Rice Nursery and Early Crop Management

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IRRI
Learning Objectives

• Describe different types of rice nursery management
• Describe the critical factors of the rice transplanting process
• Describe the advantages and constraints of manual transplanting and seedling broadcasting
• Describe preparation and leveling of fields for direct seeding
What is the goal of Crop Establishment?

→ To secure a uniform plant population that can produce high yields
Target panicles for high yield

- **Number of panicles per unit area** is the principal yield-determining factor.

- **Optimum number of panicles per unit area:**
  - Wet season: 350-400 panicles m$^{-2}$
  - Dry season: 450-600 panicles m$^{-2}$

- **Factors affecting number of panicles:**
  - Tillering capacity of the variety
  - Initial plant population (based on CE method)
  - Available N level at tillering
Transplanting: Most common method in small farms of Asia
Types of Rice Nursery

Wet-bed

Dry-bed

Dapog (Mat)

Modified mat

Bubble Tray
Wet-bed Nursery-1

• Compute the seed & seedbed area: 50 kg seed & 500 m² seedbed area for TP one ha of main field

• Locate the seedbed away from electric light in a fertile field that is easy to irrigate & drain

• Start preparing the seedbed 2 weeks before planting time
Wet-bed Nursery-2

- Add organic manures and/or fertilizers as needed

- Irrigate, plow, puddle and level the field

- Prepare beds of 1 to 1.5 m width, 4-5 cm height & any convenient length

- Pre-germinate the seeds 2 days before sowing: 24 h soaking & 24 h incubation

- Sow the pre-germinated seeds on beds
Wet-bed Nursery-3

- Water the seedbed 2-3 DAS and then maintain a water level of 2-5 cm, depending on the height of seedlings.
- Apply 20-40 g urea or DAP per m² at 10 DAS, if needed.
- Apply pesticide only when needed.
- Seedlings are ready for TP from 20-25 DAS.
Wet-bed Rice Nursery, Sri Lanka
Wet-Bed Rice Nursery: Cold Injury
Covering nursery bed in cold climate
Does anyone have questions or comments about wet nurseries?
Dry-bed Nursery-1

• **Compute the seed & seedbed area**: 50 kg seed & 500 m² seedbed area for TP one ha of main field

• **Locate the seedbed away from electric light** in a fertile field with light soil and easy access to a water source

• **Start preparing the seedbed** 2 weeks before planting time

• **Add enough organic manures &/or fertilizers**
Dry-bed Nursery-2

- **Plow and harrow** the field

- **Prepare raised seedbeds** of 1.5 m width, 0.1-0.15 m height, and any convenient length

- **Seed priming**: weigh required quantity of clean seed, soak for 24 h and then dry in the shade

- **Primed seed** is reported to germinate faster than fresh dry seed

- **Sow the primed seeds** on raised beds & cover the seed lightly with soil or rice hull
Dry-bed Nursery-3

- Water the seedbed till saturation after sowing
- Then water the bed periodically as seedlings emerge & grow
- Regulate the water supply, if necessary, to control the rate of seedling growth
- Apply pesticides to control pests, if needed
- Seedling are ready from 25-30 DAS
Dry-bed Rice Nursery
Dapog (Mat) Nursery-1

- Less labor need
- Shorter period of raising seedlings
- Easy transport of seedling-mats to main field
- Preferred for mechanical transplanting
Dapog (Mat) Nursery-2

- Select a level area near the household and/or a water source
- Mark out 1 m wide and 10 to 20 m long plots
- Spread a plastic sheet or banana leaves on the marked area
- Form the boundary with bamboo splits or banana sheath
Dapog (Mat) Nursery-3

- **Spread the pre-germinated seeds** at the rate of 1 kg per 1.5 m$^2$ area

- **40-50 kg seed sown in 60-75 m$^2$ area** is enough to plant one ha of main field

- **Sprinkle water immediately** after sowing and then as and when needed
Dapog or Mat Nursery-4

• **Protect the mat nursery** from heavy rains for the first 5 DAS

• **Seedlings will be ready** for sowing in 8 to 15 DAS

• **Roll out the seedling mats** and transport them to the mail field
Dapog Nursery
Dapog Nursery: Seedling mat
Modified mat nursery-1: Why?

- Reduced nursery area: 100 m² to plant 1 ha
- Establishing seedlings in a 4-cm layer of soil mix, arranged on a firm surface
- Robust, young seedlings (18-20 cm tall with 4 leaves) produced within 15 DAS
- Easy transportation of seedling-mats to main field
- Easy separation of seedlings for transplanting (minimum root damage)
Modified Mat Nursery-2: Preparing Soil Mix

Soil : 70-80%
Decomposed manure : 15-20%
Rice husk : 5-10%
Powdered DAP : 1.5 kg/100 m²

**4 m³ soil mix for 100 m² nursery area**
Soil + Manure + Fertilizer Mixture
Manure must be well decomposed, otherwise young seedlings suffer.
ICM: Modified Mat Nursery-3

Prepare 100 m² nursery area to plant 1 ha. Select a level area near the household and/or a water source.

Mark out 1 m wide and 10 to 20 m long plots. Spread a plastic sheet or banana leaves on the marked area.

Place a wooden frame with 4-cm deep and convenient size segments. Fill the frame with soil mixture.
Frame for Filling Soil
Filling Soil Mix in Frames
Seed: To plant 1 ha, use quality seed @ 9-12 kg seed (for 20 x 20 cm spacing at 1 seedling per hill)
18-25 kg seed (for 20 x 20 cm spacing at 2 seedling per hill)

Sow pre-germinated seeds at the rate of 100 to 150 g per m² area and cover the seed with dry soil and press it gently
Sowing Pre-germinated Seeds
After Sowing Seeds
Covering Seeds with Soil
ICM: Modified Mat Nursery-5

Sprinkle water immediately to soak the bed

Then water the bed as and when needed to keep it moist all the time

Protect the nursery from heavy rains for the first 5 DAS

Continue watering until 15 DAS

If the nursery can be flooded, flood the nursery area with 1 cm water level all around at 6-7 DAS

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Sprinkling water to soak the bed
Lifting the Frame
Mat Nursery after Sowing
Watering Mat Nursery to Keep It Moist
Seedlings at 5 DAS
Aerobic or Flooded Nursery Beds

MMN: Aerobic

MMN: Flooded
Flood the nursery area with 1 cm water level at 6-7 DAS
Optional: Sprinkle 0.5% urea solution at 9 DAS, if seedling growth is slow or leaves are yellowing (1.5 kg urea/300 l for 100 m² area)

Seedlings reach 18-20 cm tall at 15 DAS

If flooded, drain the water 2 days before lifting the seedling-mats

Lift & transport the seedling-mats to mail field

Separate the seedlings and transplant them at 1-2 per hill at 20x20 to 25x25 cm spacing
Sprinkling 0.5% urea solution at 9 DAS
Seedlings at 15 DAS
Lifting the Seedling Mats
Seedling Mats at 15 DAS
Does anyone have questions or comments about mat nurseries?
Seedling Broadcasting (SB)

- 12-15-d old seedlings with root balls
- Seedlings raised on plastic trays
  - Size: 59 cm x 34 cm with 434 embedded holes
  - 750 trays ha⁻¹
- Seed bed area: 250 m² to plant one ha
- Nursery in uplands, lowlands or near the house
- In lowlands, 75 cm wide and 9-12 cm high seed beds are used

Source: Dr. Sumith, RRDI, SL
A Plastic Bubble Tray

Source: Dr. Sumith, RRDI, SL
Bubble Tray Nursery Preparation
(250 m² to plant 1 ha)

Source: Dr. Sumith, RRDI, SL

IRRI: Rice Production Course
Bubble Tray Nursery: Seeding
(Seed rate: 15-20 kg ha$^{-1}$)

Source: Dr. Sumith, RRDI, SL
Bubble Tray Nursery: Seedlings with root balls

Source: Dr. Sumith, RRDI, SL
Does anyone have questions or comments about bubble tray nurseries?
## Rice Nursery Types: Summary

<table>
<thead>
<tr>
<th>Nursery type</th>
<th>To plant 1 ha of main field</th>
<th>Optimum seedling age, d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nursery area, m²</td>
<td>Seed rate, kg ha⁻¹</td>
</tr>
<tr>
<td>Wet-bed</td>
<td>400-500</td>
<td>50</td>
</tr>
<tr>
<td>Dry-bed</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>Dapog (mat)</td>
<td>60-75</td>
<td>40-50</td>
</tr>
<tr>
<td>Modified mat</td>
<td>100</td>
<td>9-25</td>
</tr>
<tr>
<td>Bubble tray</td>
<td>250</td>
<td>15-20</td>
</tr>
</tbody>
</table>
Transplanting: Critical Factors

• Proper nursery management
• Careful handling of young seedlings for fast revival and early growth after TP
• Shallow transplanting at 1-2 cm depth
• Optimum plant-to-plant spacing: 20 x 20 cm to 25 x 25 cm
• Optimum number of seedlings: 1-2 hill⁻¹
Effect of plant spacing & seedling number per hill on initial plant count and required tillers per plant

<table>
<thead>
<tr>
<th>Seedling number per hill</th>
<th>Plant count per m² at transplanting</th>
<th>Needed tillers per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Dry season</td>
</tr>
<tr>
<td>20 x 15 cm or 30 x 10 cm spacing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>90</td>
<td>6.5</td>
</tr>
<tr>
<td>4</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>20 x 20 cm spacing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>6</td>
</tr>
<tr>
<td>30 x 30 cm spacing (SRI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>14</td>
</tr>
</tbody>
</table>
Modified Mat Nursery: Young Seedlings

- 16-18 cm tall
- 4 leaves
- No tillers
TP: Careful Handling of Seedlings
Square Planting
(with 1-2 seedlings per hill)
Mechanical Weeding + Soil Disturbance

- Incorporates weeds at < 4-leaf stage
- Better root & shoot growth
- High tillering
ICM Crop at Heading
Manual Transplanting: what are the advantages?

- Good head start for plant growth over weeds
- Shorter duration in main field
- Easy to maintain uniform plant spacing & population, if planted in rows
Manual TP: What are the constraints?

- Tedious & labor intensive, > 30 PD ha$^{-1}$
- Drudgery & back problem
- Difficult to find labor to plant on time
- Poor plant population due to contract TP on area basis
IRRI Manual Planter
Chinese planter

Japanese planter
Seedling Broadcasting

Source: Dr. Sumith, RRDI, SL
Seedling Broadcasting-Manual

Source: Dr. Sumith, RRDI, SL
Seedling Broadcasting by Machine
Seedling Broadcasting: What are the advantages

- Low seed rate: 15-20 kg ha$^{-1}$
- Less labor for CE (16 for SB vs. 30-36 for TP)
- No bird damage in the nursery and main field
- Early crop maturity by 7-8 days
- Water saving: 10 irrigations for SBR vs. 12 for TPR
- Less use of agro-chemicals as they can be applied directly to the nursery

Source: Dr. Sumith, RRDI, SL
Seedling Broadcasting: What are the limitations?

- Farmers have to buy plastic trays
- Heavy rains just after SB may disturb the distribution of broadcasted seedlings
### SB: On-station Yield Trials

<table>
<thead>
<tr>
<th>Stand Establishment Method</th>
<th>Season</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2002/03 Wet</td>
<td>2003 Dry</td>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Manual transplanting</td>
<td>6.09</td>
<td>5.66</td>
<td>5.87</td>
<td></td>
</tr>
<tr>
<td>Seedling b/casting (SB)</td>
<td>6.06</td>
<td>5.28</td>
<td>5.67</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>6.07</td>
<td>5.47</td>
<td></td>
<td></td>
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</table>
## On-farm Yield Trials

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Site</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>SB</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weera Pedasa</td>
<td>Jayanthipura</td>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>TP</td>
<td>SB</td>
<td>TP</td>
<td>SB</td>
<td>TP</td>
<td></td>
</tr>
<tr>
<td>No. of hills m(^2)</td>
<td>38</td>
<td>42</td>
<td>49</td>
<td>39</td>
<td>44</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>No. of panicles m(^2)</td>
<td>321</td>
<td>293</td>
<td>391</td>
<td>302</td>
<td>356</td>
<td>298</td>
<td></td>
</tr>
<tr>
<td>Grain yield (t ha(^{-1}))</td>
<td>8.8</td>
<td>8.5</td>
<td>9.0</td>
<td>8.5</td>
<td>8.9</td>
<td>8.5</td>
<td></td>
</tr>
</tbody>
</table>
## TP: Labor Need and Machine Costs

<table>
<thead>
<tr>
<th>CE method</th>
<th>Nursery type</th>
<th>Labor need (person-days ha(^{-1}))</th>
<th>Machine cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nursery</td>
<td>Planting</td>
</tr>
<tr>
<td>TP-manual</td>
<td>Wet/Dry bed</td>
<td>12</td>
<td>25-30</td>
</tr>
<tr>
<td></td>
<td>Dapog (mat)</td>
<td>6</td>
<td>25-30</td>
</tr>
<tr>
<td></td>
<td>Modified mat</td>
<td>8</td>
<td>25-30</td>
</tr>
<tr>
<td>Seedling Broadcast</td>
<td>Bubble tray</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>TP-machine (Dapog or seedling trays)</td>
<td>IRRI: Walk on</td>
<td>6</td>
<td>6-7</td>
</tr>
<tr>
<td></td>
<td>Chinese</td>
<td>6</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Japanese</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

IRRI: Rice Production Course
Direct Seeding of Rice: Why?

- To reduce labor input & drudgery
- To tackle labor shortage & high wages
- To establish crops on time
- To maintain optimum plant population
Direct Seeding of Rice: Incentives

• Availability of S.D. rice varieties
• Availability of cost-efficient, selective herbicides
• Faster and easier crop establishment
Direct Seeding Requirements

- Good LP & leveling
- Furrows to drain water (WDS)
- Saturated soil (WDS) & moist soil (DDS) for first 7-10 days
- Varieties: early seedling vigor, fast canopy dev., non-lodging
- Quality seed
- Effective weed control: cultural, mechanical, herbicides
Well-prepared and Leveled Fields for Direct Seeding

Level field for DDS  Level field for WDS
Direct Seeding: Benefits

- Faster and easier crop establishment
- Less labor need (1-2 vs. 25-30 for TP)
- Earlier crop maturity by 7-10 days
- More efficient water use & higher tolerance to water stress
- Reduced cost: US$ 60-80 per ha
- Less methane emission: DDS < WDS < TP
Direct Seeding Methods

- **Wet direct seeding (WDS):** puddled soil, broadcast- or row-seeded
  - Surface WDS
  - Subsurface WDS
  - Water seeding

- **Dry direct seeding (DDS):** dry/moist soil, broadcast or drilled in rows
Most common wet seeding method
- Sprouted seeds
- Seed rate: 80-250 kg ha$^{-1}$
Sprouted seed
Seed rate: 60-80 kg ha\(^{-1}\)
Better plant stand
Drum seeder, Vietnam
8 kg wt + 12 kg seed
Drum seeder

Seed hoppers

Seed holes

Drum seeder
Dry Seeding

- Used in rainfed areas
- Dry seed
- Seed rate 300 kg ha\(^{-1}\)
- Germination with rainfall; drought
- High pest incidence

Dry broadcasting

Seeding behind plow

Machine seeding
Zero-till drill and planting
Bed Planting
TPR-B: Transplanting seedlings on bed

• Good CE, but more labor

• Good plant growth & uniform tillering

• Less water use (by 20-30%) than that of TPR

• High yield as that of TPR
DSR-B: Dry drill seeding on beds

- Fast & efficient seeding, but poor CE
- May need saturated soil for the first 25-30 days
- Conserves rain water & avoids flooding
- Saving in water (~ 20-30%)
- Micro-nutrient deficiency: Fe, Zn, Cu, etc.
- Severe weed infestation, needs effective herbicides
- Termite problems
Can anyone briefly explain:

- Seedling broadcasting?
- Direct seeding?
Thank you
Rice Nursery: Some Calculations-1

1. What is the area per ha?  
   100m x 100m = 10,000 m²

2. How many hills per ha?  
   (at 20 x 20 cm spacing)  
   10,000 / (0.2 x 0.2) = 250,000 hills per ha

3. How many seedlings per ha? (at 4 per hill)  
   250,000 x 4 = 1,000,000
4. How many seeds you need per ha?  
1,000,000 seeds per ha

5. What is the weight of 1000 seeds?  
Range: 20-30 g  
Mean: 25 g

6. How much seed you need to plant one ha?  
\[(\frac{1,000,000}{1000}) \times \frac{25}{1000} = 25 \text{ kg}\]
7. What is the % germination for rice seed?

Range: 50 to 90%
Mean: 70%

8. At 70% germination, how much seed you need per ha?

Seed: $\frac{25}{0.7} = 36$ kg

9. What % of seedlings survive in wet-bed nursery

Range: 50-90%
Mean: 70%

10. Finally how much seed you need for wet-bed nursery to plant one ha?

Seed rate: $\frac{25}{(0.7 \times 0.7)} = 51$ kg per ha
Rice Production in Asia:

IRRI: Rice Production Course