Management of Cutting Height and Nitrogen Fertilizer Rates on Grain Yield and Several Attributes of Ratoon Rice (*Oryza sativa* L.) In Iran

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**Abstract:** In order to study effects of cutting height and nitrogen fertilizer rates on yield and several attributes of ratoon rice an experiment in factorial format based on randomized complete block design with three replications in Rasht township (north of Iran) during 2009 farming year was conducted. Factors of experiment were included three levels of cutting height (H1:10 cm, H2:25 cm and H3:30 cm cutting height) and four levels of nitrogen fertilizer rates (N1: control (without nitrogen fertilizer application), N2: 30 kg/ha, N3: 60 kg/ha and N4: 90 kg/ha nitrogen fertilizer). Studied traits were grain yield, number of tillers per plant, number of grains per panicle, plant height and 1000 grains weight. Results of experiment showed that, the effect of cutting height on grain yield in 1% and on number of tillers per plant in 5% probability level was significant and on other traits was non significant. Effect of nitrogen fertilizer on grain yield and number of tillers per plant in 1% and on plant height in 5% was significant. But on number of grains per panicle and 1000 grains weight doesn’t showed significant differences. Interaction effects between cutting height and nitrogen rates on grain yield showed significant differences in 1% probability level and on other traits was non significant. Eventually, the highest grain yield with 1952 kg/ha was recorded from 30 cm cutting height along with 60 kg/ha nitrogen fertilizer application (H3N2 treatment).

**Key words:** Ratoon Rice • Cutting Height • Nitrogen Rates • Yield

**INTRODUCTION**

Rice (*Oryza sativa* L.) is one of the most important and delicious food crops of the world. There are rice growing countries in the word that occupies about 146.5 million hectares more than 90% is in Asia. Nitrogen, a plant nutrient is required by plants in comparatively larger amounts than other elements [1]. Increasing rice grain yields per unit of area is one approach to improving total rice production [2]. Ratooning is the practice of harvesting grain from tillers originating from the stubble of a previously harvested crop (main crop). It enhances rice grain yields without increasing land area [3] because it provides higher resource-use efficiency per unit of land area and per unit of time [2]. Therefore, the benefit in ratooning lies in the facts of avoiding elaborate land preparation, saving of seed planting costs [4], economic use of machineries, high water use efficiency [5] and considerable saving in cropping time as it has the advantages of reduced growth duration [6]. Satisfactory yield of ratoon rice depends on varieties, seasonal requirements, optimum fertilizer dose, time of fertilization, cutting height, planting date and spacing of main crop, harvesting date of main crop, water and pest management and etc. [2,7]. Among different factors, applications of fertilizers and cutting height have the prominent role in the performance of ratoon rice [8, 9]. According to Begum et al. [10], cultivation and cultural practices, including cutting height and fertilizer management, which provide a large quantity of reserves at harvest may be advantageous for rice ratooning. Nitrogen is required by plants in comparatively larger amounts than other elements [11]. Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll)
tissues of soft consistency and relatively poor root growth. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases [12]. Nitrogen (N) fertilizer use has played a significant role in increase of crop yield [13]. Balasubramanian and Ali [14], were reported that yield of ratoon rice increased with the increasing rate of nitrogen up to 125 kg/ha. Also, Chuang and Ding [15], were fund that the application of nitrogen fertilizer by 140 kg/ha produced better ratoon yield. Application of 100 kg/ha nitrogen produced high quality rice. Although application of nitrogen is a major factor to produce acceptable rice grain yields, excessive application of N can have negative results [9, 16, 17]. Yield of ratoon rice is also affected by cutting height. The ratoon tiller regeneration and growth depend on the number of buds which remain on the stubbles [18]. Prasher [5] mentioned that the tiller number of the ratoon crop increases with increasing in the cutting height. He reported that tillers regenerated from higher nodes formed more quickly, grew faster and matured earlier. The objectives of the present research are to determine the effect of cutting height and also nitrogen fertilizer rate on ratoon rice yield and yield components.

**MATERIALS AND METHODS**

In order to study effects of cutting height and nitrogen fertilizer rates on yield and several attributes of ratoon rice variety Hassani an experiment in factorial format based on randomized complete block design with three replications in a field situated in Rasht township (Guilan province in north of Iran) with 37° 15' N latitude and 49° 53' E longitude in 2009 farming year was conducted. Soil analysis results were showed in Table 1. The soil texture was Silty clay loam and pH 7.5. Factors of experiment were included three levels of cutting height (H:10 cm, H:25 cm and H:30 cm cutting height) and four levels of nitrogen fertilizer rates (N: control (without nitrogen fertilizer application), N: 30 kg/ha, N: 60 kg/ha and N: 90 kg/ha pure nitrogen from source of urea (46%)). The operations of preparing land for main crop includes first plough in winter and secondary plough along with giving phosphorus and potash before transplanting of main crop was done. The area of plots was 15 m². Plants spacing was 25×25 cm. harvesting of main crop in physiological maturing stage was carried based on cutting height treatments. Immediately after main crop harvesting irrigation was done and then nitrogen treatments were utilized. During growth period, cultivate cares were done ordinarily. In maturity time, grain yield, number of tillers per plant, number of grains per panicle, plant height and 1000 grains weight was measured. The yield and yield components were analyzed by using MSTAT-C software. The Duncan’s multiple range tests was used to compare the means at 5% of significant.

**RESULTS AND DISCUSSION**

**Effect of Cutting Height:** With attention to variance analysis table (Table 2), the effect of cutting height on grain yield in 1% probability level and on number of tillers per plant in 5% probability level was significant. Also, on number of grains per panicle, plant height and 1000 grains weight was non significant. Dustin et al [19] expressed that cutting at appropriate height had a positive effect on ratoon yield. The highest grain yield with 1069.167 kg/ha and number of tillers with 11.167 tillers per plant was recorded from 30 cm Cutting height (H). The H treatment (25 cm cutting height) with 10.35 kg/ha grain yield statistically was placed in same level with H treatment. On the other hand the lowest amounts of grain yield with 568.583 kg/ha and number of tillers with 9.5 tillers per plant were obtained from 10 cm cutting height (Figure 1 and 2). Similar results were reported by Prasher [5], Jones [20], Karbalaie et al [21], Mochizuki et al [8] and Daliri et al. [22].

**Effect of Nitrogen Fertilizer Rates:** Results of variance analysis (Table 2) showed that, the effect of nitrogen fertilizer rates on grain yield and number of tillers per plant in 1% probability level and on plant height in 1% probability level was significant. On the other hand, nitrogen fertilizer treatments don’t showed any significant effect on number of grains per panicle and 1000 grain weight. Maximum amount of grain yield with 1398 kg/ha was found from 60 kg/ha nitrogen fertilizer application. On the other hand the minimum amount of grain yield with 534 kg/ha was recorded from 30 kg/ha nitrogen fertilizer

### Table 1: the results of soil analysis at the experimental sites

<table>
<thead>
<tr>
<th>Depth</th>
<th>Soil texture</th>
<th>Sand %</th>
<th>Silt %</th>
<th>Clay %</th>
<th>pH</th>
<th>Sp %</th>
<th>Organic Carbon %</th>
<th>Total N %</th>
<th>Phosphorus (p.p.m)</th>
<th>Potassium (p.p.m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30</td>
<td>Silty clay loam</td>
<td>11.5</td>
<td>52.5</td>
<td>35</td>
<td>7.5</td>
<td>77.2</td>
<td>1.31</td>
<td>0.130</td>
<td>11.5</td>
<td>185</td>
</tr>
</tbody>
</table>

Table 2: Analysis of variance related to the traits of ratoon rice under cutting height and nitrogen fertilizer application

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>df</th>
<th>Grain yield (kg/ha)</th>
<th>Number of tillers per plant</th>
<th>Number of grains per panicle</th>
<th>Plant height (cm)</th>
<th>1000 grains weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>2</td>
<td>12978.111&quot;**&quot;</td>
<td>3.583&quot;**&quot;</td>
<td>0.583&quot;**&quot;</td>
<td>348.528&quot;**&quot;</td>
<td>0.809&quot;**&quot;</td>
</tr>
<tr>
<td>Cutting height (H)</td>
<td>2</td>
<td>939601.028&quot;**&quot;</td>
<td>9.333&quot;**&quot;</td>
<td>1.083&quot;**&quot;</td>
<td>422.694&quot;**&quot;</td>
<td>0.808&quot;**&quot;</td>
</tr>
<tr>
<td>Nitrogen rates (N)</td>
<td>3</td>
<td>1335993.111&quot;**&quot;</td>
<td>22.407&quot;**&quot;</td>
<td>5.741&quot;**&quot;</td>
<td>150.741&quot;**&quot;</td>
<td>0.375&quot;**&quot;</td>
</tr>
<tr>
<td>H×N</td>
<td>6</td>
<td>206757.806&quot;**&quot;</td>
<td>4.630&quot;**&quot;</td>
<td>4.157&quot;**&quot;</td>
<td>47.657&quot;**&quot;</td>
<td>0.899&quot;**&quot;</td>
</tr>
<tr>
<td>Error</td>
<td>22</td>
<td>15846.505</td>
<td>2.644</td>
<td>2.523</td>
<td>102.316</td>
<td>0.881</td>
</tr>
</tbody>
</table>

Ns, ** and * respectively: non significant, significant in 1% and 5% area

**Interaction Effect:** Interaction effect of cutting height and nitrogen fertilizer rates on all studied traits except grain yield was non significant and on grain yield showed significant differences in 1% probability level (Table 2). Between interaction effects levels, the highest grain yield with 1952 kg/ha was recorded from H2N2 (10 cm cutting height along with 60 kg/ha nitrogen fertilizer application) treatment. On the other hand the lowest grain yield with 388 kg/ha was obtained by H2N1 (10 cm cutting height along with 30 kg/ha nitrogen fertilizer application).
Fig. 3: Effect of nitrogen fertilizer rates on ratoon rice grain yield

Fig. 4: Effect of nitrogen fertilizer rates on number of tillers per plant

Fig. 5: Effect of nitrogen fertilizer rates on plant height
treatment (Figure 6). Similar results were reported by Naij-Nejad [25], Begum et al. [10], Kavoosi et al. [24] and Rahimi Petroudi et al. [26].

CONCLUSION

Obtained results from experiment clearly demonstrate that cutting height and nitrogen chemical fertilizer had a significant and positive effect on yield of ratoon rice. grain yield of ratoon rice was greater under 60 kg/ha nitrogen fertilizer and 30 cm cutting height. Due to these findings the ratoon rice variety Hassani with nitrogen fertilizer of 60 kg/ha and cutting height of 30 cm was suggested for cultivation rice in this region.

REFERENCES