 25.3 °C in the month of August, 2018. The total rainfall recorded during cropping period was 749.6 mm, out of which highest precipitation of 254.9 mm was recorded in the month of July, 2018 and 66.3 mm in September, 2018, which coincide with reproductive stage of the crop. However, no rainfall was received in the month of November during the crop period. The rainfall received during the crop growth period which was not sufficient for crop growth, for which need based irrigations were given.

The experiment was laid out in a split plot design, with three age of seedling treatments viz., 15 days, 20 days and 25 days in main plot and four levels of nitrogen viz., Control (No nitrogen), 100% RDN (120 kg N ha⁻¹), 125% RDN (150 kg N ha⁻¹) and 150% RDN (180 kg N ha⁻¹) in sub plot. Recommended doses of phosphate and potash (60 kg P₂O₅ ha⁻¹ and 40 kg K₂O ha⁻¹), along with nitrogen were applied as per treatments. The rice variety Arize-6444 Gold, developed by Bayer Bio-Science Pvt. Ltd. notified by Government of India, having 130-140 days duration, resistant to bacterial sheath blight, having milling percentage of more than 70% was selected for the present investigation.

All the recommended agronomic package of practices was implemented for the experiment. Fertilizer applications were done as per the fertilizer dose of the treatments. 50 per cent N, along with full dose of P₂O₅ and K₂O were applied at the time of transplanting as basal dose for different aged seedlings. The remaining 25% N was applied at maximum tillering stage and another 25% N at panicle emergence stage. The source of fertilizers for N, P₂O₅ and K₂O were Urea, SSP and MOP respectively. No N fertiliser was applied in control treatment plot.

The observation of growth and yield attributes were taken by taking five tagged hills into consideration. The physico-chemical properties of soil were also examined after the harvest of the crop. The Internal Nitrogen Use Efficiency, which is the additional grain yield produced by the application of nutrients over unfertilized plot per unit of nutrient applied, was calculated by the formula.

\[
\text{Internal Nitrogen Use Efficiency} = \frac{\text{Economic yield with N plot - Economic yield without N Plot}}{\text{Quantity of N applied}}
\]

The Partial Factor Productivity of Applied N was calculated by dividing grain yield of rice with the quantity of nitrogen applied and it was expressed in kg kg⁻¹.

\[
\text{Partial Factor Productivity of Applied N} = \frac{\text{Grain yield}}{\text{Quantity of nitrogen applied}}
\]

The Physiological Nitrogen Use Efficiency was calculated by the formula.

\[
\text{Physiological Nitrogen Use Efficiency} = \frac{(\text{Biological yield with N applied plot- Biological yield with control plot})}{(\text{N uptake of N applied plot}-\text{N uptake of control plot})}
\]

The cost of cultivation of different treatments was calculated on the basis of inputs used and their prevailing costs for the year 2018. Net return was calculated on the basis of grain and straw yield and their existing price for the year 2018. These values were used to calculate net return. Benefit: cost ratio was determined by dividing gross return with cost of cultivation. The data related with each parameters of rice was statistically analyzed as described by Cochran and Cox (1977). The significance of “F” test was tested at 5% levels of significance. The critical difference value was determined when “F” test was significant.

3. Results and Discussions

3.1. Effect on growth attributes

3.1.1. Plant height

The data of effect of age of seedling and levels of nitrogen on growth attributes of hybrid rice has been given in Table 1. The plant height of the crop at harvest as influenced by age...
of seed height (128.17 cm) was recorded with 20 days seedling. Significant difference in plant height of hybrid rice was noticed among nitrogen level treatments, with the highest plant height (135.16 cm), noticed with 180 kg N ha\(^{-1}\), being at par with 150 kg N ha\(^{-1}\) (133.47 cm). The interaction effect of age of seedling and N levels was found non-significant for plant height of rice at harvest, which might be due to the fact that plant height is a genetical character of a variety (Patel et al., 2010).

### 3.1.2. Leaf area index (LAI)

Significant difference in LAI was noticed for age of seedlings at 30 DAS, with highest LAI of 0.74, recorded for 15 days seedling, differing significantly with 20 days seedling (0.63), whereas, at 60 and 90 DAS, significant difference in LAI was noticed among the age of seedling treatments, with highest value observed with 15 days seedling having values of 2.39 and 5.11, respectively. LAI at 30, 60, 90 DAS and at harvest influenced significantly by nutrient level during the period of experimentation, with the highest LAI noticed with 180 kg N ha\(^{-1}\), with the value of 0.68, 2.72, 5.70, which were found at par with 150 kg N ha\(^{-1}\), with the value of 0.66, 2.51, 5.50 respectively, whereas, it was found highest with 150 kg N ha\(^{-1}\), having values of 3.85, being at par with 180 kg N ha\(^{-1}\) (3.82). The interaction effect of age of seedling and nitrogen levels was found significant for LAI of rice at 30 DAS only. After that, it resulted in non-significant result. Zeeshan et al. (2017) also reported a positive correlation of LAI with nitrogen application rate.

### 3.1.3. Crop growth rate (CGR)

The interaction effect of age of seedling and nitrogen levels was found significant for CGR at 30-60 DAS, with the highest CGR (12.95 g m\(^{-2}\) day\(^{-1}\)) recorded for 15 days seedling in combination with 180 kg N ha\(^{-1}\). The lowest CGR was recorded for 25 days seedling with control nitrogen plot, having value 6.80 g m\(^{-2}\) day\(^{-1}\). However, the interaction effect of age of seedling and nitrogen levels showed non-significant difference at 60-90 DAS and 90 DAS-harvest. However, irrespective of treatments, maximum CGR happened during 60-90 DAS was due to maximum accumulation of photosynthates during the period. This was in agreement with that of Islam et al. (2009).

### 3.1.4. Net assimilation rate (NAR)

Age of seedling significantly influenced the NAR at 30-60 DAS, the highest net assimilation rate (8.34 g m\(^{-2}\) day\(^{-1}\)) noticed with 25 days seedling, being at par with 20 days seedling, having value 7.97 g m\(^{-2}\) day\(^{-1}\), while at 60-90 DAS, it did not influence significantly. With regard to nitrogen levels, NAR was influenced significantly at 30-60 DAS, with the highest NAR (8.48 g m\(^{-2}\) day\(^{-1}\)) obtained with 120 kg N ha\(^{-1}\), being at par with 180 kg N ha\(^{-1}\), having value of 8.37 g m\(^{-2}\) day\(^{-1}\) and but differed significantly with 150 kg N ha\(^{-1}\). However, at 60-90 DAS, there was no significant difference found for NAR with regard to nitrogen level treatments. The interaction effect of age of seedling and nitrogen levels was found significant difference for NAR at 30-60 DAS, with the highest NAR obtained with 25 days seedling in combination with 120 kg N ha\(^{-1}\), having value of 9.33 g m\(^{-2}\) day\(^{-1}\). The lowest

---

**Table 1: Effect of age of seedling and levels of nitrogen on growth parameters of hybrid rice**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height at harvest (cm)</th>
<th>Leaf area index</th>
<th>CGR (g m(^{-2}) day(^{-1}))</th>
<th>NAR (g m(^{-2}) day(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 DAS</td>
<td>60 DAS</td>
<td>90 DAS</td>
<td>30-60 DAS</td>
</tr>
<tr>
<td>Main Plot (Age of seedling)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 days seedling</td>
<td>128.15</td>
<td>0.74</td>
<td>2.39</td>
<td>5.11</td>
</tr>
<tr>
<td>20 days seedling</td>
<td>128.17</td>
<td>0.63</td>
<td>2.23</td>
<td>4.92</td>
</tr>
<tr>
<td>25 days seedling</td>
<td>126.23</td>
<td>0.56</td>
<td>2.10</td>
<td>4.57</td>
</tr>
<tr>
<td>SEm±</td>
<td>2.28</td>
<td>0.01</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>CD (p=0.05)</td>
<td>NS</td>
<td>0.05</td>
<td>0.22</td>
<td>0.39</td>
</tr>
<tr>
<td>Sub plot (Nitrogen levels)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>114.33</td>
<td>0.58</td>
<td>1.76</td>
<td>3.21</td>
</tr>
<tr>
<td>120 kg N ha(^{-1})</td>
<td>127.11</td>
<td>0.65</td>
<td>1.98</td>
<td>5.07</td>
</tr>
<tr>
<td>150 kg N ha(^{-1})</td>
<td>133.47</td>
<td>0.66</td>
<td>2.51</td>
<td>5.50</td>
</tr>
<tr>
<td>180 kg N ha(^{-1})</td>
<td>135.16</td>
<td>0.68</td>
<td>2.72</td>
<td>5.70</td>
</tr>
<tr>
<td>SEm±</td>
<td>1.31</td>
<td>0.01</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>CD (p=0.05)</td>
<td>3.89</td>
<td>0.02</td>
<td>0.13</td>
<td>0.31</td>
</tr>
<tr>
<td>Interaction</td>
<td>NS</td>
<td>S</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>
NAR was recorded in 15 days seedling with control nitrogen application, having value of 6.37 g m\(^{-2}\) day\(^{-1}\), while at 60-90 DAS and 90 DAS-harvest, there was non-significant difference found for NAR.

3.2. Effect on yield attributes

3.2.1. Effective tillers

The data of effect of age of seedling and levels of nitrogen on yield attributes like effective tillers m\(^{-2}\), panicle length, total grains panicle\(^{-1}\), filled grains per panicle and test eight at harvest by hybrid rice is given in Table 2.

Data of the effect of age of seedling on effective tillers m\(^{-2}\) revealed no significant difference, whereas, with respect to different nitrogen levels, the highest number of effective tillers (236.13 m\(^{-2}\)) was recorded with 150 kg N ha\(^{-1}\), which was found at par with 120 kg N ha\(^{-1}\) and 180 kg N ha\(^{-1}\), having values of 221.08 m\(^{-2}\) and 213.73 m\(^{-2}\) respectively. There was no significant interaction effect recognised between age of seedling and different nitrogen levels on effective tiller m\(^{-2}\) at harvest. The results are in conformity with those of Tripathi and Jaishwal (2006).

3.2.2. Panicle length (cm)

Age of seedling did not influence panicle length of rice significantly, whereas nitrogen levels significantly influenced panicle length of rice during the experiment. Nitrogen levels at 150 kg N ha\(^{-1}\) recorded maximum panicle length (26.35 cm), which differed significantly with 120 kg N ha\(^{-1}\), 180 kg N ha\(^{-1}\) and control plot, having values 25.51 cm, 25.19 cm and 21.86 cm respectively. There was no significant difference in interaction effect obtained with age of seedling and nitrogen levels on panicle length at harvest. Maximum panicle length was also reported with higher nitrogen application (Metwally et al., 2011).

3.2.3. Filled grains panicle\(^{-1}\)

The result revealed that age of seedling did not affect the filled grains panicle\(^{-1}\) of hybrid rice, whereas, significant difference was observed for filled grains panicle\(^{-1}\), with the highest number of filled grains panicle\(^{-1}\) obtained with 150 kg N ha\(^{-1}\) with the value 145.44, which was significantly at par with that of 180 kg N ha\(^{-1}\) and 120 kg N ha\(^{-1}\), with values of 144.32 and 132.95 filled grains per panicle respectively. The interaction effect was found non-significant between age of seedling and different nitrogen levels on filled grains panicle\(^{-1}\) at harvest. Wu et al. (1998) also reported similar results that with increasing levels of soil fertility, the number unfilled spikelets per panicle decreased with corresponding increase in filled spikelets.

3.2.4. Test weight of grain

Data related to the effect of age of seedling on test weight revealed no significant difference during the experimentation, with the highest test weight (23.74 g) observed for 15 days seedling, followed by 20 days seedling (23.53 g). With respect to different nitrogen levels, significant difference was observed for test weight with the highest test weight obtained with 150 kg N ha\(^{-1}\), with value 24.62 g, which was at par with 180 kg N ha\(^{-1}\) and 120 kg N ha\(^{-1}\) with values 23.93 g and 23.62 g respectively and the lowest test weight was observed in control plot having value 21.36 g, which differed significantly with the rest of the subplot treatments. With respect to interaction effect of age of seedling and nitrogen levels no significant difference was observed for test weight.

Table 2: Effect of age of seedling and levels of nitrogen on yield parameters of hybrid rice

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Effective tillers m(^{-2})</th>
<th>Filled grain panicle(^{-1})</th>
<th>Test weight (g)</th>
<th>Grain yield (kg ha(^{-1}))</th>
<th>Straw yield (kg ha(^{-1}))</th>
<th>Harvest index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Plot (Age of seedling)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 days seedling</td>
<td>214.1</td>
<td>138.0</td>
<td>23.74</td>
<td>5374</td>
<td>6684</td>
<td>44.30</td>
</tr>
<tr>
<td>20 days seedling</td>
<td>209.6</td>
<td>134.1</td>
<td>23.53</td>
<td>5216</td>
<td>6552</td>
<td>44.05</td>
</tr>
<tr>
<td>25 days seedling</td>
<td>205.3</td>
<td>133.2</td>
<td>22.87</td>
<td>4934</td>
<td>6519</td>
<td>42.78</td>
</tr>
<tr>
<td><strong>SEm±</strong></td>
<td>7.21</td>
<td>5.80</td>
<td>0.72</td>
<td>75.29</td>
<td>184.57</td>
<td>0.83</td>
</tr>
<tr>
<td><strong>CD (p=0.05)</strong></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>295.63</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Sub plot (Nitrogen levels)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>167.65</td>
<td>117.7</td>
<td>21.36</td>
<td>3348</td>
<td>4803</td>
<td>41.05</td>
</tr>
<tr>
<td>120 kg N ha(^{-1})</td>
<td>221.08</td>
<td>132.9</td>
<td>23.62</td>
<td>5461</td>
<td>6788</td>
<td>44.61</td>
</tr>
<tr>
<td>150 kg N ha(^{-1})</td>
<td>236.13</td>
<td>145.4</td>
<td>24.62</td>
<td>6050</td>
<td>7310</td>
<td>45.27</td>
</tr>
<tr>
<td>180 kg N ha(^{-1})</td>
<td>213.73</td>
<td>144.3</td>
<td>23.93</td>
<td>5840</td>
<td>7439</td>
<td>43.90</td>
</tr>
<tr>
<td><strong>SEm±</strong></td>
<td>7.60</td>
<td>5.32</td>
<td>0.71</td>
<td>134.06</td>
<td>115.60</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>CD (p=0.05)</strong></td>
<td>22.57</td>
<td>15.81</td>
<td>2.10</td>
<td>398.31</td>
<td>343.46</td>
<td>2.43</td>
</tr>
<tr>
<td><strong>Interaction</strong></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>
during the experimentation. Brar et al. (2012) reported no significant effect of seedling age on 1000-grain weight and different age conceived statistically similar thousand grain weight, as test weight is a genetical character of a variety.

3.2. Effect on yield
3.2.1. Grain yield

The result of the effect of age of seedling treatments was found significant with respect to grain yield, with the highest grain yield (5374 kg ha$^{-1}$) recorded with 15 days seedling, which was statistically at par with 20 days seedling (5216 kg ha$^{-1}$) and the lowest grain yield (4934 kg ha$^{-1}$) was recorded at 25 days seedling. 15 days seedling registered an incremental grain yield of 3.02% and 8.9% superiority over 20 days and 25 days seedlings respectively. Ali et al. (2013) had tested effect of different seedling ages on Boro Rice BRRI Dhan-28 and also found maximum grain yield when young seedlings of 15 days were transplanted while minimum was observed in case of aged seedlings of 30 days.

Data inferred to different nitrogen levels revealed significant difference in grain yield with the highest grain yield (6050 kg ha$^{-1}$) for 150 kg N ha$^{-1}$, which was statistically at par with 180 kg N ha$^{-1}$, with grain yield of 5840 kg ha$^{-1}$. Reddy et al. (2011) also observed increased grain yield with increase in N upto 150 kg N ha$^{-1}$. The interaction effect of age of seedling and different nitrogen levels was found non-significant with respect to grain yield of hybrid rice during the experimentation. Awan et al. (2011) also reported maximum grain yield of rice variety, KSK-133 when nitrogen was applied at higher rate (156 kg ha$^{-1}$) while minimum was recorded from low level of nitrogen fertilizer (110 kg ha$^{-1}$).

3.2.2. Straw yield

The age of seedling resulted no significant difference in straw yield of rice, with the highest straw yield (6684 kg ha$^{-1}$) obtained with 15 days seedling, followed by 20 days seedling and 25 days seedling, with that of 6552 kg ha$^{-1}$ and 6519 kg ha$^{-1}$ straw yield respectively.

Among the nitrogen levels, significant difference in straw yield was assessed with the highest straw yield (7439 kg ha$^{-1}$) obtained with 180 kg N ha$^{-1}$ which was significantly at par with 150 kg N ha$^{-1}$ with that of 7310 kg ha$^{-1}$. The interaction effect of age of seedling and different nitrogen levels was found non-significant with respect to straw yield at harvest. Pramanik and Bera (2013) also reported maximum straw yield (7734 kg ha$^{-1}$) with the application of higher rate (200 kg ha$^{-1}$) of nitrogen fertilizer while minimum value (5213 kg ha$^{-1}$) of straw yield was obtained at control with no nitrogen application.

3.2.3. Harvest index

No significant difference in the effect of age of seedling observed with respect to harvest index. However, maximum harvest index (44.30%) was recorded in 15 days seedling, followed by 20 days seedling and 25 days seedling. Nitrogen levels influenced significant difference among sub plot treatments, with the maximum harvest index (45.27%) accounted in 150 kg N ha$^{-1}$, being at par with 120 kg N ha$^{-1}$ and 180 kg N ha$^{-1}$, with that of 44.61 and 43.90% respectively. The interaction effect of age of seedling and different nitrogen levels was found non-significant with respect to harvest index. The improved harvest index might be due to the healthier and vigorous plant growth, improved plant height, increased crop growth rate and net assimilation rate which ultimately ended in the increased harvest index. The results are in conformity with those of Bera and Pramanik (2012).

3.3. Nitrogen use efficiency and economics
3.3.1. Agronomic nitrogen use efficiency

No significant difference in agronomic nitrogen use efficiency, among the different age of seedling treatments was observed (Table 3). The highest agronomic nitrogen use efficiency (12.50 kg kg$^{-1}$) was recorded in 20 days seedling. Different nitrogen levels revealed significant effect on the agronomic nitrogen use efficiency, with the maximum value (18.01 kg kg$^{-1}$) recorded with 150 kg N ha$^{-1}$, which was found at par with 120 kg N ha$^{-1}$. The interaction effect of age of seedling and nitrogen levels was found non-significant with respect to agronomic nitrogen use efficiency. Tripathi et al. (2011) also found nitrogen use efficiency of hybrid and inbred rice cultivars which showed reverse trend against each increase in nitrogen level.

3.3.2. Partial factor productivity of applied nitrogen

Data on age of seedling recorded significant difference with respect to the partial factor productivity of applied nitrogen, with the highest partial factor productivity of applied nitrogen (26.16 kg kg$^{-1}$) obtained with 15 days seedling, which was statistically at par with 25 days seedling (25.49 kg kg$^{-1}$) and lowest partial factor productivity of applied nitrogen with 25 days seedling (23.86 kg kg$^{-1}$). The effect of different nitrogen levels also significantly influenced the partial factor productivity of applied nitrogen, with the maximum (40.33 kg kg$^{-1}$) partial factor productivity of nitrogen recorded in 150 kg N ha$^{-1}$, significantly differing from 120 kg N ha$^{-1}$ and 180 kg N ha$^{-1}$, with that of 32.44 kg kg$^{-1}$ and 27.90 kg kg$^{-1}$, respectively. The interaction effect of age of seedling and different nitrogen levels was found non-significant for partial factor productivity of applied nitrogen. That was in conformity with the findings of Sharma et al. (2007).

3.3.3. Physiological nitrogen use efficiency

Among the age of seedling treatments, no significant difference in physiological nitrogen use efficiency was observed, while, among the nitrogen levels, significant difference in physiological nitrogen use efficiency was recorded with the highest physiological nitrogen use efficiency recorded for 150 kg N ha$^{-1}$, having value of 98.19 kg kg$^{-1}$, which was found at par with 120 kg N ha$^{-1}$, having value 96.53 kg kg$^{-1}$ due to inclusion of dry matter in calculating this efficiency (Fageria and Baligar, 2003). The interaction effect of age of seedling and different nitrogen levels did not show any significant difference with
regard to physiological nitrogen use efficiency.

3.3.4. Net return

Age of seedling affected the net return of hybrid rice significantly, with the highest net return (\(\text{Rs} \ 60,850 \text{ ha}^{-1}\)) obtained with 15 days seedling, which was statistically at par with 20 days (\(\text{Rs} \ 57,889 \text{ ha}^{-1}\)) and significantly differed from 25 days seedling with that of \(\text{Rs} \ 52,904 \text{ ha}^{-1}\). With respect to the effect of nitrogen levels, significant difference was also calculated for net return, with the highest net return (\(\text{Rs} \ 73,014 \text{ ha}^{-1}\)) reported with 150 kg N ha\(^{-1}\), being at par with 180 kg N ha\(^{-1}\), with net return of \(\text{Rs} \ 69,139 \text{ ha}^{-1}\) and differed significantly from 120 kg N ha\(^{-1}\) and control plot, having ratios of \(\text{Rs} \ 62,309\) and \(\text{Rs} \ 24,397\) respectively.

There was no significant interaction effect was recognised between age of seedling and different nitrogen levels, on net return of hybrid rice.

3.3.5. Benefit: cost ratio (B:C ratio)

Age of seedling affected B:C ratio of hybrid rice significantly, with the highest benefit: cost ratio (1.40) obtained for 15 days seedling, being at par with 20 days seedling having values of 1.33 and differed significantly from 25 days seedling with values of 1.21. With respect to different nitrogen levels, significant difference in B:C ratio was recorded with the highest B:C ratio (1.67) in 150 kg N ha\(^{-1}\), being at par with 180 kg N ha\(^{-1}\) (1.56) and differed significantly with 120 kg N ha\(^{-1}\) and control plot, having ratios of 1.43 and 0.59 respectively.

4. Conclusion

Hybrid rice cultivar Arize-6444 Gold may be transplanted with 15 days seedling and fertilized with 150:60:40 kg N:P\(_2\)O\(_5\)::K\(_2\)O ha\(^{-1}\), for producing higher yield parameters, resulting in higher grain yield and net return to farmers.

5. References


Bera, A.K., Pramanik K., 2012. Response of Hybrid Rice (Oryza sativa L.) to Varying Levels of Nitrogen and Homobrassinosteroids in Lateritic Zone of West Bengal 3(2), 165–168.


