Furrow Irrigated Rice

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Row Rice
Furrow Irrigated Rice

- Reduces water usage (in theory)
- Less labor
- Less energy usage
- Reduced levee construction
- Ground equipment instead of airplanes
- Quick field drying
- Less land preparation for rotation crops
Furrow Irrigated Rice

- Graded land and water down each furrow
- 5 to 20 percent yield reductions
- Maturity delays
- Weed control problems
- Potential water stress
- Lack of information
- Nitrogen management
- Crop Insurance
Research Protocols

• Missouri Rice Research Farm (Dunklin County) forty four rice varieties were mid-May plot planted in separate paddocks having (ii) furrow irrigated rice, (ii) drill-seeded delayed-flood rice.

• Each variety was replicated four times.

• Plot dimensions were 1.52 meter (5 ft) by 3.66 meter (12 ft).
Research Protocols

• Water flood was established at the fifth-leaf stage for the drill seeded-delayed flood treatment and four to six inches of paddy water was maintained until complete panicle development.
Research Protocols

• Broadcast urea at 120 lbs N/acre applied one day prior to flood for the delayed-flood treatment. Nitrogen application for the furrow irrigated rice was applied at the same day as the nitrogen treatment for the delayed flood treatment, with furrow irrigation applied immediately afterwards. Nitrogen was applied at internode elongation (30 lbs N/acre as urea).
Research Protocols

• For the furrow irrigated rice treatment, irrigation scheduling was based on a Pessl Instrument platform employing Decagon soil moisture probes at selected soil depths.

• The somewhat poorly-drained Crowley series (Fine, smectitic, thermic Typic Albaqualfs) consist of Ap – E – Btg – C horizon sequences developed in fine-silty alluvium. Routine soil testing reveal an acidic soil; however, other soil characteristics affecting rice yield potential were appropriate.
Research Protocols

• At the fifth leaf stage and at harvest the entire areal plant from each plot were collected and subsequently separated into leaf-stem and rough rice, dried at 70ºC, and analyzed for nitrogen, phosphorus, potassium, magnesium, calcium, sulfur, iron, manganese, boron, copper, zinc and arsenic using acid dissolution coupled with ICP-MS for the routine nutrients and atomic absorption spectroscopy – hydride generation for arsenic. The plant tissue analysis was performed by Midwest Laboratories (Omaha, NE), using USEPA method 6020.
Research Protocols

- Plot yields and moisture contents were obtained using a Quantum Wintersteiger Plot Combine. Rice milling was accomplished using a Zaccaria PAZ 1 DTA milling machine.
Table 1. Nitrogen, phosphorus, potassium, magnesium, calcium and sulfur concentrations for fifth leaf stage rice from varieties cultured as delayed flood and furrow irrigation rice.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Statistics</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed Flood</td>
<td>mean</td>
<td>42.9</td>
<td>3.5</td>
<td>28.4</td>
<td>2.2</td>
<td>4.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Furrow Irrigation</td>
<td>mean</td>
<td>35.2</td>
<td>2.3</td>
<td>29.6</td>
<td>2.3</td>
<td>5.2</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Boldface indicates statistical significance
Table 2. Iron, manganese, boron, copper, and zinc concentrations for fifth leaf stage rice from varieties cultured as delayed flood and furrow irrigation rice.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Statistics</th>
<th>Fe</th>
<th>Mn</th>
<th>B</th>
<th>Cu</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed Flood</td>
<td>mean</td>
<td>95</td>
<td>753</td>
<td>5.1</td>
<td>6.8</td>
<td>31.5</td>
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<tr>
<td>Furrow Irrigation</td>
<td>mean</td>
<td>104</td>
<td>136</td>
<td>5.9</td>
<td>10</td>
<td>24.4</td>
</tr>
</tbody>
</table>

Mn, Cu and Zn are significantly different
Furrow Irrigated Rice

Panicle Weight (gram) - Delayed Flood

Panicle Weight (gram) - Furrow Irrigation

Delayed mean = 3.86
Furrow mean = 3.83
Furrow Irrigated Rice

![Graph showing the relationship between Row Rice (Bushel/Acre) and Delayed Flood (Bushel/Acre). The graph includes a scatter plot with a trend line indicating a positive correlation.]
Furrow Irrigated Rice

The graph shows yield (bushels/acre) for different cultivars under delayed flood and furrow irrigation conditions. The bars indicate the mean yield, with error bars representing the variability. The cultivars include Francis, Roy J, Taggart, Wells, Caffey, Jupiter, Mo/mm14, 11F1-2, 9F1-1, Mo/C161, CI11, and CI151.
Furrow Irrigated Rice

Seed Nitrogen (%)
Detection Limit is 0.05 mg As/kg.
Table 3. Nitrogen, phosphorus, potassium, magnesium, calcium and sulfur concentrations for paddy rice seed from varieties cultured as delayed flood and furrow irrigation rice.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Statistics</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>S</th>
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</thead>
<tbody>
<tr>
<td>Delayed Flood</td>
<td>mean</td>
<td>10.4</td>
<td>2.3</td>
<td>3.1</td>
<td>0.9</td>
<td>0.2</td>
<td>0.8</td>
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<tr>
<td></td>
<td>standard deviation</td>
<td>0.5</td>
<td>0.1</td>
<td>0.5</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Furrow Irrigation</td>
<td>mean</td>
<td>10.1</td>
<td>2.2</td>
<td>3.4</td>
<td>0.9</td>
<td>0.3</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>standard deviation</td>
<td>0.9</td>
<td>0.2</td>
<td>0.6</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
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</table>
Table 4. Iron, manganese, boron, copper, zinc and arsenic concentrations for paddy rice seed from varieties cultured as delayed flood and furrow irrigation rice.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Statistics</th>
<th>Fe</th>
<th>Mn</th>
<th>B</th>
<th>Cu</th>
<th>Zn</th>
<th>As</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>mg/kg</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Delayed Flood</td>
<td>mean</td>
<td>19.5</td>
<td>94.5</td>
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<td>60</td>
<td>38</td>
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<tr>
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<td>standard deviation</td>
<td>2.0</td>
<td>22.6</td>
<td>0.9</td>
<td>16</td>
<td>8</td>
<td>0.07</td>
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<tr>
<td>Furrow Irrigation</td>
<td>mean</td>
<td>20.6</td>
<td>59.7</td>
<td>3.1</td>
<td>72</td>
<td>44</td>
<td>&lt;0.1</td>
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<tr>
<td></td>
<td>standard deviation</td>
<td>2.8</td>
<td>19.5</td>
<td>1.3</td>
<td>26</td>
<td>13</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Mn is significantly different
Soil Water Sensors

• Key to furrow irrigated rice performance
• Rice farm as soil capacitance soil water sensors – accurate, durable, remotely sensed (home computer, cell phone)
• Assists in maintaining the proper irrigation timing.
Conclusion

• Individual rice varieties involving furrow and delayed flood irrigation regimes showed rough rice yield differences preferences.
• The mean of all rice variety yields were not significantly different between the irrigation treatments.
• Arsenic concentrations were significantly smaller in rough rice from the furrow irrigation system. Manganese rough rice concentrations were greater in rough rice from the delayed flood regime.
Missouri Rice Nitrogen Variety Trial.