A Continuous Rice Production System....
the
RICE GARDEN.

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and L.D. Haws

A handbook for rice production specialists

International Rice Research Institute
The idea of continuous year-round rice farming, or rice gardening, is not new. Farmers in some Asian countries, like Indonesia and the Philippines, had been growing three or more crops of rice in a year even before the idea was developed into a precise, intensive system. Their systems varied -- some were large scale, some small; some harvested daily, others 3 times weekly; some were mechanized, others used only man and animal power.

The rice garden, so called because of the garden-like fields within the rice farm, promises increased employment and higher production for farmers. In the Philippines a farmer can grow 4 crops a year, harvest 20–30 t/ha, and earn a steady net income -- about US$66 a week.

IRRI specialists looked for the best system for a small farm. Here is how the IRRI system was developed.

- 1973-75. Observations of intensive rice production farms in the Philippines, Indonesia, and other Asian countries were made.

- 1975-76. Varieties, fertilizers, tillage techniques, and other technology were tested individually to get the best for the system.

- 1976-77. The modern rice technology package was tested in a 1-ha field. Rice was harvested 3 times a week from 250-m² plots. Total yield was 23.7 tons for the year.
Calixto Botones (in striped shirt) of Batangas province started a 1-ha rice garden in 1979. He and his sons, seen here doing their weekly threshing, handle the daily tasks and obtain yields of 600-700 kg/week.

Dr. Gregorio M. Parra, turned rice farmer after retirement as a government physician, points to one of his rice garden plots. He started a 1-ha rice garden early in 1979, stopped in 1980 due to irrigation problems, but was back into the system in 1981 with a much improved irrigation system that assures him of water supply year round.

- 1977-78. The system was changed to weekly harvest on 1,000-m² plots. Total yield was 20.3 t/ha. Data from those plots and from the 250-m² plots were fed into a computer to determine the best plot size for the 1-ha farm. The answer: use 800-m² plots and harvest weekly.

- 1979-80. The system was tried on 800-m² plots (1.04 ha). Three laborers were hired. Transplanting and harvesting were weekly. Total yield was 21.7 t/ha and income was $75/week. The system was tried in Calatagan, Batangas, and Pototan, Iloilo, and high yields of 26.4 t/ha and 24.6 t/ha were obtained.
As a rice production specialist, you may be approached for information about the rice garden. Or, you may want to introduce the idea to farmers who need more or steadier income from their rice land.

Who can start a rice garden? What are needed to start one?

We have found the following **essentials** in a rice garden:

- At least 0.5 hectare of good rice-growing soil
- A dependable water supply all year round. The rice garden system can be used only on farms where water supplied throughout the year and where the fields can be drained any time.
- At least 3 men who can work 6 hours a day, 5 days a week. This is for a 1-ha rice garden. A bigger farm may require more manpower.
- A carabao, a tractor, or a power tiller.

**What the rice garden is**

The rice garden system is, as the name suggests, a method of growing rice in garden-like plots within the rice farm. Each plot follows a definite time schedule and management, hence the crop is at different stages (see photo). Transplanting and harvesting are weekly.
Variety to use

We have found that a variety that matures 90 days after transplanting (DT) is best for the system. The variety's resistance to as many pests and diseases as possible is another important factor to consider.

IRRI tests used IR36, a disease- and insect-resistant rice variety that matures 110 days after sowing or 90 DT. Other varieties that combine early maturity and resistance to many pests and diseases can be used for the system.

Field size

IRRI tests were on 1.04 ha but an area as small as 0.5 ha can be made into a rice garden as long as it can be divided into the number of plots that can fit weekly transplanting and harvesting scheme based on the maturity of the variety.

Plot access

It will be necessary to construct levees or bunds along and/or cutting across the field for easy transport of the carabao or the tiller to all plots.
Plot size and shape

The plots need not be of the same size nor exactly rectangular or square. The figures above are layouts of actual rice garden farms. Note the difference in size and shape of the plots.

The table on page 7 gives suggestions on the ideal plot size for specified areas of rice land.

Seedbeds

Four seedbeds, outside of the 13 plots, are needed. Their sizes will vary, depending on the size of the farm (see table on page 7 for seedbed size). A seedbed is sown every week. Seedlings are transplanted when they are 22 days old.
Machinery

The more machinery available, the easier a rice garden will operate. Ideally, one should have a 5- to 7-hp tiller, a 5- to 7-hp thresher, and a small grain dryer. But, a farmer can start with animal power for tillage, thresh by foot or with a whacking frame, and let the sun dry his grain. As his income goes up, machinery can be considered.

Advantages the rice garden gives

We have found that in addition to increased income and employment opportunities throughout the year, the risk of loss from typhoons is cut because only 2 or 3 plots are at a stage a typhoon can damage -- unless, of course, deep flooding occurs.

Some risks involved

Continuous planting may create a greater stress on the plants, causing a quicker breakdown of pest resistance. The use of insecticides and herbicides may be necessary.

Rats can also become a serious problem when the farmer's crop is the only standing crop in the area.
Determining plot size

We developed the following table, which may help one decide on plot size if a variety that matures 90 days or 13 weeks after transplanting, such as IR36, will be used. The plot sizes given in the table were calculated using the equation

\[
\text{Plot size (m}^2\text{)} = \frac{\text{Area \ available (m}^2\text{)}}{10,000 \text{ m}^2} \times \frac{120}{\text{Rice duration (weeks)}}
\]

The plot sizes were rounded off to the nearest multiple of 5 m².

<table>
<thead>
<tr>
<th>Land available (ha)</th>
<th>Seedbed size (m²)</th>
<th>Plot size (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>120</td>
<td>760</td>
</tr>
<tr>
<td>1.2</td>
<td>144</td>
<td>915</td>
</tr>
<tr>
<td>1.4</td>
<td>168</td>
<td>1065</td>
</tr>
<tr>
<td>1.6</td>
<td>192</td>
<td>1215</td>
</tr>
<tr>
<td>1.8</td>
<td>216</td>
<td>1370</td>
</tr>
<tr>
<td>2.0</td>
<td>240</td>
<td>1520</td>
</tr>
</tbody>
</table>

Plot sizes for areas other than those given in the table and for varieties that have a different duration are determined by the equation

\[
\text{Plot size (m}^2\text{)} = \frac{\text{Total rice garden area (m}^2\text{)}}{\text{rice duration (weeks)}}
\]

To determine the rice duration, we can use the following equations:

a. for transplanted rice

\[
\text{Rice duration (in weeks) = } \frac{\text{maturing period (in days)}}{7} - \frac{22}{\text{(seedling age at transplanting)}}
\]

b. for direct-seeded rice

\[
\text{Rice duration (in weeks) = } \frac{\text{muturity period (in days)}}{7}
\]

Let's take some examples.

Example 1. Given: Total rice garden area = 8,000 m²

Variety = IR36 (transplanted)

Solve for plot size.
Step 1. Determine the rice duration.

IR36, when transplanted, matures in 110 days. Therefore,

\[
\frac{110 - 22}{7} = \frac{88}{7} = 12.57 \text{ rounded off to } 13.
\]

Duration of transplanted IR36 is 13 weeks.

Step 2. Solve for plot size.

Following our equation for plot size,

\[
\frac{8,000}{13} = 615
\]

Our plot size is 615 m².

Example 2. Given: Total rice garden area = 7,800 m²

Variety - IR36 (direct seeded)

Solve for plot size.

Step 1. Determine the rice duration.

IR36, when direct-seeded, matures in 105 days. Therefore,

\[
\frac{105}{7} = 15
\]

Duration of direct-seeded IR36 is 15 weeks.

Step 2. Solve for plot size.

\[
\frac{7,800}{15} = 520
\]

Our plot size is 520 m².

HOW TO GET STARTED WITH THE RICE GARDEN

The startup schedule

Because it will take 13 weeks to get the system into full schedule, some land will at first be idle. If the farmer is shifting from a 2-crop system, he will still be ahead in income at the end of the year. With the 2-crop system, his land lies idle for 3-4 months anyway. It is possible to plant some plots to mungbean and derive some income from it.

IRRI experiments on the rice garden have used the following work schedule for the first plot, based on a 110-day variety.
<table>
<thead>
<tr>
<th>Days after sowing</th>
<th>Days after transplanting</th>
<th>Activity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
<td>Soaking seed</td>
<td>See daily schedule for rates used</td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td>Incubating seed, constructing seedbed Incorporating carbofuran</td>
<td>See daily schedule for rates used</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Sowing seedbed</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Irrigating seedbed</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Spraying insecticide on seedbed</td>
<td>See daily schedule for rates used</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plowing and first harrowing of main field</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Spraying insecticide a second time</td>
<td>Same rate as in first spraying</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Second harrowing</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Pulling seedlings; soaking roots in carbofuran; broadcasting fertilizer and carbofuran; final harrowing and leveling of first plot</td>
<td>See daily schedule for rates used</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Marking plot and transplanting</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>Irrigating plot (3–5cm depth)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>4</td>
<td>Broadcasting herbicide on plot</td>
<td>See daily schedule for rates used</td>
</tr>
<tr>
<td>33</td>
<td>10</td>
<td>Replanting missing hills</td>
<td>Could be earlier but not later. Late replants will have delayed maturity.</td>
</tr>
<tr>
<td>37</td>
<td>15–25</td>
<td>Hand or rotary weeding</td>
<td>Preferably when weeds are at 2–3 leaf stage</td>
</tr>
<tr>
<td>44</td>
<td>22</td>
<td>Topdressing nitrogen fertilizer</td>
<td>At panicle initiation</td>
</tr>
<tr>
<td>47</td>
<td>25</td>
<td>Broadcasting insecticide</td>
<td>See daily schedule for rates used</td>
</tr>
<tr>
<td>87</td>
<td>65</td>
<td>Spraying insecticide when there are 2 or more bugs per m²</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>71</td>
<td>Draining the plot</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>86</td>
<td>Harvesting the plot; threshing and drying grain</td>
<td></td>
</tr>
</tbody>
</table>
The use of a later-maturing variety, such as IR54 which matures 120 days after sowing, requires adjusting the number of plots to the maturity period. IR54, for example, requires 14 plots. All activities, except topdressing of nitrogen at panicle initiation, remain the same. The time of topdressing nitrogen can be determined by subtracting 65 days (reproductive and ripening stages) from the maturity date. If the farmer is using a 120-day variety:

$$120 - 65 = 55 \text{ days.}$$

The age of seedlings at transplanting (22) is subtracted from 55.

$$55 - 22 = 33 \text{ days.}$$

Topdressing is 33 DT.

**The daily schedule**

We have used the following daily schedule. The amounts of materials given are for 800-m$^2$ plots. For a farm more than 1 ha which will require a different plot size, the amounts of materials needed may have to be adjusted. The conversion table on pages 15–16 has been useful to farmers in measuring fertilizer and pesticides.

<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
<th>Material and amount/800 m$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONDAY</strong></td>
<td>1. Preparing carbofuran solution at 0.06% concentration (80 g carbofuran granules is dissolved in 4 liters of water)</td>
<td>2.5 kg seed (31 kg seed/ha)</td>
</tr>
<tr>
<td></td>
<td>2. Soaking seed in the solution for 24 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Harvesting (cutting close to the ground)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Irrigating the field after hauling all cut stalks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Threshing</td>
<td></td>
</tr>
<tr>
<td><strong>TUESDAY</strong></td>
<td>1. Incubating seed for 24 hours</td>
<td>42 g carbofuran (0.5 kg a.i./ha)</td>
</tr>
<tr>
<td></td>
<td>2. Constructing a 25-m$^2$ seedbed Incorporating carbofuran</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Plowing and harrowing field</td>
<td>2 kg 2,4-D granules (0.8 kg a.i./ha)</td>
</tr>
<tr>
<td></td>
<td>4. Broadcasting herbicide on plot transplanted previous week. Standing water (3–5 cm) is maintained.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Finishing threshing; drying and cleaning grain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Topdressing N fertilizer 22 DT</td>
<td>11.5 kg ammonium sulfate (30 kg N/ha)</td>
</tr>
<tr>
<td></td>
<td>7. Replanting missing hills 10 DT</td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page.
### Day  
**Activity**  
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **WEDNESDAY** | 1. Sowing seedbed  
2. Rotary or hand weeding 15—25 DT  
3. Repairing and cleaning bunds or levees  
4. Spraying insecticide on seedbed |
| Material and amount/  
800 m² | 11 ml monocrotophos (Azodrin 168EC) per 1.5 liters water (0.75 kg a.i./ha). Other insecticides may be used. |
| **THURSDAY** | 1. Preparing carbofuran solution at 0.12% concentration  
(400 g carbofuran granules is dissolved in 10 liters of water). This can be contained in a soaking pan 1 m x 1 m x 20 cm.  
2. Pulling seedlings and soaking roots in the solution for 24 hours  
3. Broadcasting basal fertilizer: urea 45% N; ordinary superphosphate 20% P₂O₅. Broadcasting carbofuran (basal)  
4. Broadcasting zinc sulfate (for zinc-deficient soil)  
5. Harrowing to incorporate inputs and leveling with a wooden plank |
| **FRIDAY** | 1. Marking field with wooden marker.  
2. Correcting zinc deficiency by preparing a 2% suspension (4 tbsp commercial-grade zinc oxide is added to every liter of water) and dipping the seedling roots in the suspension before transplanting. This is done only when Activity #4 for Thursday had been omitted because of the unavailability of zinc sulfate. Note that zinc oxide is less expensive than zinc sulfate.  
3. Transplanting 22-day-old seedlings  
4. Irrigating the seedbed sown last Wednesday and maintaining the water until the pulling of seedlings. The bed is occasionally drained to encourage root growth.  
5. Broadcasting carbofuran on plot at 25 DT |
| Material and amount/  
800 m² | 12.4 kg urea; 12.0 kg ordinary superphosphate  
2.5 kg carbofuran (1.0 kg a.i./ha)  
1.6 kg zinc sulfate |

### Some management details

The amounts given here are for 1 ha. These can be adjusted to the farmer’s plot size. For example, if we want to know how much urea and superphosphate to use on 1,100-m² plots:

In **Fertilizer application,** item #4 of this section, we see that the rate for a hectare is 70 kg N and 30 kg P₂O₅.
• How much N and P₂O₅ should be applied for every 1,000 m²? Divide 10,000 m² (square meters in a hectare) by 1,100. \(10,000 \div 1,100 = 9\). Divide 70 kg N and 30 kg P₂O₅ by 9. \(70 \div 9 = 7.7; \ 30 \div 9 = 3.3\). The amounts needed for every 1,100 m² are 7.7 kg N and 3.3 kg P₂O₅.

• What is the rate per plot? Urea is 45% N and superphosphate is 20% P₂O₅. Divide 7.7 by 0.45 to get the amount of urea per plot and 3.3 by 0.20 to get the amount of superphosphate per plot. \(7.7 \div 0.45 = 17.1; \ 3.3 \div 0.20 = 16.5\). The rate per plot is 17.1 kg urea and 16.5 kg superphosphate.

1. Land preparation

• First crop. Plots are plowed once and harrowed twice or thrice before transplanting. Harrowing is at weekly intervals, the final harrowing done the day before transplanting.

• Second to fourth crops. Each plot is irrigated immediately after harvest and plowed and harrowed the next day (Tuesday). If the mud is soft, the stubble is incorporated by passing the harrow 2 to 3 times. Final harrowing and leveling are done Thursday after broadcasting the basal fertilizer.

2. Raising seedlings

Seed (2.5 kg) is soaked in carbofuran every Monday, incubated on Tuesday, and sown on Wednesday. Seedbeds are constructed a day before sowing. Seedlings are protected from leafhoppers and planthoppers by spraying at weekly intervals. Pulling of seedlings is done 21 days after sowing.

3. Transplanting

Twenty-two-day-old seedlings are transplanted every Friday in straight rows with a wooden marker. Excess water in the field is removed and the marker is passed on the soil surface in one direction. A second pass perpendicular to the first is made to make 20 cm x 20 cm patterns. Two to three seedlings are transplanted on the corners of these square marks.
4. Fertilizer application

During the wet season, urea (60 kg N/ha) and ordinary superphosphate (30 kg P₂O₅/ha) are broadcast and incorporated at the final harrowing. Ammonium sulfate (21-0-0) is topdressed 22 DT or 7-8 days before panicle initiation at the rate of 30 kg N/ha.

Total N is increased to 100 kg/ha (70 kg as basal and 30 kg as topdressing) or higher during the dry season.

Zinc sulfate is applied at 20 kg/ha after the second crop. If zinc oxide is used, seedling roots are dipped in the suspension before transplanting (see Daily schedule, Activity #4 for Friday).

5. Insect control

To protect the rice plants against insect pests, the following control practices are done:

• Seed soaking. Seed is soaked in carbofuran solution at 0.6% concentration for 24 hours (see Daily schedule, Activity #1 for Monday, for instructions on how to prepare solution).

• Seedbed protection. Granules of a systemic insecticide are incorporated during the construction of the seedbed. The seedlings are sprayed with insecticides 2 times at 7- to 10-day intervals.

• Seedling root treatment. Seedling roots are soaked in carbofuran at 0.12% concentration 12 to 24 hours before transplanting (see Daily schedule, Activity #1 for Thursday, for instructions on how to prepare solution).

• Insecticide is broadcast or sprayed as scheduled (see Startup schedule) or when hoppers and stem borers reach recommended threshold level.

  Green leafhopper  -  1 insect/tiller
  Brown planthopper  -  1 insect/tiller
  Stem borer  -  10% deadhearts
• **Foliar spraying.** The leaves are sprayed uniformly. For planthopper infestation, spray is directed to the base of the plants. Recommended threshold level:

<table>
<thead>
<tr>
<th>Pest</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaffolder</td>
<td>10% of leaves damaged</td>
</tr>
<tr>
<td>Rice bug</td>
<td>2 insects/m²</td>
</tr>
</tbody>
</table>

6. Weed control

Because this system is done on an irrigated paddy, keeping the field flooded controls most of the grass weeds. If the field is infested with broadleaf weeds and sedges, 2,4-DEC 0.5 kg a.e. (acid equivalent)/ha is sprayed 21 DT. This is followed by hand weeding or spot weeding not later than 30 DT. If grass weeds are expected to become dominant, either of the herbicides butachlor granule at 0.75 kg a.i./ha or thiobencarb or 2,4-D at 1.0 kg a.i./ha is broadcast 4 DT.

7. Water management

Plots are irrigated 2 to 3 DT. Water, 3-5 cm deep, is maintained in the field during the early tillering stage. The water is increased gradually as the plants grow taller, but not deeper than 8 to 10 cm. Plots are drained 10 to 14 days before maturity.

8. Harvesting

Harvest is every Monday (86 DT). Plants are cut close to the soil surface so that stubbles not more than 10 cm high are left. If the straw surface is free from dew or rainwater, the plants are threshed immediately on a 7-hp portable thresher. Wet straw is allowed to dry 24 to 48 hours before threshing. The grain is dried 12 to 24 hours in a batch-type dryer. In the absence of a thresher and a dryer, threshing may be by foot or whacking frame and drying may be by the natural method or sun drying.

The International Rice Research Institute, through its Rice Production Training and Research (RPTR) Department, welcomes the opportunity to assist you in case of problem in the rice garden system. Write: Rice Garden, RPTR, International Rice Research Institute, P.O. Box 933, Manila, Philippines. Or call at the RPTR Department, IRRI, Los Baños, Laguna, Philippines.
REFERENCES


Appendix. CONVERSION TABLE (Source: PCARR 1976)

**Pesticide calculations**

Measuring spoons

- 1 teaspoon (tsp) = 5 ml (cc)
- 1 tablespoon (tbsp) = 10 ml
  - 3 tsp = 1/2 fluid ounce
- 1 cup = 16 tbsp
  - 1/2 pint = 8 fluid ounces
  - 237 ml
- 1 fluid ounce = 6 tsp
  - 2 tbsp

Ordinary tableware spoons

- 1 tsp = 5 ml (cc)
- 1 tbsp = 10 ml
  - 2 tbsp = 1/3 fluid ounce
- 1 cup = 24 tbsp
  - 2 gills = 1/2 pint
  - 8 fluid ounces = 237 ml
- 1 fluid ounce = 6 tsp
  - 3 tbsp

**Fertilization guides**

<table>
<thead>
<tr>
<th>Container</th>
<th>Fertilizer grades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21–0–0</td>
</tr>
<tr>
<td></td>
<td>–kg–</td>
</tr>
<tr>
<td>1 big kerosene can (5 gallons)</td>
<td>20.70</td>
</tr>
<tr>
<td>1 gallon</td>
<td>3.91</td>
</tr>
<tr>
<td>1 can motor oil (1 quart)</td>
<td>1.15</td>
</tr>
<tr>
<td>1 ganta</td>
<td>3.34</td>
</tr>
<tr>
<td>1 liter</td>
<td>904</td>
</tr>
<tr>
<td>1 big milk can (14.5 oz)</td>
<td>396</td>
</tr>
<tr>
<td>1 small milk can</td>
<td>175</td>
</tr>
<tr>
<td>1 cup (coffee)</td>
<td>185</td>
</tr>
<tr>
<td>1 handful (adult)</td>
<td>47</td>
</tr>
<tr>
<td>1 tbsp</td>
<td>25</td>
</tr>
<tr>
<td>1 tsp</td>
<td>11</td>
</tr>
</tbody>
</table>