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## RICE CULTIVATION AND NEED OF COLD TOLERANCE BREEDING IN EAST AND NORTH EAST INDIA

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**R**ice is the important staple food crop, widely cultivated in the different season throughout the year in North East and Eastern India. Different rice growing seasons, *Aus, Aman, Boro, Ahu, Sali, Jhum* are practiced in North East and East India. Majority, the farmers grow rice for the economic sustainability by means of nature and naturally as the important farming components in farm practices and farming patterns to meet the income from the farming and contributing food grain and fodder production (Khush, 1997). Rice grain is widely used by the majority of the consumers as major food from breakfast to lunch and dinner as major dietary requirement by means, Rice, Puff rice, Panta bhat, Chira, Khoi or Pitha which is made up of rice flour or payas which is made up of aromatic raw rice grain or some special drink in the tribal communities. Rice straws are used and consumed as fresh or dry fodder for the cattle as major cattle feed in the region.

### East and North East India

Rice cultivation in the East and North East means in the state, West Bengal, Odisha, Chhattisgarh, Bihar, Assam, Sikkim, Meghalaya, Arunachal Pradesh, Nagaland, Manipur, Mizoram and Tripura. This region contributes a major contributing to the genetic and cultivation variability in practices with the present of genetic diversity from the beginning on rice cultivation history and cultural richness with rice cultivation and rituality among the rice farmers in the region (Singh, 2002).

### Rice Growing Seasons

Rice cultivated area was higher in *Kharif/Aman/Sali* followed by *Aus/Ahu* and *Boro/Summer* in the earlier days but presently drastically decreased the cultivated area under

*Aus/Ahu* segment. *Jhum* rice cultivation only practiced in the north eastern hill by the tribal farmers under *Jhum* or shifting cultivation practices.

### Impact of Cold on *Boro* Rice Cultivation

Due to advancement and adoption of better irrigation and management practices, people are growing more rice in *Boro/Summer* season on the other hand due to better yield but again presently *Boro/Summer* rice area is decreasing due to high water consumption and least management crop like corn is getting place in place of *Boro* rice in some part of the region and parallel due to more cold intensity and injury *Boro* season is gradually being shifted towards late *Boro* or early *Ahu* segment due to cold affect during winter (Pathak *et al*, 2002).

*Boro* rice growing season is the most important due to the higher crop yield in the region, but due to cold affect germination and seedling stage are getting affected and farmers are facing challenge on raising seedling. Nurseries, at low temperature night during *Boro* season, on the other hand majority of the *Boro* varieties are cold sensitive, so challenges on raising healthy seedling is too. Different rice cultivation seasons and their brief description as have been given (Table-1).

**Table 1.** Rice growing seasons and their brief description

Season	<i>Aus/Ahu/Bhad oi</i>	<i>Aman, Kharif.Sali</i>	<i>Boro/Summer Rice</i>	<i>Jhum Rice</i>
Growing Period	February-August	June-November	November-May	June-September
Harvesting	August-September	November-December	May-June	September-October
Duration of Varieties	Early	Mid-Late	Early-Mid Early	Early-Mid-Early
Duration-Days (Seed-Seed)	95-120	125-155	135-165	100-130
Type of Cultivation	Rainfed	Rainfed/Irrigated	Irrigated	Rainfed
Planting Method	Broadcasting	Broadcasting/Transplanting	Transplanting	Broadcasting
Lead Varieties	Bhadoi, Motichur, Bornhi, Moinagiri, Kala Ahu, Dhala Ahu	Ranjit, Swarna, Bhalum -3, Tulaipanji, Gobinda Bhog, Dudheswar, BB !!	IR 64, Kshitish, Satabdi, Nabeen, Ajit, MTU 1010	RCM 3, Black Rice, Cha - Khao

Cropping System	Mono cropping	Mono-Cropping	Mono-Cropping	Mixed Cropping
Land Type	Up-land	All type of land	Mid-low land	Forest Hill Terrain
Management Practices	Traditional/Low	Medium - High	High	Minimum/Natural
Major Pest and Diseases	Bird, Blast, Gandhi Bug, Brown Plant Hopper(BPH)	Blast, BLB, Stem Borer, False Smut, BLB, Brown Plant Hopper(BPH)	Blast, Stem Borer, Blast, Bacterial Leaf Blast	Blast, BPH, Gandhi Bug.
Major Abiotic Stress	Drought	Flood, Cold	Cold	Terminal Drought
Cultivation Economy	Low	High-Medium	Medium	Low
Nutritional Status of the Varieties	High	Medium-Low	Low-Medium	High-Medium
Yield Potential	Low	Medium	High	Low
Yield Potential(qt/ha)	1.5-2.5	3.5-5.5	4.5-6.0	1.5-2.0

Rice cultivation system has been evolved by means, availability of different diverse rice genotypes suitable for the cultivation in different ecology and growing season with the help cultivation practices, practiced by the growers, generation after generation and captures the knowledge. After the advancement of rice science with the dedicated effort by the researchers and passionate rice farmers, developed the different modern technology and management techniques for the better uplift- man of life of the rice farmers with the dialogue “better rice better life”.

### **Boro Rice and Cold**

The *Boro* rice season start in winter season, means while sowing started in the month of November- December, where temperature persisted very low up to 5 0<sup>C</sup> in some part of the region and in the main sowing period that is 15<sup>th</sup> November to 15<sup>th</sup> December and in the same time germination as well as seedling development affected drastically due to cold injury and farmer failed some time to raise healthy seedling which ultimate affect the crop yield as well as economic loss to the rice farmers in the region. Cold injury during winter is the one of major stress or challenge on raising a successful crop in the region for the cultivation, the *Boro* Rice in North and North Eastern India under the climate changing world (Ghosh and Dasgupta, 2021; Singh *et al*, 2012).

## **Cold and Rice Growth & Development**

Rice is preferred to grow under warmer, humid and clear sunny day or weather conditions for better performance by means of growth and development and yield. On the other hand 27-32 °C is the most ideal temperature range for its normal growth and development but low temperature (<15 °C) adversely affect the normal growth and development of rice plant. The Rice plant come under stress and indicates, its stress below 15 °C with respect to chlorophyll synthesis, content, leaf rolling, wilting due to cold, stunting growth and development as well as weight loss, release of soluble sugar, exhibiting the reactive oxygen activities, reducing the metabolic activities and Cyto-chemical changes etc. Cold adversely affect on germination, seedling and reproductive phase, rice plant growth and development.

## **Germination and Affected Due To Cold**

During germination phase, normal temperature reach to 5 °C during winter, particularly in the month and end, December by which germination adversely affected. Due to poor germination rice seed rate increase naturally and cost of cultivation increased proportionately. Germination percent reduced due to cold at the time of germination by means of ridicule, promule, root and shoot development during germination stage as well as fail to establish the seedling in field or nursery (Satya and Saha, 2011).

## **Seedling Injury Due to Cold**

Seedling development start naturally after the seed sowing, means on 15<sup>th</sup> December onwards when air and night temperature goes down up-to 5°C which is too low with respect to rice cultivation or seedling growth and development. Due to low temperature seedling growth and development affected with cold injury and some time farmers otherwise failed to raise the healthy seedling or need more seed means seed rate increased due to cold affect on seedling raised, the seedling cost to the farmers or on the other hand due to unhealthy or poor seedling growth and development or performance of the seedling which finally affect on the crop performance with respect to yield components, the crop and ultimate loss to yield and economic yield (Lal, *et al.*, 2013).

## Cold and Reproductive Stage

Cold effect adversely on the growth and development of the rice plant and reproductive phase, like germination and seedling stages. Due to cold, hampered the normal growth and development at reproductive phase during mega –spore or pollen development, whereas due to cold, develop the sterile pollen development take place in the pollen sac, which ultimate leads to sterilities and failed in fertilization and as a results non development of seed. Sterile pollen development leads to sterility and development of chaffy grain in the panicle and as results, yield loss leads to economic loss to the farmers (Das, 2015).

## Conclusion

Looking to the above strategies on the *Boro* rice cultivation in the East and North Eastern India, identification of cold tolerance cultivar and cold tolerance varieties may be adopted for the cultivation during the *Boro* season. Breeding program for the development cold tolerance in the background of cold sensitive popular high yielding varieties may be carried out looking to the need, the region with respect to cold during the *Boro* rice cultivation with better prosperities for the rice farmers, the region, East and North – Eastern India in the climate changing world for better sustainable future of the Rice farmers.

Some leading varieties for the region are IR 64, MTU 1010, Swarna, Swarn Sub -1, Ranjit, Ranjit Sub-1, Khitish, Satabdi, BB 11, BINA 11, BR 29, Tulaipanji, Dudheswar, Gobindabhog, Kalabhat, Paijam, Aijung, Bahadur, Kalo Nunia, Moinagiri, Aghoni Bora, Kamol, Kalirai, Jalkouri, Jalamagna, Jaladhi, Bhadoi, Pankaj, Tulsibhog, Joha, Bhalum 3 Ketaki Joha, etc.

Therefore, identification or screening, the rice varieties for cold tolerance to improve the cold tolerance in the *Boro* varieties are importance looking to the need of the region, East and North East India.



**Fig 1:** Cold and Rice Life Cycle.

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