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IMPROVED PRODUCTION TECHNOLOGY FOR RICE IN GOA



ICAR RESEARCH COMPLEX FOR GOA

(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)

OLD GOA-403 402, GOA, INDIA

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PREFACE

Rice cultivation in Goa is a cause of concern owing to the escalating cost of production leading to low returns. A scientific approach both in increasing the productivity and inturn the returns as well as reducing the cost of production seems to be the viable alternatives for the problem.

Keeping this in view, an effort is hereby made to bring out a Technical Bulletin on the improved technology package for rice production under different situations that can be practiced in the State. This Research Bulletin is based on the compilation of rice research carried out by various scientists as well as the field experience gained by different extension functionaries.

While bringing out this bench mark publication, we sincerely acknowledge the invaluable contributions rendered by various visionaries, research workers and scientists and Indian Council of Agricultural Research, New Delhi for encouraging the research on rice crop.

The conduct of various on-farm trials and frontline demonstrations on rice was possible with the co-operation of Directors, Dy. Directors, Asst. Directors and Zonal Agricultural Officers of Directorate of Agriculture, Government of Goa over the years. Our special thanks are due to Mr. Amancio Fernanades, Dy. Director, Mr. Nelson, Asst. Director, Mr. Joquim Fernandes, Zonal Agricultural Officer, Mr. Kosambe, SMS (Agronomy), KVK South Goa and Shri. Satish Tendulkar, the Director, Directorate of Agriculture for the initiation of the work, arrangement of discussion meetings and their contribution.

The co-operation and enthusiasm evinced by the farmers of Goa deserves high appreciations.

It is hoped that this bulletin will help the planners, researchers, extension functionaries and the farmers at large in enhancing productivity of rice in the region.

AUTHORS

I. Introduction

Rice is the staple food crop of Goa. The crop is cultivated over an area of 47,104 ha with a production of 1,50,919 mt annually. The average productivity of the crop is about 3,204 kg/ha.

The crop is being cultivated both in *kharif* (Sod) and *rabi* (Vaigon) seasons, with an area of approximately 67 % and 33%, respectively. The average productivity of *rabi* season is relatively higher (3,890 kg/ha) as compared to *kharif* season (2853 kg/ha).

Average land holding size in Goa is relatively less (92% less than 1 ha) and that too fragmented. Further, the socio-economic situations prevailing in the State and non-availability and high cost of labour, lack of mechanization, threshing and processing facilities including marketing infrastructure are threatening the cultivation of rice crop.

The crop is cultivated in three different topographical situations i.e. rainfed uplands (*Morod*), rainfed low lands (*Kher*) and coastal saline lands (*Khazans*). The Package for these three different situations of rice cultivation is as follows:

II. Technology Package for Rainfed Rice in Uplands (*Morod* lands)

Rice crop is cultivated in rainfed uplands to an extent of 1/6 of total rice area in the State. The growing period under this situation is 115-120 days and in general the productivity levels are lower. Rice varieties like Jyoti and Annada is predominantly cultivated in these situations.

Land Preparation

Prepare the field by ploughing and cross-ploughing early in the season so that the field is ready for sowing before the regular onset of monsoon. Allow the weeds seeds to germinate. Adopt shallow harrowing to kill the weeds that emerge. Later on, level the field before sowing.

Recommended varieties

Varieties with duration up to 120 days (from seed to seed) can be grown.

Annada: White kernelled, bold seeded high yielding (4.2 mt / ha) with a duration of 110 – 115 days.

Revathy (MO-17): Red kernelled, bold seeded, with yield potential of 4.5 mt/ha.

Karjat-3: White kernelled, short bold grain, good for parboiling as well as raw rice, good head rice recovery with yield potential of atleast 5 mt / ha.



Jyoti, Revathy and Karjat-3 – the suitable rice varieties for upland cultivation

Seed Treatment

For higher productivity, use certified seeds atleast once in three years.

Select well filled, matured seed of desired variety. Immerse the seed in salt water (1.65 kg. common salt in 10 litres water). Remove chaffy and half filled grains that float on water surface. Collect heavy settled grains and wash thoroughly with fresh water and soak the seed for 24 hours.

Dry the soaked seed for 24 hours in shade for inducing stress in the plant.

Treat the seed with Carbendazim (Bavistin, Topsin, etc.) @ 2 g per kg of seed so as to get uniform seed coating (Preferably using seed drum).

Seed Rate

About 60-80 kg for drilling and 100-120 kg for broadcasting.

Time of Sowing

June 1st fortnight with the regular onset of the monsoon.

Sowing / Planting Method

Sow the seed behind the country plough in shallow furrows, 2-3 cm deep at 20 cm apart to ensure better germination. Thin out and simultaneously fill the gaps, 10-12 days after germination to ensure optimum plant population. Pre-germinated seed can be broadcasted on a levelled surface with thin film of water or sown through plough sole placement. Under transplanted situations, maintain a plant population of 50-60 hills / m² by uniform planting in lines spaced at 20 cm apart.

Manures and Fertilizers

FYM @ 10 mt/ha or any other available organic / green manure can be used. Incorporate 2-3 weeks before sowing.

Apply Rock Phosphate @ 45 kg / ha atleast one week before sowing both as a source of phosphorus and as soil conditioner.

Fertilizers : 80:50:50 kg NPK / ha.

Apply all phosphate (P_2O_5), 50% nitrogen (N) and potash (K_2O), as basal dose at the time of sowing or transplanting. After 25-30 days, apply 25% nitrogen as first top dressing. In another 20-25 days, apply balance 25% nitrogen and 50% potash as second top dressing. Weed the field and drain water wherever possible before top dressing.

Type of fertilizer and its quantity can be chosen from any of the combination given below. Use of combination of straight

fertilizers is economical with better crop response.

Weed management

Weed infestation is a chronic problem in rice cultivation. The loss caused by weeds ranges from 30-40% including quality deterioration of the grain. The first 35-40 days of the crop is the critical period for weed competition.

The weeds can be effectively controlled by using Cono weeder (low cost manually operated interculture implement) in line sown crops with availability of thin film of water in the field.

Granular herbicide formulations like Butachlor 5 G @ 20 kg / ha or Benthocarb 20 G can be mixed with water and blanket

Table 1. Fertilizer combinations for rice per hectare

Sr. No.	Type of Fertilizer	Total Quantity (kg)	Basal Dose (kg)	Top Dressing	
				I (kg)	II (kg)
1	Urea	175	175	50	50
	Gafsaphos	175	175	--	--
	Muriate of Potash	80	40	--	40
2	Urea	130	30	50	50
	DAP	110	110	--	--
	Muriate of Potash	80	40	--	40
3	Urea	130	30	50	50
	NPK 10:26:26	190	190	--	--
4	Urea	70	--	35	35
	NPK 19:19:19	260	260	--	--
5	Urea	70	--	35	35
	NPK 15:15:15	325	325	--	--
6	Urea	70	--	35	35
	NPK 20:20:0	250	250	--	--
	Muriate of Potash	80	40	--	40

spray using high volume sprayer within three days of sowing is recommended. Granular herbicides are convenient to apply as it eliminates the use of spray pump.

Alternatively, the selective herbicides like Benthocarb 50 EC @ 3.0 litres / ha or Butachlor 50 EC @ 3.0 litres/ha or Pendimethalin 30 EC @ 3.0 litres/ha or Anilophos 30 EC @ 1.0 litre / ha can be used. Benthocarb is preferred as besides killing germinating weed seeds, it also has a post emergent effect on weeds upto 1-2 leaf stage.

Alternatively, mix the above formulation with 80-90 kg of fine sand and broadcast evenly in the field. For use of granular herbicides application, drain the water from the field.

Integrated Pest and Disease Management

Insect pest management in rice

Gall midge, leaf folder and case worm are the major insect pests of rice during *kharif*. Stem borer incidence is also recorded occasionally. However, the incidences of all these insect pests are below the economic threshold level. Following management practices to be followed in case of severe infestation.

Caseworm

- ❖ Adapt wider spacing and early planting
- ❖ Periodical draining of water from the field

- ❖ Spray Endosulfan / Monochrotophos @ 0.2% in the nursery and in the transplanted crop

Leaf folder

- ❖ Grow resistant varieties
- ❖ Use minimum dose of chemical fertilizers
- ❖ Spray Endosulfan / Monochrotophos @ 0.2% during maximum tillering and maturity stage if the infestation is high.

Gall midge

- ❖ Use resistant varieties and follow early planting
- ❖ Spray Monochrotophos 35 EC @ 2ml/l at nursery stage. Application of Phorate 10G@ 4kg/acre or Carbofuran 3G@ 10kg/acre insecticides in presence of thin film of water in the field

Stem borers

- ❖ Grow resistant varieties
- ❖ Apply N fertilizers in splits
- ❖ Spray Monocrtophos / Endosulfan @ 2ml/l at nursery stage

Disease management in rice

The incidence of diseases in rice is below the threshold level during *kharif* season. The major diseases are bacterial leaf blight and sheath rot. Incidence of sheath rot increases in the later part of the crop growth and severe yield loss will happen if there is

rainfall during grain formation and filling stage. Occasional incidence of false smut is also recorded in the State. During *rabi*, blast is the major disease affecting from nursery to transplanted crop. The following management practices to be followed to avoid severe crop losses.

Blast

- ❖ Grow resistant varieties (IR-20, Jaya, IR-64).
- ❖ Remove and destroy affected straw, stubbles and weed hosts.
- ❖ Treat the seeds with Captan/ Carbendazim/Carboxin/Tricyclazole @ 2.0 g/kg.
- ❖ Treat the seeds with biocontrol agents like *Trichoderma viride* @ 4g/kg or *Pseudomonas fluorescens* @10 g/kg.
- ❖ Avoid closer spacing of seedlings in the field.
- ❖ Spray the crops with Ediphenphos (1ml/litre)/ Carbendazin(1g/litre)/ Tricyclazole (2g/litre)/ Iprobenphos (2ml/litre)/ Thiophanate methyl. Four to five sprays at 10 days interval may be needed for complete control-one at nursery, second during tillering stage and one to two sprays during panicle emergence stage.

Sheath Rot

- ❖ Apply recommended dose of fertilizers and adapt optimum spacing.
- ❖ Spray Carbendazin/ Ediphenphos/ Mancozeb/ Chlorothalanyl (0.2%) at

boot leaf stage and 15 days later. Spray may be repeated in case of repeated rains during grain formation stage.

Bacterial leaf blight (BLB)

- ❖ Use disease free seeds for sowing.
- ❖ Treat the seeds with hot water (50-54°C) for 30 minutes.
- ❖ Treat the seeds by soaking in Streptocycline (3g/litre) for 8 hours.
- ❖ Spray Streptocycline 500 ppm + Copper oxychloride (1g/litre) after 30 days of transplanting and repeating after 15 days interval.
- ❖ Avoid using excessive N-fertilizers.
- ❖ Drain the standing water in the field regularly.

False smut

- ❖ Spray Copper oxychloride (2g/litre) a few days before heading.

Harvesting and Threshing

Harvesting paddy at the right stage is vital for getting high quality grains. It also helps in proper storage of grains. Harvest the crop, when 5-10 % of the grains at the bottom of the panicle are still to dry but the rest of the grains on the panicle are fully matured.

Vaibhav sickle developed by B.S. KKV, Dapoli is an improved implement for

harvesting. The sickle helps to cut paddy near ground level, thereby minimizing the incidence of paddy stem borer, besides improving the work efficiency. Special care need to be taken for shedding varieties to avoid grain losses. The harvested produce need to be threshed immediately so as to avoid damage to grain during staking, that also enables better quality for seed purpose.

Drying and storage

Gradual drying preferably in the morning and evening hours avoiding direct exposure of grain to the sun during noon hours is essential. This prevents formation of minute cracks on the grain which leads to breakage during milling and avoids grain infestation in storage. Heaping the grain during noon time and spreading only during morning / evening is suggested for uniform drying. Bring down the moisture content of the grain by drying to less than 12–13% for better milling and storage of the produce.

Store paddy in proper storage structures after adequate drying. Take precautions to avoid infestation by the stored grain insects and the fungal infections.

Use of locally available organic insect repellants like neem, lingad, tirphal, etc, so as to prevent damage from insect and rats are also suggested.

Milling

Modern rubberized mills or paddy rollers are effective to get higher milling efficiency. With parboiling, the milling recovery can further be improved.

Mechanization of Paddy cultivation

Considering the labour intensiveness of paddy crop, it is essential to adopt farm implements / machinery as per the availability and situations. Vast scope exists for reducing the labour cost by interventions of farm machinery right from ploughing to harvesting and threshing.

Suitable implements / machines such as Seed dressing drum, Drum seeder, Power tiller, Rotavator, Cono weeder, Transplanters, Reapers, Combine (harvesting, threshing, winnowing and bagging), Thresher (manual / power operated) can be adopted specially on a community basis to reduce the cost of production.

Economic analysis of rice cultivation for high yielding coarse varieties in uplands of Goa

Table 2. Economics of rice cultivation in rained uplands

	Quantity (t/ha)	Rate/ kg (₹)	Amount (₹)
Produce (grain)	4.8	10.00	48000
Straw	4.5	0.50	2250
Gross income (A)			50250
Cost of cultivation (B)			35000*
Net income (A-B)			15250
C:B ratio			1:1.43
Cost of producing kg of paddy			7.29

* By use of improved implements and machinery through self help group, cost of cultivation can further be reduced.

III. Technology Package for Rice Cultivation in Rainfed Lowlands (*Kher* lands)

The crop is cultivated in rainfed lowlands to an extent of 1/3 of total rice area in the State. The crop growing period under this situation is relatively longer (130-135 days) and in general the productivity levels are higher.

Recommended Varieties

Jaya and Jyoti are the predominant varieties grown in *Kher* lands. Cultivation of improved varieties have proven yield increase over the ruling varieties. The following improved varieties are suitable for cultivation in Goa.

Nursery: Seedlings are raised either by dry or wet method.

1) Dry Nursery

Plough the field 3-4 times at intervals of four to five days on receipt of first showers. Apply 200-300 kg cowdung manure for every 100 sq.m nursery area, 2-3 weeks before sowing. Apply 1-2 kg Urea, 1.5 kg Mussoriephos and 1.5 kg Muriate of Potash per 100 sq.m, harrow and level the field.

Prepare raised beds 1 to 1.5 m wide, 15 cm in height and of convenient length, keeping 30 cm wide channel all around to facilitate drainage. Select seeds of a suitable variety. Use 60-65 kg seeds for 1000 sq.m area either by broadcast or sowing in close lines and cover them with thin layer of soil. Irrigate the nursery bed frequently. Hand weed

once, 15-20 days after germination. The seedlings will be ready for transplanting 20–25 days after sowing. Provide adequate

irrigation to make the soil sufficiently wet to prevent damage to the roots while uprooting.

Table 3. Suitable rice varieties for rainfed lowlands

Variety	Grain type	Duration (Days)	Yield Potential (t/ha)
1) Karjat – 3	Short Bold	115-120	6.0-6.3
2) KRH-2 (Hybrid)	Medium Slender	125-130	6.5-7.3
3) Revati (M.O-17)	Red Kernelled Bold	125-130	4.5-5.0
4) Sahyadri-1(Hybrid)	Medium Slender	130-135	6.5-7.5
5) Pusa Sugandh-5	Scented Long Slender	115-120	4.5-4.7



1) Wet Nursery

Prepare the seed bed 30 days before planting. Plough twice in the dry condition and puddle it subsequently by ploughing in the standing water (5–6 cm), three to four times at intervals of 5–6 days.

Level the field perfectly after final puddling and prepare raised beds of 1-1.5 m width and of convenient length, leaving 30 cm channel in between two beds. Total seed bed nursery area should be 10 % of the main filed (i.e. 1000 sq. m area will be required for planting one hectare land).

bags and incubate for 48 hours beneath straw with occasional sprinkling of water. Broadcast germinated seeds uniformly over the prepared seed bed and maintain water to a depth of 2.5 cm with occasional draining of field. Top dress the nursery seed bed with 1 to 1.5 kg Urea for every 100 m², at least 6 days before transplanting. Hand weed once after a fortnight of seedling emergence. The seedlings so raised are ready for transplanting, 21–25 days after germination. At the time of uprooting, the nursery bed should be sufficiently wet to avoid root damage.



A view of dry nursery for rice in different varieties

Fertilize the nursery beds with 1–2 kg Urea, 2.5 kg Mussoriephos and 1.5 kg Muriate of Potash for every 100 sq. m area before final leveling of nursery beds.

Select suitable high yielding variety seeds through use of salt solution and seed treatment. About 60 kg seeds are sufficient for nursery area of 1000 sq. m, enough to transplant one hectare land. Soak the seeds in water for 24 hours by placing in gunny

3) Dapog Nursery Raising

For use of paddy transplanter, the *Dapog* nursery is required. To transplant one hectare paddy about 100 kg of seeds are required for nursery. Nursery raising has to be done in field by polythene sheets using pre-germinated seeds covered with hay to prevent bird damage.

Main Field Preparation

Ploughing should start with first shower of monsoon to a depth of 15 cm with the help of power tiller or mould board plough. Apply well decomposed FYM (10 mt) after the first ploughing. This operation is to be completed atleast 15 days before sowing of the seed. Green manures (finely chopped) like *Glyricidia* (grown on bunds /fences), *Dhaincha* etc. or any biomass from major weeds on uplands like *Eupatorium* be incorporated as per availability. A good puddling by churning the soil with water will favour

Pre-germinated seeds can be broadcasted on a level surface after puddling and maintain a thin film of water.

In a transplanted crop, the seedlings need to be planted at the age of 21-25 days on a puddled soil with 3-4 seedlings/ hill at a spacing of 20 x 10 cm ensuring atleast 50 hills / sq.m. Shallow transplanting favours more tillering and consequently higher yield.



Land preparation including puddling through power tiller is viable option.



Use of rice transplanters with Dapog nursery saves labour and time

better water management and inturn good crop growth. Proper leveling and bunding should be ensured for better water and soil conservation.

Sowing / Planting

Direct seeding either by dibbling of seeds in dry soil at 20 X 15 cm spacing or plough sole placement before onset of regular monsoon is recommended.

Manures and Fertilizers

FYM @ 10 mt / ha or any other available organic / green manure can be incorporated 2-3 weeks before sowing.

Fertilizer Management

Apply Rock Phosphate @ 45 kg/ha atleast one week before sowing both as a source of phosphorus and as soil conditioner.



Timely and shallow transplanting in well prepared soil yields more / unit area

Recommended fertilizers:-100:50:50 kg NPK / ha.

Apply all phosphate (P_2O_5), 50% nitrogen (N) and 50% potash (K_2O) as basal dose at the time of sowing or transplanting. After 25-30 days, apply 25% nitrogen as first top dressing. Later, in another 20-25 days, apply balance 25% nitrogen and

50% potash as second top dressing. Weed the field and drain water wherever possible before top dressing.

Type of fertilizer and its quantity can be chosen from any of the combination given below. Use of combination of straight fertilizers is economical, with better crop response.

Table 4. Fertilizer chart for rainfed lowland rice

Sr. No.	Type of Fertilizer	Total Qty (kg /ha)	Basal dose (kg /ha)	Top dressing (kg N / ha)		Remarks
				I	II	
1)	a) Urea	217	109	54	54	Addition of M.O.P. at the rate 40 kg/ha as 2 nd top dressing is advisable
	b) Rock Phosphate	175	175	---	---	
	c) M.O.P	80	40	---	40	
2)	Urea	174	66	54	54	
	D.A.P.	109	109	---	---	
	M.O.P	80	40	---	40	
3)	Urea	174	66	54	54	
	N.P.K. 10-26-26	192	192	---	---	
4)	Urea	109	---	55	54	
	N.P.K. 19-19-19	263	263	---	---	
5)	Urea	109	---	55	54	
	N.P.K. 15-15-15	333	333	---	---	
6)	Urea	109	---	55	54	
	N.P.K. 20-20-20	250	250	---	---	
	M.O.P.	83	43	---	40	

Weed management:

Weed infestation is a chronic problem in rice cultivation. The loss caused by weeds ranges from 30-40% including quality deterioration of the grain. The first 35-40 days of the crop is the critical period for weed competition.

The weeds can be effectively controlled by using Cono weeder (low cost manually operated interculture implement) in line sown crops with availability of thin film of water in the field.

Herbicide formulations like Butachlor 5 G @ 20 kg / ha or Benthocarb 20 G can be mixed with water and blanket spray with high volume sprayer three days after sowing is recommended. Granular herbicides are convenient to apply as it eliminates the use of spray pump.

Alternatively, the selective herbicides like Benthocarb 50 EC @ 3.0 litres / ha or Butachlor 50 EC @ 3.0 litres/ha or Pendimethalin 30 EC @ 3.0 litres/ha or Anilophos 30 EC @ 1.0 litre / ha can be used. Benthocarb is preferred as it also has a post emergent effect on weeds upto 1-2 leaf stage besides killing germinating weed seeds.

Alternatively, mix the above formulation with 80-90 kg of fine sand and broadcast evenly in the field. For use of granular herbicides application, drain the water from the field.

In low lands, where there is standing

water, broadcast Benthocarb 10 G granules, a week after direct sowing or within 8 days of transplanting. Maintain 3-5 cm of water level in the field after granular application so that soil is under water but leaves are above water. Do not allow water to flow from one field to another. This controls a wide range of weeds for 30-35 days after application. However, if *Cyperus* and broad leaved weeds are present, spray 2,4, D @ 2.5 kg./ hectare about three weeks after transplanting or 4 weeks after sowing.

Integrated Pest and Disease Management

Insect pest management in rice

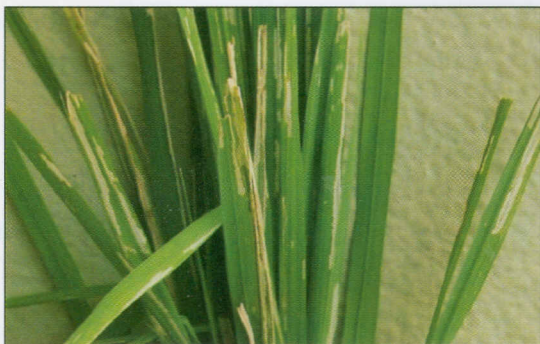
Gall midge, leaf folder and case worm are the major insect pests of rice during *kharif*. Stem borer incidence is also recorded occasionally. However, the incidences of all these insect pests are below the economic threshold level. Following management practices to be followed in case of severe infestation.

Case worm

- ❖ Adapt wider spacing and early planting
- ❖ Periodical draining of water from the field
- ❖ Spray Endosulfan / Monochrotophos @ 0.2% in the nursery and in the transplanted crop.

Leaf folder

- ❖ Grow resistant varieties
- ❖ Use minimum dose of chemical fertilizers



Case worm damage in rice



Leaf folder damage in rice

- ❖ Spray Endosulfan / Monochrotophos @ 0.2% during maximum tillering and maturity stage if the infestation is high.

- ❖ Apply N fertilizers in splits

- ❖ Spray Monocrotophos / Endosulfan @ 2ml/l at nursery stage

Gall midge

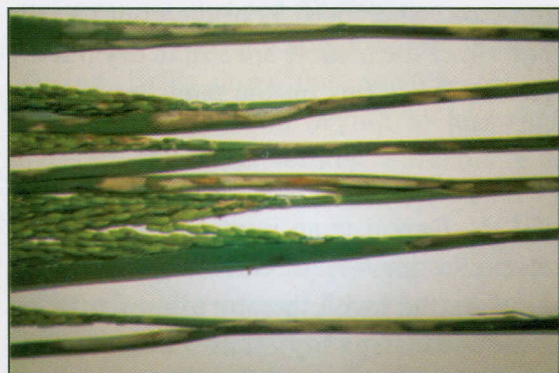
- ❖ Use resistant varieties and follow early planting
- ❖ Spray Monochrotophos 35 EC @ 2ml/l at nursery stage. Apply insecticide Phorate 10G@4kg/acre or Carbofuran 3G@10kg/acre in presence of thin film of water in the field.

Stem borers

- ❖ Grow resistant varieties

Disease management in Paddy

The incidence of diseases in rice is below the threshold level during *kharif* season. The major diseases are bacterial leaf blight and sheath rot. Incidence of sheath rot increases in the later part of the crop growth and severe yield loss will happen if there is rainfall during grain formation and filling stage. Occasional incidence of false smut is also recorded in the State. During *rabi*, blast is the



Sheath blight incidence in Rice



Blast disease symptom in Rice

major disease affecting from nursery to transplanted crop. The following management practices to be followed to avoid severe crop losses.

Blast

- ❖ Grow resistant varieties (IR-20, Jaya, IR-64).
- ❖ Remove and destroy affected straw, stubbles and weed hosts.
- ❖ Treat the seeds with Captan/Carbendazim/Carboxin/Tricyclazole @ 2.0 g/kg.
- ❖ Treat the seeds with biocontrol agents like *Trichoderma viride* @ 4g/kg or *Pseudomonas fluorescens* @10 g/kg.
- ❖ Avoid closer spacing of seedlings in the field.
- ❖ Spray the crops with Ediphenphos (1ml/litre)/ Carbendazin(1g/litre)/ Tricyclazole (2g/litre)/ Iprobenphos (2ml/litre)/ Thiophanate methyl. Four to five sprays at 10 days interval may be needed for complete control-one at nursery, second during tillering stage and one to two sprays during panicle emergence stage.

Sheath Rot

- ❖ Apply recommended dose of fertilizers and adapt optimum spacing.
- ❖ Spray Carbendazin/ Ediphenphos/ Mancozeb/ Chlorothalanyl (0.2%) at boot leaf stage and 15 days later. Spray

may be repeated in case of repeated rains during grain formation stage.

Bacterial leaf blight (BLB)

- ❖ Use disease free seeds for sowing.
- ❖ Treat the seeds with hot water (50-54°C) for 30 minutes.
- ❖ Treat the seeds by soaking in Streptocycline (3g/litre) for 8 hours.
- ❖ Spray Streptocycline 500 ppm + Copper oxychloride (1g/litre) after 30 days of transplanting and repeating after 15 days interval.
- ❖ Avoid using excessive N-fertilizers.
- ❖ Drain the standing water in the field regularly.

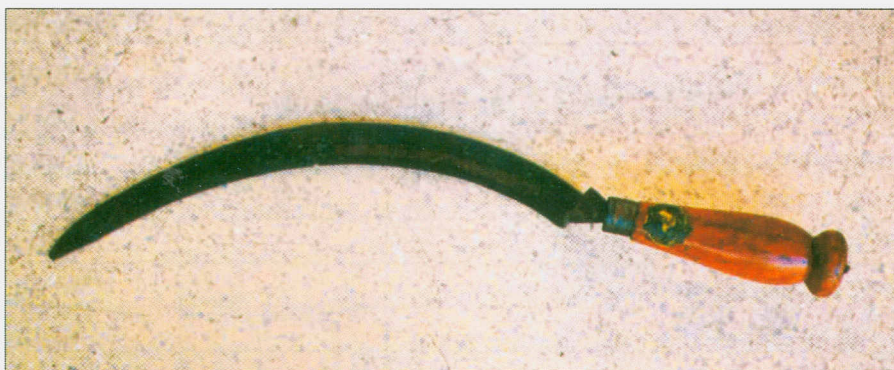
False smut

- ❖ Spray Copper oxychloride (2g/litre) a few days before heading.

Harvesting & Threshing

Harvesting paddy at the right stage is vital for getting high quality grains. It also helps in proper storage of grains. Harvest the crop, when 5-10 % of the grains at the bottom of the panicle are still to dry but the rest of the grains on the panicle are fully matured.

Vaibhav sickle developed by B.S. K.K.V, Dapoli is an improved implement for harvesting. The sickle helps to cut paddy near ground level, thereby minimizing the incidence of paddy stem borer, besides improving the work efficiency with a saving



An improved sickle - Vaibhav developed by the KKV, Dapoli with higher working efficiency

of five man days / ha for rice harvest.

Special care need to be taken for shedding varieties to avoid grain losses. The harvested produce need to be threshed immediately so as to avoid damage to grain during staking, that also enables better quality for seed purpose.

Drying

Gradual drying preferably in the morning and evening hours avoiding direct exposure of grain to the sun during noon hours is essential. This prevents formation of minute cracks on the grain which leads to breakage during milling and avoids grain infestation in storage. Heaping Paddy during noon time and spreading only during morning / evening is suggested for uniform drying. Bring down the moisture content of the grain by sun drying to less than 12–13% for better milling and storage of the produce.

Store paddy in proper storage structures after adequate drying. Take precautions to avoid infestation by the stored grain insects and the fungal infections.

Use of locally available organic insect repellants like neem, *lingad*, *tirphal*, etc, so as to prevent damage from insect and rats are also suggested.

Milling

Modern rubberized mills or paddy rollers are effective to get higher milling efficiency. With parboiling, the milling recovery can further be improved.

Mechanization of Paddy cultivation

Considering the labour intensiveness of paddy crop, it is essential to adopt farm implements / machinery as per the situations and availability. Vast scope exists for reducing the labour cost by interventions of farm machinery right from ploughing to harvesting / threshing.

Suitable implements / machines such as Seed dressing drum, Drum seeder, Power tiller, Rotavator, Cono weeder, Transplanters, Reapers, Combine (harvesting, threshing, winnowing and bagging), Thresher (manual / power operated) can be adopted specially on a community basis to reduce the cost of production.

Table 5. Economics of high yielding coarse varieties of rice

Particulars	Quantity (t/ha)	Rate/ kg (₹)	Amount (₹)
Produce (grain)	5.3	10.00	53000
Straw	4.5	0.50	2250
Gross income (A)			55250
Cost of cultivation (B)			35000*
Net income (A-B)			20250
C:B ratio			1:1.58
Cost of producing kg of paddy			6.60

* By use of improved implements and machinery through self help group, cost of cultivation can further be reduced.

Table 6. Economic analysis of high yielding scented rice varieties in Goa

Particulars	Quantity (t/ha)	Rate/ kg (₹)	Amount (₹)
Produce (grain)	4.0	15.00	60000
Straw	4.0	1.00	4000
Gross income (A)			64000
Cost of cultivation(B)			36000*
Net income (A-B)			28000**
C:B ratio			1:1.78
Cost of producing kg of paddy			9.00

* By use of improved implements and machinery through self help group, cost of cultivation can further be reduced.

** Value addition through rubberized milling can further enhance the profit.

Table 7. Cost benefit analysis for hybrid rice in Goa

Particulars	Quantity (t/ha)	Rate/ kg (₹)	Amount (₹)
Produce (grain)	6.5	9.00	58500
Straw	5.0	0.50	2500
Gross income (A)			61000
Cost of cultivation(B)			36000
Net income (A-B)			25000*
C:B ratio			1:1.69
Cost of producing kg of paddy			5.54

* By use of improved implements and machinery through self help group, cost of cultivation can further be reduced.

IV. Package for Rice cultivation in Saline (*Khazan*) areas

Rice is cultivated under varying saline situations during *kharif* in an area of nearly 12,000 ha in the State. Varieties like *Korgut*, *Azgo* are predominantly cultivated in this area.

Land Preparation and Manuring

Ploughing during summer preferably to a depth of 20 -30 cm is ideal. Apply well decomposed FYM at the rate of 10 tonnes per hectare. Alternatively, green leaves manuring from the vegetation surrounding the area preferably before flowering of weeds is suggested. Further, incorporate FYM / green manure 15 days before sowing.

Variety

Varieties with a duration of 105–115 days are suitable for this situation. Improved salt tolerant varieties like CSR-4 (3.53 t/ha), CSR-10 (4.10 t/ha), CSR-27 (4.20 t/ha), are recommended for this situation.

Seed Treatment

Select well filled, matured seed of desired variety. Immerse the seed in salt water (1.65 kg common salt in 10 litres water). Remove chaffy and half filled grains that float on water surface. Collect heavy settled grains and wash thoroughly with fresh water and soak the seed for 24 hrs.

Dry the soaked seed for 24 hours in shade for inducing stress in the plant.

Treat the seed with Carbendazim (Bavistin, Topsin, etc.) @ 2 g per kg of seed so as to get uniform seed coating (Preferably using seed drum).

Seed rate

80-100 kg / hectare.

Time of sowing

Seeds can either be broadcasted or transplanted by raising a nursery. However, it is essential to ensure sowing with regular onset of monsoon after ensuring flushing of salts.

Planting

Maintain a plant population of 50-60 hills / Sq.m by uniform sowing or transplanting. Pre-germinated seed can be broadcasted. Thinning and Gap filling is essential for maintaining optimum plant population.

Weed management

Although intensity of weed infestation is relatively low in saline soil, initial weed free situation for 30-45 days helps in enhancing the yield potential.

Water Management

Management of water is critical and needs to be monitored considering the salinity status of water specially at the time of certain breaches in the protective bunds.

Harvesting & Threshing

Since local varieties like *Korgut* / *Azgo* lodges at grain filling stage, timely harvesting



A view of Front Line Demonstration of salt tolerant rice (variety CSR-27) in farmers field.

and threshing is suggested. Drying of grains to less than 12 % moisture level is recommended for better storage. Store the paddy in proper storage structures with precaution for infestation by stored grain pests and fungal infection.

Marketing

As this rice crop is mostly cultivated without application of any fertilizer / chemical by default, it can be sold as organic rice to fetch maximum price in the market. This help to exploit the potential of niche market with proper certification.

Mechanization of rice cultivation

Considering the labour intensiveness of paddy crop, it is essential to adopt farm implements / machinery as per the availability and situations. Vast scope exists for reducing the labour cost by interventions of farm

machinery right from ploughing to harvesting / threshing.

Suitable implements / machines such as Seed dressing drum, Drum seeder, Power tiller, Rotavator, Cono weeder, Transplanters, Reapers, Combine (harvesting, threshing, winnowing and bagging), Thresher (manual / power operated) can be adopted specially on a community basis to reduce the cost of production.

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