Volume: 1, Issue: 4, October 2023

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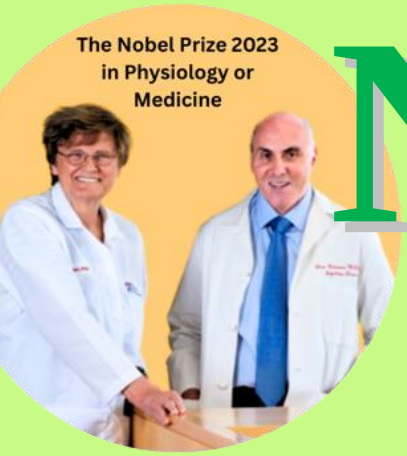

Nature Trails

M. S. Swaminathan

E-Newsletter of the Department of Botany, Dudhnoi College and
Alumni Association of Botany Department, Dudhnoi College

Nature Trails, a quarterly e-newsletter of the Department of Botany, Dudhnoi College and Alumni Association of Botany Department, Dudhnoi College
Address: Dudhnoi College, P.O: Dudhnoi, District: Goalpara, State: Assam - 783124

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Editor's Page

M.S. Swaminathan: Lifting a Nation out of Hunger

After independence in 1947, India was fighting with many of the repercussions of the British Raj – war with neighbouring countries, financial instabilities, frequent famines and low agricultural productivity. We, as today's generation, have little idea how severe the food crisis was in the country before the 1960s. Food availability was only 417 g per day per person. A country with 70% of its population dependent on agriculture had to import foodgrains to feed its people and the Prime Minister of India had to go to foreign countries with a begging bowl.

To avoid such situations, the government motivated agricultural scientists to make India self-sufficient in food grain production. One of the pioneers was Dr. M. S. Swaminathan who was working at the Indian Agricultural Research Institute (IARI) in New Delhi as a cytogeneticist.

Swaminathan collaborated with Norman Borlaug (Father of the Green Revolution and Nobel Peace laureate) for supplies of Mexican dwarf varieties of wheat and experimented with developing high-yield, good quality, and disease-free varieties for Indian conditions. As a result, high-yield varieties were developed.

Swaminathan played a crucial role in introducing high-yield varieties of wheat and rice to Indian agriculture during the 1960s and 1970s, which significantly increased food production and helped India achieve food self-sufficiency. The combination of seeds, water and fertilizer gave a boost to food grain production in the country which is generally referred to as the Green Revolution of India. The Green Revolution made India from a food-deficit country to a food-surplus country. Today, India is the largest exporter of rice and the eighth largest exporter of wheat in the world.

Swaminathan is widely regarded as the "Father of the Green Revolution in India" for his pioneering work in agricultural research and development. The legendary agricultural scientist passed away on September 28, 2023, at the age of 98 years.

mRNA Vaccine: Savior of Biggest Health Crises of Modern Times

Vaccine is considered one of the greatest inventions of all time. It has eradicated many life-threatening diseases and saved more human lives than any other medical invention in history. The history of vaccines dates back to the 10th century with the earliest hints of the practice in China. However, the first breakthrough came in 1774 by Benjamin Jesty testing his hypothesis that infection with cowpox (a mild virus) in humans could protect a person from deadly smallpox. Edward Jenner further expanded this discovery and created the world's first successful vaccine in 1796. Currently, vaccines protect against more than 20 infectious and deadly diseases. According to the WHO, vaccines save 3.5 – 5 million lives every year.

Vaccination is a technique to artificially activate the immune system to protect against infectious disease. Conventional vaccines generally contain an agent that is similar to a disease-causing microorganism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins. These types of conventional vaccines require large-scale cell culture and are resource-intensive processes which limit the possibilities for rapid vaccine production in response to outbreaks and pandemics. Therefore, researchers were trying to develop vaccine technologies independent of cell culture and the promising idea was developing a messenger RNA (mRNA) vaccine. Because, genetic information encoded in DNA is transferred to mRNA, which is used as a template for protein production.

During the 1980s, *in vitro* transcription, an efficient method for producing mRNA without cell culture was introduced, and ideas of using mRNA technologies for vaccines took off, but *in vitro* transcribed mRNA was found to be unstable and challenging to deliver. During the 1990s, Kariko and Drew Weissman (both works at the University of Pennsylvania) noticed that dendritic cells recognize *in vitro* transcribed mRNA as a foreign substance, which leads to their activation and the release of inflammatory signalling molecules. Therefore, they start working on the nucleoside base modifications and could eliminate the inflammatory response. This was a paradigm change with profound significance for using mRNA as therapy. Their findings were published in the journal *Immunity* in 2005.

Fifteen years later when the COVID-19 pandemic came, it was the Kariko and Weissman groundbreaking findings, which contributed to vaccine development at an unprecedented rate during one of the greatest threats to human health in modern times.

In 2023, Katalin Karikó and Drew Weissman were jointly awarded the Nobel Prize in Physiology or Medicine for their discoveries concerning nucleoside base modifications that enabled the development of effective mRNA vaccines against COVID-19.

~Shahadev Rabha

Oroxylum indicum (L.) Vent. : A Significant Medicinal Plant

Dr Dipali Deka
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O*roxylum indicum* (L.) Vent. is a threatened species of flowering plant belonging to the monotypic genus *Oroxylum* and the family Bignoniaceae. It is commonly called the 'Indian Trumpet tree'. This species is distributed throughout India in semi-evergreen and deciduous forests and is native to the Indian subcontinent. In the present days, it is observed that due to the heavy trade of its root bark and stem bark, the population of this medicinal plant species is falling. FRLHT (Foundation for Revitalization of Local Health Traditions) has assessed the Red List status of this species. For Karnataka, it has been assessed as 'vulnerable' for Kerala as 'Endangered', 'Data deficient' for Tamilnadu and 'Threatened' for Assam.

Oroxylum indicum is a medium-sized tree, up to 40 ft. in height, with few branches and an open crown. Its stem bark is brownish-grey, soft and corky outside. Leaves are ternately bipinnate, opposite, leaflets more or less 7.5-10.2 x 2.5-7.2 cm, broadly ovate, entire, obtuse to acuminate and glabrous. Flowers are large in long terminal lax racemes, bell-shaped, purplish yellow, peduncle stout. Calyx fleshy, scarcely toothed; corolla campanulate, tubes green outside, lobes reddish; stamens 5, all fertile; ovary compressed, ovules numerous; capsule shortly stipitate, grow 50-100cm long, brown, flat and woody, at maturity, they open along sides and split into two parts for dispersal of seeds; seeds thin, flat, surrounded by a broad white wing and size is around 4-8 x 3-6 cm.

Flowering: May-September

Fruiting: October-January

Distribution: India, Burma, Sri Lanka and S.E. Asia, available in Assam, common throughout Goalpara district along roadsides, open fields and in-house campuses.

Habit of *O. indicum*

Bark of *O. indicum*

Flowers

L.S. of a flower

Matured capsules

Matured capsule split open

Chemical constituents: Stem and root bark contains Oroxylin A ($C_{16}H_{12}O_5$), Baicalein, Oroxindin ($C_{22}H_{20}O_{11}$), Scutellarein ($C_{15}H_{10}O_6$), Tetuin ($C_{21}H_{20}O_{10}$), Tannic acid, Chrysin, β-sitosterol, Stigmasterol and Neglectein, traces of alkaloid and Galactose. Seeds contain analgesic, antimicrobial and anti-inflammatory properties.

The root bark of *Oroxylum indicum* was a traditional Chinese medicine. It is a special type of plant, which is used in several Ayurvedic preparations. A well-known Ayurvedic medicine is 'Dasamularishtam', which is available in the market in the form of fermented liquid. This Ayurvedic medicine is advised to take in the treatment of bronchial and urinary problems and to improve immunity. Dasamularishtam is a combination of roots of a total of ten herbs ('Dasa' means ten and 'Mula' means roots), the most important ingredient of which is the roots of *Oroxylum indicum.*

The root bark of *Oroxylum indicum* is reportedly used in the management of blood sugar and the treatment of rheumatic pain, diarrhoea and dysentery. Decoction of leaves is taken to cure stomachache and rheumatic pain. Paste of tender leaves is applied externally in the treatment of enlarged spleen. Flowers and tender fruits are cooked and eaten, which is believed to have curative power against indigestion.

Usage of *Oroxylum indicum* in ethnomedicine: A large number of herbs have medicinal properties and are used for therapeutic purposes. Assam, one of the seven states of North East India has a strong base in indigenous herbal formulations. The composite knowledge persisted within the tribal communities of Assam living in harmony with nature has tremendous scope to deliver the leads for modern therapeutics. The aboriginal communities of Goalpara district of Assam always prefer natural methods of treating diseases using herbs which are considered to be more reliable on one hand and most of the herbs are readily available on the other. Folklore practices have been followed especially by four major tribal communities namely Rabhas, Bodos, Garos and Hajongs inhabited in different villages of Goalpara district since time immemorial, which were recorded during a course of our ethno-medicobotanical study in 2003-05. Among the recorded ethnomedicinal plants, *Oroxylum indicum* was worth mentioning.

Local name: Bhatghila (Assamese); Kharong, Khardai (Bodo); Khiring (Garo); Naora gach (Hajong); Dingdinga, Dhalphul (Rabha).

Parts used in enthnomedicine: Stem bark, Root bark and Seeds.

Ethnomedicinal usage by four different tribes of Goalpara district:

Bodos –

i. 100 g of stem bark is ground and the extracted juice is given to take orally in the morning on an empty stomach for 3 days in the treatment of stomachache.
ii. 50 g of dry seeds are powdered and mixed with 200 ml water. 20 ml of the filtered aqueous mixture is prescribed to be taken orally twice a day for 10 days in the treatment of Malaria.

Garos and Hajongs - Juice extracted from fresh stem bark is given orally against Jaundice in a dose of 50 ml twice a day for one week.

Rabhas –

i. Stem bark (250 g) mixed with 5-6 nos. of tender leaves of *Ananas comosus* (L.) Merr. is pounded and the extracted juice is filtered. 100 ml of the filtered juice is taken orally on an empty stomach for 7 days in the treatment of Jaundice.

ii. 100 g of fresh root bark is pounded with 50 g of seeds of *Sesamum orientale* L. and the extracted juice is prescribed as laxative (in a dose of 100 ml once in an empty stomach for one week).

Fried flowers, tender fruits and tender leaves are taken as vegetables by all four tribes which were taken for study and believed to have anthelmintic, astringent, antibronchitic and digestive properties.

Reference in ancient literature: This plant species is mentioned in Yajur Veda and its various medicinal properties have been much discussed in the Samhitas such as Charaka and Susruta. Later, in the 20th century, its reference is abundant in the works of Kirtikar and Basu (1981), Jain (1991) Dam and Hajra (1981), Pandey and Rawat (1994) and many others.

The use of stem bark and root bark of the plant as an ingredient in preparing medicine for the treatment of liver trouble by the aboriginal population was observed and studied by Vedic personalities. Although almost every part of the plant is of various utility, it has been observed that it still has not gained a high status and importance.

Conclusion: It was observed during our field survey that the number i.e. population and size of this plant species were rapidly decreasing in natural habitat due to some anthropogenic activities and over-exploitation. The root and stem bark of this species has high market demand because it is used as an important ingredient in some Ayurvedic formulations like Brahma Rasayana, Chyavanprasa, Amritarista, Dasamularista etc. for which many people are involved in harvesting its stem and root bark continuously from many years. Moreover, due to different types of natural calamities like floods, storms, etc., the number of this soft wooded species has been decreasing. Thus, these facts may contribute to its presently threatened status.

Though *O. indicum* has been playing a significant role in human health care in the Goalpara district for centuries, still it is neither domesticated nor conserved efficiently. So, based on our study it may be stated that an integrated strategy should be made to conserve this species *in-situ* as well as *ex-situ*. Considering its importance in the field of traditional herbal medicines, steps for its domestication, conservation and cultivation should be urgently undertaken to satisfy market demand and to protect its wild population.

Oroxylum indicum provides high remedial effects for certain serious diseases. These remedies fulfil the needs of the four aboriginal communities inhabiting the remote areas of Goalpara district of Assam where neither medical aid nor primary healthcare facilities are available. The valuable potential of the traditional knowledge needs to be carefully evaluated on modern scientific lines and considering the decreasing population of the medicinally important but threatened plants like *Oroxylum indicum*, strategies should be made for their conservation. ■

A Survey on Aquatic Angiosperms of Urpad Beel, Goalpara District (Assam)

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Aquatic plants are the plant that has adapted to live in aquatic environments. They are also referred to as hydrophytes or macrophytes. Because of the predominance of water anaerobic conditions in wetlands have formed and to deal with the stress imposed by flooding, aquatic plants have adapted in several special ways to cope with their environment. These adaptations include pressurized gas flow, the creation of oxidized root zones anaerobic respiration etc. These adaptations allow aquatic plants to remain productive in stressful conditions, making wetlands the most productive ecosystem in the world (Whittaker & Likens, 1973). According to the mode of adaptation aquatic plants are classified into four types. These are –

1. **Emergent**: Rooted plants that stand above the surface of the water and stems are somewhat stiff or firm.
2. **Marginal:** Grow in shallow water around the margin of wetlands.
3. **Submerged:** Completely grow underwater with root attached to the substratum or without any root system.
4. **Floating:** Grow freely on the surface of water.

A wetland is an area of land that is saturated with water and provides a habitat for plants and animals. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristics of vegetation of aquatic plants adapted to unique hydric soil. Wetlands habitats serve essential functions in an ecosystem including acting water filters, providing flood and erosion control and furnishing food and home for fish and wildlife and it also provides aesthetic value. Ramsar Convention of Wetlands 1971, defined a wetland as an "Area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including the area of marine water, the depth of which at low tide does not exceed 6 meters". According to Westlake and Pratt 2006, the Wetlands are an area of land that is either temporarily or permanently covered by water. This means that a wetland is neither truly aquatic nor terrestrial. Wetlands exhibit enormous diversity according to their geographical location, water regime, Chemistry, dominant plants and soil and sediment characteristics.

According to the National Wetland Atlas, 2019, Wetlands are classified into the following types –

1. Inland wetlands:

A. Natural Lakes: (a) Lakes, (b) Ox-bow lakes/cut–meanders, (c) high altitude wetlands, (d) Riverine wetlands, (e) Waterlogged and (f) River/stream.
B. Man-made Lakes: (a) Reservoirs / Barrages, (b) Tanks/ Ponds, (c) waterlogged and (d) Salt pans.

2. Coastal wetlands:

A. Natural Lakes: (a) Lagoons, (b) Creeks, (c) Sand/ Beach, (d) Intertidal mud flats, (e) Salt marsh, (f) Mangroves and (g) Coral Reefs.
B. Man-made Lakes: (a) Salt pans, (b) Aquaculture ponds.

Study Area:

In the state of Assam, a total of 5097 wetlands and 6081 small wetlands have been identified which encompasses 764372 hectares which is around 9.74% of the total geographical area of the state. The wetland occupies as high as 21.43 % of the geographical area in the Dibrugarh District and as low as 1.35% in the North Cachar Hills District. In terms of total area, Sonitpour is the leading district (83427 hectares, 10.19%) and Hilakandi is the least (2600

hectares, 0.34%). Goalpara district occupies 1824 sq. Km, 18.21 % geographical area and 33221 hectares, 4.35% of the total wetland area.

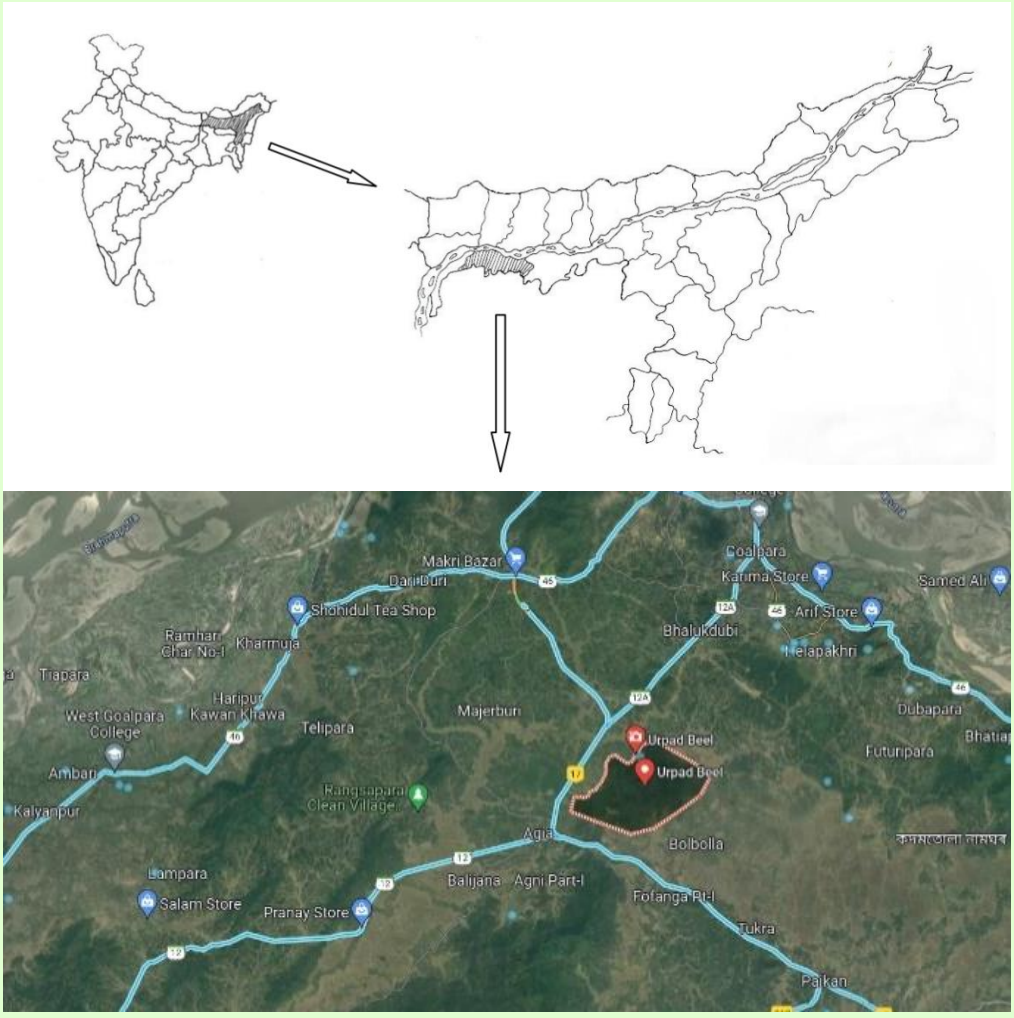

Fig: Location map of Urpad Beel, Goalpara district, Assam

Urpad Beel is located between 25°282 to 26°152 N latitude and 89°422 to 90°152 E longitudes south of the Brahmaputra river of Goalpara district, Assam. The total area covered by the Urpad beel is about 649.38 hectares (Deka and Das, 2020). It is considered one of the largest lakes in Lower Assam. The lake has many natural resources, which makes livelihood easier for several people in the area. Several aquatic plants such as the water lily, water hyacinths etc. also abound in this lake, thus enhancing its aesthetic appeal to the viewer. The lake is also very rich in Birds diversity, large number of migratory birds come to the lake each year.

Table: List of aquatic plants observed in Urpad Beel, Goalpara district, Assam.

SN	Scientific name	Family
1	*Centipeda minima* (L.) A. Braun & Asch.	Asteraceae
2	*Cyperus rotundus* L.	Cyperaceae
3	*Eleocharis congesta* D.Don.	Cyperaceae
4	*Enhydra fluctuans* Lour.	Asteraceae

5	*Grangea maderaspatana* (L.) Poir.	Asteraceae
6	*Hydrilla verticillata* (L.f.) Royle.	Hydrocharitaceae
6	*Hydrolea zeylanica* (L.) Vahl.	Hydroleaceae
7	*Hygroryza aristata* (Retz.) Nees ex Wight & Arn.	Poaceae
8	*Ipomea carnea* Jacq.	Convolvulaceae
9	*Torenia crustacea* (L.) Cham. & Schltdl.	Linderniaceae
10	*Lindernia rotundifolia* (L.) Alston.	Linderniaceae
11	*Ludwigia adscendens* (L.) H.Hara.	Onagraceae
12	*Ludwigia octovalvis* (Jacq.) P.H.Raven.	Onagraceae
13	*Limnophila repens* (Benth.) Benth.	Plantaginaceae
14	*Najas indica* (Willd.) Cham.	Hydrocharitaceae
15	*Nymphea rubra* Roxb. ex Andrews.	Nymphaeaceae
16	*Nymphoides cristata* (Roxburgh) Kuntze.	Menyanthaceae
17	*Nymphoides indica* (L.) Kuntze.	Menyanthaceae
18	*Utricularia aurea* Lour.	Lentibulariaceae
19	*Oenanthe javanica* (Blume) DC.	Apiaceae
20	*Ottelia alismoides* (L.) Pers.	Hydrocharitaceae
21	*Persicaria glabra* (Willd) M.Gomez.	Polygonaceae
22	*Pontederia crassipes* Mart.	Pontederiaceae
23	*Pontederia hastata* L.	Pontederiaceae
24	*Potamogeton crispus* L.	Potamogetonaceae
25	*Potamogeton nodosus* Poir.	Potamogetonaceae
26	*Rotala rotundifolia* (Buch. Ham. ex Roxb.) Koehne.	Lytharaceae
27	*Sagittaria sagittifolia* L.	Alismataceae
28	*Trapa natans* L.	Lythraceae
29	*Vallisneria spiralis* L.	Hydrocharitaceae

Fig: A view of Urpad Beel, Goalpara district, Assam

During the present survey, 29 aquatic angiosperms belonging to 26 genera and 19 families have been recorded and it was observed that Urpad beel acts as a source of livelihood for the people living in the vicinities. They collect various resources from the lake such as vegetables, medicine, fodder, fish, water for irrigation etc. However due to various anthropogenic and natural pressures like eutrophication, flood, construction of house, and cultivation during the winter season, the development of commercial fisheries in the wetland directly influence the floral diversity as well as faunal diversity of the wetlands. Based on the study it can be concluded that Urpad beel of Goalpara district is quite rich in aquatic angiosperms. It shows great diversity due to the presence of water in wetlands throughout the year which promote the luxurious growth of various aquatic plants. The Urpad beel has a

luxurious growth of aquatic plants. The area is not only rich in floral diversity but also rich in faunal diversity. Several bird species such as *Rallus indicus*, *Leptoptilos javonicus*, *Bubulcus ibis*, etc. are also found in the wetland. Therefore, Urpad beel is an important ecosystem in the area that houses good and diversified flora and associated fauna and needs to be protected by special agencies for its important services to the environment including local human residents.

Fig: A. *Nymphaea rubra*, B. *Nymphoides indica*, C. *Sagittaria sagittifolia*, D. *Utricularia aurea*, E. *Nymphoides cristata*, F. *Ludwigia octovalvis*, G. *Torenia crustacea*, H. *Hydrolea zeylanica*, I. *Enhydra fluctuans*, J. *Ottelia alismoides*, K. *Rotala rotundifolia* L. *Potamogeton crispus*

References

1. Whittaker, R. H., & Likens, G. E. (1973). Primary production: the biosphere and man. Human Ecology, 1, 357-369.
2. Deka, P., & Das, R. (2020). Geo-ecological studies on the diversity of macro flora in Urpad beel, Goalpara district, Assam. Plant Arch, 20(2), 3499-3502.
3. Kanjilal, U.N., Kanjilal, P.C., De, R.N. and Das, A. 1934. Flora of Assam, Vol-I. Part-I, Govt. of Assam Press, Shillong.
4. Kanjilal, U.N., Kanjilal, P.C., De, R.N. and Das, A. 1934. Flora of Assam, Vol-II, Govt. of Assam Press, Shillong.
5. Kanjilal, U.N., Kanjilal, P.C., De, R.N. and Das, A. 1934. Flora of Assam, Vol-III, Govt. of Assam Press, Shillong.
6. Kanjilal, U.N., Kanjilal, P.C., De, R.N. and Das, A. 1934. Flora of Assam, Vol-IV, Govt. of Assam Press, Shillong.
7. Kanjilal, U.N., Kanjilal, P.C., De, R.N. and Das, A. 1936. Flora of Assam, Vol-I. Part-II, Govt. of Assam Press, Shillong
8. https://powo.science.kew.org/
9. https://wfoplantlist.org/plant-list.

Nature Trails, Volume: 1, Issue: 4, October 2023

Enhanced Diazotrophs- A Potential Alternative to Fertilizers

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Nitrogen is a crucial nutrient for plants. Despite making up around 78% of the Earth's atmosphere, N_2 is not readily available to plants, and in agricultural systems, N is frequently a limited nutrient. Diazotrophs are organisms such as bacteria and archaea that can convert dinitrogen (N_2) in the atmosphere into ammonium. For almost a century, plant-diazotroph interactions have been studied as a nitrogen (N) source for crops to boost agricultural production and sustainability.

In industries N fertilizers are largely created by a process, often known as the Haber-Bosch method, utilizing energy from natural gas. These synthetic fertilizers have been used extensively in agriculture since the beginning of the Green Revolution to overcome the N constraint.

However, growing crops with synthetic fertilizers are very expensive, especially in developing nations. Additionally, problems like the eutrophication of rivers, degradation of coastal areas and emissions of greenhouse gases arise as a result of their extensive use. Therefore, low-cost, environmentally friendly fertilizers are desired over synthetic ones.

Diazotrophs utilize ATP as an energy source and the nitrogenase enzyme complex as part of biological N fixation. The nitrogenase enzyme, however, is hindered by oxygen and needs a lot of ATP for it to function. Numerous diazotrophs exist in the soil, some interact with plants to extract carbon from photosynthesis. In some cases, the plant may even provide a low-oxygen environment that shields the nitrogenase enzyme from oxygen in the form of root nodule symbioses, particularly rhizobium–legume associations. Numerous diazotrophs can supply host plants with considerable amounts of nitrogen in exchange for such symbiotic associations. These symbiotic relationships result in the formation of new organs, the root nodules, which provide a suitable environment for N fixation and in which plant cells are infected intracellularly by alpha- or beta-proteobacteria known as rhizobia or Frankia actinobacteria. However, only a few plants in the monophyletic "N-fixing" clade, such as the Fabale, Fagale, Cucurbitale, and Rosale (FaFaCuRo) plant families, exhibit these connections. Agriculture continues to face difficulty about how to improve nitrogen fixation in non-legume crops.

Numerous strategies are being investigated to maximise the economic and environmental advantages of biological N fixation on crops, particularly cereals, which need substantial N inputs to produce their highest yields. These strategies include expressing the nitrogenase enzyme in plant organelles, engineering root nodule symbioses in plants other than the N-fixing clade, examining plant natural diversity to identify better host genotypes for diazotrophs, and engineering plants to secrete specific metabolites that can enhance specific diazotrophs in the rhizosphere.

Out of all these strategies, a group of scientists addressed the most promising use of genetic engineering to promote mutualistic interactions between plants and diazotrophs, by imitating the mutualisms between legumes and nitrogen-fixing bacteria, these artificial partnerships might assist crops in absorbing nitrogen from the atmosphere.

The strategy would rely on natural; bi-directional signalling that already takes place between plants and microorganisms. Chemoreceptors in microbes enable them to sense the metabolites that plants emit into the soil, whereas chemoreceptors in plants enable them to sense the molecular patterns and plant hormones that are connected with microbes. To improve communication between pairs of designed plants and microorganisms, these signalling pathways could be altered genetically.

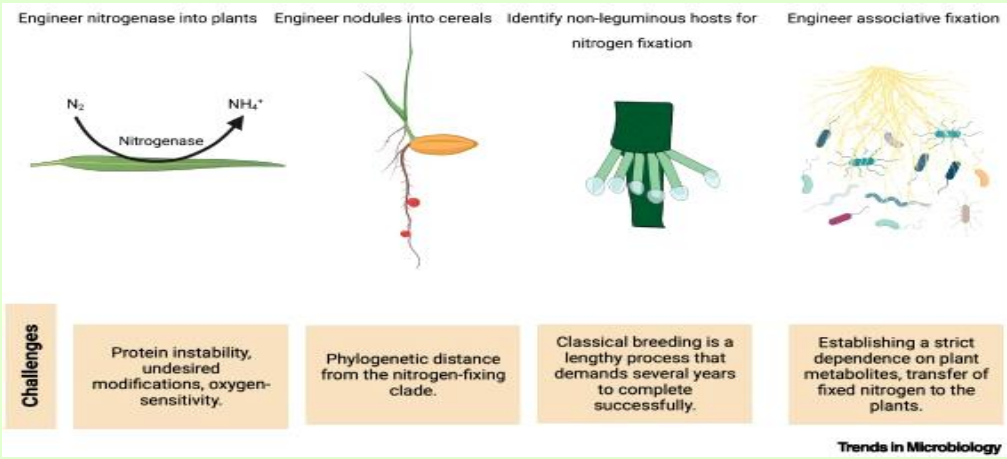

Fig: Strategies to enhance biological nitrogen (N) fixation in non-leguminous crops and their challenges

Some associative diazotrophs can dwell inside plant tissues as entophytes, while others can also grow as epiphytes on plant surfaces. Endophytic bacteria react to plant exudates more strongly than other rhizosphere-dwelling bacteria. *Azospirillum brasilense*, *Azoarcus* sp. strain BH72, and H. seropedicae are three examples of organisms that connect with plant roots and express nif genes. Plants interacting with the wild-type strain of *Azoarcus* sp. strain BH72 produced greater growth and higher N accumulation than the mutant, which lacked the nitrogenase enzyme, according to a comparison between the two strains.

The nitrogenase activator (nifA) and the important negative regulator of nitrogenase biosynthesis (nifL) are located in an operon in some gamma-proteobacteria. Therefore, replacing the nifL gene with a constitutive promoter is one method frequently used to improve N fixation. This genetic modification eliminates the nitrogenase negative regulator, increasing the amount of nitrogenase activator in N-rich conditions.

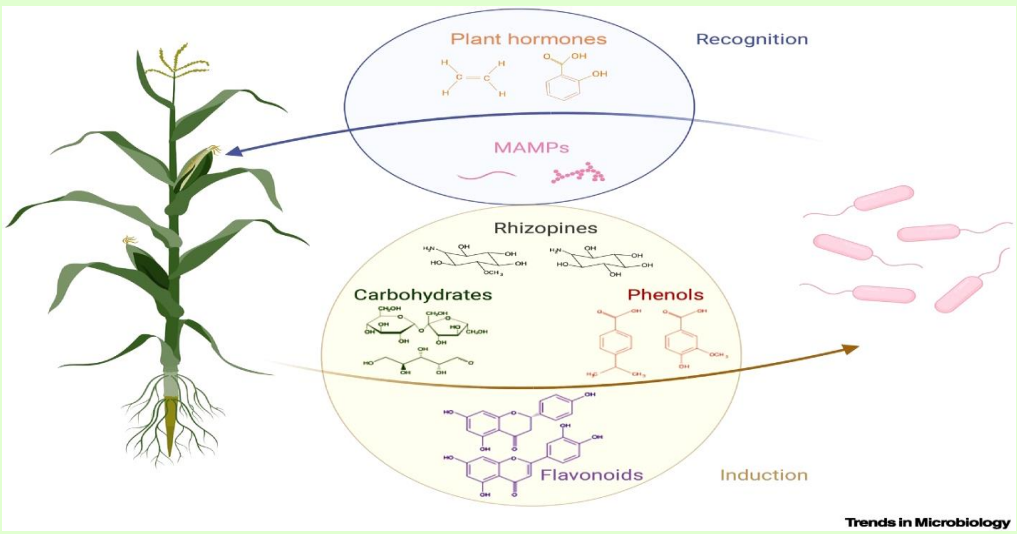

Fig: Common chemical signalling mechanisms used for synthetic associations between bacteria with engineered crops

In Gram-positive bacteria, models for N-fixing regulation have also been established. For instance, in the genus *Paenibacillus*, glnR activates N fixing when N is scarce. The

feedback-inhibited conformation of glutamine synthetase inhibits glnR from stopping the transcription of nif genes in N-rich circumstances. However, overproduction of alanine, which inhibits glutamine synthetase and mimics the intracellular milieu of N-starved conditions, can be used to increase fixation under N-rich conditions in some species of *Paenibacillus.*

Future research should concentrate on the capacity to stack advantageous features in the same microenvironment once specificity in engineered diazotroph-crop interactions has been attained.

Engineering associative diazotrophs to supply N to crops is a promising and comparatively fast realizable answer to the high cost and sustainability difficulties associated with synthetic N fertilizers. Along with being diazotrophs, several of these bacteria can help plants in many ways, including by promoting plant development and enhancing their resilience to stress. However, it is difficult to test these genetically modified bacteria in the wild due to the presence of various constraints.

Reference:

1. Chakraborty et al., Scripting a new dialogue between diazotrophs and crops, Trends in Microbiology (2023). DOI: 10.1016/j.tim.2023.08.00. ■

RECENT FINDINGS

Threat of Invasive Plant Species

Invasive plant species are non-native plants that have been introduced to a new ecosystem and have the ability to spread rapidly and outcompete native vegetation. These plants can cause harm to the environment, economy, or human health. Invasive plants often disrupt the balance of native ecosystems by outcompeting native species, altering habitats, increasing fire Risk, and disrupting food webs.

A recent study reports that about 66% of India's natural ecosystem is threatened by invasive plant species and the loss due to this biological invasion may cost up to $182 billion to the Indian economy.

Some of the high-concern invasive plant species reported in the study are *Lantana camara*, *Prosopis juliflora*, *Chromolaena odorata*, *Senna tora*, *Xanthium strumarium*, *Mesosphaerum suaveolens*, *Mikania micrantha* and *Ageratina adenophora*.

The report says that human modifications, shifting soil moisture regimes, historical propagation of invasive plants and altered cycles of natural disturbances are the main driving factors behind the invasions.

Healing Properties of a Neglected Weed of Goalpara District, Assam

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Alumna, Dept. of Botany, Dudhnoi College, Batch 2020-2023

Assam one of the seven states of North-East India is having rich diversity of medicinal plants. A large number of herbs have medicinal value and are also used for the treatment of different kinds of diseases. Most people use various plants as a source of medicine for healing some common illnesses.

In the Goalpara district, people always prefer natural methods of treating diseases using herbs. Nowadays, it is observed that a large number of roadside plants are cut down, for making highways and other constructive works, as a result of which many medicinal plants are destroyed. Any wild plant that grows in an unwanted place is called a "weed". Constructive works related to urbanization may have a very harmful impact on these weeds, which may be a cause of their endangered status soon. There are many weeds which have medicinal properties to cure different kinds of diseases. Among these weeds, *Chromolaena odorata* L. is one of the most important plants to cure different kinds of diseases.

Chromolaena odorata L. is a rapidly growing flowering shrub. It belongs to the Asteraceae family. Chromolaena odorata L. is known as Jarmany Bon in Assamese, Khonkhomari or Sam-ganri in Rabha and Bangi lewa in Bodo. *Chromolaena odorata* L. is a tall, perennial shrub, which grows up to 2.5-10 m in height. The stems are aerial, erect, cylindrical, branched and herbaceous. The leaves are opposite and aromatic when crushed, 4-10 cm long and 1-5 cm wide. The leaf petioles are 1-4 cm long. The plant is profusely branched, hairy and glandular. The inflorescence is compound capitulum, homozygous, only disc floret present. Flowers are white or pale pink. The white to pale pink tubular flowers are in panicles of 10-35 flowers that form at the ends of branches. The seeds are achenes and hairy. They are mostly dispersed by wind. Seeds need light to germinate. The plant can also regenerate from the roots. In favourable conditions, the plant can grow more than 3 cm per day.

Fig: *Chromolaena odorata* plant and flower

Chromolaena odorata L. is an important wild medicinal plant. It is largely used in the treatment of many diseases such as wounds, skin infections, burns, diabetes, malaria, fever, inflammation, stomach problems etc. There are many health benefits of *Chromolaena odorata* L. leaves. The fresh leaves are used for cuts or wounds which drastically reduce bleeding. The leaves of *Chromolaena odorata* L. are also used in the treatment of cysts, body pain, uric acid, vertigo, ulcers, cough etc. For malaria treatment, the leaves of *Chromolaena odorata* L. ingredient with lemon grass and guava leaves are used traditionally. Cervical cancer is one of the diseases that is very dangerous for women. The roots of *Chromolaena odorata* L. are used traditionally in the treatment of cervical cancer. The leaves are also used to decrease blood pressure and to decrease cholesterol. Dried leaves are also used as mosquito repellant. It is used as an antimicrobial agent against *Bacillus cereus* and as an antifungal agent against *Aspergillus niger*. Secondary metabolites identified in *Chromolaena odorata* L. are alkaloids, flavonoids, tannins, saponins and steroids. The other uses of the leaves of *Chromolaena odorata* L. are green manure and insecticide. The dried stem of *Chromolaena odorata* L. is also used as fuel.

There are some side effects of *Chromolaena odorata* L., such as it contains carcinogenic pyrrolizidine alkaloids. This can cause liver toxicity and cancer. Pyrrolizidine alkaloids are the responsible agent for liver injury. However, aboriginal people of Assam including Goalpara district have been using this plant species to cure different kinds of ailments, since time immemorial.

It has been observed that many medicinal plants are destroyed to fulfil human needs due to a lack of knowledge about the medicinal value of these plants. Thus there is a need for in situ conservation of the weedy medicinal plants like *Chromolaena odorata* L. for the benefit of the future generation.

RECENT FINDINGS

World's Most Popular Banana Variety and Panama Disease

The Cavendish banana, the world's most popular banana variety eaten by 47% of the human population worldwide, is under the attack by a fungus called Panama disease (*Fusarium wilt*) tropical race 4 (TR4).

The study reports that The Cavendish banana could go extinct because of the fungal attack.

The TR4 fungus was first discovered in 1989 in Taiwan and has spread to leading banana producing countries such as China and parts of Africa and Middle East, as well.

Traditional Uses of *Nyctanthes arbor-tristis*: A Holy Plant Species

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N*yctanthes arbor-tristis* Linn is known as 'Night Jasmine' in English, 'Xewali phool' in Assamese, 'Shiuli' in Bengali, 'Parijatam' in Telegu, and 'Ganga shiuli' in Odisha and many other names in other states of India. It is a member of the family Oleaceae which is available in Goalpara district, Assam. This plant species is a shrub or a small tree attains a maximum height of 10 meters. It has rough, tetragonal and scabrous spreading branches. The leaves are shortly petiolate, decussately opposite and ovate which are cuneate to subcordate at the base and acute or accuminate at the apex. The leaf margin is entire when young and dentate when matured, scabrous above with bulbous-based hairs and pubescent beneath.

The flowers of this species start blooming in the autumn season between August to December. Autumn is the time in India when Hindus celebrate the Durga Puja. So when the blooming starts religious people of India come to know that Durga Puja is almost at their doorstep. Along with other flowers, the loose flowers of *Nyctanthes* are used as offerings to God. As soon as the light of down falls, it also falls forming a white-orange carpet on the dewy grass of the morning. Night Jasmine is a 'symbol flower' of Saradiya Puja or worship of the Hindu Goddess Durga in autumn, who is known as the mother of the universe. Durga Puja festival marks the victory of 'good' over 'evil' and flowers play a significant role in this celebration. The delicate white flowers of *Nyctanthes* are considered as a symbol of sacredness, pleasure and purity and it is believed that its fragrance attracts Goddess Durga and gives her positive energy.

From the orange-coloured corolla tube, a natural dye (fabric) is obtained by the aboriginal people of the remote areas of Goalpara district, Assam. Special kinds of fragrances are also made from *Nyctanthes* flowers which are used in making perfumes and incense sticks.

It is the official 'State Flower' of West Bengal. Beautiful fresh flowers of this species have various ways of cooking in Assamese traditional dishes. Starting from making curries people use its dried flowers as a flavouring agent. An ideal winter meal known as 'Teeta Bhat' prepared by frying the fresh flowers of *Nyctanthes* with boiled rice is popular with all aboriginal communities of Goalpara district. Rabha people of Goalpara district intake fresh and dried flowers making pakoras. Tender leaves are also consumed making pakoras as well as fish curries with herbal alkali (Khar) which is believed to be a good appetizer.

This shrub can be propagated by seeds as well as by cuttings. It is widely cultivated in tropical and subtropical regions all over the world.

There are numerous health advantages associated with both the flowers and tender shoots of this species. It holds a strong place in some Ayurvedic preparations, which have been used for the treatment of various diseases since ancient times. It is a traditional remedy for treating a wide range of gastrointestinal disorders like diarrhoea, indigestion and stomach pain. Village people use its leaves as medicine against fever. Dried fruits are grinded to make a smooth powder which is given to take orally to get relief from cough. Decoction prepared from dried flowers is prescribed for fertility problems in women. Tender leaves are boiled and the juice extracted by pounding these boiled leaves is taken orally to cure Malaria. It is believed by the aboriginal communities of Goalpara district that the oral intake of tender leaf juice of this plant has anthelmintic properties i.e. it can expel worms. A smooth paste of fresh fruits is applied to the skull to promote hair growth.

The leaves of *Nyctanthes* contain fructose, glucose, carotene etc. The bark of this plant is useful due to its alkaloids and glycoside content.

Fig: *Nyctanthes* tree and flower

Nyctanthes have been considered a holy tree of India since the time of Lord Krishna. So, it is planted as an ornamental plant near temples as well as in gardens. According to Hindu belief, *Nyctanthes* tree was planted by Lord Indra in heaven which was later brought to Earth by Lord Krishna. The flowers of this plant species are regarded as the Jewel of God in India. Therefore religious people of India have been using its flowers white worshiping different deities in different states since time immemorial.

Fun Fact

Did You Know?

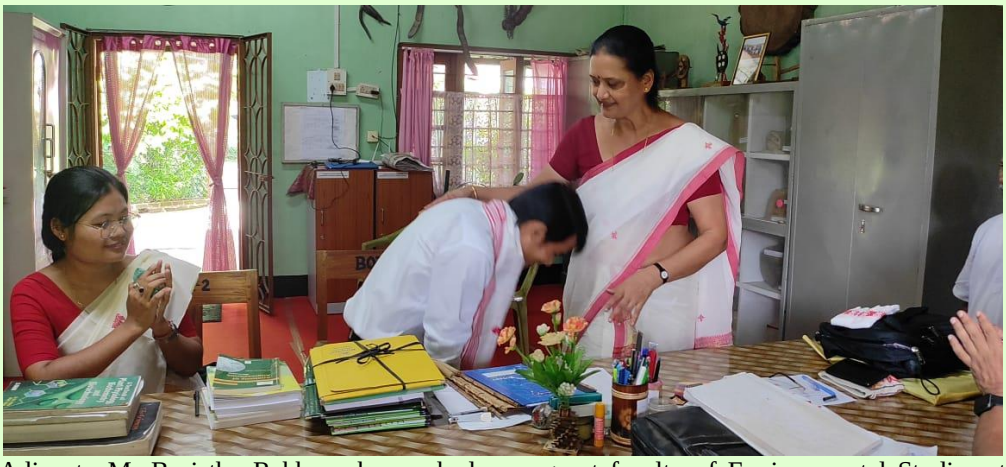
The *Armillaria ostoyae*, or "honey fungus," is considered the largest living organism on Earth. It's a fungal organism that stretches over 2,385 acres in Oregon's Malheur National Forest.

Photo Story

1.

Celebration of Teachers Day 2023 at the Department and unveiling of "Plantarum", the wall magazine of the Botany Department, Dudhnoi College on the auspicious occasion of Teachers Day.

2.



Adieu to Mr Basistha Rabha, who worked as a guest faculty of Environmental Studies at Dudhnoi College. Farewell ceremony was held on 29th Sept. 2023.

3.





Mushroom cultivation practical cum training to the B.Sc. first Semester students who have taken Mushroom Cultivation Technology as Skill Enhancement Course. The training was provided by the HoD and faculty members of Botany Department, Dudhnoi College in October 2023.

4.

Felicitation to Ms Jimari Sontok, guest faculty of Botany Department on her successful completion of B.Ed degree. Felicitation ceremony was held on 16th Oct. 2023.

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