



**BAO VARIETIES OF RICE ROLL OF INDIA IN
DEVELOPING RICE VARIETIES AGAINST
WATERLOGGED STRESS**

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UNIVERSITY ROLL NO: 170611610032

REG. NO: 201701010546 OF 2017-2018

B.SC GENERAL BOTANY (DISSERTATION REPORT PRESENTATION) (DSE2)

ACKNOWLEDGMENTS:

I have immense pleasure in presenting this Report presentation On bao varieties of rice roll of india in developing rice varieties against waterlogged stress.

Thank you, Dr. Pritam Chattopadhyay Sir, for give this dissertation topic.

The subject is an interesting one. It gave me an opportunity to have detailed study on the subject and showed how to thing work in the practical world.

I came to understand and analyze the importance and the role of horticulture industry.

I had a great time working on the report presentation. I have provided information to the fullest of internet, knowledge and finding own self.

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SUMMARY

Bao-dhan, a deep-water paddy that produces a particular type of iron-rich, is an integral part of Assam's food habits. The rice having a high content of iron, protein, vitamins, magnesium, phosphorus, selenium, thiamine, niacin, manganese and high in fibre.

Bao Dhaan generally grown in low, swampy lands and flood-prone areas with water stagnation beyond 50 cm height that remains for periods of 2–6 months in their growing season,

Due to poor economic conditions of the farmers along with little scope of applying the fertilizers due to water stagnation, cultivation of Bao Dhan is by default organic in nature.

INTRODUCTION:



Bao dhaan an organic and indigenous rice paddy of Assam, popularly known as red-rice or Deep-water paddy, as it is cultivated on low, swampy lands and flood prone areas.

Bao (deep water rice) grown during April/ May/ December/ January. These are mainly grown during broadcast occasionally transplanted in the low-lying areas. Adapted to deep water situations enduring water depth more than 100cm. These are sown at the time when Sail rice is harvested to take about 270 – 300 days to harvest.

Bao rice is rice in iron, protein, vitamins and other nutrients. There are several varieties of Bao rice in Assam such as Neghari-Bao, Dal-Bao, Dal-bao, Sabita, Rangi-Bao, Badal, etc.



It is generally grown in low-laying areas with water stagnation beyond 50cm for more than a month in the season. The area covered has no option to grow bao rice with very low productivity and full of risk, both abiotic and biotic. Some of the varieties grown for Bao cultivation are Negharibo, Dal-bao, Panindra and Maguribao.



Low plant population due to early inundation is the reason for the poor yield of Bao rice. Advancing the sowing season to March-April and direct seeding ensure early crop establishment and higher plant population. Agronomic practices like basal fertilizer application to tolerate submergence are to be developed and popularized. Varietal development programme should aim to incorporating both submergence tolerance and elongation ability in addition to biotic stresses like stemborer, ufra, hispa, BLB etc.

Transplanting two months old seedling of suitable variety after flood water recedes in the last week of September is another promising alternative. Local rice varieties like Hatipanjari, Banskathi, Mala, Manoharsali, Biron etc. are suitable for the purpose.

Deep-water rice (DWR) is grown in many states of India in limited areas, the main area of DWR cultivation is the Brahmaputra valley of Assam. Although rice plays a pivotal role in the socio-cultural life of the people of Assam, DWR is God's gift to Assam, which provides food and nutrition to 30 million people in a condition where other crops cannot be cultivated due to year-round stagnation of water.



The state is severely affected by floods almost every year during rainy season due to overflow of the Brahmaputra basin causing enormous damage to crops, livestock, land and properties. However, DWR rice is naturally grown in such areas, giving some economic relief to the flood-prone poor farmers.

Bao Dhaan generally grown in low, swampy lands and flood-prone areas with water stagnation beyond 50 cm height that remains for periods of 2–6 months in their growing season,

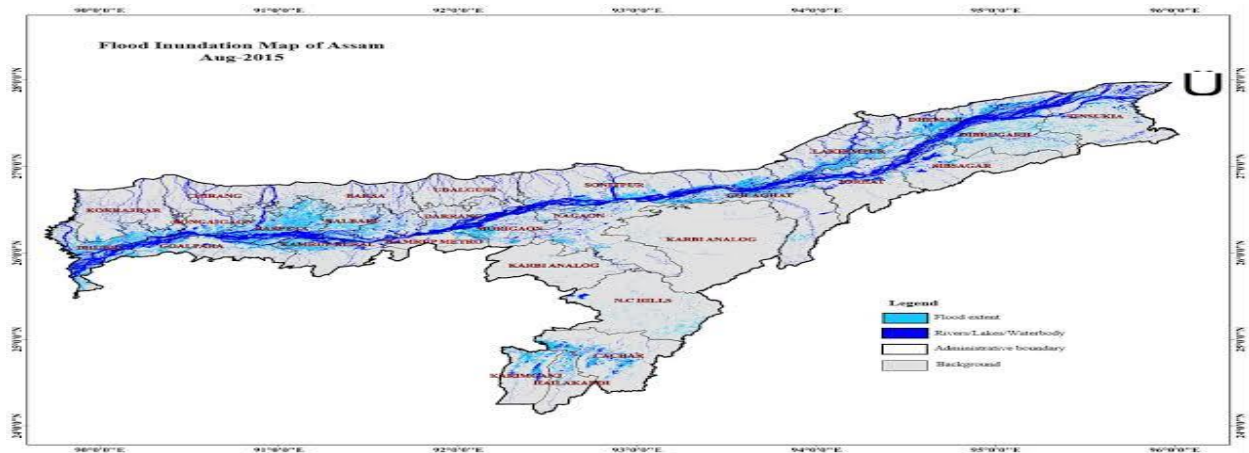
The average yield of DWR is poor, ranging from 1.5 to 2.0 t/ha, because of the fragile ecosystem that prevails right from seedling to harvesting stage of the crop

Due to poor economic conditions of the farmers along with little scope of applying the fertilizers due to water stagnation, cultivation of Bao Dhan is by default organic in nature.



Discussion

1) Geographical distribution



Apart from Assam, DWR is also cultivated in Bihar, West Bengal, Uttar Pradesh and Odisha. Most of the areas are in Dhemaji, Lakhimpur, Sibsagar, Majuli districts of Upper Assam, but some areas are also found in certain pockets of Middle and Lower Assam district, such as Kamrup, Nalbari, Barpeta, Goalpara and Morigaon. Over the years, these areas have been experiencing an increasing number of precipitations-driven flash floods and longduration floods.

2) Traits



Assam has several traditional DWR varieties; some of the popular ones are Kekowa, Amona, Negheri, Bezel, Maguri, Jul and Phuti.

- Bao Dhan being organic in nature has high nutritional value in comparison to other improved rice varieties. Besides, some DWR varieties, viz. Jul Bao and Negheri Bao possess significantly higher content of protein in comparison to other rice varieties.

- They are also considered to be nutritious, being rich in iron, zinc, vitamins, minerals and anthocyanin.
- Although DWR is tolerant to most types of biotic stress, Ufra diseases caused by a rice stem nematode (*Ditylenchus angustus*) is prominent, which causes yield loss of 30–100% depending on the severity of. Due to infection, the leaf first turns whitish and then the tips turn brown; stems become distorted above the last node.
- There is also arrest of growth and development of the ear and a severe attack leads to death of the entire plant. The incidence was first reported in Uttar Pradesh, with a crop loss of 50%, Later, it was reported in West Bengal that under severe infection up to 80% of crop loss occurred.

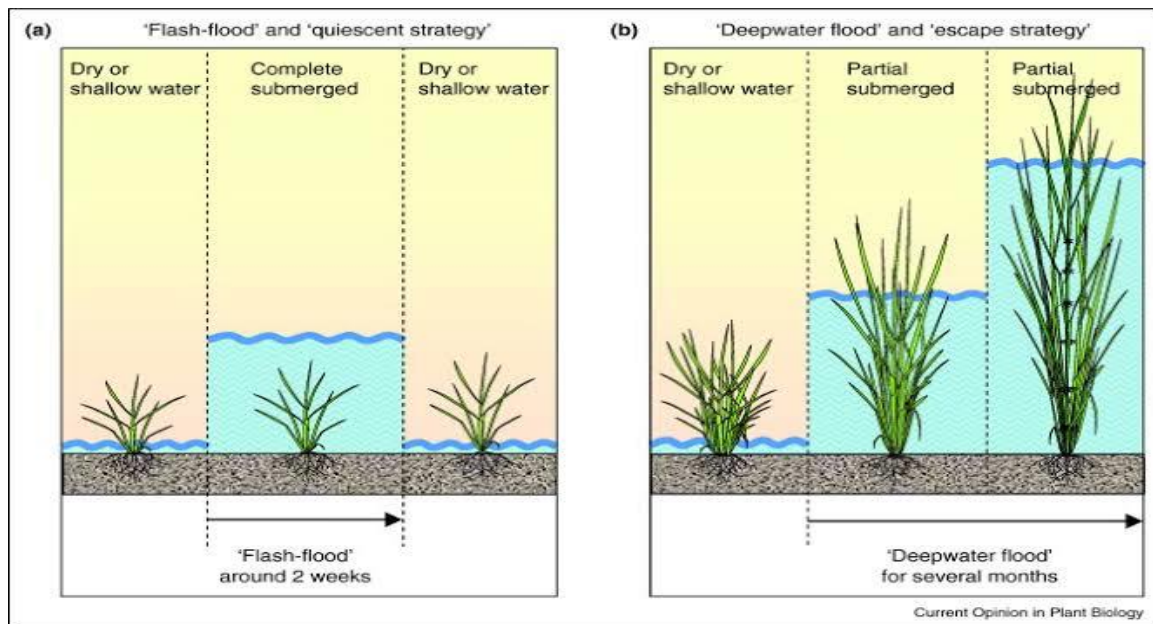


- Another important trait of DWR is the weedy competitiveness. The spreading character of tillers at the early vegetative stage can suppress weed growth, and conserve soil moisture by reducing soil evaporation, though this trait is genotype-dependent and is not present in all the Bao genotypes.

3) Botany and adaptation

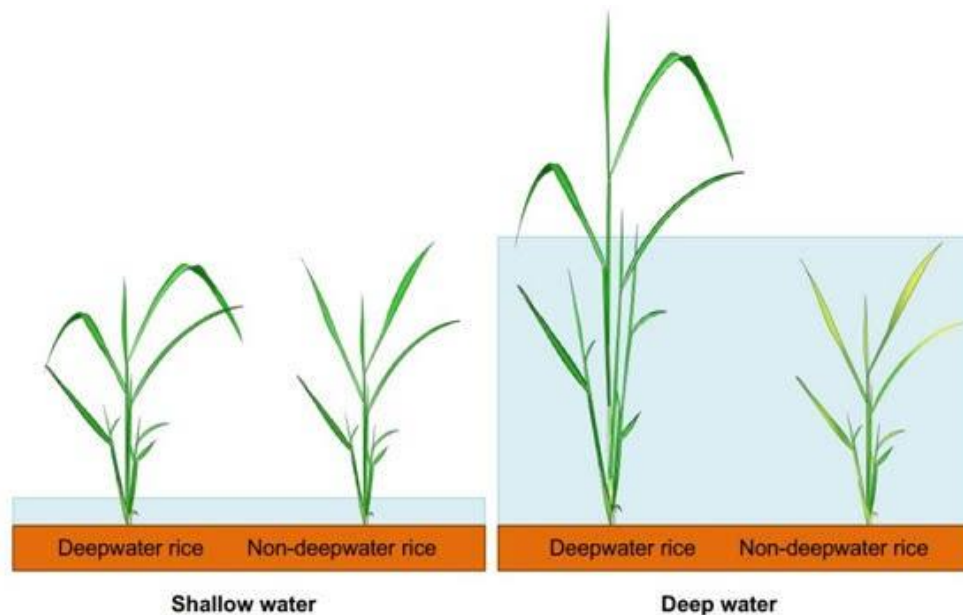
- DWR under flooding can grow up to a height of 2 m.
- Prolonged submergence during seed sowing leads to death of the seedlings.
- At early vegetative stage (4–6 weeks after germination), height of the plants increases rapidly with gradual rise in flood-water level.
- Interestingly, in late vegetative stage or in advance growth stage, elongation ability become slower indicating it is developmental stage-specific.
- Most of the DWR varieties have red kernels, which may be due to the accumulation of more anthocyanins in the aleurone layer and in the starchy endosperm as well.

- The mature seed is visible with a long awn, which is considered to be an introgressed trait from its wild progenitor.



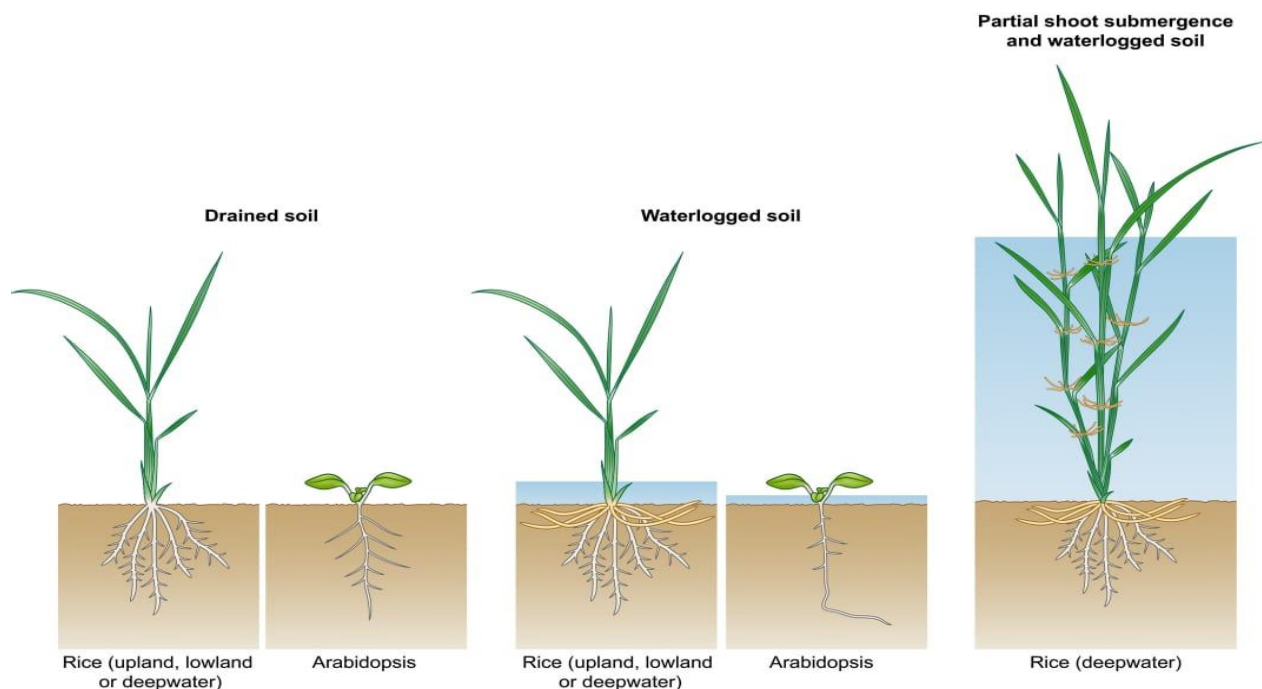
- The maximum elongation per day per plant can be as high as 25 cm; however, it depends on genotype as well as level of submergence
- The culm or stem of DWR does not grow entirely erect, rather it becomes zigzag under deep-water condition.

- When grown under such conditions, the size of air cavities in the culm increases, while diameter of the cells of cortex and thickness of phloem remain the same compared with plants that are not grown under deep-water condition.



- Plants that grown under normal water condition show rapid tillering as compared to plants grown under deep water condition though primary tiller in DWR is taller than the other tillers. Branching does not take place as the water level rises.

- Below the surface water a few nodes start forming branches when the water level stabilizes.
- Branching increases with warm water during summer months along with prolonged submergence.
- Adventitious roots first develop from the uppermost nodes below the water surface and are capable of extracting nutrients from the water.



- As the plant grows under water, the first node develops a few coarser and unbranched roots.
- Interestingly, DWR has a greater number of leaves, longer panicle and a large number of spikelet's per panicle compared to crops grown without deep water situation, indicating their hydrophilic nature.



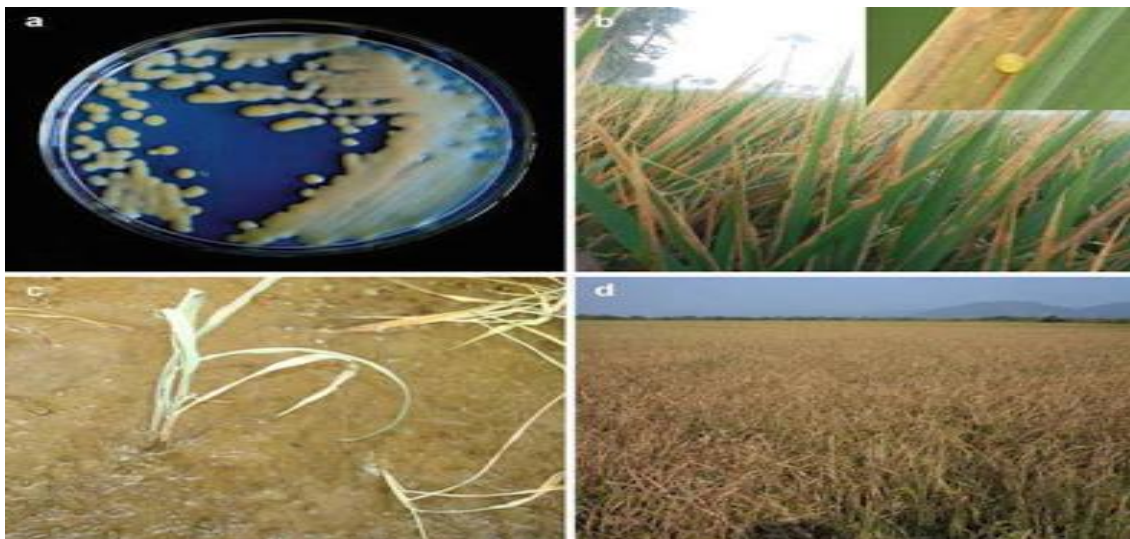
- Elongation of internodes is faster before panicle emergence than post-panicle emergence.
- In basal tillering of DWR, primary culm comes from the main culm at the base of the plant; secondary tillers originate from the primary tillers and tertiary tillers from the secondary, and so on, up to quaternary tillers.



4) Cultivation

Sowing of all DWR varieties in Assam is done during March to April, as they take more than 300 days to mature. There are many different methods of sowing in the state.

For Ahu areas, seeds of Ahu and Bao rice are mixed in the ratio 4:1 and for Bao areas, monoculture of Bao rice is recommended. Seeds are normally sown directly in the soil at 60–130 kg/ha before the rainy season.



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Some areas puddled land is also used for sowing the seeds directly. In some areas of upper Assam, seedlings grow under upland condition due to low moisture in the soil.

As a result, early seedling stage may encounter a drought-like situation in the early stage of growth. However, early submergence during seed sowing and early vegetative stage may lead to the death of plants. Harvesting is done after the flood water recedes.

Early and medium maturing varieties are usually harvested with the help of boats due to the presence of high level of water. Chemical fertilizers are not used, though some progressive farmers use neem-coated urea @ 30 kg N/ha in limited areas in two equal splits as basal and at maximum tillering stage as pesticides to control Ufra disease.

5) Marketing at commercial scale

Owing to its high nutritional value coupled with its default organic nature, Bao Dhan has seen a steady rise in demand in the international market.



For example, recently, the US-based Lotus Food Inc. has imported 70 q of DWR from Dhemaji district, Assam, through its partner company Nature Biofoods India Ltd, Haryana. The demand in the domestic market of Assam alone for DWR was 3000 q in 2012-2013, which has increased to 12,000 q recently (Dhiren Chaudhary, pers. commun). However, for a fully commercial venture, there is a need for systematic supply chain, and the involvement of more entrepreneurs for both cultivation as well as export of DWR to other parts of India and abroad.

Major beneficiaries of the increased cultivation of DWR will be the marginal farmers, who will get high returns on their investment as the demand for Bao Dhan in the market is gradually increasing

CONCLUSION

One of the major areas of concern in DWR cultivation is its low yield. This may be attributed to the fact that most varieties lacks high-yielding characters such as broad, erect, dark leaves, photoperiod insensitiveness or multiple productive tillers with heavy panicles. Unfortunately, till today there is no systematic efforts has been made to improve DWR.

Transfer of appropriate traits from high-yielding popular genotypes to traditional DWR genotypes along with the incorporation of biotic stress tolerance genes would be an appropriate option, which can be addressed using markerassisted breeding technique. Advances could lead to enhanced tolerance levels by pyramiding desirable agronomic traits to produce novel genotypes. Novel allele if

identified for various traits related to deep-water stress tolerance, will be useful for developing new varieties for flood-prone regions not only for Assam, but for the whole country as well.

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