THE IMPACT OF MANAGEMENT PRACTICE ON YIELD AND IRRIGATION WATER USE EFFICIENCY FOR PADDY RICE UNDER SHORTAGE ENVIRONMENT

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THE AVERAGE ANNUAL ISOHYETAL MAP OF TAIWAN (1949-2013)

WORKSHOP : PRECISION IRRIGATION FOR SUSTAINABLE CROP PRODUCTION
• **BMP**: the best water management practice.
• **Modify SRI**: the modify system of rice intensification.
• **MBMP**: conducting rotation irrigation interval of 7 days during heading stage.

<table>
<thead>
<tr>
<th></th>
<th>BMP</th>
<th>Modify SRI</th>
<th>MBMP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planting Date</strong></td>
<td>January 16(^{th})</td>
<td>February 16(^{th})</td>
<td>January 16(^{th})</td>
</tr>
<tr>
<td><strong>Reaping Date</strong></td>
<td>June 4(^{th})</td>
<td>June 14(^{th})</td>
<td>June 4(^{th})</td>
</tr>
<tr>
<td><strong>Growth Period</strong></td>
<td>140 days</td>
<td>119 days</td>
<td>140 days</td>
</tr>
</tbody>
</table>
Material:

- The experiment rice variety would be Tainan No. 11, which is widely used in Taiwan with high yields.

- The soil texture of the experiment fields is sandy clay loam.
Materials

- Experimental Environment
  - Meteorological Information

![Average Daily Temperature](image1)

![Average Daily Evaporation](image2)
Materials

- Experimental Environment
  - Meteorological Information

![Global Solar Radiation](chart1.png)

![Daily Precipitation](chart2.png)
Methods

- Analysis of Variance
- Analysis of Impact on Crop Water Requirement of Paddy Rice
- Analysis of Drought Tolerance and Water Saving Efficiency of Paddy Rice
- Water Resource Productivity Index
Analysis of Variance

- This research took analysis of variance with randomized complete block designs in hope of learning the differences in various responses to irrigation, of which by applying two different estimate variances would reach the same result as comparing various average numbers.

\[ SST = SS_t + SS_b + SS_e \]

- **SST**: Total sum of squares
- **SS_t**: Treatment sum of squares
- **SS_b**: Block sum of squares
- **SS_e**: Error sum of squares
Methods

Analysis of Impact on Crop Water Requirement of Paddy Rice

• This research adopts the most accurate Penman-Monteith Equation (Monteith, 1994) to calculate the reference crop water (ET₀).

\[
ET_0 = 0.408 \left( R_n - S \right) + \gamma \frac{900}{T + 273} U_z (e_a - e_d)
\]

• The ET₀ of Tainan area could plus crop coefficient with various planting interval could further obtain the crop water requirement (ETₜₐₙ) in different growth stages.

\[
ET_{\text{crop}} = K_c \times ET_0
\]
Methods

Analysis of Drought Tolerance

\[ R_i = \left( 1 - \frac{Y_i}{Y_a} \right) \times 100\% \]

- \( R_i \): the yield reduction rate (%) under different management practice
- \( Y_i \): the yield under different management practice (Kg/ha)
- \( Y_a \): the paddy rice yield in controlled area under general management practice (Kg/ha)
Methods

Analysis of Water Saving Efficiency

\[ S_i = \left(1 - \frac{\text{FIR}_i}{\text{FIR}_a}\right) \times 100\% \]

- **S\_i**: the **water saving rate** (%) of first-season paddy rice under different management practice
- **FIR\_i**: the field irrigation water of first-season paddy field under different management practice (m\(^3\)/ha)
- **FIR\_a**: the field irrigation water of first-season paddy rice in controlled under general management practice (m\(^3\)/ha)
**Methods**

**Water Resource Productivity Index**

\[
WB_i = \frac{Y_i}{FIR_i}
\]

- **WB** \(_i\) : the water resource productivity under various management practice (Kg/m\(^3\))
- **Y** \(_i\) : the productivity under various management practice (Kg/ha)
- **FIR** \(_i\) : the field irrigation water under various management practice (m\(^3\)/ha)
### Analysis of the Impact on Management Practice to Agronomic Traits

<table>
<thead>
<tr>
<th>Variable</th>
<th>Different Management Practice</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degrees of Freedom</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>plant height</td>
<td>43.8**</td>
<td>19.1</td>
</tr>
<tr>
<td>total tiller number per cluster</td>
<td>207.9**</td>
<td>17</td>
</tr>
<tr>
<td>effective tiller number per cluster</td>
<td>205.3**</td>
<td>16.1</td>
</tr>
<tr>
<td>spikelet number per spike</td>
<td>2580.0**</td>
<td>98.1</td>
</tr>
<tr>
<td>grain number per spike</td>
<td>1750.5**</td>
<td>99</td>
</tr>
<tr>
<td>spike weight per cluster</td>
<td>0.0034**</td>
<td>0.00022</td>
</tr>
<tr>
<td>fertility</td>
<td>123.7**</td>
<td>9.2</td>
</tr>
<tr>
<td>yield</td>
<td>1003479**</td>
<td>53745</td>
</tr>
</tbody>
</table>

Note: *and** shows significant difference on level of 5% and 1%
Results and Discussions

Analysis of Impact on Crop Water Requirement and Field Irrigation Water for Different Management Practice of Paddy Rice

The accumulated crop water requirement is 498 mm.
The accumulated crop water requirement is 450 mm.
Results and Discussions

Analysis of the Impact on Management Practice to Yield Reduction Rate and Water Saving Efficiency

WORKSHOP: PRECISION IRRIGATION FOR SUSTAINABLE CROP PRODUCTION
Results and Discussions

Analysis of the Impact on Management Practice to Water Resource Productivity

![Bar Chart showing Water Resource Productivity (kg/m²) for different Management Practices]

- 16-Jan BMP
- 16-Jan Modify SRI with single seedling
- 16-Jan Modify SRI with numerous seedlings
- 16-Feb BMP
- 16-Feb MBMP
This research applies the irrigation experiment design that combines regional rainfall, physiological characteristic of crops and rotation irrigation.
Conclusion and Suggestion

In the overall evaluation of yield reduction rate and water saving rate, the field irrigation water of first-season paddy rice planted on February 16th has reached water saving efficiency of 14.1%~27.3%, comparing with the ones planted on January 16th.

In addition, the field irrigation water of Modify SRI on January 16th has reached water saving efficiency of 39.7%, comparing with BMP on January 16th, but has influence on yield.

On water resource productivity, Modify SRI with numerous seedling is also the best management practice.
Conclusion and Suggestion

To view from the growing days and crop water requirement, the plant date of first crop adjusted from January 16th to February 16th, its growing days would change from 140 days to 119 days; and the accumulated crop water requirement from 498mm to 450mm.

The field irrigation water decreases due to the extension of rotation irrigation interval. This finding could be applied on facility preparation of paddy rice hovering stage and irrigation water use plan establishment.
Thank you for your attention.