

# **RICE**

- 1. System of Rice Intensification (SRI) Cultivation**
- 2. Transplanted Puddled Lowland Rice**
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- 5. Dry Seeded Rainfed Un-Puddled Lowland Rice (with Supplemental Irrigation)**
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# 1. System of Rice Intensification (SRI) Cultivation

## 1.1. Season

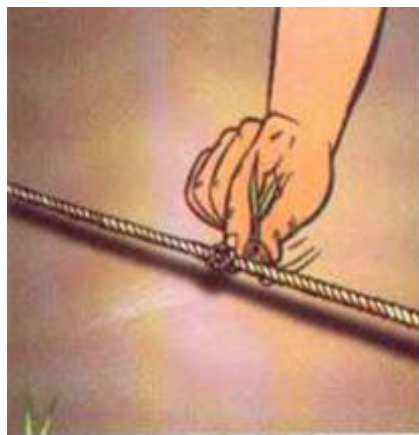
- Dry season with assured irrigation is more suitable.
- Difficulty in crop establishment may be seen in areas with heavy downpour (NE Monsoon periods of Tamil Nadu)

## 1.2. Varieties

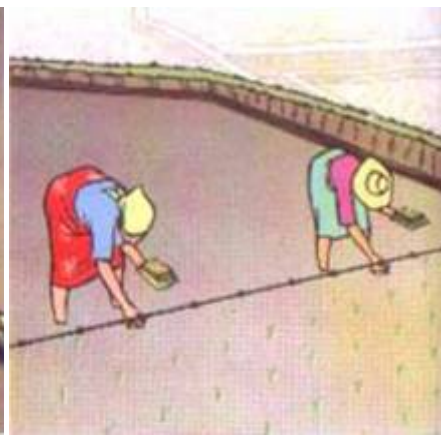
- Hybrids and varieties with heavy tillering



*Young Seedling  
(14 days old)*



*Single Seedling/hill*



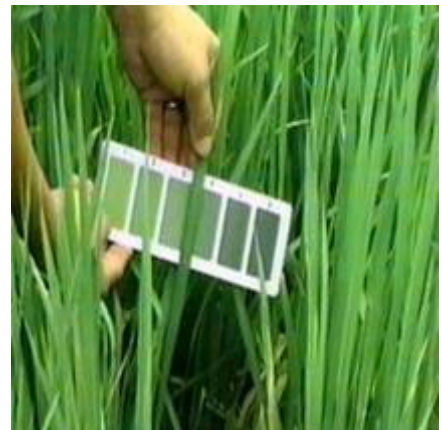
*Square Planting*



*Weeding by Cono Weeder*



*Alternate Wetting & Drying*



*LCC based N Management*

*Fig: Components of System of Rice Intensification (SRI) Cultivation*

## 1.3. Nursery

### 1.3.1. Seed rate: 7- 8 kg for single seedling per hill

**1.3.2. Preparation of Nursery Area:** Prepare 100 m<sup>2</sup> nurseries to plant 1 ha. Select a levelled area near the water source. Spread a plastic sheet or used polythene gunny bags on the shallow raised bed to prevent roots growing deep into soil.



*Fig: Preparation of Nursery Area*

**1.3.3. Preparation of Soil Mixture:** Four (4) m<sup>3</sup> of soil mix is needed for each 100 m<sup>2</sup> of nursery. Mix 70% soil + 20% well-decomposed pressmud / bio-gas slurry / FYM + 10% rice hull. Incorporate in the soil mixture 1.5 kg of powdered di -ammonium phosphate or 2 kg 17-17-17 NPK fertilizer.



*Fig: Preparation of Soil Mixture*

#### **1.3.4. Blending Soil Mixture**

**Filling in soil mixture:** Place a wooden frame of 0.5 m long, 1 m wide and 4 cm deep divided into 4 equal segments on the plastic sheet or banana leaves. Fill the frame almost to the top with the soil mixture.

**Pre-germinating the seeds 2 days before sowing:** Soak the seeds for 24 h, drain and incubate the soaked seeds for 24 h, sow when the seeds sprout and radical (seed root) grows to 2-3 mm long.



**1.3.5. Sowing:** Sow the pre-germinated seeds weighing 90 -100 g / m<sup>2</sup> (100g dry seed may weigh 130g after sprouting) uniformly and cover them with dry soil to a thickness of 5mm. Sprinkle water immediately using rose can to soak the bed and remove the wooden frame and continue the process until the required area is completed.

### 1.3.6. Sowing Sprouted Seeds

**Watering:** Water the nursery with rose can as and when needed (twice or thrice a day) to keep the soil moist. Protect the nursery from heavy rains for the first 5 DAS. At 6 DAS, maintain thin film of water all around the seedling mats. Drain the water 2 days before removing the seedling mats for transplanting.



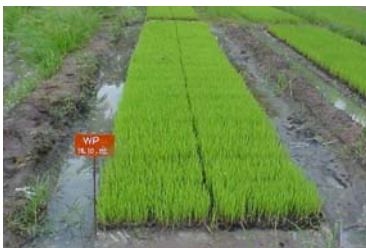
*Fig: Sowing*



*Fig: Watering with Rose Can*

**Spraying fertilizer solution (optional):** If seedling growth is slow, sprinkle 0.5% urea + 0.5% zinc sulfate solution at 8-10 DAS.

**Lifting seedling mats:** Seedlings reach sufficient height for planting at 15 days. Lift the seedling mats and transport them to main field.



*Mat Nursery*



*Lifting Seedlings*



*Lifting Seedling Mats*

## 1.4. Main field preparation

- Puddled lowland prepared as described in transplanted section
- Perfect leveling is a pre-requisite for the water management proposed hereunder

## 1.5. Transplanting

- Single seedling of 15 days old.
- Square planting of 25 x 25 cm.
- Fill up the gaps between 7th and 10th DAT.
- Transplant within 30 minutes of pulling out of seedlings.
- There may be difficulty in crop establishment in areas with heavy downpour (North East Monsoon periods of Tamil Nadu)



*Square planting with single seedling*



*Transplanted Young Seedling*

## 1.6. Irrigation management

- Irrigation only to moist the soil in the early period of 10 days
- Restoring irrigation to a maximum depth of 2.5cm after development of hairline cracks in the soil until panicle initiation
- Increasing irrigation depth to 5.0cm after PI one day after disappearance of ponded water



*Alternate wetting and drying (irrigate until hairline crack develop)*

## 1.7. Weed management

- Using rotary weeder / Cono weeder
- Moving the weeder with forward and backward motion to bury the weeds and as well to aerate the soil at 7-10 days interval from 10-15 days after planting on either direction of the rows and column.
- Manual weeding is also essential to remove the weeds closer to rice root zone.





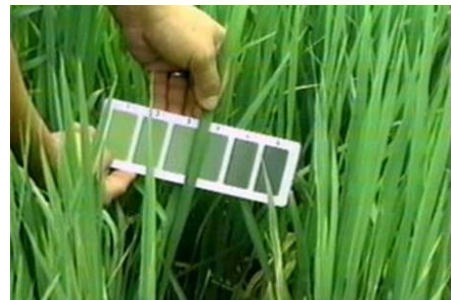
*Using rotary weeder / Cono weeder - Weeder should be moved in both directions*

### 1.8. Nutrient managements

- As per transplanted rice.
- Use of LCC has more advantage in N management.

### 1.9. N management through LCC

- Time of application is decided by LCC score
- Take observations from 14 DAT in transplanted rice or 21 DAS in direct seeded rice.
- Repeat the observations at weekly intervals up to heading
- Observe the leaf colour in the fully opened third leaf from the top as index leaf.
- Match the leaf color with the colours in the chart during morning hours (8-10 am).
- Take observation in 10 places.



*Leaf Color Chart based N Management*

- LCC critical value is 3.0 in low N response cultures like White Ponni and 4.0 in other cultivars and hybrids
- When 6/10 observations show less than the critical colour value, N can be applied @ 35kg N/ha in dry season and 30kg N/ha in wet season per application per ha.
- Green manure and farm yard manure application will enhance the growth and yield of rice in this system approach.

## 2. Transplanted Puddled Lowland Rice

### 2.1. Nursery management

#### 2.1.1. Wet nursery

##### Nursery area

Select 20 cents (800 m<sup>2</sup>) of land area near to water source for raising seedlings for one hectare.

##### Seed rate

30 kg for long duration

40 kg for medium duration

60 kg for short duration varieties and

20 kg for hybrids

##### Seed treatment

- Treat the seeds in Carbendazim or Pyroquilon or Tricyclozole solution at 2 g/l of water for 1 kg of seeds. Soak the seeds in water for 10 hrs and drain excess water.
- This wet seed treatment gives protection to the seedlings up to 40 days from seedling disease such as blast and this method is better than dry seed treatment.
- If the seeds are required for sowing immediately, keep the soaked seed in gunny in dark and cover with extra gunnies and leave for 24hrs for sprouting.
- **Seed treatment with *Pseudomonas fluorescens*:** Treat the seeds with talc based formulation of *Pseudomonas fluorescens* 10g/kg of seed and soak in 1lit of water overnight. Decant the excess water and allow the seeds to sprout for 24hrs and then sow.
- **Seed treatment with *Azospirillum*:** Three packets (600 g/ha) of Azospirillum and 3 packets (600g/ha) of Phosphobacteria or 6 packets (1200g/ha) of Azophos. In bioinoculants mixed with sufficient water wherein the seeds are soaked overnight before sowing in the nursery bed (The bacterial suspension after decanting may be poured over the nursery area itself).
- Biocontrol agents are compatible with biofertilizers
- Biofertilizers and biocontrol agents can be mixed together for seed soaking
- Fungicides and biocontrol agents are incompatible

##### Forming Seedbeds

- Mark plots of 2.5m breadth with channels 30cm wide all around the seedbeds.
- Length of the seed bed may vary from 8 to 10m according to soil and slope of the land.
- Collect the puddled soil from the channel and spread on the seedbeds or drag a heavy stone along the channel to lower it, so that the seed bed is at a higher level.
- Level the surface of the seedbed, so that the water drains into the channel.

**Sowing:** Sow the sprouted seeds uniformly on the seedbed, having thin film of water in the nursery.

### Water Management

- Drain the water 18 to 24hrs after sowing
- Care must be taken to avoid stagnation of water in any part of the seedbed.
- Allow enough water to saturate the soil from 3rd to 5th day. From 5th day onwards, increase the water depth to 1.5cm depending on the height of the seedlings.
- Thereafter maintain 2.5cm depth of water.

### Weed Management

- Apply any one of the pre-emergence herbicides viz., Pretilachlor + safener 0.3kg/ha, on 3rd or 4th day after sowing to control weeds in the lowland nursery. Keep a thin film of water and allow it to disappear. Avoid drainage of water. This will control germinating weeds



*Apply pre-emergence herbicides viz., Pretilachlor + safener 0.3kg/ha, on 3rd or 4th day after sowing to control weeds in the lowland nursery.*

### Nutrient management

- Apply 1tonne of fully decomposed FYM or compost to 20cents nursery and spread the manure uniformly on dry soil.
- Basal application of DAP is recommended when the seedlings are to be pulled out in 20-25 days after sowing in less fertile nursery soils.
- For that situation, before the last puddling, apply 40kg of DAP and if not readily available, apply straight fertilizers 16kg of urea and 120kg of super phosphate.
- If seedlings are to be pulled out after 25 days, application of DAP is to be done 10 days prior to pulling out.
- For clayey soils where root snapping is a problem, 4kg of gypsum and 1kg of DAP/cent can be applied at 10 days after sowing.

#### 2.1.2. Dry nursery



- Dry ploughed field with fine tilth is required.
- Nursery area with sand and loamy soil status is more suitable for this type of nursery.
- Area 20cents.
- Plots of 1 to 1.5 m width of beds and channels may be formed. Length may be according to the slope and soil. Raised beds are more ideal if the soil is clayey in nature.
- Seed rate and seed treatment as that of wet nursery.
- Sowing may be dry seeding. Seeds may be covered with sand and finely powdered well decomposed farm yard manure.
- Irrigation may be done to wet the soil to saturation.
- Optimum age for transplanting – 4th leaf stage
- This type of nursery is handy in times of delayed receipt of canal water.

## 2.2 Main Field Management

### 2.2.1. Land preparation

- Plough the land during summer to economize the water requirement for initial preparation of land.
- Flood the field 1 or 2 days before ploughing and allow water to soak in. Keep the surface of the field covered with water.
- Keep water to a depth of 2.5cm at the time of puddling.



Keep water to a depth of 2.5cm at the time of puddling

- Special technologies for problem soils:

- For fluffy paddy soils: compact the soil by passing 400kg stone roller or oil-drum with stones inside, eight times at proper moisture level (moisture level at friable condition of soil which is approximately 13 to 18%) once in three years, to prevent the sinking of draught animals and workers during puddling.
- For sodic soils with pH values of more than 8.5, plough at optimum moisture regime, apply gypsum at 50% gypsum requirement uniformly, impound water, provide drainage for leaching out soluble salts and apply green leaf manure at 5 t/ha, 10 to 15 days before

transplanting. Mix 37.5kg of Zinc sulphate per ha with sand to make a total quantity of 75kg and spread the mixture uniformly on the leveled field. Do not incorporate the mixture in the soil. Rice under sodic soil responds well to these practices.

c) For saline soils with EC values of more than 4 dS/m, provide lateral and main drainage channels (60cm deep and 45cm wide), apply green leaf manure at 5 t/ha at 10 to 15 days before transplanting and 25% extra dose of nitrogen in addition to recommended P and K and ZnSo<sub>4</sub> at 37.5 kg/ha at planting

d) For acid soils apply lime based on the soil analysis for obtaining normal rice yields. Lime is applied 2.5t/ha before last ploughing. Apply lime at this rate to each crop up to the 5th crop.

### 2.2.2. Stand Establishment

**Optimum age of seedlings for quick establishment:** Optimum age of the seedlings is 18-22 days for short, 25-30 days for medium and 35-40 days for long duration varieties.

#### Pulling out the seedlings

- Pull out the seedlings at the appropriate time (4th leaf stage).
- Pulling at 3rd leaf stage is also possible. These seedlings can produce more tillers, provided enough care taken during the establishment phase (See section 1.8 Integrated Crop Management (ICM) - Rice-SRI) through thin film of water management and perfect leveling of main field.
- Transplanting after 5th and higher order leaf numbers will affect the performance of the crop and grain yield. Then they are called as 'aged seedlings'. Special package is needed to minimize the grain yield loss while planting those aged seedlings.

#### Root dipping

- Prepare the slurry with 5 packets (1000 g)/ha of Azospirillum and 5 packets (1000g/ha) of Phosphobacteria or 10 packets of (2000g/ha) of Azophos inoculant in 40 lit. of water and dip the root portion of the seedlings for 15 - 30 minutes in bacterial suspension and transplant.

#### Planting seedlings in the main field

Soil	Medium and low fertility			High fertility		
Duration	Short	Medium	Long	Short	Medium	Long
Spacing (cm)	15x10	20x10	20x15	20x10	20x15	20x20
Hills / m <sup>2</sup>	66	50	33	50	33	25

- Transplant 2-3 seedlings/hill for short duration and 2 seedlings/hill for medium and long duration varieties
- Shallow planting (3 cm) ensures quick establishment and more tillers.
- Deeper planting (> 5cm) leads to delayed establishment and reduced tillers.
- Line planting permits rotary weeding and its associated benefits.
- Allow a minimum row spacing of 20 cm to use rotary weeder.
- Fill up the gaps between 7th and 10th DAT.

## Management of Aged seedlings

- \* Which developed tillers / underwent node elongation in the nursery itself and
- \* About half of its leaf producing capacity may be already over.

- Follow the spacing recommended to medium and low fertility soil
- Plant one or two seedlings per hill
- Avoid cluster planting of aged seedlings, which are hindering the formation of new tillers.
- New tillers alone are capable of producing normal harvestable panicle. Weak panicle may appear in the mother culm within three weeks after transplanting and vanishes well before harvest.
- To encourage the tiller production, enhance the basal N application by 50% from the recommended and thereafter follow the normal schedule recommended for other stages.

**Gap filling:** Fill the gaps if any within 7 - 10 days after planting.

### 2.2.3. Nutrient management

#### Application of organic manures

- Apply 12.5 t of FYM or compost or green leaf manure @ 6.25 t/ha.
- If green manure is raised @ 20 kg /ha *in situ*, incorporate it to a depth of 15 cm using a green manure trampler or tractor.
- In the place of green manure, press-mud / composted coir-pith can also be used.

#### Stubble incorporation

- Apply 22 kg urea / ha at the time of first puddling while incorporating the stubbles of previous crop to compensate immobilization of N by the stubbles.
- This may be done at least 10 days prior to planting of subsequent crop. This recommendation is more suitable for double crop wetlands, wherein, the second crop is transplanted in succession with short turn around period.

#### Biofertilizer application

- Broadcast 10 kg of soil based powdered BGA flakes at 10 DAT for the dry season crop. Maintain a thin film of water for multiplication.
- Raise azolla as a dual crop by inoculating 250 kg/ha 3 to 5 DAT and then incorporate during weeding for the wet season crop.
- Mix 10 packets (2000 g)/ha of Azospirillum and 10 packets (2000g/ha) of Phosphobacteria or 20 packets (4000g/ha) of Azophos inoculants with 25 kg FYM and 25 kg of soil and broadcast the mixture uniformly in the main field before transplanting and
- *Pseudomonas fluorescens* (Pf 1) at 2.5 kg/ha mixed with 50 kg FYM and 25 kg of soil and broadcast the mixture uniformly before transplanting.



## Application of inorganic fertilizers

- Apply fertilizer nutrients as per soil test recommendations
- N dose may be through Leaf Color Chart (**LCC**)
- P & K may be through Site Specific Nutrition Management by Omission plot technique (Ref. Appendix II)
- If the above recommendation are not able to be followed, adopt blanket recommendation as follows:

Nutrients	N	P2O5	K2O
	(kg/ha)		
Short duration varieties ( <b>dry season</b> )			
a) Cauvery delta & Coimbatore tract	150	50	50
b) For other tracts	120	40	40
Medium and long duration varieties ( <b>wet season</b> )	150	50	50
Hybrid rice	175	60	60
Low N responsive cultivars (like Improved White Ponni)	75*	50	50

\*For Ponni, N should be applied in three splits at AT, PI and H stages\*\* in addition to GLM or FYM application.

### \*\*Phenological stages of rice (days after sowing)

Stages	Short (105)	Medium (135)	Long (150)
Active Tillering (AT)	35-40	50-55	55-60
Panicle Initiation (PI)	45-50	70-75	85-90
Heading (H)	70-75	100-105	115-120

## Split application of N and K

- Apply N and K in four equal splits viz., basal, tillering, panicle initiation and heading stages.
- Tillering and Panicle initiation periods are crucial and should not be reduced with the recommended quantity.
- N management through **LCC** may be adopted wherever chart is available as given below

### N management through LCC

- Time of application is decided by LCC score
- Take observations from 14 DAT in transplanted rice or 21 DAS in direct seeded rice.
- Repeat the observations at weekly intervals up to heading
- Observe the leaf colour in the fully opened third leaf from the top as index leaf.
- Match the leaf color with the colours in the chart during morning hours (8-10 am).

- Take observation in 10 places.
- LCC critical value is 3.0 in low N response cultures like White Ponni and 4.0 in other cultivars and hybrids
- When 6/10 observations show less than the critical colour value, N can be applied @ 35kg N/ha in dry season and 30kg N/ha in wet season per application per ha.

### **Application of P fertilizer**

- P may be applied as basal and incorporated.
- When the green manure is applied, rock phosphate can be used as a cheap source of P fertilizer. If rock phosphate is applied, the succeeding rice crop need not be supplied with P. Application of rock phosphate + single super phosphate or DAP mixed in different proportions (75:25 or 50:50) is equally effective as SSP or DAP alone.

### **Application of zinc sulphate**

- Apply 25 kg of zinc sulphate mixed with 50 kg dry sand just before transplanting.
- It is enough to apply 12.5 kg zinc sulphate /ha, if green manure (6.25 t/ha) or enriched FYM, is applied.
- If deficiency symptom appears, foliar application of 0.5% Zinc sulphate + 1.0% urea can be given at 15 days interval until the Zn deficiency symptoms disappear.

**Application of gypsum:** Apply 500 kg of gypsum/ha (as source of Ca and S nutrients) at last ploughing.

**Foliar nutrition:** Foliar spray of 1% urea + 2% DAP + 1% KCl at PI and 10 days later for all varieties.

### **Nutrient deficiency / toxicity symptoms**

- **Nitrogen deficiency:** Plants become stunted and yellow in appearance first on lower leaves. In case of severe deficiency the leaves will turn brown and die. Deficiency symptoms first appear at the leaf-tip and progress along the midrib until the entire leaf is dead.
- **Potassium deficiency:** Bluish green leaves - when young, older leaves irregular. Chlorotic and necrotic areas - grain formation is poor - weakening of the straw which results in lodging.
- **Magnesium deficiency:** Leaves are chlorotic with white tips.
- **Iron toxicity:** Brown spots on the lower leaves starting from tips and proceeding to the leaf base and turns into green or orange purple leaves and spreading to the next above leaves.
- **Zinc deficiency:** Lower leaves have chlorotic particularly towards the base. Deficient plants give a brown rusty appearance.

### **Neem treated urea and coal-tar treated urea**

- Blend the urea with crushed neem seed or neem cake 20% by weight. Powder neem cake to pass through 2mm sieve before mixing with urea. Keep it overnight before use (or) urea can be mixed with gypsum in 1:3 ratios, or urea can be mixed

with gypsum and neem cake at 5:4:1 ratio to increase the nitrogen use efficiency. For treating 100 kg urea, take one kg coal-tar and 1.5 litres of kerosene. Melt coal-tar over a low flame and dissolve it in kerosene. Mix urea with the solution thoroughly in a plastic container, using a stick. Allow it to dry in shade on a polythene sheet. This can be stored for a month and applied basally.

#### 2.2.4. Weed management

- Use of rotary weeder from 15 DAT at 10 days interval. It saves labour for weeding, aerates the soil and root zone, prolongs the root activity, and improves the grain filling through efficient translocation and ultimately the grain yield.
- Cultural practices like dual cropping of rice-azolla, and rice-green manure (described in wet seeded rice section 2.5 & 2.6 of this chapter) reduces the weed infestation to a greater extent.
- Summer ploughing and cultivation of irrigated dry crops during post-rainy periods reduces the weed infestation.

#### Pre-emergence herbicides

- Use Butachlor 1.25kg/ha or Anilophos 0.4kg/ha as pre-emergence application. Alternatively, pre-emergence application of herbicide mixture viz., Butachlor 0.6kg + 2,4 DEE 0.75kg/ha, or Anilophos + 2, 4 DEE 'ready-mix' at 0.4kg/ha followed by one hand weeding on 30 - 35 DAT will have a broad spectrum of weed control.
- Any herbicide has to be mixed with 50kg of dry sand on the day of application (3 - 4 DAT) and applied uniformly to the field with thin film water on the 3rd DAT. Water should not be drained for next 2 days from the field (or) fresh irrigation should not be given.



*Herbicide mixed with 50kg of dry sand*

#### Post - emergence herbicides

- If pre-emergence herbicide application is not done, hand weeding has to be done on 15th DAT.
- 2,4-D sodium salt (Fernoxone 80% WP) 1.25 kg/ha dissolved in 625 litres with a high volume sprayer, three weeks after transplanting or when the weeds are in 3 - 4 leaf stage.

#### 2.2.5. Water management

- Puddling and leveling minimizes the water requirement



- Plough with tractor drawn cage wheel to reduce percolation losses and to save water requirement up to 20%.
- Maintain 2.5cm of water over the puddle and allow the green manure to decompose for a minimum of 7 days in the case of less fibrous plants like sunnhemp and 15 days for more fibrous green manure plants like Kolinchi (*Tephrosia purpurea*).
- At the time of transplanting, a shallow depth of 2cm of water is adequate since high depth of water will lead to deep planting resulting in reduction of tillering.
- Maintain 2 cm of water up to seven days of transplanting.
- After the establishment stage, cyclic submergence of water (as in table) is the best practice for rice crop. This cyclic 5cm submergence has to be continued throughout the crop period.

Days after disappearance of ponded water at which irrigation is to be given

Soil type	Summer	Winter
Loamy	1 day	3 days
Clay	Just before/immediately after disappearance	1 - 2 days

- Moisture stress due to inadequate water at rooting and tillering stage causes poor root growth leading to reduction in tillering, poor stand and low yield.
- Critical stages of water requirement in rice are a) panicle initiation, b) booting, c) heading and d) flowering. During these stages, the irrigation interval should not exceed the stipulated time so as to cause the depletion of moisture below the saturation level.
- During booting and maturity stages continuous inundation of 5cm and above leads to advancement in root decay and leaf senescence, delay in heading and reduction in the number of filled grains per panicle and poor harvest index.
- Provide adequate drainage facilities to drain excess water or strictly follow irrigation schedule of one day after disappearance of ponded water. Last irrigation may be 15 days ahead of harvest.

### Precautions for irrigation

- The field plot can be 25 to 50 cents depending on the source of irrigation.
- Field to field irrigation should be avoided. Field should be irrigated individually from a channel.
- Small bund may be formed parallel to the main bund of the field at a distance of 30 to 45cm within the field to avoid leakages of water through main bund crevices.
- To minimize percolation loss, the depth of stagnated water should be 5cm or less.
- In water logged condition, form open drains, about 60cm in depth and 45cm width across the field.
- Care should be taken not to allow development of cracks.
- In canal command area, conjunctive use of surface and ground water may be resorted to for judicious use of water.
- In double cropped wetland of command area, raise groundnut / pulse in the place of *Kuruvai* rice if water is a constraint or go for rice cultivation as described in 5. *Dry Seeded Irrigated Un-Puddled Lowland Rice*.

### 2.3. Harvesting

- Taking the average duration of the crop as an indication, drain the water from the field 7 to 10 days before the expected harvest date as draining hastens maturity and improves harvesting conditions.
- When 80% of the panicles turn straw colour, the crop is ready for harvest. Even at this stage, the leaves of some of the varieties may remain green.
- Confirm maturity by selecting the most mature tiller and dehusk a few grains. If the rice is clear and firm, it is in hard dough stage.
- When most of the grains at the base of the panicle in the selected tiller are in a hard dough stage, the crop is ready for harvest. At this stage harvest the crop, thresh and winnow the grains.
- Dry the grains to 12% moisture level for storage. Grain yield in rice is estimated only at 14% moisture for any comparison.
- Maturity may be hastened by 3-4 days by spraying 20% NaCl a week before harvest to escape monsoon rains.

## 3. Wet Seeded Puddled Lowland Rice

**3.1. Area:** Direct wet seeding can be followed in all the areas wherein transplanting is in vogue.

**3.2. Season:** As that of transplanted rice

### 3.3. Field preparation

- On receipt of showers during the months of May - July repeated ploughing should be carried out so as to conserve the moisture, destroy the weeds and break the clods.
- After inundation puddling is to be done as per transplanting. More care should be taken to level the field to zero level.
- Stagnation of water in patches during germination and early establishment of the crop leads to uneven crop stand.
- Land leveling has say over efficient weed and water management practices.
- Provision of shallow trenches (15cm width) at an interval of 3m all along the field will facilitate the draining of excess water at the early growth stage.



## Varieties

All the varieties recommended for transplanting can do well under direct wet seeded conditions also. However, the following varieties are more suited.

Varieties	Duration (days)	Time of sowing
Ponmani	160 to 165	1st to 30th August
Co 43, IR20, ADT 38 ADT 39, Ponni, Improved White Ponni	125 to 135	1st to 30th September
ADT 36, ADT 37	105 to 110	1st to 10th October

## 3.4. Sowing

- Follow a seed rate of 60 kg / ha
- Pre-germinate the seeds as for wet nursery
- Seed treatments as adopted for transplanted rice
- Sow the seeds by **drum seeder** or broadcast uniformly with thin film of water.
- Dual cropping of rice-green manure is economic for nutrient budget and efficient for grain production. For this method use 'TNAU Rice-Green manure seeder'.



*Paddy Cum Daincha Seeder*



*Drum Seeder*



### 3.5. After cultivation

- Thinning and gap filling should be done 14 - 21 days after sowing, taking advantage of the immediate rain.
- If dual cropped with green manure, incorporate the green manure when grown to 40cm height or at 30 days after sowing, whichever is earlier, using Cono-weeder.
- Green manure incorporated fields may be operated again with rotary weeder a week later in order to aerate the soil and to exploit organic acids formed if any.

### 3.6. Manures and fertilizer application

- For direct wet seeded lowland rice, the recommendation is same as that of transplanted rice.
- Apply N and K as 25% each at 21 DAS, at active tillering, PI and heading stages.
- If N applied through LCC, use the critical value 3 for broadcasted and 4 for line sown drill seeded rice.
- Entire P as basal applied in the last plough or at the time of incorporation of green manure/ compost.
- Biofertilizers as recommended to transplanted rice may be followed wherever feasible and moisture available.
- Micro nutrient, foliar application and biofertilizers as recommended to transplanted rice.

### 3.7. Weed management

- In wet seeded rice, pre-emergence application of pretilachlor 0.75kg/ha on 8 DAS or pretilachlor + safener (Sofit) at 0.45kg/ha on 3-4 DAS followed by one hand weeding on 40 DAS.

### 3.8. Water management

- During first one week just wet the soil by thin film of water.
- Depth of irrigation may be increased to 2.5cm progressively along the crop age.
- Afterwards follow the schedule as given to transplanted rice.

**Other package of practices:** As recommended in transplanted rice.

## 4. Dry Seeded Rainfed Un-Puddled Lowland Rice

### 4.1. RAINFED RICE

The crop establishment, growth and maturity depend up on the rainfall received. There will be standing water after crop establishment for a minimum period of few days to a maximum up to grain filling, depending up on the rainfall. This type of cultivation in Tamil Nadu is called as '**rainfed rice**', with the assumption that the soil moisture will be under

unsaturated (dry) condition during establishment or entire growth period, with reference to tropical climate.

**4.2. Area:** Coastal districts of Tamil Nadu like Kanchipuram, Tiruvallur, Pudukottai, Ramanathapuram, Virudhunagar, Sivagangai and Kanyakumari.

#### **4.3. Season**

- June – July – (Coastal northern districts)
- September – October (Coastal southern districts)

#### **4.4. Field preparation**

- Dry plough to get fine tilth taking advantage of rains and soil moisture availability.
- Apply gypsum at 1 t/ha basally wherever soil crusting and soil hardening problem exist.
- Perfect land leveling for efficient weed and water management.
- Provide shallow trenches (15 cm width) at an interval of 3m all along the field to facilitate draining excess water at the early growth stage.

**4.5. Varieties:** Short duration varieties as mentioned in season and varieties including local land races suitable for those tracts.

#### **4.6. Sowing**

- Seed rate: 75kg/ha dry seed for any recommended variety.
- Seed hardening with 1% KCl for 16 hours (seed and KCl solution 1:1) and shade dried to bring to storable moisture. This will enable the crop to withstand early moisture stress.
- On the day of sowing, treat the hardened seeds first with *Pseudomonas fluorescens* 10g/kg of seed and then with *Azophos* 2000g or *Azospirillum and Phosphobacteria* @ 600g each per ha seed, whichever is available.
- Drill sow with 20 cm inter row spacing using seed drill.
- The seeds can also be sown behind the country plough
- Depth of sowing should be 3 - 5 cm and the top soil can be made compact with leveling board.
- Pre-monsoon sowing is advocated for uniform germination.

#### **4.7. After cultivation**

- *Azospirillum* inoculants 10 packets (2000g/ha) and *Phosphobacteria* 10 packets (2000g/ha) or 20 packets (4000g/ha) of *Azophos* mixed with 25 kg of FYM may be broadcasted uniformly over the field just after the receipt soaking rain / moisture.
- Thinning and gap filling should be done 14 - 21days after sowing, taking advantage of the immediate rain
- Spray Cycocel 1000 ppm (1 ml of commercial product in one lit. of water) under water deficit situations to mitigate ill-effects.
- Foliar spray of Kaolin 3% or KCl 1% to overcome moisture stress at different physiological stages of rice.

#### 4.8. Manures and fertilizer application

- Blanket recommendation : 50:25:25 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O /ha
- Apply a basal dose of 750 kg of FYM enriched with fertilizer phosphorus (P at 25 kg/ha)
- Apply N and K in two equal splits at 20 - 25 and 40 - 45 days after germination.
- If the moisture availability from the tillering phase is substantial, three splits (25 kg N and 12.5 kg K at 20-25, 40-45 and 60-65 DAG) can be adopted.
- N at PI may be enhanced to 40 kg, if the tiller production is high (may be when the estimated LAI is greater than 5.0) and moisture availability ensured by standing water for 10 days.
- Basal application of FeSO<sub>4</sub> at 50 kg/ha is desirable for iron deficient soil.
- Foliar spray of 1% urea + 2% DAP + 1%KCl at PI and 10 days later may be taken up for enhancing the rice yield if sufficient soil moisture is ensured

#### 4.9. Weed management

- First weeding can be done between 15 and 21 days after germination.
- Second weeding may be done 30 - 45 days after first weeding.
- Apply pendimethalin 1.0kg/ha on 5 days after sowing or Pretilachlor + safener (Sofit) 0.45kg/ha on the day of receipt of soaking rain followed by one hand weeding on 30 to 35 days after sowing.

**Harvesting:** Same as that for wet rice cultivation

### 5. Dry Seeded Rainfed Un-Puddled Lowland Rice (with Supplemental Irrigation)

#### 5.1. Semi dry rice

It is called as **semi-dry rice**. Crop establishment is as that of rainfed rice but the rain water collected in village tank (Kanmai) is supplemented to protect the crop during peak vegetative and reproductive phases. Interaction between applied nutrients and crop is positive here due to better moisture availability than rainfed rice and hence varieties may be improved ones and nutrient levels may be higher than the previous system.

**5.2. Area:** Kanchipuram/Tiruvallur, Ramanathapuram, Sivaganga, Kanyakumari, Nagapattinam/ Tiruvarur and Pudukottai.

#### 5.3. Seasons

- July to August - Kanchipuram/Tiruvallur, Kanyakumari
- August - Nagapattinam/Tiruvarur, Pudukottai
- September to October - Ramanathapuram, Sivaganga

#### 5.4. Field preparation

- Dry plough to get fine tilth taking advantage of rains and soil moisture availability.
- Apply gypsum at 1 t/ha basally wherever soil crusting and soil hardening problem exist.
- Perfect land leveling for efficient weed and water management.
- Provide shallow trenches (15 cm width) at an interval of 3m all along the field to facilitate draining excess water at the early growth stage.

#### 5.5. Varieties

- Short duration varieties as mentioned in season and varieties including local land races suitable for those tracts.
- Since there is supplemental irrigation high yielding improved short duration varieties can yield more yield than the land races.

#### 5.6. Sowing

- Seed rate: 75kg/ha dry seed for any recommended variety.
- Seed hardening with 1% KCl for 16 hours (seed and KCl solution 1:1) and shade dried to bring to storable moisture. This will enable the crop to withstand early moisture stress.
- On the day of sowing, treat the hardened seeds first with *Pseudomonas fluorescens* 10g/kg of seed and then with *Azophos* 2000g or *Azospirillum and Phosphobacteria* @ 600g each per ha seed, whichever is available.
- Drill sow with 20 cm inter row spacing using seed drill.
- The seeds can also be sown behind the country plough
- Depth of sowing should be 3 - 5 cm and the top soil can be made compact with leveling board.
- Pre-monsoon sowing is advocated for uniform germination.

#### 5.7. After cultivation

- Azospirillum inoculants 10 packets (2000g/ha) and Phosphobacteria 10 packets (2000g/ha) or 20 packets (4000g/ha) of Azophos mixed with 25 kg of FYM may be broadcasted uniformly over the field just after the receipt soaking rain / moisture.
- Thinning and gap filling should be done 14-21days after sowing, taking advantage of the immediate rain
- Spray Cycocel 1000 ppm (1 ml of commercial product in one lit. of water) under water deficit situations to mitigate ill-effects.
- Foliar spray of Kaolin 3% or KCl 1% to overcome moisture stress at different physiological stages of rice. .

#### 5.8. Manures and fertilizer application

- Blanket recommendation : 75:25:37.5 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O /ha
- Apply a basal dose of 750 kg of FYM enriched with fertilizer phosphorus (P at 25 kg/ha)
- Apply N & K in three splits at 20-25, 40-45 and 60-65 days after germination.



- Each split may follow 25kg N and 12.5 kg K<sub>2</sub>O.
- If the moisture availability is substantial, split application at panicle initiation may be done with 40 kg N and 12.5 kg K<sub>2</sub>O.
- If the moisture availability is substantial, the split at 40-45 DAS (panicle initiation) may be applied up to 40kg N and 12.5kg K<sub>2</sub>O to enhance the growth and the grain yield.
- Basal application of ZnSO<sub>4</sub> at 25kg/ha and FeSO<sub>4</sub> at 50/ha is desirable wherever Zinc and iron deficiency were noted.
- Biofertilizers as recommended to transplanted rice may be followed wherever feasible and moisture available.
- Foliar spray of 1% urea + 2% DAP + 1%KCl at PI and 10 days later may be taken up for enhancing the rice yield if sufficient soil moisture is ensured

### 5.9. Weed management

- First weeding should be done between 15 and 21 days after germination.
- Second weeding may be done 30 - 45 days after first weeding.
- Apply pendimethalin 1.0kg/ha on 5 days after sowing or Pretilachlor + safener (Sofit) 0.45kg/ha on the day of receipt of soaking rain followed by one hand weeding on 30 to 35 days after sowing.

### 5.10. Water management

- The crop is irrigated from 30-35 days onwards, utilizing water impounded in the tanks.
- Irrigation may be to a depth of 2.5 -5.0cm only. Follow the schedule of one day after disappearance of ponded water in order to save water and to bring additional area under this type of rice cultivation.

### 5.11. Harvest

- It is same as that of transplanted rice.
- These areas are more suitable for combine-harvester

## 6. Dry seeded Irrigated Un-Puddled Lowland Rice

**6.1. Also be called 'semi-dry rice':** It is a contingent plan to command areas, anticipating the release of water; rice crop can be established under rainfed condition up to a maximum of 45 days as that of previous two situations. Field is converted to wet condition on receipt of canal water. Conversion depends up on receipt of canal water and nutrient management is decided according to the period of irrigation.

**6.2. Area:** Tiruvarur and Nagapattinam districts

**6.3. Season:** Samba / Thaladi seasons command areas.

#### 6.4. Field preparation

- Dry plough to get fine tilth taking advantage of rains and soil moisture availability.
- Apply gypsum at 1 t/ha basally wherever soil crusting and soil hardening problem exist.
- Perfect land leveling for efficient weed and water management.
- Provide shallow trenches (15 cm width) at an interval of 3m all along the field to facilitate draining excess water at the early growth stage.

#### 6.5. Varieties

- Medium duration varieties, if sown in August and short duration varieties beyond September, as mentioned in season and varieties.
- Since there is assured irrigation from canal, high yielding improved short or medium duration varieties can be cultivated depending up on the situation (month of sowing, nearness to canal, depth of standing water during NEM etc).

#### 6.6. Sowing

- Seed rate: 75kg/ha dry seed for any recommended variety.
- Seed hardening with 1% KCl for 16 hours (seed and KCl solution 1:1) and shade dried to bring to storable moisture. This will enable the crop to withstand early moisture stress.
- On the day of sowing, treat the hardened seeds first with *Pseudomonas fluorescens* 10g/kg of seed and then with *Azophos* 2000g or *Azospirillum* and *Phosphobacteria* @ 600g each per ha seed, whichever is available.
- Drill sow with 20 cm inter row spacing using seed drill.
- The seeds can also be sown behind the country plough
- Depth of sowing should be 3 - 5 cm and the top soil can be made compact with leveling board.
- Pre-monsoon sowing is advocated for uniform germination.
- Pre-monsoon sowing with medium duration variety is an advantage for higher grain yield and as well to manage the heavy rainy season.

#### 6.7. After cultivation

- *Azospirillum* inoculants 10 packets (2000g/ha) and *Phosphobacteria* 10 packets (2000g/ha) or 20 packets (4000g/ha) of *Azophos* mixed with 25 kg of FYM may be broadcasted uniformly over the field just after the receipt soaking rain / moisture.
- Thinning and gap filling should be done 14 - 21 days after sowing, taking advantage of the immediate rain.

#### 6.8. Manures and fertilizer application

- Apply FYM/compost at 12.5 t/ha or 750 kg of FYM enriched with 50 kg P<sub>2</sub>O<sub>5</sub> as basal dose in clay soils of Nagapattinam / Tiruvarur district.
- N and K in three splits at around 20-25, 40-45 and 60-65 days for short duration varieties or four splits for medium duration varieties at around 20-25, 40-45, 60-65 and 80-85 days after germination is suitable.
- Each split may follow 25kg N and 12.5 kg K<sub>2</sub>O.

- If the moisture availability is substantial and canal water received from tillering phases itself, the split at panicle initiation (40-45 DAS in short duration and 60-65 DAS in medium duration) may be applied up to 40kg N and 12.5kg K<sub>2</sub>O to enhance the growth and the grain yield.
- To induce tolerance under short and prolonged drought situation in Kuruvai season, apart from seed treatment, foliar spray with 1% KCl + CCC at 500ppm during vegetative stage is effective in mitigating the drought and in increasing the yield.
- Basal application of ZnSO<sub>4</sub> at 25kg/ha and FeSO<sub>4</sub> at 50 kg/ha is desirable wherever Zinc and iron deficiency were noted.
- Biofertilizers as recommended to transplanted rice may be followed wherever feasible and moisture available.
- Foliar spray of 1% urea + 2% DAP + 1%KCl at PI and 10 days later may be taken up for enhancing the rice yield if sufficient soil moisture is ensured

### 6.9. Weed management

- First weeding should be done between 15 and 21 days after germination.
- Second weeding may be done 30 - 45 days after first weeding.
- Apply pendimethalin 1.0kg/ha on 5 days after sowing or Pretilachlor + safener (Sofit) 0.45kg/ha on the day of receipt of soaking rain followed by one hand weeding on 30 to 35 days after sowing.



*Hand weeding*

### 6.10. Other special cultural practices

- Spray Cycocel 1000 ppm (1 ml of commercial product in one lit. of water) under water deficit situations to mitigate ill-effects.
- Foliar spray of Kaolin 3% or KCl 1% to overcome moisture stress at different physiological stages of rice.
- For delayed water release in LBP area, irrigating rice to 5cm depth three days after disappearance of ponded water and growing ADT 38 rice can be resorted to if the release of water is delayed up to September.
- The first top dressing should be applied immediately after the receipt of sufficient rain or canal water.
- Hand weeding, thinning and gap filling should be done before N-fertilizer application.
- Subsequent top dressings in two or three splits should be done before heading.

### 6.11. Water management

- As that of irrigated rice when canal water is used for irrigation
- Possibility of subsequent conversion towards deep water situation is seen in this tract, then variety should be specific for those areas.

**6.12. Harvest:** As that of transplanted rice. This area is more suitable to combine harvester.

**DEEP WATER RICE:** Cultivation is like the methods described in this section except the harvest. Harvest may sometimes restricted only to panicle because of the standing water even after maturity.

## 7. Dry seeded Upland Rice

**7.1. Area:** There are small batches in and around Dharmapuri district. Rainfall availability in these tract is better than the rainfed rice cultivated in other parts of Tamil Nadu. There is no bund to stagnate the water. Moisture availability is there but crop growth depends on the nutrient status.

### 7.2. Other Cultural practices

- As recommended to semi-dry rice
- Nutrient may be split applied depending up on the growth.
- LCC based N application is more suitable for this tract.

**7.3. Intercropping:** Blackgram for every four rows of rice.

**7.4. Grain Yield:** Grain yield depends up on the moisture availability and nutrient status.

## 8. Transplanted Hybrid Rice

<b>Seed rate</b>	20 kg per hectare
<b>Nursery</b>	Basal application of DAP at 2 kg/cent of nursery area. Sparse sowing of seeds at one kg/cent of nursery area will give robust seedlings with 1-2 tillers per seedling at the time of planting. If the soil is heavy, apply 4 kg gypsum/cent of nursery area, 10 days before pulling of seedlings.
<b>Age of seedling</b>	20 to 25 days
<b>Spacing (cm)</b>	20 x 10 (50 hills/m <sup>2</sup> ) or 25 x 10 (40 hills/m <sup>2</sup> ) according to soil fertility
<b>Seedlings/ hill</b>	One (along with tillers if already produced)
<b>Fertilizer</b>	175:60:60 kg N, P <sub>2</sub> O <sub>5</sub> and K <sub>2</sub> O/ha



## 9. Seedling Throwing Method

- 20 days old seedlings of short duration rice varieties
- Requirement of seedlings will be approximately 20% more than the line planting or equal to random planting.
- The seedlings are thrown into the puddled leveled field by labour without using force.
- Suitable for all seasons except *Thaladi* or heavy rain season.
- 50% labour saving as compared to line planting and 35% to random planting.
- Up to 7-10 days of seedling throwing care should be taken to maintain thin film of water (similar to wet seeded rice).
- Other cultural operations are same as in transplanted rice
- Grain yield will be equal to line planted crop and 10-12% higher than random planted crop.

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