

## CROP : RICE (*Oryza Sativa*)

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### PlantCharacteristics

Rice can be cultivated under a variety of climatic and soil conditions. Rice cultivation is conditioned by temperature parameters at the different phases of growth. The critical mean temperature for flowering and fertilization ranges from 16 to 20°C, whereas, during ripening, the range is from 18 to 32°C. Temperature beyond 35°C affects grain filling. Rice comes up well in different soil types. For normal growth, a pH range of 5.0-8.0 is suitable.

In general, rice can be grown as transplanted or direct sown crop during three seasons as shown below depending on the agroclimatic situations.

[View Table 1. Different rice growing seasons of Kerala](#)

During second crop, for higher yield in photosensitive high yielding varieties in Palakkad district, where assured irrigation is available, the crop commencement may be adjusted in such a way that it flowers only during the second fortnight of December, facilitating proper integration with the weather, better utilization of applied fertilizers and high filling percentage.

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### SelectionCriteriaForPlantingMaterials

[View Table 2. Rice varieties suited for different situations](#)

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### Varieties

[View Table 3. Important characteristics of varieties recommended for cultivation](#)

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### SeedsAndCultivation

Tips on quality seed production in rice and maintenance of viability of stored seeds  
Assure that the seeds for further multiplication are either from a research station or government farm or recognized seed producers.

The land used for seed production should be free from volunteer plants of other varieties grown previously.

To assure genetic purity, a minimum isolation distance of 3 m from other varieties may be given in the field. Harvesting for seed purpose can also be done leaving a border row of 3 m within the field.

Rogue diseased plants, weeds and off-types in time.

Line planting facilitates roguing and giving alleyways of 30 cm after every 3 m planting helps in manuring, plant protection operations and supervision.

Drain water at least one week before harvesting to assure that the plants attain equal maturity at harvesting. Harvest the crop when 80% of the grains in a panicle are mature (at physiological maturity).

During summer months, assure that the plants get sufficient water at dough stage till maturity.

Thresh the sheaves on the same day of harvest, as seeds of heaped sheaves may not perform well.

Dry seeds properly and assure that the moisture content is not more than 13 per cent.

Avoid excess drying in summer months especially short duration varieties as it reduces the period of viability.

While drying and storing, avoid contamination from yards or through baskets or

While drying and storing, avoid contamination from yards or through baskets or bags.

Seeds may be stored in damp-proof situations for avoiding absorption of moisture from atmosphere thereby losing viability early.

Polythene bags of 700 gauge or double gunny bags may be preferred for storing.

Never stack seed bags in open floors. Store on pallets or wooden benches. The benches should be 30 cm away from wall and floor for proper aeration.

Never pile more than eight bags in a stack. This should be limited to three bags if the seeds require further drying.

Avoid storing plant protection chemicals, herbicides, fertilizers etc. in seed store.

Fill up the cracks and crevices of storeroom by cementing to make it rat proof.

Spray 2% malathion solution in the godown before storing seeds to check insect pests.

Place pieces of cloth dipped in neem oil between stacked bags or neem oil cake covered in cloth bags inside seed bags to ward-off pests.

Test seed germination at monthly intervals if the seeds are to be stored for more than eight months.

The viability of short duration varieties can be extended for a further period of 2-3 months at 80% level if the seeds are soaked for four hours in water and re-dried in shade, back to original weight at 13% moisture content. Seeds of short duration varieties like Jyothi and Triveni of virippu crop reach this level of germination 9-10 months after harvest and that of mundakan 8-9 months after harvest when stored under ambient conditions.

Seed rate for Kuttanad may be enhanced from 80-100 kg/ha to 125 kg/ha, provided excess plants are removed in order to maintain optimum plant population.

To keep sprouted pokkali seeds viable for two weeks, sprouted seeds are to be kept in baskets made of plaited coconut leaves in which koova, banana, karingotta or teak leaves are used as internal lining material within the baskets.

#### **Seed rate**

Transplanting 60-85 kg/ha

Broadcasting 80-100 kg/ha

Dibbling 80-90 kg/ha

Note: The above seed rates are specified for farmers' field on the basis of minimum germination of 80%. In pokkali cultivation, for Vyttilla varieties, 100 kg/ha may be sown on the beds or mounds formed in the field.]

#### **Seed treatment**

##### **Dry seed treatment**

Dress seeds with the following fungicides on the previous day of sowing (12 to 16 hours ahead) at dosage given below:

Pyroquilon (Fongorene 50 WP) 2 g per kg of seed

Carbendazim (Bavistin 50 WP) 2 g per kg of seed

3. Tricyclazole (Beam 75 WP) 2 g per kg of seed

##### **Wet seed treatment**

Soak seed for 12 to 16 hours in a solution of any of the following fungicides and drain to induce germination.

0.2% Fongorene 50 WP 2 g/kg of seed/l of water

0.2% Bavistin 50 WP 2 g/kg of seed/l of water

Treatment with the above fungicides either dry or wet protects the seedlings from blast disease up to 30 to 60 days after sowing.

The above seed treatment can also be recommended for giving protection from seedlings blast in endemic areas.

Soak paddy seeds in CuSO<sub>4</sub> (0.25%) and ZnSO<sub>4</sub> (1%) solution for 24 hours. Drain and keep for sprouting. For soaking 1 kg of seed, 1 litre of micronutrient solution would be needed.

#### **Nursery**

For transplanting, healthy seedlings have to be raised in seedbed. Healthy seedlings can cope up better with the field conditions that affect the growth of young rice plants. Adopt wet or dry method for raising seedlings. The choice depends primarily on the availability of water.

##### **Wet method**

The wet method can be adopted in areas where water is available as in the second crop season. Seedlings raised by the wet bed method can be harvested one week earlier. The seedbed should be prepared in advance, so that the pre-germinated seeds can be sown in time. As far as possible, fertile lands with irrigation and drainage facilities should be selected for raising the nurseries. Such lands should be suitably located to receive full sunlight. The following are the steps in raising wet

nursery.

Plough and harrow the fields two or three times until the soil is thoroughly puddled and levelled. Prepare raised beds 5 to 10 cm high 1 to 1.5 m wide and of convenient length with drainage channels between the beds. The total seedbed area should be 1000 m<sup>2</sup> for each hectare of the field to be transplanted.

Apply compost or cattle manure @ 1 kg per m<sup>2</sup> of the nursery bed and mix well with the soil at the time of preparation of the field.

Treat the seeds by wet method. Drain and incubate in warm moist place for sprouting. Never allow the seeds to dry up. Moisten them occasionally. Sow germinated seeds on the third day. Delay will result in poor seedling stand.

Irrigation may be commenced on the 5th day after sowing and continued up to the 7th, to a depth of about 5 cm. After this period, irrigate the seedbed continuously to a depth of about 5 cm in order to control weeds.

Drain occasionally to encourage production of vigorous seedlings with short roots. Flooding the soil with too much water for long periods produces tall and weak seedlings, which do not readily recover during transplanting.

If symptoms of nitrogen deficiency are observed, broadcast urea at the rate of 1 kg for 100 m<sup>2</sup> as top dressing about 10 days prior to pulling out of seedlings, depending upon the duration of variety.

#### **Dry method**

This method is practised in areas where sufficient water is not available and the time of planting is uncertain. During first crop season, wherever transplanting is done depending upon receipt of rainfall, it is safer to adopt this method since growth of the seedlings can be controlled.

Plough the nursery area to a fine tilth. Prepare raised beds of 1 to 1.5 m width, 15 cm in height and of convenient length. Apply compost or cattle manure at the rate of 1 kg/m<sup>2</sup> of the nursery bed and mix well with the soil at the time of preparation of the field.

Sow the seeds treated as described under dry seed treatment method, evenly over the bed and cover with fine sand / soil.

Water the nursery as and when required depending upon the receipt of rains.

Note: Rice seedlings from solarised nursery beds showed high initial growth, early maturity and resistance to leaf blast disease (ad hoc recommendation).

#### **Age of seedlings**

Seedlings are ready to be pulled out when they attain the stage of 4-5 leaves, about 18 days after sowing in the case of short duration varieties and 20-25 days after sowing in the case of medium duration varieties. Under ill drained conditions, the long duration varieties like Pankaj, Jagannath and IR5 may be planted 30 days after sowing. Seedlings more than 30 days old when transplanted in the field recover slower than younger seedlings, especially, if they suffer stem and root injury. However, during the virippu season, age of seedlings can go up to 35 days in case of medium duration varieties and 25 days for short duration varieties. If the seedlings are over aged, plant at a closer spacing with 3 or 4 seedlings per hill and apply extra dose of nitrogen @ 5 kg/ha as basal dressing.

Irrigate seedbeds a day before pulling out the seedlings to soften the soil and to facilitate washing of roots. Pull out one or a few seedlings at a time to reduce damage. Wash off mud and soil from the roots carefully and tie the seedlings into bundles of convenient size for transplanting.

Pruning of the top portion and root is not recommended as it inflicts wounds through which disease causing organisms may subsequently enter.

#### **Preparation of land**

##### **General**

Plough the field thoroughly to incorporate the weeds and straw into the soil. Ensure a smooth, level field for transplanting the seedlings. It would be better to transplant 10-15 days after incorporating organic manure. Before transplanting or sowing, apply manures and fertilizers at the rates specified for the region and varieties as indicated in Table 4. Apply fertilizers on the drained soil at the time of final ploughing and levelling and thoroughly mix into the soil.

##### **Kuttanad**

Drain out standing water from the main field. Plough the field thoroughly to incorporate the weeds in the field. Ensure a smooth and levelled field. Maintain a thin film of water to facilitate sowing so that the germinated seeds do not get covered with clayey soil, which affects seedling establishment.

##### **Kole**

For the first crop in Kole, after the cessation of the heavy monsoon, dewatering is

effected by petti and para or centrifugal pump and rarely by chakkram. Land is ploughed thoroughly and transplanting is done.

For the second crop, land is prepared thoroughly and direct sowing of sprouted seeds or transplanting is done.

#### **Onattukara**

With the onset of pre-monsoon showers, land is ploughed thoroughly. Dibbling of unsprouted seeds behind the country plough is the common practice.

#### **Pokkali**

By April, the bunds are being strengthened and sluices repaired for regulating water level. Fields are then drained during low tide and the sluices are closed. When the soil in the field becomes dry, mounds of 1 m base and 0.5 m height are formed. This facilitates the washing down of the dissolved salts from the surface of the mounds, which are ultimately removed from the field by tidal action. The mounds act as elevated in situ nursery and protect the seedlings from flash floods.

A special method is adopted for sprouting the seeds. The seeds are tightly packed in baskets made of plaited coconut leaves, the inside of which is lined by banana or teak leaves. These baskets are then immersed in fresh water ponds for 12 to 15 hours. They are then taken out and stored in shade. The radicle just sprouts and remains quiescent under this condition for more than 30 days. When the soil and weather conditions become favourable for sowing, the baskets containing the seeds are re-soaked for 3 to 6 hours before sowing. The mounds in the field are then raked and top levelled. The sprouted seeds are sown on the top of mounds, which act as an in situ nursery. When the seedlings reach a height of 40-45 cm (in 30-35 days), the mounds are cut into pieces with a few seedlings, which are uniformly spread in the field.

#### **Koottumundakan**

In this system of rice cultivation, a mixture of seeds of a non-photosensitive (virippu) variety and a photosensitive (mundakan) variety of rice in the proportion 70:30 (w/w) is sown during virippu season. This system is practiced in areas where sowing / planting of mundakan crop is not possible due to excess water in the field. Hence, mixture of the two varieties is sown in the first crop season (April-May). The first crop variety will be ready for harvest in August-September and the second crop variety can be harvested in December-January. No cultivation is practised after the harvest of first crop season variety. But both organic and inorganic manures are applied and incorporated. Though the yield will be less than that of the two independent crops, this type of cultivation is taken up in view of the special circumstances prevailing in such areas.

#### **Transplanting**

Transplant seedlings of appropriate age for the variety @ 2-3 seedling per hill in rows, at spacing as shown in Table 5. Leave wider row of 30 cm after every 3 m to facilitate spraying and other cultural operations. Transplant seedlings at a depth of 3-4 cm

[View Table 4. Spacing for rice transplantation](#)

[View Table 5. Cropping pattern / system](#)

#### **Hints for reducing cost of cultivation**

1. Grow a green manure crop like daincha in April-May in areas where the virippu crop is usually transplanted. Application of organic manures @ 10 t/ha will help to reduce the fertilizer level by 50%.
2. If azolla is available, this may be applied instead of green leaf or FYM at 5t/ha.
3. Puddle and level the field thoroughly. This will help to reduce the cost of weed control and also the loss of water and nutrients through percolation.
4. Maintain optimum plant density per unit area, i.e., 50 hills/m<sup>2</sup> for mid duration varieties and 67 hills/m<sup>2</sup> for early duration varieties.
5. Plant the seedlings shallow (3-4.5 cm), as shallow planting increases the tillering of seedlings.
6. Control the weeds during the vegetative phase itself. One weeding thoroughly on the 30th day after sowing is ideal. Use herbicides for weed control, wherever it is cheaper than hand weeding.
7. Under good management practices (vide item 1-6) reduce the dose of fertilizer N to half the present recommended level. Apply the fertilizer when the plant is able to make the best use of it, at tillering and seven days before panicle initiation.
8. When the field preparation and planting are done on rainy seasons, postpone the application of the basal dose of nitrogen to the early tillering stage (10 days after planting).

9. When the amount of available N is limited, apply it 7 days before panicle initiation. This is the best time for top dressing N.
10. Adopt agronomic practices for increasing fertilizer use efficiency such as: (a) Incorporating ammoniacal N in the reduced zone in the soil (b) Incubating urea with moist soil (1:6) for 24 hours (c) Blending urea with neem cake.
11. Choose fertilizer materials, which are cheaper, e.g. urea is cheaper than ammonium sulphate; rock phosphate is cheaper than superphosphate.
12. Apply phosphatic and potash fertilizers once in two seasons in areas where there is no marked response for these nutrients.
13. Adopt timely control measures against insect pests and diseases based on surveillance.
14. Harvest the crop at optimum moisture content in order to avoid loss due to shedding and also for improving the recovery of rice.

#### Integrated pest management (IPM) in rice

The indiscriminate use of pesticides for pest control has led to disturbances in natural ecosystem leading to resurgence of pests, secondary pests outbreak, toxic hazards and residues besides environmental pollution. This has led to major emphasis on integrated pest management and gained greater momentum. Integrated pest management programmes promote favourable, ecological, economic and sociological outcome, which is accomplished by the best mix of pest control tactics. The use of appropriate scouting tactics, proper diagnosis of pest, the use of economic thresholds and conservation of naturally occurring biocontrol agents are fundamental components of a sound Integrated pest management programme. The use of chemicals is restricted. It is used only if it is absolutely essential based on surveillance. The important components in the IPM are the use of tolerant/resistant varieties, regulating planting density, adjusting the time of planting / sowing, group farming practices, cultural management of pests, integrated nutrient management, removal of weeds, use of botanical pesticides and preservation of natural enemies. For the preservation of natural enemies, collect the egg masses of pests in perforated polythene bags and keep them in the field so that the parasites that emerge can establish in the field effectively.

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### WaterManagement

[View Table6 .categories of irrigation schedule for rice](#)

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### NutrientManagement

#### Manuring

##### Organic manuring

Apply organic manure in the form of farmyard manure or compost or green leaf @ of 5 t/ha and incorporate into the soil while ploughing. The entire quantity of phosphatic fertilizers may be applied along with the organic manures.

Use of biofertilizers is recommended

Cowpea may be raised as an intercrop in dry seeded low land (semi-dry) rice by sowing 12.5 kg seed/ha along with rice to serve as a source of green manure. When the rice field gets submerged with the onset of southwest monsoon, cowpea at the age of about six weeks and at active vegetative stage decays and gets self-incorporated in the soil adding substantial quantity of green manure. Such a system of concurrent growing of cowpea also reduces weed pressure in semi-dry rice.

##### Fertilizer application

The rates of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O recommended as fertilizers are given in Table 7 and stages of application in Table 8.

[View Table7 . Fertilizer recommendation for rice, kg/ha](#)

[View Table8 . stages of fertiliser application in rice](#)

For modan cultivation (upland crop) and direct seeded crop in wet lands, apply nitrogen in three equal split doses, first as basal dressing, second at tillering stage (three weeks after seeding) and the third at panicle initiation stage (about thirty days before flowering). Apply the full dose of P<sub>2</sub>O<sub>5</sub> at the time of land preparation as basal dressing. Apply K<sub>2</sub>O either in a single dose as basal or in two split doses half as basal and half at the panicle initiation stage

as basal and half at the panicle initiation stage.

In Kuttanad region, wherever wet broadcasting (direct seeding) is adopted, give the first basal application of the N at the time of letting in water after drying the field. Water-soluble phosphorus can be recommended for application in two split doses in Kuttanad region, as basal and at maximum tillering stage.

The general principle to be followed is that in light soils as well as in soils with high leaching, N may be applied in three or four split doses according to the duration of the variety.

For typical Onattukara region, where soil is sandy loam and with iron toxicity problem, apply 5 tonnes of organic matter and 67.5 kg K<sub>2</sub>O/ha.

During the first crop season, when basal application of N is not possible due to incessant rains, basal dose can be shifted to 15 days after transplanting.

A fertilizer dose of 60:30:30 kg/ha is recommended in the second crop season for photo-insensitive variety Dhanya under Onattukara conditions.

For dry sown Mahsuri, the fertilizer dose of 50:25:25 kg/ha N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O is sufficient. Nitrogen dose may be given in three equal splits at basal and 45 and 85 days after sowing.

In coarse sandy loam soils with high percolation as in Onattukara region, N and K<sub>2</sub>O fertilizers may be applied in five equal splits given at planting, 15th, 38th 53rd and 70th day for medium duration varieties. These periods coincide with the stages of early tillering, neck node differentiation, early reduction division and heading stages respectively in the case of medium duration varieties.

For Thiruvananthapuram and Malappuram districts, P<sub>2</sub>O<sub>5</sub> application is essential for increasing rice yields. Rock phosphate may be substituted for superphosphate.

In Onattukara region, continuous application of N in the form of fertilizer without P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O shows deleterious effects. Basal dose of N may be postponed to initial tillering phase of rice crop, especially during the rainy season. Nitrogen top dressing at the initial tillering, mid-tillering and panicle initiation favours maximum rice production. Split application of K<sub>2</sub>O, 50% basal, 25% at tillering and 25% at panicle initiation stage is recommended for this region.

In Pokkali (acid saline) areas, apply entire quantity of fertilizers (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O) at the rate of 20:40:0 kg/ha at the time of dismantling of mounds.

(Note: Not applicable to Kaipad areas)

#### **Specific dose of fertilizer for Koottumundakan system**

A fertilizer dose of N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O 20:10:10 kg/ha for the first crop and 30:15:15 kg/ha for the second crop is recommended for high yield in Koottumundakan system. N and K<sub>2</sub>O may be applied in two equal parts for the first crop, one as basal and other at panicle initiation stage. P<sub>2</sub>O<sub>5</sub> may be applied fully as basal. The fertilizer for second crop may be applied as a single dose immediately after the harvest of the first crop (ad hoc recommendation)

Fertilizers (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O) @ 40:20:20 kg/ha for virippu and 20:10:10 kg/ha for the photosensitive mundakan crop are recommended as economic dose for the northern region under koottumundakan practice.

#### **Methods of fertilizer application**

For pre-planting application, apply the fertilizers at the final ploughing. In areas where availability of water is assured, temporarily draining the field one day prior to application and re-flooding after twelve hours is recommended for top dressing of fertilizer.

For increasing the efficiency of urea for top dressing, mix urea with six times its weight of slightly moist soil and apply to the field 24-28 hours after mixing. Oil seed cakes such as punna and neem cakes can also be mixed with urea (1 part of oil cake + 5 parts of urea by weight) for increasing fertilizer efficiency. This method is particularly useful for basal application of N. Under special conditions of drought and waterlogging, apply N as foliar spray. Urea may be applied as a low volume spray at 15% concentration using power sprayer or at 5% concentration using a high volume sprayer, the quantity applied in one application being limited to 15 kg/ha.

Whenever carbofuran application is needed at around 20 days after planting, it would be advantageous to mix 10 kg N in the form of urea. Carbofuran should be used @ 0.75 kg ai/ha.

When zinc deficiency is noticed, apply zinc sulphate @ 20 kg/ha. Early stages of zinc deficiency are evidenced by interveinal chlorosis, bleaching of midribs and light yellow colouration of the leaf. Older leaves develop brown rusty spots and are extremely brittle. Zinc sulphate and potash should not be applied on the same day.

Split application of water-soluble phosphatic fertilizers in two equal splits as basal and at maximum tillering stage is effective in giving higher grain and straw yield than the full dose as basal dressing under certain situations.

Application of chemical fertilizers can be dispensed with for Vattila-1 and Vattila-2 in

Application of chemical fertilizers can be dispensed with for vyttila-1 and vyttila-2 in pookkali rice fields.

When the soil has less than 10 ppm of calcium chloride extractable sulphur or 15 ppm of phosphate extractable sulphur, substitute urea with ammonium phosphate sulphate to correct sulphur deficiency. For medium duration rice grown in brown hydromorphic soils ammonium phosphate sulphate may be used to supply 25 kg sulphur per hectare to protect the crop from sulphur deficiency (ad hoc recommendations)

#### **Liming**

In general, addition of lime is absolutely necessary when the pH is lower than 5.5 and it is advisable when pH varies between 5.5 and 6.5

For direct seeded crops during the first season, apply lime @ 600 kg/ha in two split doses, the first dose of 350 kg/ha as basal dressing at the time of first ploughing and the second dose of 250 kg/ha as top dressing about one month after sowing.

For transplanted crop, apply lime @ 600 kg/ha in two split doses, 350 kg/ha as basal dressing and 250 kg/ha as top dressing about one month after transplanting.

For Pookkali areas, apply lime @ 1000 kg/ha, 50% at the time of preparation of mounds and the rest at the time of dismantling the mounds.

A time lag of one week should be given between application of lime and fertilizers. For top dressing, lime may be applied one week prior to the application of fertilizers.

#### **Water management**

Maintain water level at about 1.5 cm during transplanting. Thereafter increase it gradually to about 5 cm until maximum tillering stage. Drain water 13 days before harvest.

[Note: In areas where water for irrigation is assured and where acidity is high, draining and reflooding every 15 days are recommended. In flood prone areas, aged seedlings of Mahsuri or other varieties recommended for waterlogged conditions may be planted. The planting may be preponed or postponed to avoid synchronization of the critical stages of maximum tillering or heading with the usual flood period in the tract.]

During the mundakan crop season, water level of 5 cm need not be maintained continuously after the cessation of northeast monsoon. Five centimetre irrigation once in 6 days will be quite adequate for project areas where water is assured.

For summer rice (in situation where the ground water level is shallow, i.e., within 1 m from the surface), 5 cm irrigation two days after disappearance of ponded water is sufficient instead of 5 cm continuous submergence throughout the crop period.

Irrigation schedule for rice under limited water resources

For summer rice under limited resources of water, phasic stress irrigation can be practised to the advantage of saving substantial quantity of irrigation water without any significant reduction in yield. About 20-30% more area can be irrigated with the same water resources by adopting any of the following phasic stress irrigation schedules (Table 7). Depending up on the schedule, water saving ranges from 24-36% of the requirement for 5 cm continuous submergence throughout the crop growth. Grain yield reduction in the above practice is only 0.1% to 1.6%.

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## **Weed Management**

### **Weeds and their control**

**Common weeds in rice fields of Kerala are:**

**Grasses:** *Oryza rufipogon* (varinellu), *Echinochloa crusgalli* (kavada), *E. colona* (kavada), *E. stagnina* (kavada), *Sacciolepis interrupta* (polla), *Isachne miliacea* (choverippullu, naringa).

**Sedges:** *Cyperus iria*, (manjakora, chengoal), *C. difformis* (thalekkattan), *Fimbristylis miliacea* (mungai)

**Broad leaved weeds:** *Monochoria vaginalis* (neelolppalam), *Ludwigia perennis* (neergrampu), *Limncharis flava* (nagappola), *Ammania baccifera* (nellicheera)

**Ferns:** *Salvinia molesta* (African payal), *Marsilea quadrifolia* (naalilakodian), *Azolla pinnata* (azola)

**Algae:** *Chara* spp. (chandi), *Spirogyra* spp. (payal)

Control

Keep the rice fields free from weeds up to 45 days either by hand weeding or by use of herbicides. The recommendation for use of herbicides in different systems of rice culture are given below:

**A. Dry seeded rice [upland and lowland (semi-dry) rice]**

Spray any of the following pre-emergent herbicides: Thiobencarb @ 1.5 kg ai/ha, butachlor @ 1.25 kg ai/ha, oxyfluorfen @ 0.15 kg ai/ha, pendimethalin @ 1.50 kg ai/ha, pretilachlor @ 0.75 kg ai/ha on the same day of seeding or within six days of seeding.

**B. Wet seeded rice (direct seeding with sprouted seeds under puddled conditions)**

Spray any of the following herbicides:

Butachlor @ 1.25 kg ai/ha or thiobencarb @ 1.00 kg ai/ha 6-9 days after sowing;

(b) Pretilachlor + safener (sofit) @ 0.45 kg ai/ha 3-5 days after sowing.. Give a follow up application of 2,4-D @ 0.8 kg ai/ha at 20 days after sowing.

To control Echinochloa sp. spray cyhalofop butyl @ 0.08 kg ai/ha at 15-18 days after sowing.

In certain areas like Kuttanad, wild rice has become a menace in recent years. If effective water control is possible, the following agronomic practices can successfully control the infestation of wild rice.

Coat dry seeds with 20% calcium peroxide using 4% PVA solution as an adhesive and then broadcast in the field with 10-15 cm column of standing water. (b) Maintain the water level for 10-12 days to prevent germination of wild rice. (c) Drain the field and apply N and K fertilizer as per recommendation for rapid growth of the rice seedlings. (d) Where yeranda (common teal) is a problem, bird scaring should be arranged till the water is drained.

**C. Transplanted rice**

Apply any of the following herbicides at 0-6 days after transplanting.

Thiobencarb @ 1 kg ai/ha, pendimethalin @ 1.5 kg ai/ha, butachlor @ 1.25 kg ai/ha, anilofos @ 0.4 kg ai/ha.

Where broad-leaved weeds and sedges are predominant, apply 2,4-D @ 1.0 kg ai/ha at 25 days after transplanting. Wherever the fields are level and water management could be effectively done, 2,4-D can be mixed with 10 kg urea/ha and broadcast on 20 DAS/DAT. This would save the spraying charges.

Control of *Salvinia molesta* (African payal)

Trampling salvinia in situ in the wet lands a week before transplanting will control the weed and add to soil fertility. For chemical control of salvinia, spray paraquat @ 0.75 kg ai/ha. Herbicides should be applied only in areas where protected drinking water supply is available.

Precaution while using herbicides

Apply herbicides at the recommended dose and time.

Drain the field before herbicide application.

Re-flood after 48 hours to prevent further weed germination when post emergent herbicides are used. For pre-emergent herbicides, wait for a week before re-flooding the field.

Use herbicide nozzle (flood jet / flood fan) for herbicide application.

Move at uniform speed when applying herbicides.

Spray without gaps and overlapping.

(7) Use 300-400 litres of water per hectare for spraying the herbicide.

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**PestManagement**

Adopt control measures only if the pest / disease population exceeds the economic threshold levels which are given in Table 12.

**Pests****Rice stem borer (*Scirpophaga incertulas*)****Symptoms**

In the vegetative phase, the central shoot dies off turning yellow in colour (dead heart). In the ear bearing stage, the ear head appears completely chaffy and white in colour (white ear head). Both come out easily when pulled up and show indication of feeding injuries at the base.

**Control**

1. Collect egg masses from the nursery plants and observe for parasitisation.
2. Cultivate tolerant varieties like IR-20 in endemic areas.
3. In areas where stem borer occurs as a serious pest in all seasons, apply any one of the following insecticides first 15-20 days after transplantation and then at the boot leaf stage keeping minimum water level: Fenthion, quinalphos (spray or granules), fenitrothion, monocrotophos, carbosulfan (granule), carbofuran



formethion, monocrotophos, carbofuran (granule), carbaryl.

4. Use sex pheromone for the control of rice stem borer as detailed in Table 9.

Note: (1) The population should be estimated on the basis of careful and regular surveillance. (2) When natural enemies of brown plant hopper, green leaf hopper, stem borers and leaf folders are present, application of chemical measures can be delayed or dispensed with.

[View Table 9 : Sex pheromone used for the control of rice yellow stem borer \(ad hoc recommendation\)](#)

### **Gall midge (*Orseolia oryzae*)**

#### **Symptoms**

Presence of silver shoot in the place of central leaf is the prominent symptom. The symptom appears from the nursery to the flowering stage. However, in very young seedling the silver shoots are not always expressed. Instead, a swelling at the basal portion and excess tillering are often noticed.

#### **Control**

1. Use tolerant varieties like Pavithra, Panchami and Uma
2. Avoid late transplantation during the first crop season.
3. Careful monitoring of the crop seasons in the month of July during additional crop season and October during pancha season.
4. Use optimum seed rate of 100 kg/ha
5. Destruction of collateral host like wild rice *Cynodon dactylon*, *Ischaemum aristatum*, *Echinochloa* spp. and *Isachne* sp.
6. Dipping germinated seed in 0.2% chlorpyrifos solution for 3 hours before sowing give protection up to 30 days.
7. In transplanted crop the root of seedlings may be dipped in 0.02% chlorpyrifos suspension for 12 hours prior to planting.
8. The nursery treatment has to be followed by main field treatment, 10-15 days after transplantation using anyone of the following insecticides: quinalphos, phorate, carbaryl, carbofuran.
9. In areas where the pest is of regular occurrence, apply granules of phorate 10G (1.5 kg ai/ha), carbofuran 3G (0.5 kg ai/ha), quinalphos (1.5 kg ai/ha) or chlorpyrifos 10G (0.5 kg ai/ha) within 10 days after sowing. The granules should be broadcast in 2-3 cm of water and the field should be impounded for at least 4 days.

### **Rice bug (*Leptocorisa acuta*)**

#### **Symptoms**

Look for the presence of bug in the field during the early ear bearing stage. Due to de-sapping, grains show brownish discoloured patches on the husk.

#### **Control**

1. Strict vigilance is necessary at milky stage.
2. Keep the field and bunds free of weeds and grasses.
3. Avoid overlapping cultivation in an Ela.
4. When the bug is seen in large numbers apply one of the following insecticides: Malathion, carbaryl, formotion, methyl parathion.

Note: Since the occurrence of the bug coincides with the flowering stage, application of the insecticide may be done either before 9 a.m. or after 3 p.m. so that fertilization of the flowers is not adversely affected.

### **Leaf folder (*Cnaphalocrocis medinalis*)**

#### **Symptoms**

The leaves of the plant are seen folded, rolled and often webbed together with white patches on them indicating the areas fed by caterpillar. When such folded leaves are opened up, larvae can be seen. Shaded conditions and application of excess nitrogen are conducive for leaf folder attack

#### **Control**

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1. Open up the leaf folds with the help of a thorny twig.

2. Apply one of the following insecticides in the field where the symptoms of attack are manifested: quinalphos, carbaryl, monocrotophos, methyl parathion, fenitrothion, fenthion, phosalone, phenthoate (EC/AF formulations) triazophos or acephate.

Note: - In the initial stages restrict spraying to infested patches only. The field may be sprayed completely in case the infestation occurs uniformly.

### **Brown plant hopper (*Nilaparvata lugens*)**

#### **Symptoms**

Yellowish circular patches appear here and there in field. The plants in these areas dry up very soon (hopper burn) and the yellowing and drying extend rapidly. Examine the plants as soon as the yellowing appears. Presence of the hoppers at the base of the plants confirms the infestation. Very close planting leads to enhanced attack.

#### **Control**

1. Use resistant varieties such as Jyothi, Bharathi, Aiswarya, Kanakom, Nila etc. for cultivation.

2. Apply one of the following insecticides as soon as the yellowing symptom is observed, covering the infested patches and the areas surrounding the patches: Carbaryl, quinalphos, fenthion, carbofuran, monocrotophos, phosalone and imidacloprid. While spraying and dusting, care has to be taken to see that the insecticides reach the base of the plants.

3. Drain away water from the field and keep it in that conditions until the pest population dwindle.

4. In Kuttanad tract, early planting of paddy in September-October is advisable, wherever possible.

### **Rice case worm (*Nymphula depunctalis*)**

#### **Symptoms**

Leaves of plants are eaten by the caterpillars, which remain within small cylindrical cases and are seen hanging on the leaves. It occurs in ill drained fields. The cases may be seen floating on water also.

#### **Control**

1. Drain away the water from the fields.

2. If infestation is severe, apply carbaryl dust or spray.

### **Rice swarming caterpillar (*Spodoptera mauritia*)**

#### **Symptoms**

It appears in the field sporadically and cyclically in large swarms and feed on crops gregariously. The nursery and early stages of the crop are attacked leaving the plant as mere stumps.

#### **Control**

Apply carbaryl, endosulfan, trichlorphon, fenthion or methyl parathion as soon as the caterpillars are noticed.

### **Rice hispa (*Dicladispa armigera*)**

#### **Symptoms**

The adults feed on the green tissues of the leaves and the feeding scars appear as short white lines on the leaf surface. The grubs mine the leaves causing formation of white blotches. Early stages of the crop are more susceptible.

#### **Control**

Spray any contact insecticide.

### **Rice thrips (*Stenchaetothrips biformis*)**

#### **Symptoms**

The crop is highly susceptible in the nursery stage for the first 23-25 days after transplanting/sowing. The tips of leaves get rolled longitudinally into needle like outgrowths and turn whitish. In severe cases, the lower leaves also turn yellowish. The infestation may be rated as mild, if there is less than three needle like leaves

and as severe, if there are more than three outgrowths with the lower leaves also showing chlorosis and scorching.

**Control**

In severe infestations, apply carbaryl 50% WP 1.25 kg ai/ha + DDVP 100% EC/AF 250 ml/ha or dimethoate or quinalphos or phenthoate (EC/AF formulation).

**Whorl maggots (*Hydrellia philippina*)**

Infestation is common in the nurseries and in the main fields up to six weeks after transplantation. Yellowish patches and streaks are seen along the margins of leaves, which may become deformed.

**Control:** Apply phorate 10G @ 1.5 kg ai/ha, if infestation is severe.

**Leaf hoppers (*Nephotettix* spp.)**

**Symptoms**

General yellowing of the leaves is seen, if the attack is severe. When the plants are disturbed, the jassids are seen jumping out.

**Control**

Apply carbaryl, quinalphos, monocrotophos, fenthion or fenitrothion, if needed.

**Rice mealy bug (*Brevinnia rehi*)**

**Symptoms**

Weak yellowish stunted plants are seen in patches. White waxy fluff is seen in leaf sheaths.

**Control**

Apply dimethoate at 0.05%

**Rice root nematode (*Hirschmanniella oryzae*)**

**Symptoms**

Infests paddy roots and make them partially hollow. Feeding adversely affects absorption of water and nutrients. Plants show stunted growth in patches. Tiller production is affected.

**Control**

Treat the nursery with carbofuran @ 0.75 kg ai/ha and dip the roots of seedlings in 0.2% dimethoate for six hours before transplanting in tracts where nematode attack is detected.

**Rice cyst nematode (*Heterodera orydicola*)**

The cyst nematode occurs in various proportions in certain areas of the State. The symptoms of infestation include leaf chlorosis, stunting and reduction in the number of leaves, earhead length etc. In seriously affected patches, yield is substantially reduced.

**Control**

Soak paddy seeds in 0.02% solution of carbofuran for six hours. Wherever possible, dip paddy seedlings in 0.02% solution of carbofuran for six hours before planting.

Note: This recommendation is to be adopted in areas where the nematodes occur at very heavy population causing severe damage. The suggested measures are to be adopted only if the measures are warranted on the basis of soil and root sample assay for nematode population levels.

[View Table 10. Insecticide guide for rice pest control](#)

Note:

1. Sub-lethal concentration of insecticides may lead to pest resurgence.
2. Granular application is recommended only up to the booting stage.
3. Spot application method should be resorted to wherever possible
4. Use 200, 300 and 500 l/ha of spray fluid at 10, 25, 45 DAT or 30, 45, 60 DAS respectively for high volume spray equipment.
5. When low volume spray equipment is used the spray fluid can be limited to 90, 120, 180 l/ha, but the quantity of insecticide should remain the same as used in high volume spray 200, 300 and 500 l/ha respectively.
6. Waiting periods for quinalphos, fenthion and mercaptothion are 7, 7 and 3 days respectively.

7. In regions where BPH is a regular pest avoid the application of the following insecticides due to the chances of resurgence: Methyl parathion, fenitrothion, deltamethrin, carbaryl, fenthion and quinalphos.

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## DiseaseManagement

### Diseases

#### A. Diseases affecting leaf blade

1. Symptoms appear as distinct leaf spots

- a. Blast (*Pyricularia oryzae*): Appear as distinct large indefinite spindle shaped spots with grey centre and brown margin.
- b. Brown spot (*Helminthosporium oryzae*): Spots small, definite and may be oval or oblong, with light brown, or straw coloured center and dark reddish brown margin.
- c. Narrow brown leaf spot (*Cercospora oryzae*): Numerous, linearly arranged small and narrow spots on leaf with light brown or darker margin.

2. Symptoms appear as lesion, not distinct spots

- a. Sheath blight (*Rhizoctonia solani*): Greenish grey irregular lesions with dark line on margins, lesions large and develop indefinitely on older plants.
- b. Stackburn (*Alternaria padwickii*): Large oval or circular dark brown, lesions with narrow distinct margins.
- c. Leaf scald (*Rhynchosporium oryzae*): Lesions olive with reddish brown margin and with typical zonations with dark coloured wavy lines. Usually start at the tip and extend downwards. Sometimes arise at the margin and advance inside. Never start at centre.
- d. Bacterial blight (*Xanthomonas oryzae* pv. *oryzae*): Leaves with undulated yellowish white or golden yellow marginal necrosis, drying of leaves back from tip and curling, leaving mid rib intact are the major symptoms.
- e. Bacterial leaf streak (*Xanthomonas oryzae* pv *oryzicola*): Leaves with fine narrow brownish yellow translucent interveinal line joining to form large dirty white patches.

#### B. Diseases affecting stem and sheath

- a. Blast (*P. oryzae*): The symptoms appear on the stem one or two nodes just below the panicle as greyish black or dark lesions. The grains are mostly half filled or unfilled.
- b. Sheath blight (*R. solani*): Greenish grey or dark edged whitish lesions appear on the sheath. Lesions are oval, oblong or irregular and necrotic. Small white or brown globular sclerotial bodies loosely attached to the surface are also seen.
- c. Foot rot (*Fusarium moniliformae*): Drying of leaves and leaf sheath, discolouration of lower nodes and adventitious roots are the major symptoms. Pink bloom on the sheath above water level is also seen. Sometimes plants are taller than the normal.
- d. Sheath rot (*Sarocladium oryzae*): Oblong or irregular lesions with brown margins and grey centre or greyish brown appears throughout on the leaf sheath, especially on the sheath covering the panicles. The panicles remain within the sheath or only partially emerge with whitish powdery fungal growth inside the rotten sheath.

#### C. Diseases affecting the entire plant

- a. Bacterial blight: Transplanted seedling showing bluish colouration within curled central leaf. Plants completely rot, starting from the outer leaves. If these plants are cut and immersed in water bacterial ooze appear at the cut ends.
- b. Foot rot: Plants turn pale yellowish green, thin, abnormally elongated or rot in patches in the field.

**Virus diseases:** General stunting, abnormal tillering, discolouration and death of affected parts.

1. Tungro: Brownish yellow discolouration, severe to mild stunting and reduced tillering of plants are the usual symptoms. Leaves tested with iodine show black or dark brown colour.
2. Yellow dwarf: Leaves yellowish green usually with rusty spots, pronounced stunting and excessive tillering with slight curling of leaves.
3. Grassy stunt: Leaves pale green with rusty spots or blotches, severe stunting, excessive tillering and erect habit with grassy appearance.
4. Ragged stunt: Stunting, ragged appearance of leaves, leaf edges are serrated and twisting of the leaf tips, nodal branching, vein swelling, incomplete panicle emergence and infested grains are the symptoms. The vector of this disease is brown plant hopper.

#### D. Diseases affecting the grains

- a. Blast: Grains partially chaffy and brittle or unfilled. Panicles show white appearance.
- b. Brown spot: Dark brown or black. oval or oblong spots on the glumes or whole

surface of the grain turning black and velvety.

- c. Stackburn: Pale brown to whitish spots with dark brown margin bearing black dots in the centre
- d. False smut (*Ustilagoidea virens*): Grains completely replaced by large spherical yellowish or orange body, which changes to powdery mass later.
- e. Udbatta (*Ephelis oryzae*): Whole panicle transformed in to a cylindrical rod covered with white mycelium.

[View Table 11. Guide on control of rice diseases](#)

Note:

1. Spray fresh cowdung extract for the control of bacterial blight. Dissolve 20 g cowdung in one litre of water; allow to settle and sieve. Use supernatant liquid.
2. Application of bleaching powder @ 5 kg/ha in the irrigation water is recommended for checking the spread of bacterial leaf blight particularly in the kresek stage.
3. Before application of antibiotics for control of bacterial blight, identify the disease by observing the bacterial ooze.
4. Ediphenphos may be applied by high volume sprayers only. For control of sheath blight and sheath rot the following prophylactic measures may be adopted:
  - (a) Apply neem cake-coated urea as recommended under fertilizer application.
  - (b) Apply 50% more potash than normal recommended dosage in split application.
  - (c) Control weeds as suggested under weed control.
5. For control of sheath rot, spray the fungicides at the time of panicle emergence.
6. Application of carbofuran granules @ 1 kg ai/ha on the 25th day after planting is advised to control sheath blight and sheath rot and to keep down the population of rice nematode.
7. Spraying of any fungicide, preferably dithiocarbamate before the heading stage of the crop may be followed for the control of false smut and leaf scald diseases. Wherever control measures are adopted for sheath blight and sheath rot diseases, separate treatments are not needed for the control of leaf scald and false smut. Use 500 liters water for high volume spraying and 200 liters water for low volume spraying. It is advisable to use chemical on a rotational basis than using the same product continuously.

[View Table 12. Economic threshold levels \(ETLs\)](#)

[View Table 13. Common natural enemies of insect pests found in rice ecosystem](#)

Effective and eco-friendly pest management in wet land rice ecosystem

1. Cultivate tolerant varieties
2. Monitor the field at least at weekly intervals
3. Pest and natural enemy population should be monitored for deciding about spraying schedule.
4. Spraying should be avoided during the reproductive phase.
5. Spot application of insecticide may be adopted in heavily infested pockets to control further spread of the pest and to conserve the existing natural enemy population in rice ecosystem.