RICE

Introduction

Rice (*Oryza sativa*) is one of the three most important food crops in the world and is a staple for over 2.7 billion people. It is grown in almost all countries, except the USA. The total global area under rice cultivation is 150.8 million ha, with a total output of 573 million tonnes of paddy at an average yield of 3.83 tonnes per ha. More than 90% of the global rice area is in Asia. Out of 2.7 billion rice-consuming people, more than 95% live in Asia. China and India are two major rice producers. These two countries account for 49.1% of the total rice area (74.1 m ha) and 55.2% of the world's production (310.1 m tonnes). India is the world's largest rice-growing country, while China is the largest rice producer. In India, the area under rice cultivation is 44.6 m ha with a total output of 80 m tonnes (paddy) and an average productivity of 1,855 kg/ha. Rice is grown in almost all the states. West Bengal, Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, Andhra Pradesh, Assam, Tamil Nadu, Punjab, Maharashtra, and Karnataka are major rice-growing states and contribute to a total of 92% of rice area and production.

Climate and Soil Requirements

Rice grows best in tropical climate regions. However, it is also grown successfully in humid to sub-humid regions under subtropical and temperate climates. Rice is cultivated in almost all types of soils with varying degrees of productivity. Under high temperature, high humidity with sufficient rainfall and irrigation facilities, rice can be grown in any type of soil. The major soil groups where rice is grown are riverine alluvium, red-yellow, red loamy, hill and sub-montane, tarai, laterite, coastal alluvium, red sandy, mixed red and black, and medium and shallow black soils.

Rice Cultivation Seasons

Depending upon the climate and water availability, rice is grown in all three seasons, i.e., kharif, rabi, and summer. Depending upon the variety, the crop duration varies from 100 to 150 days. In northern and western India (J & K, Himachal Pradesh, Punjab, Haryana, Uttaranchal, Uttar Pradesh, Gujarat, Rajasthan, Maharashtra), rice is grown mainly in the kharif season, while in southern and eastern India it is grown throughout the year, in all three seasons, with varying sowing times and periods.

Cropping Systems

Rice is usually grown as a monocrop in rice-wheat, rice-rice, or rice-legume rotation. In eastern and southern India, rice is grown in rice-rice rotations. In rain-fed areas, rice is followed by short-duration legumes such as moong, black gram, or horse gram. In Punjab, Haryana, and Uttar Pradesh, rice is grown in rice-wheat or rice-vegetable rotations.

Field Preparation

During April—May, plough the field once or twice, 20—25 cm deep, with a soil-turning (mould board) plough. Deep ploughing helps in the eradication of weeds and improves the water-holding capacity of the soil. It also exposes the eggs of harmful insects and pests to the

hot sun. Prepare bunds around the field to check the loss of rainwater by runoff. Keep the field flooded or saturated with water for about 15 days. This will help in the decomposition of the chaff and straw of previous crops. Begin puddling two weeks ahead of transplanting, after erecting a 30 cm tall earthen bund around the field. Different types of bullock and tractor-drawn puddlers are used. Puddling helps to bury and destroy weeds. Puddle the field in standing water with 3—4 runs, and even out the soil surface. Mix leaves of neem, custard apple, pongamia, etc., to build pest resistance in the soil and the crop. Plant trees of neem, babul, pongamia, sesban, glyricidia, etc., on the field bunds to get adequate leaf litter for soil nutrition. Trees also attract birds that control insect pests.

Seed Selection and Treatment

To select good quality, healthy seeds, suspend the seeds in a salt solution (300 gm common salt in ten litres of water). Healthy seeds will sink in the solution while lighter, empty seeds will float. Discard floating seeds and chaff, wash the seeds in water 3—4 times, and dry them for 24 hours. Depending upon the soil and climate conditions, cultivation practices, and water availability, rice is cultivated by direct seed sowing or by transplantation of seedlings.

Direct Seed Sowing

For direct-seed-sown paddy, seeds are either broadcast or sown by line or by drilling or by seeding behind the plough in wet soil. Treat the seeds with a mixture of beejamrut (200 gm/kg seed) and *Trichoderma viride* (8 gm/kg of seed). Dry the seeds in the shade. Once again, treat the seeds with azospirillum and PSB biofertilizer (10 gm each per kilo of seed) and dry the treated seeds again in the shade. These seeds should be sown within 6—8 hours of their treatment. In south Indian states, panchagavya is being used in place of beejamrut. Seeds are soaked in diluted panchagavya for 20 minutes, dried, and then treated with *Trichoderma viride*, PSB, and azospirillum. About 100 kilos of seed are needed per ha under the broadcasting method of sowing, while 60 kg will be enough for inline sowing per ha. The row-to-row distance for in-line sowing should be 20 cm.

Transplanting Method

In each case, transplant seedlings at 2—3 cm depth. Do not plant seedlings deeper than 2—3 cm, as deeper planting delays and inhibits tillering. Planting in lines is unnecessary: with 50 hills per sq. m. that ensures adequate population.

Advantages of Transplanting:

1. It enables an optimum plant population at the desired spacing in the field.
2. It provides an opportunity for thorough cultivation and puddling that reduces weeds.
3. As nurseries occupy only a small area, controlling pests and diseases as well as irrigation and manuring are easier and cheaper at the early seedling stage.

However, as transplanting has become very expensive nowadays due to high labour costs, farmers are resorting to direct-seeded rice, which also produces as much as transplanted rice, provided the cultivation is planned well.

Weed Management

In upland rice cultivation, weeds are common and require manual removal 40—45 days after sowing.

Water Management

Paddy is a tropical dry land crop and needs a sufficiently wet soil for its growth. Flooding is unnecessary. Watering is also unnecessary if in the first ten days the area receives good rains. Avoid flooding if weeds can be controlled manually. Flooding is done to suppress weed growth and increase nutrient availability, such as phosphorus, potassium, calcium, iron, and silica. Provide water only at critical stages, i.e., during the initial seedling period covering about ten days, during the tillering to flowering stage, and at the panicle initiation stage.

Pest and Disease Management

Paddy is attacked by a large number of insect pests and diseases, and usually, 20—30% losses are attributed to such attacks. Use of resistant varieties and healthy seed stock is the best and most effective way of preventing pest and disease attacks. Crop rotation with legumes and other green manure crops also helps in keeping the pest problem below the ETL.

Harvesting

Harvest the crop as soon as it matures. If delayed, grain may be lost due to damage by rats, birds, insects, shattering, and lodging. Timely harvesting ensures good quality, consumer acceptance, and the grains do not break when milled. The right stage for harvesting is when about 80% of panicles have 80% ripened spikelets and their upper portion is straw-coloured. The grain contains about 20% of moisture.

SORGHUM

Sorghum [Sorghum bicolour (L.) Moench] is an indigenous crop to Africa, and though commercial needs and uses may change over time, sorghum will remain a basic staple food for many rural communities. The latter is especially true in the more drought-prone areas of South Africa, where this hardy crop provides better household food security than maize.

Sorghum is mainly cultivated in drier areas, especially on shallow and heavy clay soils. The production of sorghum in South Africa varies from 100,000 tonnes (130,000 ha) to 180,000 tonnes (150,000 ha) per annum. The Free State and Mpumalanga provinces are the largest contributors to the area planted to sorghum and sorghum production.

In recent years, there has been a shift in sorghum production from the drier western production areas to the wetter eastern areas. This change in production area has resulted in the identification and development of cultivars that are more tolerant to lower temperatures.

Crop Based Cropping System
Rabi sorghum is sown after a fallow period (kharif) in certain medium to deep soil areas where the rainfall frequency is high. However, double cropping of black gram/green gram/cowpea (fodder) and rabi sorghum is recommended wherever found operationally

feasible. Soybean–rabi sorghum sequential cropping is found feasible and profitable in irrigated conditions. Intercropping of sorghum + safflower in a 4:2 or 6:3 ratio is recommended on deep soils.

Soil
Sorghum is grown in a variety of soils in India. Soils with clay loam or loam texture, having good water retention capacity, are best suited for sorghum cultivation. It does well in a pH range of 6.0 to 8.5, as it tolerates considerable salinity and alkalinity.

Season
Being a rain-dependent kharif crop, sowing is best done with the onset of monsoon. In a normal season, sowing is completed in July in most of the area. The rabi planting around the middle of September is ideal but can be extended up to the last week of October.

Seed Rate and Spacing
The plant population of 0.18 to 0.2 million plants/ha is optimum. The recommended spacing to achieve this plant population is 45 cm between rows and 10-12 cm between plants within rows. A seed rate of 8-10 kg/ha is recommended to obtain the required plant population.

Manuring and Fertilization
For sustaining productivity on a long-term basis, application of farmyard manure @ 10 tonnes/ha, 15 days before sowing, is important. In addition to farmyard manure, application of 60 kg N and 40 kg P_2O_5/ha is recommended. To enhance the utilization of applied nitrogen, split application (50% as a basal dose and 50% as a top-dress) is suggested. However, the P_2O_5 is to be given as a basal dose only.

Irrigation
July-sown rainy season crop may also need 1-2 irrigations depending upon the distribution of rains. For summer-sown crops, 5-6 irrigations are required due to the high evaporative demand of the atmosphere. In the Southern region, rabi season crops need about 4 irrigations.

Pest Management
The major pests are shoot fly, stem borer, midge, and earhead bug. Shoot fly can be avoided by suitable adjustment of planting time so that the vulnerable stage of the crop escapes from shoot fly damage. Stem borer damage, which is not serious in most situations, can be checked by the application of insecticides, viz. Carbaryl 3G, Malathion 10D, or Furadan 3G @ 10-12 kg/ha in the whorl at 30-35 days after germination.

Disease Management
Disease management involves a combination of cultural and chemical control measures, using Aureofungin (200 ppm) and 0.2% Captan during flowering. Spraying Dithane M-45 (2%) 2-3 times during the early growth of plants gives good control. Sorghum downy mildew is commonly prevalent in the transitional belt of Karnataka and Tamil Nadu. Growing resistant cultivars and practicing clean cultivation can effectively control the disease. Seed dressing with Metalaxyl compounds, viz. Ridomil 25 or Apron 35 SD @ 1 g a.i./kg seed, gives satisfactory control.

Harvesting and Yield
Harvesting at physiological maturity is very important to avoid grain mold damage. The average yield is 8-14 qtl/ha.