



Crop Production Technology of Rice

PROGRAMME FOR IMPROVED NUTRITION IN SINDH

In support of the Accelerated Action Plan, Government of Sindh

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Introduction

In Pakistan, rice is the second most important food as well as a cash crop. In Sindh, the potential yield of recommended rice varieties is comparatively higher than the average yield obtained by small farmers. Those who cultivate using the latest rice production technology achieve higher yields than average.

Causes of Low Yields

- Less number of plants per unit area
- Scarcity of labor during rice transplantation period
- Careless transplanting by hired labor
- Transplanting of aged rice nursery
- Disproportionate use of inputs at improper time (for instance, fertilizer)
- Climate change (drought & floods)

Important Rice Producing Districts in Sindh

- Thatta
- Badin
- Tando Muhammad Khan
- Dadu
- Larkana
- Qamber Shahdadkot
- Shikarpur
- Jacobabad
- Kashmore

Seed Selection and Treatment

Use healthy and undamaged seeds. Put the seed in a solution of 2.5% salt made by dissolving 25g of common salt in 1 liter of water. Discard any seeds that float. Wash the seeds in clean water and dry in a shady area. To protect the plant from leaf blast and other diseases, the seeds should be soaked with 2.5 gm of a suitable fungicide in one litre of water for 24 hours to combat seed-borne diseases. For seed-dressing, use 2.5g of chemical fungicide for every kilogram of seed. Seeds can be treated in a rotating drum or putting the seed in a container and shaking it well after adding the chemical.

Sources of Good Quality Seed

Good quality seed is a must for high productivity. It should possess the following characteristics:

- Varietal purity
- High germination capacity and vigor
- Uniform sized healthy seed
- Free from weed seeds, diseases and other inert material

Farmers can get certified rice seed from the following sources:

- Punjab and Sindh Seed Corporations
- Rice Research Institute (RRI), Kaka Shah Kaku,
- Rice Research Institute (RRI), Dokri, Larkana
- Private seed companies
- Farmer can use their own good quality seed

Seed Rate

Seed Rate for Nurseries (Kg/Acre)				
Rice Varieties	Wet method	Dry method	Raab method	Germination
DR-82, DR 83, DR-92, KSK 133, KS 282, KSK 434, IR6, IR9	6 - 7	8 - 10	12 - 15	Above 80 %

Time of Nursery Sowing and Transplanting

Sowing & Transplanting Time of Nursery		
Rice Varieties	Sowing Time	Transplanting Time
KSK 133, KS 282, KSK 434, IR6, IR9	20th May to 7th June	20th June to 7th July

According to the Pest Control Act, a rice nursery cannot be sown before May 20. This needs to be strictly implemented.

Soil

Rice can be grown in any type of soil except sandy soil. Clay loam soil with an optimum quantity of organic matter and more water holding capacity is the best for rice cultivation.

Improve Rice Soil Health

Rice soils have been exhausted by continuous cultivation of rice and wheat and have become deficient in organic matter. To improve the physical health of soil, green manuring (guara or cowpeas) or the inclusion of legumes in between rice and wheat crops is a must. Similarly, the incorporation of rice and wheat straw (instead of burning) in soil can also help in increasing the organic matter of the soil. The incorporation of farmyard manures (cow and buffalo dungs and poultry feces) into the soil also helps improve soil health by increasing the organic matter in the soil.

Nursery Raising

For transplanting one acre of land by conventional practice, a nursery area of 250 square metre is sufficient. For rice cultivation there are different methods of raising nursery, depending on water availability, soil characteristics and traditional farming practices of an area. **Wet, Dry** and **Raab** methods are generally used for nursery raising.

Wet Method

The soil with water standing ability (clay – clay loam) is suitable for wet nursery. Start by preparing the seedbed 2 weeks before when you plan to plant. The nursery should be thoroughly ploughed and perfectly leveled so that a thin layer of water is maintained during the emergence. After the manuring and puddling, sprouted seeds are uniformly broadcasted in each seed bed. To sprout seed treated through seed-dressing, keep it in wet gunny bags for up to 48 hours. Water the seedbed 2-3 days after sowing. Maintain a water level of 2-5 cm, depending on the height of the seedlings. Irrigate in the morning and drain in the evening for a week. Apply 20-40gm of urea or DAP per metre square at 10 DAS, if needed. Seedlings are ready for transplanting in 25 - 35 days.

Dry Method

A raised seed bed is prepared under dry conditions. In areas with high rainfall, ensure that the seed bed is at least 10cm in height. Treated dry seeds should be evenly broadcasted in each bed after manuring. Water the seedbed till saturation after sowing. Then, water the plots periodically as seedlings emerge and grow. This method is practiced in areas where soils are loamy or silt loam and puddling is not possible. This method needs weed control. The nursery will be ready in 35 - 40 days and uprooting it is easy.

Raab Method

This is practiced in areas where the soil is hard and uprooting the nursery is not possible. Plough and plank the dry field to get a fine shape. A 2-inch deep layer of farmyard manure, wheat or rice straw is first spread uniformly over the plot and burnt out. Then, the next day, dry treated seed is broadcasted over it, which is followed by irrigation. The nursery is ready in 35 - 40 days. The method leads to less weeds, easy uprooting and soil sterilization, resulting in reduced diseases.

Land preparation (Main Field)

The crop and weed residues should be chopped and mixed with the soil at the time of the first ploughing.

For transplanting

Prepare the land properly and uniformly leveled with peripheral earthen dykes. Puddling may be done 2 - 3 times to make it weed-free and water-retentive. Use 25 - 30 day-old seedlings. Avoid the use of very young seedlings.

Direct dry seeding of rice-cultivation system/for furrow and raised bed (FRB)

This is a suitable substitute to manual seedling transplanting. Direct dry seeding of rice is a new rice cultivation method in which rice is seeded directly into moist watar soil conditions like winter wheat by using a seed drill. Any

approved rice variety can be used for this system. After harvesting the wheat crop, conduct a single deep cultivation of the field. Then, at the time of sowing of the rice, first irrigate the field (called Rouni irrigation) just a few days before sowing the crop. When field is in watter condition (optimum soil moisture level), prepare the fine seedbed by applying 1-2 shallow cultivations, either with a tractor or bullocks followed by light planking. A raised bed of 70 cm width is alternated with a furrow of 30 cm width. Then use a Rabi drill to seed the crop in a well-prepared and leveled field at optimum soil moisture conditions. Broadcasting of the seeds is not recommended. Farmers must always use a drill for sowing the rice crop to get optimum crop germination and achieve the desired stand establishment of the crop. This system encourages crop diversification and conserves resources like water and seed.

Transplanting Critical Factors

- Proper nursery management
- Careful handling of young seedlings for fast revival and early growth after transplanting
- Shallow transplanting at 1-2 cm depth
- Optimum plant-to-plant spacing: 25x25 cm or 9x9 inches
- Optimum number of seedlings: 1-2 hill
- Transplantations of seedlings in a levelled field and the depth of water will be 1-1.5 inches
- Avoid old age seedlings for transplantations
- Use only 30 to 40 days old seedlings

Plant Population

The optimum plant population is very important to get a good yield. To establish the optimum plant population, the distance between plants and rows should be kept at 9 inches. Gaps should be filled within 7-10 days after transplanting.

Fertilizer and Micro Nutrients

Most soils provide only a limited amount of nutrients to the crop. Therefore, fertilizers need to be applied to increase grain yield. Always use fertilizer on the basis of soil analysis. Use a recommended dose of fertilizer should be used. Full doses of phosphate fertilizer and half a dose of potassium and nitrogen should be applied with the last ploughing, the remaining half dose of nitrogen and potash is top dressed at 30-35 days after transplanting. Inorganic fertilizers must be stored in a dry and cool place that is out of children's reach.

The use of potassium is highly essential where tube well is the only/main source of irrigation. With established crops, apply chemical fertilizer only in standing water and evenly across the whole field. Do not apply high rates of fertilizer for traditional varieties as they may have limited response and this

may cause lodging.

- The deficiency of zinc appears in all the rice varieties. Therefore, it is imperative to apply zinc to get a good yield. Application of zinc sulphate (35% Zn) at 5 kg per acre at 10-12 days after transplanting is recommended
- The deficiency of boron results in white and rolled tips of emerging leaves. Therefore, it is imperative to apply boron to get a good yield. Application of 3 kg borax per acre at 10-12 days after transplanting improves paddy yield

Weed Management

Weeds compete directly with the rice plants and reduce rice yield. Each 1 kg dry matter of weeds is equivalent to 1 kg grain loss. Weeds cause most yield loss within the first 20–50 days after crop establishment. Weeding after panicle initiation may also be important to prevent weed shedding seeds in future crops.

- Rice weeds reduce yield by 15-20% normally, but in some cases, losses may go as high as 50%
- Weeds in rice are highly competitive as they have continuous germination and higher densities
- Weeds cause serious problems in nursery raising especially when seeds are dry sown

Effective weed management can be done by:

- Plowing and harrowing in fallow should be undertaken at least 10–14 days apart or after rain
- Good land leveling reduces weed growth because most weeds have trouble germinating under water
- Select varieties which have early vigor
- Use clean rice seed which is free of weed seeds
- Irrigate the crop early — weeds cannot germinate under water
- The first round of weeding begins within 2–3 weeks after establishment and the second in another 3–4 weeks. Weeding must be done before the fertilizer application and hoeing should follow each weeding
- Use the herbicide specific to the weed type
- Spray weedicide/herbicide when the weeds are small
- Apply pre-emergence herbicides after planting, prior to establishment
- Apply post-emergence herbicides after emergence, being careful of crop damage
- Herbicides are poisonous; if they are not used properly, they can cause health and environment problems. Label them clearly and keep them out of children's reach.
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Water Management

Good water control increases crop yields and grain quality as well as improving the efficiency of other inputs such as fertilizer, herbicide, and pesticides. To maximize water-use efficiency, do the following:

- Maintain the bunds
- Level the fields and puddle the fields where possible
- The water depth at the time of transplanting and one week later should be kept low (1-1½ inch). It should be gradually increased to about 2 inch for a period of 25 days.
- About 25-30 days after transplanting, the field should be allowed to dry for 5-6 days and then re-irrigated after the application of fertilizer
- After that, continue irrigation at saturated conditions but keep water standing for 5-6 days at the time of granular insecticide application
- Watering should be stopped after grain formation to allow the crop and field to sufficiently dry for harvesting.

Salinity Susceptibility

The rice plant is susceptible to salinity, especially at the seedling stage and during the panicle development stage from panicle initiation to booting. Symptoms of salt toxicity include firing of leaves and reduced dry matter production. The effects of high salinity during panicle development are less obvious as there is little leaf effect, but florets and grain numbers per panicle are reduced greatly which in turn reduces yield.

Plant Protection Measures

Farmers lose an estimated average of 37% of their rice crop to pests and diseases every year. In addition to good crop management, timely and accurate diagnosis can significantly reduce losses. The best control for pests and disease problems is prevention. To limit pest and disease incidences in a rice crop, the following recommendations can be followed:

- Clean equipment at regular intervals
- Clean the field between seasons by managing stubbles and ratoons and by maintaining and repairing bunds
- Use clean seeds and resistant varieties. Certified seed are recommended. If certified seed is not available, use clean seed that have no discolored seeds, weed seeds or other rice varieties mixed in
- Use short-duration and resistant cultivars to decrease insect and pest populations
- Timely seed sowing in nurseries and transplanting in the field

- Plant at the same time as your neighbors (or within a 2-week window) to minimize insect, disease, bird, and rat pressure on individual fields
- Do not apply fertilizer in excessive quantities. Using the recommended fertilizer dose is important because high nitrogen can increase susceptibility to certain pests and diseases
- The overuse of pesticide is common among farmers and can kill natural enemies of pest that can also lead to pest outbreaks
- Do not apply pesticide within 40 days of planting
- Crop rotations also reduces insect pest and disease problems substantially

Rice crops can recover from early damage without affecting yield. Get appropriate information on specific diseases that require early management. When deciding to use a chemical for pest and disease control, it is important to

- Use well-maintained spray equipment that has been properly calibrated
- Apply the dosage recommended by the manufacturer
- Follow the safety precautions for mixing and spray applications

Harvesting

Harvesting the crop on time is very important to maximize yields and grain quality. Crops harvested too early will have many unfilled and immature grains. Immature grains break easily when milled and will not germinate when used for seed. If crops are harvested late, heavy losses will occur through shattering and bird attacks. Quality will also decrease due to grain weathering, resulting in breakage and downgrading due to undesirable grain color. Harvesting should be done when 80% grains are matured and crop will be at the yellow ripening stage.

Crops should be harvested when

- Grain moisture is between 20–22%, which is normally about 30 days after flowering
- 80–85% of the grains are straw colored
- 30 days after flowering

Rice crop harvesting process includes

- **Cutting:** cutting the panicles and straw
- **Hauling:** moving the cut crop to the threshing location
- **Threshing:** separating the paddy grain from the rest of the cut crop
- **Cleaning:** removing immature, unfilled and non-grain materials
- **Field drying:** (optional) leaving the cut crop in the field and exposing it to the sun for drying
- **Stacking/Piling:** (optional) temporarily storing the harvested crop in stacks or piles

Losses During Cutting

- **Shattering loss:** premature shedding of mature grains from the panicle caused by birds, wind, rats, and handling operations. Certain rice varieties shatter more easily than others
- **Lodging loss:** plants with mature grains in the panicles fall on the ground making the grains difficult to recover.
- **Standing crop loss:** standing plants with mature grains are left standing in the field after harvesting operations as a result of oversight, carelessness or haste.

Losses During Threshing

- **Separation loss or blower loss:** mature grains that are mixed with straw or chaff during the cleaning operation.
- **Scatter loss:** mature grains that are scattered on the ground during the threshing and cleaning operation
- **Threshing loss:** mature grains that remain attached to the panicle in the straw after completion of the threshing operation. High threshing efficiency will lead to low threshing loss and vice versa

Recommendations for Optimizing Quality

- Harvest at the right time and moisture content
- Best results can be obtained only if crop is harvested in the morning and threshed in the afternoon on the same day
- Avoid stacking the cut crop in the field (Minimizing the time the cut panicles remain in large bundles in the field)
- Ensuring the panicles do not touch the ground or lay in water
- Avoid delays in threshing after harvesting (thresh within 24 hours of cutting)
- Use the proper machine settings when using a threshing machine
- Clean the grain properly after threshing
- Drying the grains as soon as possible after threshing
- Avoid delays in drying after threshing
- Sun drying on tarpaulins or clean drying pads
- Turning or stirring the grains at least once every hour when sun drying to achieve uniform drying
- Keeping the thickness of the grain layer at 3–5 cm

Winnowing and Cleaning

- Winnowing can be done by hand or through mechanical winnowing
- This removed chaff, straw and empty grains
- A combination of fan and oscillating sieves may be used
- To remove lighter materials, air-deliver by fan
- To remove larger straw particles, use top sieves with large holes
- To remove small seeds (e.g. weed seeds), bottom sieves with smaller holes should be used

Store Safely

Rice is best stored as paddy because the husk provides some protection against insects and helps prevent grain quality deterioration. A safe storage system will prevent the grain from getting wet after drying and also give protection from insects, rodents, and birds.

Rice can be stored for longer periods if

- Moisture content is maintained at less than 14% for grain and 12% for seed
- Grain is protected from insects, rodents, and birds
- Grain is protected from re-wetting by rain or from the surrounding air
- A rule of thumb for seed is that the life of the seed will be halved for every 1% increase in moisture content or a 5°C increase in storage temperature above recommended levels.

Rice storage systems Bag storage system

- Bags should not be stacked higher than 4 meters
- Bags should be stacked under a roof, in a shed or under water-proof tarpaulins
- A one-meter gap should be left between and around stacks
- Bags should be stacked on pallets or above ground
- Bags should be stacked so that fumigation can be undertaken if necessary

Hermetic or sealed storage

Sealed or hermetic storage systems are an effective means of controlling grain moisture content and insect activity for seed or grain stored in tropical regions. Sealed storage containers come in all shapes and sizes ranging from 50 kg super bags, small 25-liter plastic containers, and 200-liter oil drums to costly sealed large plastic commercial storage units of 1–300 tons.

Seed Productions

Farmers can produce the seed of approved rice varieties at their own farms to meet their needs. Farmers must follow the given instructions:

- **Selection of field:** Select a field of farm which is free from soil-borne diseases
- **Isolation:** For seed purpose, different varieties should not be grown adjacent to each other to avoid out crossing. Isolation in time may be a possibility. Otherwise, suitable space isolation could be used effectively
- **Protection from insect pests, diseases and weeds:** Crop must be fully protected through cultural practices and pesticide use
- **Rouging:** Removal of undesired plants from seed crop is necessary for seed purification. Best rouging time is when the crop is in full flowering stage
- **Harvesting and threshing:** Normally the appropriate harvesting time ranges from 30-35 days after flowering when 85-95% panicle becomes straw colored. Keep the harvested crop 2-3 days for drying before threshing.

Do not harvest seed crop with combine harvesters to avoid admixture. The threshing floor should be kept clean during harvesting and threshing operations. After drying and cleaning, seed should be packed in bags, labeled and stored properly.

Domestic Prices of Rice Paddy

- The wholesale market price of rice paddy is between Rs. 1876/40 kg to Rs. 1950/40 kg and the seasonal price ranges from Rs. 1480/40kg to Rs.1700/40kg
- The wholesale market price of IRRI-6 is in the range Rs. 920 to Rs.1150/40kg

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