Physiological parameters and grain yield as influenced by time of transplanting and rice (Oryza sativa) hybrids

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ABSTRACT

A field experiment comprising 4 dates of transplanting (15, 25 June and 5, 25 July) in conjunction with 4 genotypes (3 hybrids: ‘OR1 161’ ‘PHB 71’ ‘PMS2A/IR31802, ‘PMS10A/PR106’ and 1 inbred variety ‘HKR 126’) was conducted during rainy season of 1993 and 1994. Crop-growth rate (CGR) prior to panicle-initiation (PI) stage was higher in July transplanting, whereas it increased significantly in 25 June planting during post-PI stage through flowering period. Leaf-area duration (LAD) during pre-PI stage was the longest in the most delayed planting, but 25 June planting excelled over other dates during flowering period of crop growth. Leaf-area ratio (LAR) was the highest in June-planted crop at all the time intervals. Panicles/m², grain and straw yields were higher in 25 June-planted crop, followed by 5 July. Spikelet sterility was maximum in 25 July and minimum in 25 June-transplanted crop. Hybrid ‘OR1 161’ (‘PHB 71’) exhibited superiority to other genotypes in CGR, LAD, grain yield and straw yield. Spikelet sterility (%) was lowest in ‘OR1 161’, followed by ‘HKR 126’.

Key words: Physiological parameters, Yield, Rice, Transplanting

Heterosis in rice brings about 14–28% increase in grain yield (Siddiq, 1993) and its commercial exploitation is the only alternative to combat the arising situation of food insecurity. An effective agronomic management is, therefore, necessary to exploit the yield potential of hybrid rice. Temporal variability at a particular location may influence growth and development of the plant. Thus, the knowledge of rate and pattern of growth parameters with respect to grain yield may offer a pertinent ground for the inductive assessment of hybrids. To collect the information in this context, the present study was undertaken.

MATERIALS AND METHODS

A field study was undertaken during wet seasons of 1993 and 1994 at Rice Research Station, Kaul (Kaithal). The experiment comprised 4 dates of transplanting (15, 25 June and 5 and 25 July) in main plots and 4 genotypes (3 hybrids: ‘OR1 161’ ‘PHB 71’) ‘PMS2A/IR31802’ and ‘PMS10A/PR106’
and 1 inbred variety ‘HKR 126’) in sub-
plots. The soil of the experimental site was
clay-loam, with pH 8.1, EC 0.26 dS/m,
O.C. 0.31%; and 99.6, 26.0 and 389.7 kg/ha
available N,P and K respectively.

Two seedlings/hill were planted at a
spacing of 20 cm × 15 cm in split-plot
design with 4 replications. Staggered
sowing of nursery was done to get 30-day-
old seedlings at the time of transplanting
except in 25 July transplanting in 1993,
where 40-day-old seedlings were used. The
field was fertilized with 150 kg N, 60 kg
P₂O₅ and 25 kg ZnSO₄/ha. Nitrogen was
applied in 3 equal splits at 4, 21 and 42
days after transplanting (DAT).

The observations on leaf-area index
(LAI) and dry-matter accumulation were
recorded at an interval of 20 days. The
crop-growth rate (CGR) and leaf-area
duration (LAD) were worked out using the
formula given by Watson (1952) and Power
et al. (1967) respectively. The LAR was
calculated by the formula described by
Ahlawat and Sharma (1993). The time
intervals for which the growth rates have
been computed are symbolised by: T₁, 20
days duration before panicle-initiation (PI)
stage; T₂, 20 days duration after PI stage;
and T₃, 20 days duration during flowering
stage.

RESULTS AND DISCUSSION

Crop-growth rate (CGR)
The crop transplanted on 25 June
recorded the highest CGR during post-PI
stages (T₂ and T₃), which was significantly
superior to that obtained in other dates of
planting except 15 June in T₃ (20 days after
PI stage) in 1993 (Table 1). Prior to PI stage
(T₁) 5 July in 1993 and 25 July in 1994
were significantly better for CGR over
other dates. The (CGR) either remained
consistent or increased with the advanced
growth of the crop in first 3 dates, whereas
it decreased from T₁ onwards in 25 July
planting. These results are in partial
confirmation with those of Kim (1985).

Hybrid ‘ORI 161’ (‘PHB 71’) was either
significantly superior or at par with other
genotypes at all the time intervals. During
flowering stage (T₃), inbred cultivar ‘HKR
126’ was significantly better than other
hybrids except ‘PHB 71’.

Leaf-area duration (LAD)
The LAD was significantly longer in
most delayed planting (25 July) than other
dates before PI stage (Table 1). After that
25 June transplanting recorded the longest
LAD except in T₂ during 1994. The results
of 5 July transplanting were significantly
superior to the earliest planting (15 June) at
all the time intervals except at T₃ in 1994,
where the differences were non-significant.
The LAD was the longest in hybrid ‘PHB
71’ followed by ‘PMS2A/IR31802’ at all
the time intervals. There was a tremendous
increase in LAD from T₁ to T₂ but
thereafter it decreased through flowering
period (T₃).

Leaf-area ratio (LAR)
The LAR was highest before PI stage
(T₁) which decreased through T₂ and
remained at minimum level during heading
stage (T₃) irrespective of time of
transplanting and genotypes (Table 2). In
1994, LAR was significantly higher in 15
June planting than other dates except in T₃.
Table 1. Effect of time of transplanting and rice hybrids on crop-growth rate and leaf-area duration

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Crop-growth rate (g/m²/day)</th>
<th>Leaf-area duration (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$T_1$</td>
<td>$T_2$</td>
</tr>
<tr>
<td>Time of transplanting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 June</td>
<td>15.0</td>
<td>10.0</td>
</tr>
<tr>
<td>25 June</td>
<td>12.5</td>
<td>15.5</td>
</tr>
<tr>
<td>5 July</td>
<td>18.0</td>
<td>19.5</td>
</tr>
<tr>
<td>25 July</td>
<td>12.5</td>
<td>25.5</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>1.8</td>
<td>3.2</td>
</tr>
<tr>
<td>Rice hybrid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘PHB 71’</td>
<td>15.5</td>
<td>19.0</td>
</tr>
<tr>
<td>‘PMS2A/IR31802’</td>
<td>15.5</td>
<td>17.0</td>
</tr>
<tr>
<td>‘PMS10A/PR106’</td>
<td>13.5</td>
<td>18.0</td>
</tr>
<tr>
<td>‘HKR 126’</td>
<td>13.5</td>
<td>16.5</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>1.5</td>
<td>NS</td>
</tr>
</tbody>
</table>

$T_1$, 20 days duration before PI stage; $T_2$, 20 days duration after PI stage; $T_3$, 20 days duration during flowering stage
Table 2. Effect of time of transplanting and hybrids on leaf-area ratio and yield of unhusked rice

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Leaf area ratio (cm²/g)</th>
<th>Panicles/m²</th>
<th>Spikelet sterility (%)</th>
<th>Grain yield (q/ha)</th>
<th>Straw yield (q/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 June</td>
<td>135 225 105 138</td>
<td>46 68</td>
<td>303 232</td>
<td>26.2 27.6</td>
<td>72.0 67.8</td>
</tr>
<tr>
<td>25 June</td>
<td>141 188 129 118</td>
<td>70 66</td>
<td>347 263</td>
<td>20.4 23.4</td>
<td>78.9 75.4</td>
</tr>
<tr>
<td>5 July</td>
<td>119 170 100 115</td>
<td>55 66</td>
<td>326 204</td>
<td>22.1 25.4</td>
<td>76.3 72.1</td>
</tr>
<tr>
<td>25 July</td>
<td>103 167 58 105</td>
<td>24 53</td>
<td>291 204</td>
<td>28.8 37.9</td>
<td>55.3 42.4</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>18 21 13 11</td>
<td>5 6</td>
<td>24 10</td>
<td>2.1 1.8</td>
<td>4.0 2.7</td>
</tr>
</tbody>
</table>

Rice hybrid

PHB 71’ | 119 185 94 120 | 47 63 | 327 242 | 19.2 24.4 | 77.8 73.5 | 69.3 68.0 |

PMS2A/IR31802’ | 136 212 99 126 | 49 68 | 336 253 | 25.3 29.7 | 72.6 65.7 | 66.1 63.9 |

PMS10A/PR106’ | 122 162 95 112 | 49 62 | 294 226 | 30.1 33.9 | 63.2 57.7 | 62.9 63.8 |

HKR 126’ | 122 199 103 117 | 51 62 | 310 227 | 23.5 27.6 | 69.0 60.8 | 63.6 62.2 |

CD (P = 0.05) | NS 17 NS NS | NS NS | 20 14 | 2.0 2.0 | 1.9 2.0 | 2.7 2.8 |

T₁, 20 days duration before PI stage; T₂, 20 days duration after PI stage, T₃, 20 days duration during flowering stage
where it was at par with 25 June and 5 July planting. In 1993, 25 June planting excelled over other dates in LAR. The LAR due to genotypes did not differ significantly except during pre-PI stage in 1994.

**Yield and yield attributes**

Grain yield was significantly higher in 25 June transplanted crop (75.4 q/ha) in 1993, but at par with 5 July planting in 1994. Panicles/m², grain and straw yields were the highest in 25 June planting. Spikelet sterility increased when the crop was planted on the earliest date (15 June) or July planting and reached the highest level in 25 July planting. Hybrid ‘PHB1’ gave 7.2, 23.1 and 12.8; and 11.9, 27.4 and 20.9% higher grain yield than hybrids ‘PMS2A/IR31802’, ‘PMS10A/PR106’ and inbred cultivar ‘HKR 126’ in 1993 and 1994 respectively. Straw yield was the highest and spikelet sterility was the lowest in ‘PHB 21’, followed by variety ‘HKR 126’. The superiority of hybrid ‘PHB 71’ in grain yield over other genotypes was reported by Singh and Panwar (1994). The increase in grain yield with 25 June planting and hybrid ‘PHB 71’ might be due to higher CGR and LAR, longer LAD particularly after PI stage and lowest spikelet sterility.

**REFERENCES**


