



Best Management Practices of *Sali, Boro/Early Ahu* Paddy in Assam

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Contributors:

Kanwar Singh¹, Rupam Borgohain², Vipin Kumar¹, Suryakanta Khandai¹, Vivek Kumar¹, Jyoti Bikash Nath¹, Rahul Priyadarshi¹, Kasturi Goswami¹, Mridupaban Mudoi¹, Ankita Sahu¹, Virendar Kumar¹, Puja Rajkhowa¹, Sudhanshu Singh¹, Khagen Kurmi², Debanand Das², Ramani Kanta Thakuria², and Ashok Bhattacharyya²

International Rice Research Institute¹

Assam Agricultural University²

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E-mail: rkbassam2021@gmail.com

www.rkbassam.in

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Introduction

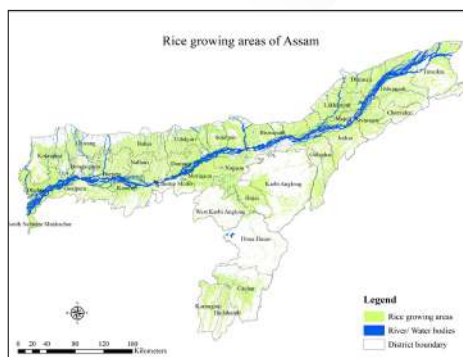
Rice is the single most important crop in Assam, occupying 2.5 million ha of the gross cropped area (4.16 million ha) and contributing 96% of the total food-grain production of the state. Assam, well recognized for its rich rice genetic diversity, and cultivation of rice under diverse agro-ecological conditions over the years has resulted in the development of a multitude of strains with specific adaptations through natural selection and farmers' discretion. The physical features, geographical location and historical realities have made the state a hub of unique diversity and ethnic migration, and immigration to the state over the years has led to the introduction of different types of rice genetic stock. With the pressing needs to produce more, the farmers are replacing their traditional rice varieties with modern ones.

Based on the agro-climatic variation, there are three rice-growing seasons in the state, namely *Sali* or Winter (Jun/Jul-Nov/Dec); *Ahu* or Autumn (Mar/Apr-Jun/Jul); and *Boro* or Summer (Nov/Dec-May/June). The rice germplasm of Assam are classified on the basis of growing season, crop duration, land and hydrological characteristics, size, shape and aroma of seed, and endosperm characteristics. In recent times, modern photoperiod-sensitive varieties of different durations are being widely grown, and the irrigation facilities are being increasingly utilized for the rice cultivation in the state.

Best management practices of *Sali* or winter rice

Varieties: Stress Tolerant Rice Varieties (STRVs)

The high yielding long-duration varieties such as Swarna-Sub1, Ranjit-Sub1 and Bahadur-Sub1, can tolerate complete submergence for two weeks. Depending on flood-water quality, the submergence-tolerance period may vary. Turbidity of water hinders radiation to reach plants, thereby impacts the photosynthesis process in plants. BINA Dhan 11, a medium-duration submergence-tolerant rice variety could be grown in all districts of Assam including the areas having low rainfall, and under delayed post-flood sowing conditions. The varieties for different growing situations along with their brief characteristic description are listed below.



Variety	Days to maturity	Grain type	Plant height (cm)	Grain yield (t/ha)	Salient features
Swarna-Sub1	140-145	Medium bold	100	5.5-6.0	Suitable for cultivation in lowland areas. Submergence tolerance up to two weeks. However, if stagnation prolongs for more than a month over 25 cm water depths, tillering is drastically reduced.
Ranjit-Sub1	150-155	Medium slender	115	5-5.5	
Bahadur-Sub1	150-155	Medium bold	115	5-5.5	
BINA Dhan 11	115-120 days during <i>Sali</i> season, may extend to 135 days in <i>Boro</i> season	Medium slender	107-115	5.5-6.0	Suitable for medium shallow land. Submergence tolerance up to two weeks. Shorter duration may permit delayed transplanting/ sowing, and timely maturity help escaping drought.

Selection of seed

Certified seed is a prerequisite for satisfactory and quality crop production. There are a few steps to be followed before sowing/planting the seed. The certified seed purchased from the market can be used by farmers for the next two seasons by following seed production process. Seed should be certified or it should be from a reliable source. A few steps are required to maintain the quality of seed.

Seed quality

High quality seed reduces the required seeding rate and produces strong, healthy seedling, resulting in a more uniform crop with high yield. Good quality seed is:

Clean: with no stones, soil, or weed seeds.

Pure: containing seeds of one variety only

Healthy: having full big seeds of the same colour with no cracks or spots.

High quality seed can be bought as certified seed or can be produced by the farmer.

Seed cleaning

Seed cleaning should be done in salt solution, using 200g common salt/litre of water for one kg of seed. To check concentration of the solution, put a potato/egg till it floats. After that, seed should be poured into the prepared solution for cleaning. The light and diseased seeds, which float on the prepared solution, should be removed. Seeds settled at the bottom should be cleaned three times with plain water to remove the salt completely from the seed surface.

Seed treatment

The cleaned seed should be kept in water for 12-24 hours before the fungicidal treatment. Seed treatment prevents seed- and soil-borne diseases. Seed treatment is used to avoid damping off, wilt and root-rot in the seedling stage. It improves germination, vigour and productivity. Seed treatment is recommended by using fungicides, such as Carboxin @ 2.5 g/kg of seed. The treated seed should be kept for incubation for 48-72 hours.

Fungicide	Dose (g/kg seed / liter of water)	Use
Chlorothalonil 75% WP	2.0	To avoid damping off, wilt and root-rot in seedling stage
Carboxin	2.5	
Trifloxystrobin 25% WP	1.5	

Seed cleaning and treatment process



Alternatively, seed treatment can also be done using biocontrol agent *Trichoderma* spp. @ 10g/kg of seed. For this, first soak the seeds in water for 12 hours, then decant water and mix with a biocontrol agent and store as heap covered with moist gunny bag for 6-12 hours before sowing.

Safety precaution: Plastic gloves should be used while handling chemicals to avoid ill-effects on health.

Nursery raising

- **Time of sowing:** Last week of May to first week of June is the most appropriate time for raising a nursery.
- **Seed rate:** 40-45 kg per hectare
- **Nursery size:** For one hectare of the main field, nursery seedbed size should vary between 750 and 1000 m², but should not be more than 1/10th of the main field size. Land is thoroughly puddled and seedbeds of 10 m length, 15 cm height and 1.5 m breadth are prepared keeping a 60 cm gap in between the beds. The length of the bed may vary according to convenience and availability of space.
- **Irrigation:** Irrigate to maintain saturated condition in the surface soil of seedbeds. Maintain 2-3 cm standing water 2-3 days prior to uprooting.
- **Plant protection:** Adopt plant protection measures in the standing nursery as per standard package of practices (see insect-pest and disease management section below).
- **Seedling priming:** Seedling root dip treatment can be done with *Trichoderma* or *Pseudomonas* spp. @ 5-10 % to protect the seedlings from soil- and seed-borne pathogens. Alternatively, spray Thiamethoxam 25% WG @ 0.2 g/L of water in standing nursery 5-7 days before uprooting.
- **Nursery fertilizer:** Use 3-1-2 g of N-P₂O₅-K₂O + 2 kg manure per m² i.e., equivalent to 3-1-2 kg N-P₂O₅-K₂O + 2 tons manure in 1000 m² of nursery area for one-hectare main field.

When?	What?	How much? (g/m ² or kg/1000 m ²)		Application method
		Through DAP	Through SSP	
Basal (Same day as sowing)	Manure	2000	2000	Soil incorporation
	Urea	5.6	6.5	
	DAP	2.2	-	
	SSP	-	6.3	
	MOP	3.3	3.3	

Main field preparation

For preparation of the main plot, following points should be kept in mind -

- Field should be prepared thoroughly by ploughing with desi plough 4 times, followed by harrowing and laddering.
- Ploughing should be started at least 2-3 weeks ahead of transplanting so that weeds are dried up/decayed.
- Alternatively, one pass of mouldboard plough followed by one or two passes of modified helical blade puddler are sufficient for obtaining good quality puddled soil.
- The ploughing intervals should be spaced such that weeds germinated after the first round of ploughing are knocked down in the next round.
- If available, apply compost or manure uniformly prior to field preparation and mix it well with the soil.
- Repair the bunds to reduce water losses from the field during the cropping season. Level the field best by maintaining a shallow water layer in the field.
- The basal fertilizer dose is applied to the field (see fertilizer section below).

Fertilizer management

For transplanted rice, fertilizer recommendation per hectare is 60-20-40-5 kg of N-P₂O₅-K₂O-Zn. The base nitrogen dose is split into 3 equal applications - 1/3rd as basal, 1/3rd at tillering, and 1/3rd at panicle initiation stage. Under submerged condition, additional 20 kg N and 20 kg K₂O per hectare is applied 5-7 days after recession of flood to facilitate regeneration and boost recovery from flood-shock. The detailed schedule and method of applying all nutrients is given in the table below:

Stage of fertilizer application	Name of fertilizer	Fertilizer application				Application method
		(kg/ha)		(kg/bigha)		
		Through DAP	Through SSP	Through DAP	Through SSP	
Basal	Urea	23	40	3	6	Broadcast & incorporate in soil at the time of field preparation
	DAP	44	-	6	-	
	SSP	-	125	-	17	
	MOP	67	67	9	9	
	ZnSO ₄	25	25	3	3	
Active tillering after 1 st weeding	Urea	45		6		Broadcast
Panicle initiation after 2 nd weeding	Urea	45		6		Broadcast
5-7 days after recession of flood water	Urea	45		6		Broadcast
	MOP	33		4.5		Broadcast

Note

- Stop urea broadcast, in case bacterial blight symptoms appear.
- Apply ZnSO₄ in soils deficient in zinc, once in three years.
- As far as practicable, drain out standing water before fertilizer application.

Weed management

- Ploughing and harrowing in fallow field should be undertaken at least 10-14 days before sowing or just after rains.
- Good land levelling reduces weed growth because most weeds have trouble germinating under water.
- Keep standing water in field so that early-weeds cannot germinate under water.
- Use clean rice seed which is free of weed seeds.
- First hand-weeding should be done 20-25 days after transplanting.
- Second weeding at 40-45 days after transplanting would further reduce weed intensity.
- Weeding should be done before fertilizer application.

Herbicide application

Herbicides should be selected based on presence of weed flora and considering even previous weed pressure in the field.

- **Equipment:** Given their superior effectiveness, herbicides should only be applied using multi-nozzle boom fitted with flat-fan nozzles. While spraying, the new spray-swath

should always overlap 30 % of the previous spray-swath margin to ensure uniform application.

- **Pre-emergence (PE) Herbicides:** Most PE herbicides require moisture at the soil surface at the time of application. Without sufficient moisture, the PE herbicide will not be that much effective. Pre-emergence herbicides can be used by splash method in 3-5 cm standing water in the field, preferably within 0-3 days after transplanting.
- **Post-emergence (PoE) Herbicides:** PoE herbicides, if required, should be applied between 15-25 DAT when weeds attain 2-4-leaf stage. Ensure that there is no standing water in the field; however, the field should have sufficient moisture at the time of PoE application.
- **Spray volume:** Use spray volume of 500 liters/ha in all herbicide applications.

Safety measures

- Read the label prior to use to understand both the toxicity level and the safety measures required.
- Plastic gloves, goggles or face-shield, and full clothing should be worn by the person while mixing and during application of the herbicides.
- Post-application, all clothes need to be washed separately from the family laundry.

Select suitable and need based herbicide(s) from the table given below

When does it kill weeds	Chemical name	Dose (a.i., g/ha)	Type of weeds it kills		When to apply	Commercial dose (g or ml/ha)	Commercial dose (g or ml/bigha)
Pre-emergence	Pretilachlor 50% EC	750	Narrow leaf	Some broadleaf	0-3 DAT	1500 ml	200 ml
	Pyrazosulfuron Ethyl 10% WP	18.8	Narrow leaf (sedges)	Some broadleaf	0-3 DAT	187.5 ml	25 g
	Oxadiargyl 80% WP	100	Narrow leaf	Some broadleaf	0-3 DAT	125 gm	16.6 g
Post-emergence	Bispyribac- sodium 10% EC	25	Narrow leaf (grasses + sedges)	Some broadleaf	15-25 DAT	250 g	33 g
	Chlorimuron ethyl 10%WP + Metsulfuron methyl 10% WP	4 (2+2)	Broad leaf	Some sedges	15-25 DAT	20 g	3 g
	Pyrazosulfuron Ethyl 10% WP	25	Narrow leaf (sedges)	Some broadleaf	15-25 DAT	250 g	33 g

DAT= Days after transplanting.

Given below are some of the recommended herbicide combinations. Depending on weed flora, Follow application timing and doses as per above table:

- Pretilachlor (PE) fb Bispyribac-sodium (PoE)
 - Pretilachlor (PE) fb Bispyribac-sodium+ Pyrazosulfuron (PoE)
 - Pretilachlor (PE) fb Bispyribac-sodium+ Pyrazosulfuron (PoE) fb Spot hand weeding
- * fb: followed by

Water management

Water availability largely determines the potential crop yield. To continue to grow, a crop requires water supply similar to or a little above evapo-transpiration. In an efficient system, each 1 kg of rice seed produced requires a minimum of 2000 litres (2 m³) of water in the field. In the absence of rain, application of 5 cm irrigation water 3 days after disappearance of standing water is recommended in medium and heavy soils.

Insect-pest and disease management

Rice crops should be checked regularly for insect-pest and disease outbreaks. Control measures should only be applied when pest number reaches an Economic Threshold Level (ETL). Integrated Pest Management (IPM) is a sustainable approach to manage pests by combining cultural, mechanical, biological, and chemical tools in a way that minimizes economic, health and environmental risks. The IPM approach is a better approach to control pest and disease in the rice field. It is applied, if threshold level of pests are present in the field. Following plant protection measures can be adopted as per the requirement.

Table: Major insect-pests and diseases and their management

Sl. No.	Pest/disease	Treatment/control
1	Stem borer	<ul style="list-style-type: none"> • Clipping of the seedling leaf tips before transplanting, harvesting close to ground and flooding fields after harvest of the crop. • Installation of light traps and pheromone traps @ 1 trap per bigha for monitoring the pest. • Installation of bird perches @ 3 no. per bigha and removal before ripening of the crop. • Biological control – Tricho cards having <i>Trichogramma japonicum</i> should be installed @ 7000 eggs/bigha 5 to 6 times at weekly intervals starting from 30 days after transplanting. • Spray Chlorantraniliprole 0.4% G @ 10 kg/ha or Flubendiamide 20% WG @ 0.25 g/L of water or Cartap hydrochloride 50% SP @ 2 g/L of water.

Sl. No.	Pest/disease	Treatment/control
2	Leaf folder	<ul style="list-style-type: none"> • Elimination of alternate grassy weed hosts. • Avoid use of excessive nitrogenous fertilizer. • Drawing of a kerosene-soaked rope across fields to dislodge/kill the larvae. • Field release of <i>Trichogramma chilonis</i> @ 7000/bigha starting from 35 days after transplantation with 3 repetitions at fortnightly interval. • Spray Chlorantraniliprole 0.4% G @ 10 kg/ha or Flubendiamide 20% WG @ 0.25 g/L of water or Cartap hydrochloride 50% SP @ 2 g/L of water.
3	Rice gundhi bug	<ul style="list-style-type: none"> • Hanging some foul-smelling dead frog or dead poultry in the field which attracts the gundhi bug towards the foul smell and then it can be easily destroyed. • Spraying of NSKE 1500 ppm @ 3-5 ml/L of water, Neemazal 1% @ 2-3 ml/L of water.
4	Swarming caterpillar	<ul style="list-style-type: none"> • EDigging of trenches around fields to check the spread of the caterpillars. • Flooding of the field to expose the hiding larvae to the surface. • Installation of bird perches @ 3 no. per bigha. • Release of ducks into the field to feed on the larvae. • Spray Chlorantraniliprole 0.4% G @ 10 kg/ha or Flubendiamide 20% WG @ 0.25 g/L of water. Spraying is advocated only during evening hours.
5	Caseworm	<ul style="list-style-type: none"> • PPractice alternate wetting and drying method of irrigation to kill the larvae. • Spray Chlorantraniliprole 0.4% G @ 10 kg/ha or Flubendiamide 20% WG @ 0.25 g/L of water.
6	Brown spot	<ul style="list-style-type: none"> • Proper fertilization and correction of nutrient deficiencies in soil. • Spray Propineb 70% WP @ 3-4 g/L or Chlorothalonil 75% WP @ 2 g/L of water, and the spray may be repeated after 10 days
7	Blast	<ul style="list-style-type: none"> • Seed treatment with Chlorothalonil 75% WP or Tricyclazole @ 2 g/kg of seed or with biocontrol agents, <i>Trichoderma harzianum</i> or <i>T. viridae</i> @ 10 g/kg of seed or <i>Pseudomonas fluorescens</i> @ 10 g/kg of seed. • Reduced application of nitrogenous fertilizers with more number of splits. • Field should not be drained in case of disease incidence. • Spray Tricyclazole 75% WP @ 0.6 g/L or Isoprothiolane 40% EC @ 1.5 ml/ L of water.

Sl. No.	Pest/disease	Treatment/control
8	Bacterial leaf blight	<ul style="list-style-type: none"> Seed treatment by mixing 0.025% solution of Agrimycin-100 + 0.05% wettable Ceresan, and then transferring the seed to hot water at 52-55°C for 30 minutes. When the disease is noticed, stop or reduce the further application of nitrogenous fertilizers. Spray a ready-mix combination of Streptomycin sulphate 90% + Tetracycline hydrochloride 10% SP @ 100-150 ppm. Indigenous Technical Knowledge (ITK): For controlling bacterial blight in rice, prepare a slurry of 20 kg cowdung in 200 liters of water, and filter it through a gunny bag. Dilute the filtrate with 50 liters of water and allow it to settle. The filtered water is then decanted, strained & sprayed on healthy plants to check the spread of disease.
9	False smut	<ul style="list-style-type: none"> Use of good quality and disease free seeds. Spray Chlorothalonil 75 WP @ 2 g/L or Azoxystrobin 23% SC @ 1ml/L or Tebuconazole 25.9% EC @ 1 ml/L of water.
10.	Sheath blight	<ul style="list-style-type: none"> Seed treatment with <i>Trichoderma harzianum</i>/ <i>T. viridae</i> @10g/kg of seed. Spray Hexaconazole 5% @ 2ml/L. Spray Validamycin 3% L @ 3-4ml/L of water.

Best Management Practices for *Boro* (Summer Rice) and Early *Ahu*

Boro (Summer rice)

Traditionally grown during November/December-May/June, these varieties are photoperiod-insensitive, grown transplanted, traditionally in the beel and marshy land situation with minimal or no tillage. With expansion of irrigation, *Boro* rice is now grown transplanted with irrigation in diverse rice land situations. Due to low temperature stress during the vegetative phase, these varieties take longer time to mature (170-200 days).

Early *Ahu*

Grown during January/February-June/July, the varieties belonging to this group are photoperiod-insensitive, early maturing (80-130 days) and grown under variable water depth. The varieties can be sub-grouped into two categories: one grown direct-seeded (broadcast) under upland situation with natural precipitation and the other transplanted with irrigation. The direct-seeded varieties are relatively earlier in duration than the transplanted ones. In Barak Valley, the direct-seeded *Ahu* rice varieties are further classified as dumai, murali and chengri, mainly depending on duration. Varieties belonging to dumai are shortest in duration (80-90 days).

Details of varieties

Name of variety	Days to maturity	Grain type	Plant height (cm)	Yield (t/ha)	Salient features
Joymati	160-170	Medium slender	120	6.5	Long duration variety, suitable for early nursery planting in November-December
Dinanath	160-165	Medium slender	90-95	6.3	Moderately resistant to blast and sheath blight
Swarnabh	160-165	Medium slender	85-90	6.2	Resistant to blast and moderately resistant to sheath blight
Kanaklata	160-165	Medium slender	115-120	6.5	Long duration variety, suitable for early nursery planting in November-December
BINA Dhan 11	135 in <i>Boro</i> and 125-130 in Early <i>Ahu</i> season	Medium slender	107-115	5.5-6.0	Suitable for medium-shallow land, short to medium duration, suits for delayed transplanting/sowing and can help escaping drought
DRR Dhan 44	120-125	Long slender	100-105	5.0-5.5	Suitable for medium or upland, drought-tolerant

Selection of seed: Refer to seed selection process of *Sali* rice

Nursery raising

Time of sowing

***Boro* season:** November–December is the most appropriate time for raising nursery for targeting transplanting in the last week of January to the first week of February when the seedlings are at 5-6-leaf stage.

Early *Ahu* season: Second fortnight of January is the most appropriate time for raising nursery to target the transplanting by 2nd fortnight of February preferably with short to medium duration varieties, when the seedlings are at 5-6-leaf stage.

Seed rate: 40-45 kg per hectare

Nursery-bed size: For one-hectare area of the main field, the nursery size varies from 750-1000 m², but ideally it should not be more than 1/10th of the main-field size. Land is thoroughly puddled and seedbeds of 10 m length, 1.5 m breadth and 15 cm height are prepared keeping a 60 cm gap in between the beds. The length of the bed may vary according to convenience and availability of space.

Low temperature management: Low height poly-tunnel on bamboo structure (height-75 cm, width-150 cm and length as per bed size) may be used for raising seedlings during cold periods (mid-Dec to first week of Jan), for advancing transplanting.

After five days of sowing, the seed-bed should be covered with a polyethene sheet/poly tunnel to moderate the microclimate. This will help increase the temperature inside the poly-tunnel. Before transplanting in the main field, the nursery is acclimatized by retrograding to

exposure beginning from 7 days prior to transplanting, for an hour at 8.00-9.00 AM on the first day, then steadily increasing the exposure on each successive day (8.00-10.00 AM, 8.00 AM-12.00 PM, 8.00 AM-2.00 PM), and thus reaching the exposure for whole day (8.00 AM to 4.00 PM) on the 5th day, then finally keeping the nursery completely exposed for 2 days before transplanting the seedlings in the main field.

Irrigation: Apply irrigation as per the requirement to maintain saturated seed-bed. Maintain 2-3 cm standing water 2-3 days prior to uprooting.

Plant protection: Adopt plant protection measures in the standing nursery as per standard package of practices.

Seedling priming against insects: As protective measure against stem borer, gall midge and hoppers, the uprooted seedlings are washed and the root portion is dipped in the solution of Flubendiamide 20% WG @ 0.25 g/L of water or Thiamethoxam 25% WG @ 0.2 g/L of water along with 1% urea (10 g/liter of water) for 3 hours. Alternatively, spray Thiamethoxam 25% WG @ 0.2 g/L of water in the standing nursery 5-7 days before uprooting.

Nursery fertilizer: Use 3-1-2 g of $N-P_2O_5-K_2O$ + 2 kg manure per m^2 that is equivalent to 3-1-2 kg $N-P_2O_5-K_2O$ + 2 tons manure for 1000 m^2 of nursery area.

When?	What?	How much? g/ m^2 or kg/1000 m^2		Application method
		Through DAP	Through SSP	
Basal (At sowing)	Manure	2000	2000	Soil incorporation
	Urea	5.6	6.5	
	DAP	2.2	-	
	SSP	-	6.3	
	MOP	3.3	3.3	

Main field Preparation

For preparation of the main plot, the following points should be kept in mind -

- Field should be prepared thoroughly by ploughing with desi plough 4 to 5 times, followed by harrowing and laddering.
- Ploughing should be started at least 2-3 weeks ahead of transplanting so that weeds are dried up/decayed.
- Alternatively, one pass of mouldboard plough followed by one or two passes of modified helical blade puddler are sufficient for obtaining good quality puddled soil.
- The ploughing intervals should be spaced such that the weeds germinating after the first round of ploughing are ploughed up in the next round.
- If available, apply compost or manure uniformly prior to field preparation and mix it well with soil.
- Repair the bunds to reduce water losses from the field during the cropping season.
- Field should be levelled well, better maintaining a thin water layer. The basal fertilizer dose is applied to the field (see fertilizer section below).

Fertilizer management

For transplanted rice, fertilizer recommendation per hectare is 60-30-30-5 kg of N-P₂O₅-K₂O-Zn. The nitrogen dose is applied in 3 splits - 1/3rd as basal, 1/3rd at active tillering, and 1/3rd at panicle initiation. The detailed schedule and method of applying all nutrients is given in the table below:

Time of fertilizer application	Name of fertilizers	Fertilizer dose				Application Method
		(kg/ha)		(kg/bigha)		
		Through DAP	Through SSP	Through DAP	Through SSP	
Basal	Urea	18	43	2	6	Broadcast & incorporate in soil at the time of field preparation
	DAP	65	-	9	-	
	SSP	-	188	-	25	
	MOP	50	50	7	7	
	ZnSO ₄	25	25	3	3	
Active tillering, after 1 st weeding	Urea	43	43	6	6	Topdressing
Panicle initiation, after 2 nd weeding	Urea	44	44	6	6	Topdressing

Note

- Stop urea broadcast, in case bacterial blight symptoms appear.
- Apply ZnSO₄ in soils deficient in zinc, once in 3 years.
- As far as practicable, drain out standing water before fertilizer application.

Water management

During *Boro/Early Ahu* season, in the absence of rain, application of 5 cm irrigation water 3 days after disappearance of ponding water is recommended in medium and heavy soils. For saving water in the *Boro/Early Ahu* season follow Alternate Wetting and Drying (AWD) - a technique for precision management of irrigation water.

Weed management

Weeding: Keep the field weed-free especially in the early stage of the crop, as the weeds cause the most damage in the early crop stage. But the later control is also important to prevent seed setting by the weeds. First weeding is done manually or mechanically with paddy weeder or power weeder or hoe at 3 weeks after transplanting, and the second weeding is done at 6 weeks after transplanting.

Herbicide application

Equipment - Given their superior effectiveness, herbicides should only be applied using multi-nozzle booms fitted with flat-fan nozzles. While spraying, the new spray-swath should always overlap 30% of the previous spray-swath margin to ensure uniform application.

Pre-emergence (PE) herbicides - Most PE herbicides require moisture on the soil surface at the time of application. Without sufficient moisture, the PE herbicides will not be that much effective.

Pre-emergence herbicides can be sprinkled by splash method in 3-5 cm standing water in the field preferably within 0-3 days after transplanting.

Pre-emergence herbicides supplemented with one hand weeding may be more effective to take care of the germinated weeds, and the weeds emerging later in the season.

Post-emergence (PoE) herbicides - PoE herbicides, if required, should be applied 15-25 DAT when weeds attain 2-4-leaf stage. Ensure that there is no standing water in the field; however, the field should have sufficient moisture at time of PoE application. If draining out water is a problem, wait for water to subside till the weeds are exposed.

Spray volume - Use spray volume of 300 litres/ha in all herbicide applications.

Herbicide safety

Read the label prior to use to understand both the toxicity level and the safety measures required.

Plastic gloves, shoes, goggles or face-shield, and full clothing should be worn by the person while mixing and during application of the herbicides.

Post-application, all clothes need to be washed separately from the family laundry.

Select suitable and need-based herbicide(s) from the table given below

Table: Herbicides, their doses, time of application and type of weed flora they kill in paddy field

When does it kill weeds	Chemical name	Dose (a.i. g/ha)	Type of weeds it kills		When to apply	Commercial dose (g or ml/ha)	Commercial dose (g or ml/ Bigha)
Pre-emergence	Pretilachlor 50% EC	750	Narrow leaf	Some Broad leaf	0-3 DAT	1500 ml	200 ml
	Pyrazosulfuron ethyl 10% WP	18.8	Narrow leaf (sedges)	Some Broad leaf	0-3 DAT	187.5 ml	25 ml
Pre-emergence	Oxadairgy 80% WP	100	Narrow leaf	Some Broad leaf	0-3 DAT	125 g	16.6 g
Post-emergence	Bispyribac-sodium 10% EC	25	Narrow leaf (Grasses + sedges)	Some Broad leaf	15-25 DAT	250 g	33 g
	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% g/ha (Almix 20% WP),	4 (2+2)	Broad leaf	Some sedges	15-25 DAT	20 g	3 g

When does it kill weeds	Chemical name	Dose (a.i. g/ha)	Type of weeds it kills		When to apply	Commercial dose (g or ml/ha)	Commercial dose (g or ml/ Bigha)
Post-emergence	Pyrazosulfuron 10% WP	25	Narrow leaf (sedges)	Some Broad leaf	20-25 DAT	250 g	33 g

DAT= Days after transplanting.

Given below are some of the recommended herbicide-combinations. Depending on weed-flora, follow the application timing and doses as per above table:

- Pretilachlor (PE) *fb* Bispyribac-sodium (PoE)
 - Pretilachlor (PE) *fb* Bispyribac-sodium + Pyrazosulfuron (PoE)
 - Pretilachlor (PE) *fb* Bispyribac-sodium + Pyrazosulfuron (PoE) *fb* Spot hand weeding
- * *fb* - followed by

Plant protection measures: It is applied if the threshold level of pest is present in the field. Follow plant protection measures as per the state recommendations. (*Refer to plant protection measures of Sali season*)

Harvest and post-harvest

- Harvest when 80-85% of the grains attain physiological maturity i.e. visually straw-coloured.
- Minimize the time during which the harvested plants remain in the field and avoid field drying. Make sure that the panicles stay dry.
- Thresh and dry within two days after harvesting. In the absence of mechanised drying, alternatively follow sun drying on a mat or plastic sheet, keeping the thickness of the grain layer at 3 to 5 cm.
- Clean the grain thoroughly by winnowing. Store the rice in a cool, dry and clean area.

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