Crop establishment, water management, and plant type characteristics: moving toward more productive cultural practices

Flooded rice is estimated to take up 3,000 L to produce 1 kg of grain and its consumption of irrigation water on earth is about 1 trillion m³ yr⁻¹. In one theoretical calculation from FAO, a 1% increase in water productivity in food production will make available an extra 24 L per head of population. At the time when it is required to grow rice with less water and less labor input, and to cope with transient water shortage in less favorable conditions, it is essential to identify plant types appropriate to promising crop management approaches. An evaluation of a wide set of six contrasting genotypes was conducted under transplanting, wet and dry direct seeding, and aerobic management.

### Results

#### Effect of crop establishment and genotypes on grain yield (t ha⁻¹), productive tiller number, filled grain number, and percent filled grain, 2004 wet season, IRRI, Philippines.

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Grain yield (t ha⁻¹)</th>
<th>Productive tiller number (no. m⁻²)</th>
<th>Filled grain number (no. prod-1)</th>
<th>Harvest Index (ab)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>6.92 B</td>
<td>4.55 B</td>
<td>6.50 C</td>
<td>6.01 D</td>
</tr>
<tr>
<td>E2</td>
<td>6.83 A</td>
<td>4.77 A</td>
<td>7.06 A</td>
<td>6.61 A</td>
</tr>
<tr>
<td>E3</td>
<td>7.17 A</td>
<td>5.04 A</td>
<td>7.82 A</td>
<td>6.32 A</td>
</tr>
<tr>
<td>E4</td>
<td>5.32 C</td>
<td>3.68 C</td>
<td>8.24 B</td>
<td>6.37 C</td>
</tr>
</tbody>
</table>

Productive tiller number per field area (g m⁻²): 67.00 B a 47.40 A b 52.30 A b 49.40 Abc

Filled grain number per field area (g m⁻²): 63.50 Abc 59.60 A b 56.00 B ab 53.80 B c

Harvest Index: 0.37 Abc 0.31 B b 0.31 A a 0.30 A b 0.30 A b 0.30 A b 0.30 A b

*In a column, means followed by different small letters are significantly different at the 5% level by LSD test (n=4).

Wet and dry row seeding (E2 and E3) appreciably outyielded transplanting and aerobic management (E1 and E4), regardless of genotype, by about 1.5 t ha⁻¹ on average (see table).

Dry row seeding (E3) had the tendency to be more productive than wet row seeding (E2) for three genotypes (18, H4, 121, see table). Higher harvest index seemed to have played a role in compensating the productive tiller number with filled grain number per tiller generally occurred.

The best genotypes under E1 (N1, H4, and I4), E2 (I4, N1, and H4), E3 (H4, I4, and E4) were those with the highest harvest index and often those with the highest number of productive tillers (see table). In most cases, they were not characterized with the quickest early growth and highest maximum tillering (Fig. 2a to d).

Dry matter accumulation rate of H4 was maintained under E4 compared with E3, while 14 (H4) were those with the highest harvest index and often those with the highest number of productive tillers (see table).

Water productivity was observed higher in E2 than in E3, regardless of genotype (Fig. 3). This was mostly due to the greater amount of water applied to E3 at the end of the dry establishment. Water productivity was also higher in E2 than in E1 mainly due to its higher grain yield (Fig. 3). Water productivity in E4 was not calculated because seepage and percolation were not controlled and evaluated (absence of plastic bunds).

### Conclusions

- Wet and dry row seeding outyielded conventional transplanting by 1.5 t ha⁻¹, regardless of genotype, but considering that land levelling and water input were finely tuned.
- Good performance in dry establishment and aerobic conditions seemed supported by an increase in plant harvest index, possibly due to an increase in sink strength.
- Dry crop establishment, however, did not appear promising for increasing water productivity significantly in the soil conditions of the IRRI farm.
- Harvest index appeared as a key trait to support the performance of the best genotypes and reinforce the plan to focus further studies on plant assimilate partitioning strategies.