Diallel Analysis of Inheritances of the Heading Date of Rice under the Short Day Condition

Jae-Seong Jo and In-Seop Lee*

SUMMARY

To information on the inheritance of heading date of rice under the short-day condition, the F₂ seeds obtained from all possible combinations of the diallel crosses between five leading rice varieties: Nongbaek, Tongil, Palgueng, Mangyeong and Gimmaze were grown under the short-day condition and natural condition. The days to heading were investigated and analysed for genetic components.

The results obtained are summarized as follows.

1. Under the natural condition, the durations to heading of all combinations excluding Nongbaek x Palgueng and Nongbaek x Mangyeong were longer than those of their parents. Whereas, under the short-day condition, the duration to heading of Mangyeong x Gimmaze combination was equal to that of their parents mean, and those of all other combinations were significantly shorter than those of their parents mean.

2. Under the natural condition, the non-allelic gene interactions were significant in days to heading, but under the short-day condition, the non-allelic gene interactions were not significant, and inheritance of days to heading revealed partial dominance in which additive effects were greater than dominant effects.

3. Tongil and Gimmaze were located on dominant zone under the natural day-length, and Nongbaek and Mangyeong were under the short-day condition.

4. Under the natural condition, dominant effects were greater than additive effects, and both heritabilities of the broad and the narrow senses were significantly low. Under the short-day condition, additive effects were significantly higher than dominant effects, and both heritabilities of the broad and the narrow senses were high.
緒言

統一을위한 많은統一型新品種의育成과
아울러 새로운栽培技術의普及으로 오랫동안
米穀의 自給を達成할 수있게 되었으나 이를新品
種을 역사 白黒枯病과 아울러是年 계급問題가
稲田熱病에 對한耐病性 그리고 밀추에 對한
耐虫性 및 米質, 低溫下의 黏稠問題 등 많은
問題點들을
包含하고 있어 결실 없는 新種事業이
要求되고 있다.

요약의 原则으로 稲穀自給率の達成하기 위해서는
米穀目標を達成하기 위해서는عر리가目標로
する向日葵와 다가미미리의 生育 및 收量
에 關係되는 여러가지 向日葵의 遺傳에 關係한
情報を
把摂収から必要하며 特히 出穗期는 비의
熟期を制定
する重要な 向日葵自稈이 아니라 다른 向日葵의
発現
으로
는
る
日稈 및
温度에
 크게
影響する
向日葵로서
環境條件에
 따라
遺傳様式이
 다르게
 나타난다. 5,6,7,8,9,10)

Morinaga와 Kuriyama11)는 日本稈型의 日稈反應
에는 6系의 遗傳子가 關與하여 그중 2系은
温度에
對한
反應에
따라
間接의
役割을
行へ고
하여
Jennings12)는 慶光性과 慶温性이
強한 日本稈型의
交雑에서 F1은 雙稈의
平均에
比해
慶光性이
強敏한
가능이
있었고
12個의
稈稈系統과 台灣의
日本稈型
稈稈的
組合에서는 F1의
兩稈의
平均에
比해
 모두
早熟方向으로
 나타난다고
行へ하고
したが
Li와 Chang11)은
慶光性이
弱한
4系稈稈の
二種交雑에서 相加の
效果
が
でき
 나타나며
若干の
慶光性効果도
確認을
報告
하였고
Chang12)는 慶光性이
強한
品種와
弱한
品種
으로
の
交雑組合에서 F1의
基本營養成長期間
은
短縮되었으나
交雑組合에
따라
短縮된
t하는
程度는
各自
 다르다고
行へ하며
IRRI의
報告에서도
基本營養
成長期間이
短縮된
こと
에
比較
慶光性이
行へ와

Table 1. Days to heading of parents and F2 generations under the natural day-length

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>T</th>
<th>P</th>
<th>M</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>109.6</td>
<td>138.85</td>
<td>114.00</td>
<td>114.50</td>
<td>117.70</td>
</tr>
<tr>
<td>T</td>
<td>21.05</td>
<td>126.00</td>
<td>138.25</td>
<td>129.10</td>
<td>123.35</td>
</tr>
<tr>
<td>P</td>
<td>-0.80</td>
<td>15.25</td>
<td>120.00</td>
<td>128.15</td>
<td>132.30</td>
</tr>
<tr>
<td>M</td>
<td>-6.20</td>
<td>0.20</td>
<td>2.25</td>
<td>131.80</td>
<td>126.00</td>
</tr>
<tr>
<td>G</td>
<td>2.80</td>
<td>0.35</td>
<td>12.20</td>
<td>0.00</td>
<td>120.20</td>
</tr>
</tbody>
</table>
表 2. 短日照条件下父母及 F2 代的出穗天数。

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>T</th>
<th>P</th>
<th>M</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>106.8</td>
<td>107.0</td>
<td>91.9</td>
<td>95.7</td>
<td>98.3</td>
</tr>
<tr>
<td>T</td>
<td>-13.9</td>
<td>135.0</td>
<td>115.9</td>
<td>112.8</td>
<td>117.5</td>
</tr>
<tr>
<td>P</td>
<td>-12.5</td>
<td>-2.6</td>
<td>102.0</td>
<td>100.9</td>
<td>101.0</td>
</tr>
<tr>
<td>M</td>
<td>-13.7</td>
<td>-10.6</td>
<td>-6.5</td>
<td>112.0</td>
<td>107.10</td>
</tr>
<tr>
<td>G</td>
<td>-5.9</td>
<td>-0.8</td>
<td>-1.7</td>
<td>0.3</td>
<td>101.6</td>
</tr>
</tbody>
</table>

表 3. 短日照条件下父母及 F2 代的出穗天数。

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>T</th>
<th>P</th>
<th>M</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2.80</td>
<td>31.85</td>
<td>22.10</td>
<td>18.80</td>
<td>19.40</td>
</tr>
<tr>
<td>T</td>
<td>-9.00</td>
<td>22.35</td>
<td>16.25</td>
<td>5.85</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>18.00</td>
<td>27.65</td>
<td>32.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>19.80</td>
<td>18.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>18.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

一般栽培の場合、親×八穂及親×五穂組合の F2 代において短日栽培の出穂期が延びたが、親×五穂及親×八穂組合の F2 代における出穂期は、親×八穂及親×五穂組合の出穂期に比べて遅かった。

表 2 に示すように、F2 代における出穂期の短縮は、親×八穂に比べて親×五穂の場合に顕著であった。特に、親×五穂組合における出穂期の短縮は、F2 代の出穂期を延ばす効果が認められた。

Jenningsらによると、短日栽培における出穂期の短縮は、親×八穂及親×五穂組合の F2 代における出穂期が短縮されたここと一致している。したがって、短日栽培における出穂期の短縮は、親×八穂及親×五穂組合の F2 代における出穂期が短縮されたことに起因していることが示唆される。

自然日の短日下における出穂期の短縮は、親×五穂及親×八穂組合の F2 代における出穂期が短縮されたことに起因していることが示唆される。

自然日の短日下における出穂期の短縮は、親×五穂及親×八穂組合の F2 代における出穂期が短縮されたことに起因していることが示唆される。
Table 4. ANOVA of regression-coefficients and test of Unit slope.

<table>
<thead>
<tr>
<th>S. V.</th>
<th>Short day-length</th>
<th>Natural day-length</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>6.30</td>
<td>2.00</td>
</tr>
<tr>
<td>b</td>
<td>0.90</td>
<td>0.27</td>
</tr>
<tr>
<td>T-Value+</td>
<td>2.84</td>
<td>0.56</td>
</tr>
<tr>
<td>T-Value++</td>
<td>-0.32</td>
<td>-1.49</td>
</tr>
</tbody>
</table>

Remarks: ++ Test of significance of regression co-efficients to Unit slope.
+ Test of goodness of fit of regression.

Fig. 1. $W_r$, $V_r$ graph for days to heading under the natural day-length.

$W_r = \sqrt{16.99V_r}$

Fig. 2. $W_r$, $V_r$ graph for days to heading under the short day-length.

$W_r = \sqrt{47.68V_r}$

$W_r = 6.20 + 0.90V_r$

Fig. 3. $W_r$, $V_r$ graph for days to heading under the natural day-length (excluding Tongil).

自然日長의 경우 $V_r$에 대한 $W_r$의 回歸係数는 0.27으로서 Unit slope과는 거리가 멀지만 아니라 回歸도 전히 有意性이 認定되지 않아 優性效果와의 다른 非相加的 效果가 存在함을 나타내고 있었는데 $W_r$, $V_r$ graph에서 정확한 $統一$이 優値라고 하고 $統一$은 除柵으로 하는 組合를 除外한 나머지 交配組合과 組合벨로 $W_r$, $V_r$를 算出하고 回歸分析을 하였던 바 回歸係数는 0.73으로 Unite slope과有意性차가 認定되지 않았으며 適合度検定에서는 $\alpha = 0.05$ 水準에서는 有意性이 認定되지 않았으나 $\alpha = 0.10$水準에서는 有意性이 認定되었으며 回歸線은 原點を 通過하고 있어 部分優値を 나타내었다. 그러나 短日下에서는 出穏期에 있어서는 $V_r$에 대한 $W_r$의 回歸係数가 0.50으로 Unit slope를 가면 満足시키고 있으며 回歸的 適合度는 $\alpha = 0.10$의 水準에서는 有意하여 優性效果 外의 다른 非相加的 效果는 存在하지 않는 것으로 생각되며 回歸線は 原點を 通過하고 있어 部分優値を 나타내었다. 自然日長의 경우 5個 交配組合 및 이들 交配組合을 모두 使用하여 $W_r$, $V_r$을 算出하고 graph를 作成하였으며는 $統一$, $統一$은 原點에서 垂直 優性带에 그리고 優性带은 劣性带에 位置하였으나 $統一$ 및 $統一$을 偏離으로 하는 組合를 除外하였을 경우 賽生種인 $農白$이 優性带에 그리고 出穏期가 높은 萬頃이 劣性帶에 位置하였으며 短日條件下로서는 賽生種인 優性带과 短日에 依属 出穏期의 短穏效果가 가장 크게 나타난 萬頃이 優性에 그리고 短日
### Table 5. Analysis of variance of diurnal crosses.

<table>
<thead>
<tr>
<th>S.V.</th>
<th>df</th>
<th>Short day-length</th>
<th>Natural day-length</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>4</td>
<td>238.90**</td>
<td>97.22*</td>
</tr>
<tr>
<td>b</td>
<td>10</td>
<td>21.06**</td>
<td>51.01</td>
</tr>
<tr>
<td>b₁</td>
<td>1</td>
<td>99.85**</td>
<td>44.18</td>
</tr>
<tr>
<td>b₂</td>
<td>4</td>
<td>22.31**</td>
<td>31.64</td>
</tr>
<tr>
<td>b₃</td>
<td>5</td>
<td>4.31</td>
<td>67.86*</td>
</tr>
<tr>
<td>c</td>
<td>4</td>
<td>7.50</td>
<td>12.96</td>
</tr>
<tr>
<td>d</td>
<td>6</td>
<td>2.77</td>
<td>22.96</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>2.96</td>
<td>24.94</td>
</tr>
</tbody>
</table>

### Table 6. Genetic components of variation for heading days.

<table>
<thead>
<tr>
<th></th>
<th>Short day-length</th>
<th>Natural day-length</th>
</tr>
</thead>
<tbody>
<tr>
<td>√H₁/D</td>
<td>0.73</td>
<td>2.55</td>
</tr>
<tr>
<td>H₂/4H</td>
<td>0.19</td>
<td>0.23</td>
</tr>
<tr>
<td>Kd/Kr</td>
<td>1.18</td>
<td>2.29</td>
</tr>
<tr>
<td>Herit(N)</td>
<td>0.78</td>
<td>0.07</td>
</tr>
<tr>
<td>Herit(B)</td>
<td>0.94</td>
<td>0.29</td>
</tr>
</tbody>
</table>

### 摘 要

短日条件下での水稲出穗期の遺伝子優劣の影響をみると、農薬を施した場合の5個の水分品種の全組織における二面交配を実施した結果、F₂を自然日中の短日条件下で栽培した場合、出穗期が延長されます。短日条件下での出穗期は、長日下での出穗期に対する相対的な効果が最も顕著であり、環境条件や品種の特性により異なることが示されました。全体的に、短日条件下での出穗期が長日条件下での出穂期に比して延長することが確認されました。

自然日長下での出穂期が長日条件下での出穂期に比して延長する傾向が見られたが、その程度は品種や栽培条件により異なることが示されました。特に、農薬の処理が鉄桝に著しい影響を及ぼすことが観察されました。出穂期の延長は、農薬の散布が時季や空間的な影響を及ぼすことが示唆されました。
引用文献