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FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

CULTIVATION OF RICE

BOTINACAL NAME	*Oryza Sativa* L.
FAMILY	Gramineae
CHROSOME NUMBER	2n=24
COMMON NAME	Dhan

INTRODUCTION:-

Rice is central to the lives of billions of people around the world. Possibly the oldest domesticated grain (~10,000 years), rice is the staple food for 2.5 billion people and growing rice is the largest single use of land for producing food, covering 9% of the earth's arable land.

Rice provides 21% of global human per capita energy and 15% of per capital protein.

Calories from rice are particularly important in Asia, especially among the poor, where it accounts for 50-80% of daily caloric intake.

As expected, Asia accounts for over 90% of the world's production of rice, with China, India and Indonesia producing the most.

Only 6-7% of the world's rice crop is traded in the world market. Thailand, Vietnam, China and the United States are the world's largest exporters.

The United States produces 1.5% of the world's rice crop with Arkansas, California and Louisiana producing 80% of the U.S. rice crop.

85% of the rice that is produced in the world is used for direct human consumption.

Rice can also be found in cereals, snack foods, brewed beverages, flour, oil, syrup and religious ceremonies to name a few other uses.

Rice belongs to the genus *Oryza* and has two cultivated and 22 wild species.

The cultivated species are *Oryza sativa* and *Oryza glaberrima*. *Oryza sativa* is grown all over the world while *Oryza glaberrima* has been cultivated in West Africa for the last ~3500 years.

Rice is grown under many different conditions and production systems, but submerged in water is the most common method used worldwide. Rice is the only cereal crop that can grow for long periods of time in standing water, 57% of rice is grown on irrigated land, 25% on rainfed lowland, 10% on the uplands, 6% in deepwater, and 2% in tidal wetlands.

The flooded rice paddy is a field of aquatic biodiversity, providing a home for fish, plants, amphibians, reptiles, mollusks, and crustaceans, which many of can be used as a means to incorporate protein into the diets of poor and malnourished people in low and middle income countries that farm rice.

ECONOMIC IMPORTANCE:-

Rice farming is the largest single use of land for food.

Rice production totaled 600 million tonnes. 90% rice is produced in Asia alone.

Only 6-7% of production is exported from area of production. Rice field covers 11% of arable land.

It is the most important economic activity of earth.

Rice eaters and growers form the bulk of the worlds' poor.

Single most important activity of rural people in the world

Rice is grown in 250 million Asian farms. Rice farming is 10,000 years old.

Once basis of social order and occupied major place in religions and customs

Rice is used pay debts, wages, and rent.

Staple food for largest number of humanity in the world

It is single largest source of energy for poor. Rice is synonym with food throughout Asia.

ORIGIN:-

Rice cultivation probably dates back to the antiquity and has probably been the staple food and the first cultivated crop in Asia.

In India, rice has been cultivated since ancient times.

This supported by archaeological evidences and by the numerous references made to rice in ancient Hindu scriptures and literature.

Carbonised paddy grains were found in the excavation at Hasthinapur (Uttar Pradesh) at a site dated between 1000-750 B.C.

This is the oldest rice specimen yet known in the world. From the study of Sanskrit and of other different languages in South Eastern Asia, many investigators have come to the conclusion that rice was known in India before the present era.

CLIMATIC REQUIREMENTS:-

In India, rice is grown under widely varying conditions of altitude and climate.

Rice cultivation in India extends from 8 to 350 N latitude and from sea level to as high as 3000 meters.

Rice crop needs a hot and humid climate. It is best suited to regions which have high humidity, prolonged sunshine and an assured supply of water.

The average temperature required throughout the life period of the crop ranges from 21 to 370 C.

At the time of tillering the crop requires a higher temperature than for growth.

Temperature requirement for blooming is in the range of 26.5 to 29.50 C. At the time of ripening, the temperature should be between 20-250 C^{o}.

Photo-periodically, rice is a short-day plant. However, there are varieties which are non-sensitive to photoperiodic conditions.

SOIL REQUIREMENT:-

In India, rice is grown under so diverse soil conditions that it can be said that there is hardly any type of soil in which it cannot be grown, including alkaline and acidic soils.

Soils having good water retention capacity with good amount of clay and organic matter are ideal for rice cultivation.

Clay or clay loams are most suited for rice cultivation, such soils are capable of holding water for long and sustain crop. Rice being a semi-aquatic crop grows best under submerged conditions.

A major part of rice crop in India is grown under ‘lowland’ conditions.

Rice plant is able to tolerate a wide range of soil reaction, but, it does have a preference for acidic soils.

It grows well in soils having a pH range between 5.5 and 6.5. It can be grown on alkali soils also, after treating them with gypsum or pyrite.

IMPROVED VARIETIES:-

The dwarf high yielding varieties, no doubt, have a higher yield potential than the traditional or so called tall varieties.

Under low fertility too, the high yielding dwarf varieties yield comparatively more than the traditional tall varieties.

METHOD OF SOWING:-

In direct-seeded, upland, an early maturing variety of 100-105 days duration as per recommendation for your area.

The medium or late maturing varieties suffer due to water stress at maturity stage.

In direct seeded puddle fields, varieties of 115-125 days duration are preferred.

Under transplanted condition method of sowing, the selection of varieties differs in accordance with the time of nursery sowing.

Variety which takes 130-135 days from seed to seed yields maximum if sown by the last week of May or early June (In north India).

But their yields are poor if sown later than this.

Medium duration varieties (115-120 days) should be preferred if nursery is to be sown in mid or last week of June.

In case nursery is delayed by mid July due to some unavoidable reasons, an early maturity variety of 100-105 days duration should be grown.

Month of Sowing	Season	Duration
Dec-Jan	Navarai	< 120
Apr-May	Sornavari	<120
Apr-May & May-June	Early Kar Kar	<120
June-July	Kuruvai	<120
July-Aug.	Early Samba	130

August	Samba	130-135 and >150
Sep-Oct	Late Samba Thaladi/ Pishanam	130-135
Hybrid Variety	**Duration**	**Yield (q/ha)**
APHR-1	130-135	71
APHR-2	120-125	75
MGR-1	110-115	60
CNRH-3	125-130	60
DRRH-1	125-130	73
KRH-2	125-130	73
Pant Shankar Dhan-1	115-120	68
ADTRH-2	115-120	71
Sahyadri	125-130	66
Narendra Shanker Dhan-2	125-130	61

Ruling Varieties in Tamil Nadu:-

Short duration: ADT 48 (95-100 days), ADT 43 (110 days), ADT 37 (105 days), ADT 36 (115 days), CO 47 (110-115 days), ASD 20 (110 days), ADS 17 (101 days), ADS 16 (110 days), IR 64 (115-120 days).

Latest varieties: RMD (R) 1 (100-105 days), TPS (R)4 (95 days), PMK (R)4 (100-105 days),

Medium duration: (120 –145 days): IR 20, Bhavani, CO 43, CO 46, IR 36, MDU 3, MDU 4, ADT 38, ADT 39, ADT 44, ADT 46, TPS 2 , TPS 3, ASD 19, TRY 1.

Latest varieties: CO(R) 48, CO(R) 49, CO(R) 50, TRY 3.

Long duration: (>150 days): Ponmani (CR 1009) /Savithri, White Ponni, BPT 5204 (Samba Masourie), PY 4 (Jawahar)

TYPES OF RICE CULTIVATION –TRANSPLANTED, PUDDLED & LOWLAND RICE

NURSERY MANAGEMENT:-

WET NURSERY:-

Nursery area: -

Select 20 cents (800 m2) 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 with Carbendazim or Pyroquilon or Tricyclozole solution @ 2 g/l of water for 1 kg of seeds.

This wet seed treatment gives protection to the seedlings up to 40 days from 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 1.0 lit of water overnight. Decant the excess water and allow the seeds to sprout for 24hrs and then sow

Seed treatment with Azospirillum: -

Treat with 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).

Bio-control agents are compatible with bio-fertilizers.

Bio-fertilizers and bio-control agents can be mixed together for seed soaking.

Fungicides and bio-control agents are incompatible.

Forming seedbeds:-

Mark plots of 1.5 to 2.0m breadth with channels of 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 sufficient 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 level from 1.5cm depending on the height of the seedlings.

Thereafter maintain 2.5cm depth of water.

Weed management:-

Apply 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.

Nutrient management:-

Apply 1.0 tonne of fully decomposed FYM or compost to 20 cents 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 of area can be applied at 10 days after sowing.

ii. DRY NURSERY:-

Dry ploughed field with fine tilth is required.

Nursery area of 20 cents with sand and loamy soil status is more suitable for this type of nursery.

Plots of 1 to 1.5m width of beds and channels to be formed

Length is 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 is dry seeding. Seeds are covered with sand and finely powdered well decomposed farm yard manure.

Irrigation to 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.

FIELD MANAGEMENT:-

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.

Problem soil management:-

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 to18%) once in three years, to prevent the sinking of draught animals and workers during puddling.

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/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.

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 $ZnSO_4$ at 37.5 kg/ha at planting.

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.

Pulling out the seedlings: -

Pull out the seedlings at the appropriate time (4th leaf stage).

Management of aged seedlings:-

Follow the spacing recommended to medium and low fertility soil

Plant one or two seedlings/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.

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 trample 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.

Bio-fertilizer application:-

Broadcast 10 kg of soil based powdered Blue Green Algae (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

If the above recommendation is not able to be followed, adopt blanket recommendation as follows:

NUTRIENTS	N(kg/ha)	P (kg/ha)	K (kg/ha)
Short duration varieties (Dry season)			
Cauvery delta & Coimbatore tract	150	50	50
(a)For other tracts	120	40	40
(b)Medium and long duration varieties (Wet season)	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 Active tillering (AT), panicle initiation (PI) and harvest (H) stages.

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.

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.

Neem 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.

Coal-tar treated urea:-

For treating 100 kg urea, one kg coal-tar and 1.5 litres of kerosene is required. 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.

Weed management:-

Manual weeding is also essential to remove the weeds closer to rice root zone. •

Cultural practices like dual cropping of rice-Azolla, 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 3 DAT. Water should not be drained for next 2 days from the field (or) fresh irrigation should not be given.

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.

Water management:-

Puddling and leveling minimizes the water requirement

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 sun hemp 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. • About 5cm submergence has to be continued throughout the crop period.

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/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.

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.

Yield:-

Grain yield varies between 40-60 q/ha depending on the management and climatic conditions. Straw yield of 80-100 q/ha can normally be obtained.