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Nature Trails

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
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Celebrating One Year of Nature Trails

As we joyously mark the completion of one year of our cherished newsletter, Nature Trails, an initiative of the alumni association of Botany Department and published by the Botany Department of Dudhnoi College, it is a momentous occasion that calls for reflection and celebration. Over the past 12 months, Nature Trails has become a beacon of knowledge within our academic community of Dudhnoi College and others also, weaving together the diverse tapestry of living world and scientific inquiry.

From its inception, the aim of Nature Trails has been to bridge the gap between the academic realm and the broader community, fostering a deep appreciation for the natural world around us. We have strived to make each edition a testament to the incredible biodiversity that surrounds us and to highlight the research and initiatives within our very own Botany Department.

The journey of Nature Trails has been one of continuous growth and evolution. In its pages, we have delved into the intricacies of local ecology, environment, and Ethnobotany. Our writers and contributors have worked diligently to bring forth content that not only educates but also instills a sense of wonder and curiosity about the living world.

We express our heartfelt gratitude to our readership, whose enthusiasm and support have been the driving force behind the success of Nature Trails. Your feedback and engagement have been invaluable to continually improve and deliver content that resonates with your interests and passions.

Looking ahead, Nature Trails will continue to be a platform for showcasing the research, noteworthy achievements, and the inherent beauty of the living world.

As we raise our glasses to toast the completion of this first year, we extend our sincere thanks to the Botany Department faculty especially Dr Dipali Deka (HoD) for her continuos support and guidence and all the contributors who have played a pivotal role in making Nature Trails a resounding success. The journey thus far has been enriching, and we eagerly anticipate the years ahead as we continue our exploration of the wonders of nature through the pages of our beloved newsletter.

Warm Regards
Shahadev Rabha

Traditional Systems of Medicine in India: An Overview

Dr Dipali Deka
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The transmission of customs or beliefs related to the past from generation to generation that are commonly accepted as historical though not variable, is termed tradition. In other words, tradition may also be defined as a customary pattern of thought, which is inherited and established. Again, the term 'folk' refers to a group of people forming a tribe, nation, a certain kind or specified class of people. They also may be defined as simple, unaffected, unsophisticated or open-hearted people. In other words, the term 'folk' refers to any group of people, who usually share a common factor. The factor may be a common language or religion or some own traditions which help the group in having a sense of group identity. Thus, folk may be a group, which could be as large as a nation or as small as a family (Dundles, 1978).

Like any other country, religion, morality and medicine have been co-existing together in India also since time immemorial till date. Different methods of therapies are strongly based on empirical knowledge gained from wide and varied experiences, intuitions and practices which have been adopted under minute observation. Attempts were made from time to time to codify them systematically. In India, such codified knowledge has been identified as 'Ayurveda', while the overflowing undercurrent of empirical knowledge at large is identified as folk medicine. So, Ayurveda is the specialization which evolved from folk medicine. Thus, folk medicine as a healing art is as old as human civilization.

When religion, medicine and morality are found together in the behavioural act or event, folk medicine becomes "Social medicine" to an extent not found in an industrialized society. A great part of the task of folk medicine, especially of preventive medicine is borne by cultural practices which are oriented towards different social purposes and have important functional implications for health. In all societies, rudimentary medical knowledge is an aspect of culture and the practice of folk medicine is variably institutionalized (Charles, 1989).

India has a rich history of traditional systems of medicine based upon six systems. Out of these six systems, Ayurveda stands to be the most ancient, most widely accepted, practised and flourishing indigenous system of medicine. The other five allied systems of medicine in India are Unani, Siddha, Homoeopathy, Yoga and Naturopathy.

The ancient wisdom in this traditional system of medicine is still not exhaustively explored. The rich knowledge gained from different traditional systems of medicine can lead to new avenues in the herbal drug discovery process. The lack of understanding of the differences and similarities between the theoretical doctrines of these systems is the major hurdle towards their convergence apart from the other impediments in the discovery of plant-based medicines.

Since the 2nd century BC, Ayurveda has been considered and accepted worldwide as one of the oldest systems of traditional medicine. The ancient schools of Hindu philosophical teachings named Vaisheshika and the school of logic named Nyaya have laid the foundation of Ayurveda. The Vaisheshika School preached about inferences and perceptions that should be obtained about a patient's pathological condition for treatment. Again, the basis of teaching in Nyaya School was that one should acquire thorough knowledge about the patient's disease condition before proceeding with treatment. The school of Vaisheshika classifies the attributes of any object into six types- substance, particularity, activity, generality, inherence and quality called Dravya, Vishesha, Karma, Samanya, Samabaya and Guna respectively in the Sanskrit language. Even today the origin of Ayurveda is considered to be divine, information from the Hindu God Brahma who is called the creator of the universe. The information about the healing properties of the herbs was composed in the form

of poems, called 'Shlokas'. Later these were used by sages to describe the use of medicinal plants.

The practice of Ayurveda is based upon the knowledge gained from Yajur Veda, Rig Veda, Sam Veda and Atharva Veda. Agnivesha compiled the knowledge from the Vedas which was later edited by Charaka and some other scholars. Presently it is called 'Charaka Samhita'. Charaka Samhita describes all aspects of Ayurvedic medicines and Sushruta Samhita describes the science of Surgery. Both these legendary compilations are still used by practitioners of traditional medicine.




The Siddha system of medicine follows the similar principle of Ayurveda. According to this system human body is constituted from the five elements of the universe like the Panchamahabhootas. The physical, moral and physiological well-being of an individual is governed by 96 factors as per considerations of the Siddha system. These 96 factors include perception, speech, diagnosis of pulse etc. The Siddha system uses many preparations of plant and mineral origin in power form, prepared through various methods including calculations.

The Unani system of medicine was introduced by Hippocrates, a famous philosopher as well as a physician during the period 460-366 BC. So, this system of medicine originated in Greece. Hippocrates laid down the "Humoral theory" for the treatment of diseases. This theory describes the wet and dry characteristics of each humour that constitutes the human body. In India, this system of medicine was introduced by the Arabs. It grew stronger in India when some scholars and physicians of this system fled to our country after the invasion of Persia by the Mongols. Unani system of medicine has made a firm footing in India since that time. The government of India recognized this system for clinical practice and research findings. The plant-based formulations like oil tincture, powder, ointment etc. are used in the treatment of this system.

A German physician, Dr. Samuel Hahnemann brought into practice a different kind of medicine system known as Homeopathy during the mid-17th and 18th centuries. "Immunological memory", "Memory of water", and "Pharmacological aspects of the drug and the disease" are the basis of Homeopathy. This system has been practised in India for more than a century and has formed an integral part of the Indian traditional system of medicine. It is recognized by the Government of India and there are different institutions, research centres and regulatory bodies which help the propagation of this system. In this system of medicine, the mother tinctures or aqueous extracts of drugs (plant/animal origin substances, venoms and minerals) are diluted and succussed (specific method of mixing or shaking) following pharmacopeial methods to prepare formulations of very low potencies.

In the ancient period 'Yoga' originated in India. Yoga suggests meditative exercises and lifestyle management to obtain improved health. Its therapies and diagnosis are practised based on pulse and analysis of the Tridosha state of an individual. The Asanas (Postures) of Yoga are applied in various clinical and non-clinical conditions for curing many physical and emotional conditions.

Naturopathic medicine system or Naturopathy originated in Germany in the 19th century and nowadays it is found to be practiced in various countries. It is not an ancient

system of medicine. However, some traditional medicine practitioners use Naturopathy in combination with the main medicine system. The naturopathic system is based on the use of the curative power of nature in combination with traditional and modern techniques to restore good health. Herbal formulations, Homeopathy, Hydrotherapy etc. are some of the treatment methods followed by this system.

In recent decades, Ayurveda has experienced a significant change in the outlook of researchers, towards its applications. The therapeutic principles of Ayurveda focused on 'prakriti' and 'tridoshas' which explain that every individual has a unique constitution called prakriti. Prakriti determines the characteristic response of each individual to medications, environmental conditions and dietary factors. Traditional systems of medicine are now taken into consideration for re-course to some limitations faced by Western medicine. Rotti *et al.* (2015) studied to correlate the concept of Prakriti in Ayurveda to present-day science. A classification method for the human population, concerning DNA methylation signatures is reported which is based on the traditional Ayurveda concept of Prakriti.

The necessity of providing and fostering the scientific basis of the principles of Ayurveda is increasing. So, it may be expected that it will keep this age-old valuable system of medicine as a living tradition in future. If the knowledge of modern analytical techniques is integrated with a broader perspective for applications of Ayurveda principles then it can help in its wider acceptance globally.■

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Dragon Fruit: A Healthy Exotic Fruit Popular Among Modern Farmers in Goalpara District

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Exotic fruit is an imported fruit which means "from a foreign faraway country" that grows specifically in countries with tropical climates. Dragon fruit is also an exotic fruit which is a vine cactus species belonging to the family Cactaceae and genus *Hylocereus*. The most commonly used English name for this plant is "Dragon fruit" and it is popular by different names such as Pitaya or Pithaya in Mexico, Pitaya Roja in Central and Northern America, and Pithajah in Thailand. In India, it is known as "Kamalam" which comes after the Sanskrit name lotus. It has also drawn worldwide attention for its economic value and multiple health benefits because of which it is also known as the "Wondrous Fruit of 21st Century". *Hylocereus spp*. is considered native to Southern Mexico, the Pacific coast of Guatemala, Costa Rica and El Salvador. Although 18 *Hylocereus spp*. have been reported worldwide only 4 species such as *H. undatus, H. monocanthus, H. costaricensis* and *H. megalanthus* are commercially cultivated and widely distributed throughout the tropics and some temperate regions of the world. Among them, *H. undatus* and *H. costaricensis* are mostly cultivated in some parts of Indian states like Karnataka, Kerala, Tamil Nadu, Gujarat, West Bengal, Mizoram, Nagaland and Assam. It is best suited to tropical weather conditions with an annual rainfall of about 50 cm and a temperature range of 20ºC to 30ºC.


Habit of *H. costaricensis*


Planting pattern


Flower


Fruit


L.S. of a fruit


Seedlings

Hylocereus spp. is a fast-growing climbing cactus which reaches up to 1.5 to 2.5 meters in height with leafless vine-like branches. It is an epiphytic cactus with elongated stems normally 3 angled or 3 winged green stems. The stem is fleshy with many branched segments and each segment has 3 flat wavy wings which have 1 to 3 small spines or maybe spineless. It requires support for their proper growth and development. The aerial roots of the plant grow on the underside of the stem. Flowers are bell-shaped white while stamens and stigma are cream colored. It usually blooms at night and is hermaphroditic. Fruit is bright red skin with green scales and white or red flesh up to 6 to 2 cm long and 4 to 9 cm thick. Seeds are small, black, and elongated or kidney-shaped.

Hylocereus spp. start flowering during the hot season i.e. from May to August and its opening takes place in the early evening with flower petals closing again completely by dawn. Flowers may open earlier in the day in warm, low-light conditions and later in the evening under cooler temperatures. *Hylocereus spp*. usually starts bearing fruits from June to October.

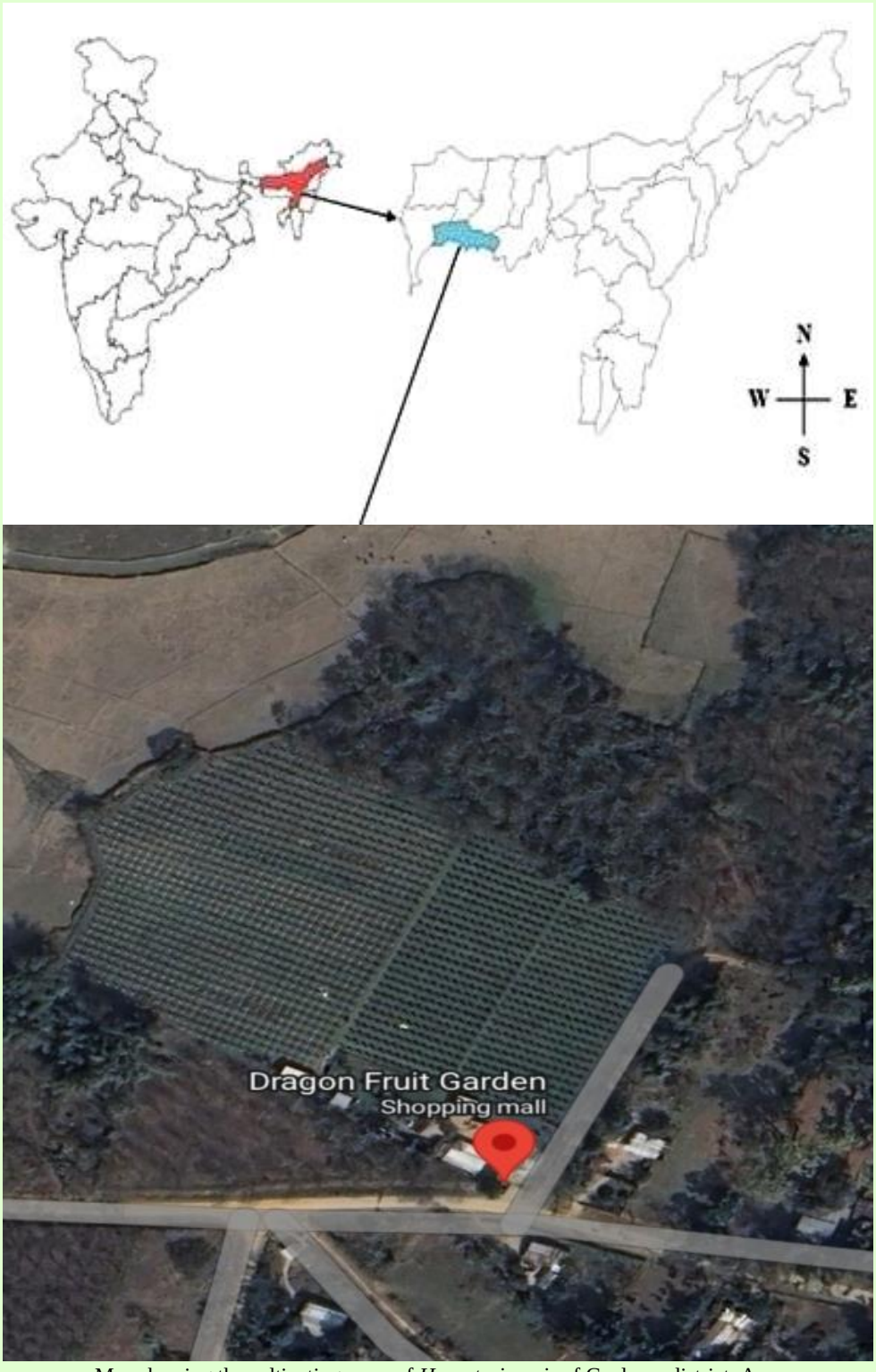
The importance of *Hylocereus spp*. is that it has multiple health benefits along with nutritional and medicinal properties. It contains a significant amount of minerals such as sodium, potassium, phosphorus and magnesium. *Hylocereus spp*. is rich in Vitamin C including glucose, fructose and dietary fiber. The use of dragon fruit as a dietary supplement has further benefits associated with its mixed oligosaccharide content, including the increase of colonic smooth muscle contractions without morphological change, bulk-forming facilitation, and laxative stimulation to increase faecal output and intestinal motility (Khuituan et al. 2019). It is globally accepted for its high sources of polyphenolic components and antioxidant properties. The numerous small black seeds of these fruits contain potential sources of micronutrients and high-quality essential fatty acids.

The world's largest producer and exporter of dragon fruit is Vietnam, where the plant was brought by the French in the 19th century. With an average yield of 8 to 10 tonnes of *Hylocereus spp*. per hectare per year, Karnataka is the largest producer of dragon fruit in India. It is grown through organic methods with the help of drip irrigation. In the year 2022, Mizoram tops among the states that cultivate this fruit. Dragon fruit is also cultivated in some parts of Assam like Kachamari village, Jamurighat etc.

In the Salmari area of Goalpara district, Assam *H. costaricensis* is widely cultivated by Subhash Rabha. It is situated in the southernmost part of Goalpara town having latitude 26.10ºN and longitude 90.57ºE. They brought the plant from Kerala in the year 2019. *H. costaricensis* has vigorous vines, stems are waxy white and flowers are long with margins. Its fruit is ovoid covered with scales and has a red-purple flesh with many black seeds having good taste and texture. The cultivation of *H. costaricensis* in Goalpara district is purely organic and no fertilizer has been used. Though the fruit is eaten raw according to the cultivar they consume the flower of the fruit as vegetables or as fries. *H. costaricensis* is rich in belatinins meeting the increasing trade interest for antioxidant products and natural food colorant.

The dragon fruit, due to its ecological characteristics, benefits human health, and its commercial value has become a cost-effective product for the economy and a driving force in the sustainable development of a country. It is the second most important commercial cactus species concerning fruit production after *Opuntia ficus-indica* (prickly pear). It is also grown as ornamentals for their large, attractive flowers and as bonsai specimens. *Hylocereus spp*. provides fast return with economic production in the first year after planting and full production is attained in 3-4 years. Its life expectancy is about 20 years. At present the market rate of small-size dragon fruit is Rs. 100 per kg and the large one is Rs. 300 per kg. As the crop doesn't require intensive management and also fetches a retail price of more than Rs. 100-120 in the nearby markets farmers can generate some income during the second year itself, about Rs. 4 lakh per ha during the third year and Rs. 6-7 lakhs from 4th year onwards.

Recently this year, the Union Ministry of Agriculture & Farmers Welfare approved a Centre of Excellence (CoE) for dragon fruit to be established by the Indian Institute of Horticultural Research (IIHR), Bengaluru, Karnataka. In this endeavour under the Mission for Integrated Development of Horticulture (MIDH), a roadmap is being prepared for the cultivation of dragon fruit.■



Map showing the cultivating areas of *H. costaricensis* of Goalpara district, Assam.

The Beautiful World of Desmids

Soumin Nath
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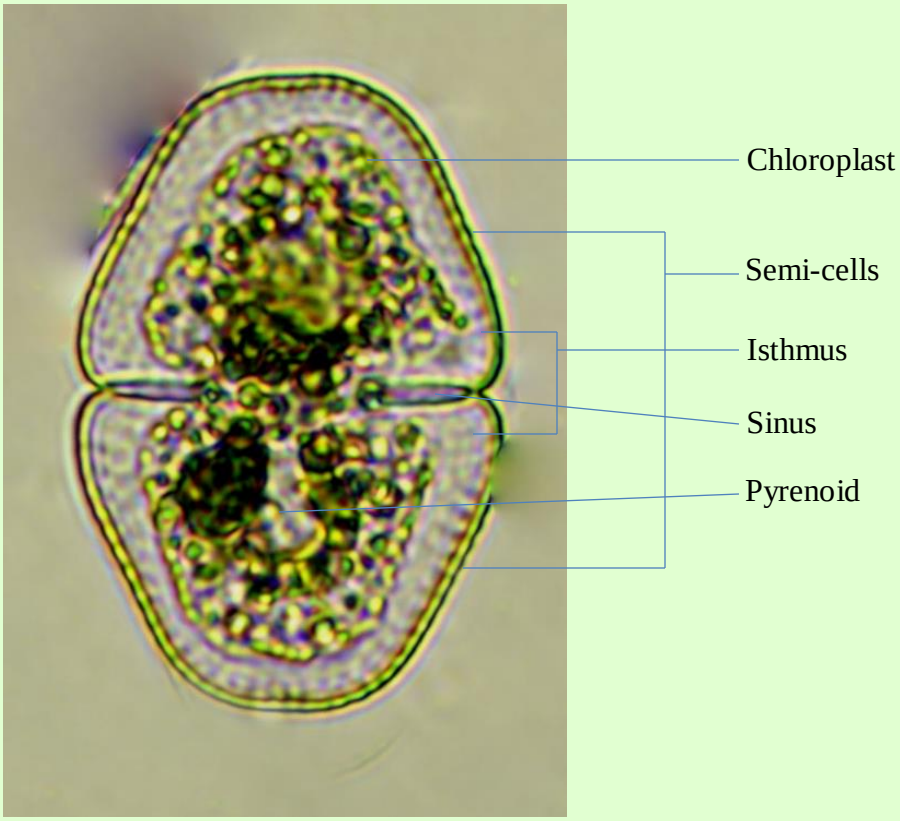
Desmids are the most fascinating organisms at the level of primary producers of any freshwater ecosystem. They are microscopic and unicellular freshwater algae that belong to the kingdom Plantae and class Zygnematophyceae under the phylum Charophyta. Most desmids are made up of two parts termed semi-cells, which are connected to form a sinus in the isthmus. Every semi-cell possesses one or more chloroplasts along with one or more pyrenoids. Desmids are strictly found in fresh water. They are most commonly found in aquatic ecosystems with stagnant water. Very favourable environments for their existence are pukhuri, beel, khola, reservoirs, and bog pools, in association with other aquatic plants like moss. Desmids have been found to favour a small amount of acidity in their growing habitat. Depending on the chemistry of the water body, their occurrence can vary. So, they can be used as indicators of pollution and they may also be helpful in characterizing water bodies (Das & Keshri 2016).

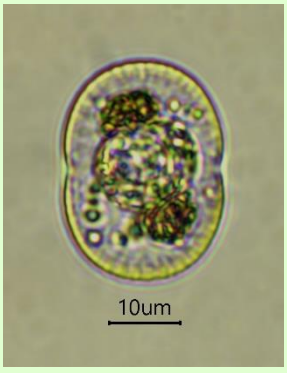


Morphological features of a typical Desmid (*Cosmarium*)

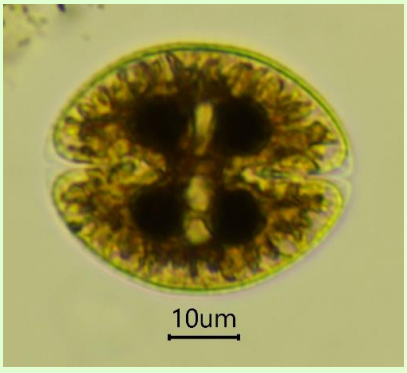
Some of the important Desmid genera are mentioned here –

1. ***Actinotaenium*** (Nägeli) Teiling, 1954: Solitary, fusiform to cylindric, short to elongate cells with rounded or truncate ends and a slight median constriction (isthmus) where the semi-cell walls overlap. Smooth or prominently dispersed pores or scrobiculations in the

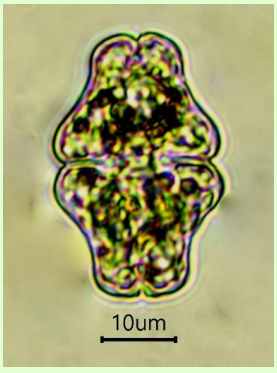
cell wall. Chloroplasts one per semi-cell with a central pyrenoid (rarely 2-3 in an axial row) (Guiry, 2013).



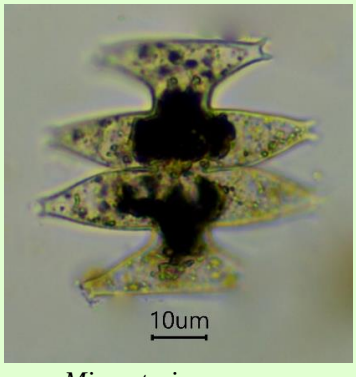
Actinotaenium sp.



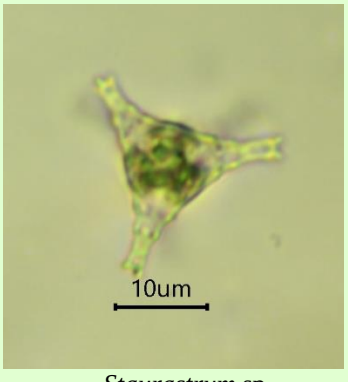
Cosmarium sp.



Euastrum sp.



Micrasterias sp.



Staurastrum sp.

2. ***Cosmarium*** Corda ex Ralfs, 1848: Solitary, small to large-sized cells with shallow to deep median constriction (isthmus). Semicells rounded, reniform, pyramidal, quadrate with a whole or undulate edge; subcircular to elongate-oval (biradiate) in apical view. The cell wall can be either smooth and have little or big granules, emarginate verrucae, circular or triangular pits, or short spinules as decorations. Central and peripheral decoration vary or are identical. The mucilaginous sheath that envelops cells is secreted through spherical holes in the cell wall. One to many chloroplasts per semicell, either axial or parietal, with one to multiple pyrenoids per chloroplast (Guiry, 2013).
3. ***Euastrum*** Ehrenberg ex Ralfs, 1848: Solitary cells are often longer than broad and have a deep median constriction or isthmus, where the semi-cell walls overlap. Oval to elliptical (biradiate) in apical view, frequently with a widened central area (rare triangular variants reported). Every semi-cell typically has separate lateral and apical lobes, with the apical lobe having an emarginate apex or an apical incision. The cell wall is smooth with dispersed pores, or differently decorated with granules, verrucae or tiny spinules. Typically, each semi-cell has one chloroplast and one or more pyrenoids (Guiry, 2023).
4. ***Micrasterias*** C. Agardh ex Ralfs, 1848: Small to large-sized cells with a very deep median constriction (isthmus) are typically solitary (*Micrasterias foliacea* is filamentous). Each semi-cell typically has two lateral lobes and an apical lobe, which can be further divided, depending on other shallow or deep incisions. The semi-cells of *M. dickiei* and *M. ralfsii* are separated. Cells are normally flattened and disc-shaped (*M. dickiei* possesses elliptic, triradiate cells). Some species processes, spines, or protuberances of different sizes. Typically, a semi-cell has one chloroplast with one or many pyrenoids (Guiry, 2022).

5. ***Staurastrum*** Meyen ex Ralfs, 1848: The cells exhibit two intergrading cell morphologies and a shallow or deep median constriction (isthmus) where the semi-cell walls overlap. The cells range in size from small to large and radiate in an end view from 2 to 12. The majority of species have long, hollow processes on each semi-cell; the number of these processes varies according to radiation pattern. The processes typically have two or more terminal spinules, and there may be one or more series of denticulations, spines, or verrucae along the process, as well as on the apex and body of the semi-cell's central axis. In some species, the cell wall is smooth or has rows of tiny granules or spinules; the semi-cell angles are rounded, truncated, or have short processes. Chloroplasts are typically one per semi-cell, stellate (lobed) in end view, and have one axial pyrenoid or many pyrenoids in lobes that extend into cell angles or processes (Guiry, 2013).■

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Invited Article

Euryale ferox – an important component of the Deepor Beel Ecosystem

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E*uryale ferox* is a native aquatic plant of Assam. It can be easily recognized by its huge leaves floating on the water in various wetlands of Assam. It is commonly known as Nikori and Makhna but many other local names are also known from different parts of Assam. It belongs to the water lily family Nymphaeaceae and is called Prickly Waterlily because of its thorns. *Euryale ferox* is an economically important plant as its seeds are used to make makhana. Makhana is very healthy and nutritious. So, it is used in various dishes and is also very popular as a snack (like popcorn). Euryale ferox is cultivated in our country India and China. In the Indian state of Bihar, Makhana is cultivated in thousands of hectares of wetlands and the state alone produces 90% of the world's makhana. The government also assists farmers through various schemes to cultivate the plant in the state. In contrast, makhana cultivation is not well-organized in Assam; occasional news reports indicate its collection and export from various wetlands in the region.

Leaves of Makhana or *Euryale ferox*

Deepor Beel is the only Ramsar site in Assam. Once Deshbhakta Tarun Ram Phukan wrote, “Deepor is a large beel - about 9 miles west of Guwahati.” Today, the city of Guwahati is extended to Deepor Beel. This Beel is also a Bird Sanctuary and an IBA (Important Bird Area). Deepor Beel and the Rani Reserve Forest which is in the southern bank of the beel are important habitats for elephants. The name Deepor Beel even comes from Elephants (Deep means elephants in Sanskrit and Beel is an Assamese word for a type of wetland) reflecting the historical presence of elephants in the area. There are many elephant corridors between the

beel and the hill forest. Once upon a time, Deepor Beel was a food store for elephants. There were different plants that elephants liked to eat. Local elders told us that elephants used to stay in Deepor Beel for up to 1 month. *Euryale ferox* is one of the most notable plants that elephants like to eat in the Deepor Beel. Once, the whole beel got covered by leaves of *Euryale ferox*. Especially in the dry months of Fagun-Sot (March-April), Elephants migrate from the hills of the Rani Reserve forests to Deepor Beel due to food scarcity in the hills, and then *Euryale ferox* play a crucial role in their nutrition as elephants eat the tubers and stems of this plant. The Deepor beel is a significant habitat and breeding ground for various local and migratory birds. Deepor Beel also supports local communities, with over 80 families engaging in fishing, and the collection of *Euryale ferox* fruits serves as an additional source of income for them. Therefore, during the ripening of Makhana fruits, these fruits are often seen in the markets along the banks of Deepar Beel.

However, Deepor Beel is now facing severe pollution issues. The once-clear water has turned dark green and is on the verge of turning black. Most of the local fishes in Deepor Beel disappeared from the lake. Similarly, the diversity of migratory birds visiting Deepor Beel has decreased drastically. Pollution has led to the death of endangered birds like the Greater Adjutant due to poisoning in the water. The presence of plastic in the soil beneath the water has hindered the growth of aquatic plants, allowing the invasive Water hyacinth (Meteka) to thrive. During the rainy season, the lake becomes overrun with water hyacinths, posing a threat to the lives of various lake animals, including fish. While water hyacinth helps absorb some pollutants through phytoremediation, it can damage the ecosystem. Local fishermen are currently taking measures to control this invasive weed and protect the overall health of Deepor Beel.

These changes in the last few years have posed a serious threat to the Deepor Beel and its biodiversity. There were a lot of grasses and aquatic plants in the beel a few years back and now the ecosystem of Deepor Beel is in great turmoil. *Euryale ferox* which filled the entire lake a few years ago, the Water hyacinth has replaced it. Now, *Euryale ferox* is seen only in the western part of the beel. If the level of pollution continues to increase, this economically and environmentally important native plant Makhana or *Euryale ferox* may soon disappear from the beel. Then gradually the coexistence of elephants and humans in the vicinity of Deepor Beel will turn into elephant-human conflict. Therefore, there is no other way but to prevent the pollution of Deepor Beel to conserve this important ecosystem and to conserve *Euryale ferox*.■

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Invited Article

Agarwood Cultivation and Its Economic Significance

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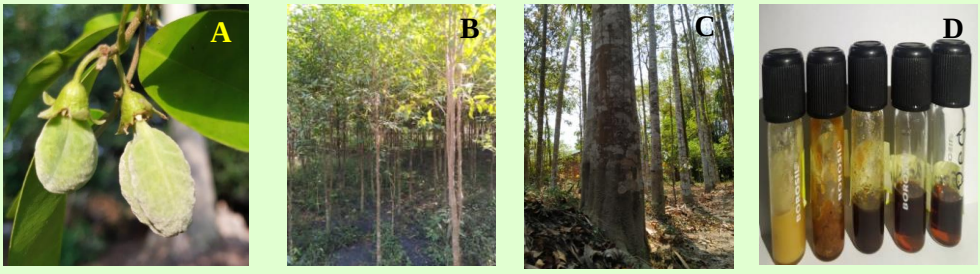
Agarwood (*Aquilaria malaccensis* Lamk.) plant belongs to the family Thymelaeaceae, commonly known as "Sachi gosh" and "agar" and it has a high demand in the market through it processes a resinous oil which is developed in the plant stems. The northeast region of India is very rich in natural resources and globally recognized as a mega biodiversity hot spot. Natural populations of Agaru are distributed in south and south East Asia and India it occurs mostly in the foothills of the northeastern region (Assam, Arunachal Pradesh, Nagaland, Meghalaya, Mizoram, Manipur, and Tripura) as well as West Bengal. In Assam, wild Aquilaria was reported in the districts Tinsukia, Jorhat, Dibrugarh, Silchar, Sivsagar, Golaghat, Nagaon, Lakhimpur, Sonitpur, Darrang, Goalpara, Kokrajhar, Karbi Anglong, North Cachar Hills and Cachar districts. In Assam, large-scale commercial plantations and home gardens of Aquilaria have been reported in Hojai, Golaghat, Jorhat, and Sivsagar districts. Processing and oil extraction units are also found in this district. A major hub for trading and transporting is found in the Hojai district of Assam, Golaghat and foothill terrains.

Agarwood products of this region have made a special place in the international scenario because of their unique quality. Agarwood plant being the non-timber tree species, the non-infected and healthy trees have no value as such in trade.

Agar is propagated by seeds, which are available in June and July (Figure A). The germination of the seed is epigeal, therefore, special care should be taken in nursery management. They are first germinated in seed beds and poly bags and then ready to transfer to the field (Figure B). Aquilaria species grow naturally in all ecological zones and on a variety of soils under wide climatic conditions. The cultivation, and propagation process is easy and cost-effective.



Figures (A) Fruits of *Aquilaria malaccensis*, (B) Aquilaria plantation, (C) Naturally infected plant ready for harvesting, and (D) Agarwood oil

The agar inside the agarwood tree is formed only after the tree is infected by fungi or getting some stress condition, so the aroma is called a "Stress Aroma". There are many hypotheses are found regarding agar formation. Agar formation is considered a synergistic approach of both biotic and abiotic factors. Natural infection occurs when the plant stem is injured either by a stem borer insect however artificial infections are also found which is caused by putting nails on the stem of the plant by mechanical or natural means and inoculating some fungal stains. The borer makes vertical tunnels inside the tree trunk and thus the surface of the tunnels becomes the initial site for infection. *Neurozerra conferta* Walker. (syn. *Zeuzera conferta*) a lepidopteran wood borer belonging to the family Cossidae plays a major role in the development of resin inside the infected plants (Figure C). From the infected resinous plants, valuable agarwood oil is obtained. Good-quality agarwood oils are obtained from naturally infected agarwood plants (Figure D). Superior quality agarwood oil and its products have high demand in the national and international markets. When resins are formed

in the plants as a defense mechanism colour of the wood becomes dark in colour, and it produces a good fragrance. These black colour woods are exported to the international market at high prices.

In the Middle East and India, it has been used for 2000 years in the medicine, perfume industry and some other religious ceremonies. Phytochemicals are the constituents that are extracted from the different parts of plants that are leaves, bark, stem etc. Primary bioactive constituents of Aquilaria are alkaloids, saponins, steroids, terpenoids, tannins, flavonoids and phenolic compounds that have a large potential in the pharmacological industry. People used Aquilaria since time immorally for different purposes so it's evidence from an Ethnomedicinal point of view. Till now some chemical compounds are still unexplored, and this may have a large potential in new drug discoveries. Although Aquilaria is a highly economical and medicinal plant their cultivation, propagation and management practices are most important nowadays. Aquilaria plant has been reported to possess several pharmacological activities such as antinociceptive, antimicrobial, laxative, anti-oxidant, sedative, antihyperglycaemic, thrombolytic, antidiabetic, ulcer protective, anticancerous, antidiarrhoeal, hepatoprotective and CNS activities. It has several pharmacological activities such as aphrodisiac, alternative, anodyne, antidiarrhoeal, antiasthmatic, astringent, carminative, cordial, diuretic, laxative, stomachic and tonic and incorporated.

In developing countries, their health care system primarily depends on traditional medicinal systems and they are highly dependent on traditional medicinal plants due to the large population. Since ancient times India has been known for its herbal medicinal systems. Agarwood has been used for different medicinal purposes all over the world for thousands of years. Different parts of Aquilaria have been used to diagnose different types of diseases from time immemorial, as we know that Aquilaria is a highly medicinal and economic plant. Different parts of the plants such as leaves, stems, wood, and oils are used in different forms for example as a powder, or paste their aqueous extract is used to treat different types of diseases. Among all the species Aquilaria malaccensis has higher medicinal importance. Diseases like diarrhoea, vomiting, dysentery, anorexia, mouth and teeth diseases, Inflammation, arthritis, cardiac disorders, cough, asthma, leprosy and anorexia people use agarwood to treat such type of diseases traditionally. It reduces cough and also helps with bronchitis and asthma. Because of its cooling effect, Agarwood paste and leave paste are used in fevers associated with chills, both internally and externally and agarwood Oil massage is found to be effective in rigours in fevers. Agarwood incense has been burned to produce a pleasant aroma for centuries, in important religious ceremonies, by Buddhists, Hindus and Muslims.

Agarwood oil is considered a liquid gold or black gold due to its high demand in the market. Assam especially in upper Assam and middle Assam are rich in agar plantation so it will create income generation, employment generation and it will generate Entrepreneurship development in the rural as well as in the urban areas. Northeast Indian agarwood oil has high commercial value and is graded as A+, A, B, C, D likewise. A+ is considered an oil with 100% purity, which is only found in Assam, India. As the demand for agarwood increases and plants become extinct in the wild, it has a high economic and medicinal importance people have exploited agarwood from the existing resources as the whole population of agarwood decreases. It's high time to conserve the endangered plant in natural resources as well as in cultivated land.■

Oil Palm Cultivation in Assam with Special Reference to Goalpara District

Jimari Santok
Guest faculty, Dept of Botany, Dudhnoi College

Oil palm bears a resemblance to our local 'Khejury' plant, belonging to the Arecaceae family, with the primary cultivated species being *Elaeis guineensis* and *E. oleifera*. However, a globally cultivated hybrid variety called 'Tenera' is preferred for its dwarf characteristics and higher productivity. The oil palm exhibits a seed-yielding capacity for 25-30 years, after which they are replaced with new plants. Currently, fifty per cent of palm oil in the country is imported from Indonesia and Malaysia. Originating in the tropical rainforest region of West Africa, its main belt extends through the Southern latitudes of Cameroon, Ghana, Liberia, Nigeria, Sierra Leone, and Togo, and into the equatorial region of Angola and the Congo. It was introduced to India at National Royal Botanical Gardens,Kolkata during the year 1886.

The oil palm is a monocotyledonous plant featuring a crown of 35-60 pinnate fronds arranged on a vascular stem. A single bud at the base of the crown gives rise to fronds and inflorescences. The flowers are organized in inflorescences, with some being male and others female, situated in the axil of each frond unless early abortion occurs. The fruits, abundant in oil, are oval, fleshy drupes grouped in "bunches" weighing between 1 to 60 kg. Capable of reaching heights between 15 and 30 m, the oil palm can endure for up to 300 years. It is monoecious, with male and female inflorescences occurring separately.

Habitat of Oil Palm

Oil palm grows well where it is hot all year round and the temperature remains between 25-28 degree Celsius. If the temperature falls, the oil palm produces fewer leaves and is attacked by diseases. It can be grown in any type of soil, but it does best on deep loamy alluvial soil, well-drained which is rich in organic matter and well-balanced soil pH. It comes to flowering 14-18 months after planting. The best season for oil palm plantations is June to September.

Assam has set a target of 3.75 lakh hectares under oil palm cultivation. The Govt of Assam said that the main objective of this movement is to revolutionise agro-economy through oil palm plantation. He said that as a part of a series of steps to promote oil palm plantation, Patanjali Food Limited (PFL), a food-based company has set a target of 60,300 hectares of plantation by 2026. He said that since farmers are keen to adopt oil palm as a new crop to supplement and boost their income, the government is taking steps to promote the cultivation of oil palm trees. It is also said that Patanjali Food Limited will develop palm oil plantations in seven districts namely Dibrugarh, Tinsukia, Golaghat, Jorhat, Nagaon, Kamrup(Metro) and Goalpara. PFL is planning to set up 16 nurseries by the coming year to

facilitate quality seeding supply to farmers and will set up 12 refineries in seven districts this year and another four by next year. Moreover, it will set up an oil palm processing factory at Dhing and Nagaon.

The first oil palm plantation in Assam was set up in Khungkhrajani village, around 6 km from Dudhnoi town, back in 2015. It is cultivated in some places like Baida, Kalyanpur etc. Around eight years ago, the Rabha Hasong Autonomous Council, an autonomous council that administers almost the entire Goalpara district and parts of Kamrup, decided to cultivate oil palm in Goalpara. Oil palm was virtually unknown to the people of Assam at that time, and Goalpara became the first district to start oil palm cultivation in the state. A farmer named Raghuev Rabha cultivated oil palm in Mogho, Baida of Goalpara district. In the interview, he said that palm oil cultivation is of great economic value and he benefits from that cultivation.

Palm oil has great economic importance. It is used for human consumption: margarine, basic vegetable fat, food oil, cooking oil and specialist fats. It is also used to make derivatives for industrial use: fatty acids, soaps, cosmetics, inks, resins, methyl esters etc. It is also used as a biofuel in many parts of the world. It is commonly used in processed foods and as an oil for frying. Palm oil has a great medicinal value. It is used for malaria, heart disease, cancer, etc.

Modern educated farmers should be encouraged to cultivate palm oil in some parts of the Goalpara district. Still, it is controversial as it is a major driver of deforestation of some of the world's most biodiverse forests, destroying the habitat of already endangered species like the Orangutan, pygmy, elephant and Sumatran rhino.■

Early stage

Growing stage

Fully-grown fruits

Dried fruits to prepare oil

Figures: Different fruiting stages of Oil Palm

Small-Scale Mushroom Cultivation in Dudhnoi and an Encouraging Farmer

Florina Boro
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Dudhnoi, located in the Goalpara district of Assam, India, is renowned for its diverse agricultural practices. Traditionally, Dudhnoi has thrived on farming methods passed down through generations, focusing on cultivating rice, jute, and staple crops like potatoes, tomatoes, and various fruits. The fertile soil and favourable climate contribute to successful rice cultivation, a staple in the region. Furthermore, tea cultivation thrives, contributing to Assam's renowned tea industry. These agricultural practices are deeply rooted in local culture.

As global and local economic landscapes evolve, Dudhnoi farmers are exploring alternative avenues to sustain their livelihoods, one of which is mushroom cultivation. In recent years, small-scale mushroom cultivation has emerged as a promising alternative for Dudhnoi farmers. The region's climate and soil conditions make it suitable for growing a variety of mushrooms, with Oyster mushrooms gaining popularity due to their adaptability and high market demand.

A notable shift is occurring as some farmers transition to innovative practices like mushroom cultivation, driven by the potential for higher returns and mushrooms' adaptability to local conditions. Many farmers are embracing this change, recognizing the economic benefits and sustainability of cultivating mushrooms. This shift reflects a blend of preserving traditional agriculture while embracing newer, more lucrative opportunities in the Dudhnoi area.

Chenaisri Basumatary, an inspiring farmer from Bhalukdubi, Rangjuli, has been cultivating mushrooms for several years. Encouraged by KVK (Krishi Vigyan Kendra), Kamrup, in 2015, Chenaisri has also ventured into cocoa cultivation. His journey into mushroom cultivation began with a deep-rooted connection to the land. Raised in a rural setting, he witnessed the challenges faced by traditional farmers and recognized the need for alternative, sustainable practices. Intrigued by the potential of mushrooms, he embarked on a learning journey that eventually led him to become a trailblazer in this field.

Chenaisri Basumatary's oyster mushroom cultivation and product

One of Chenaisri's key initiatives involves conducting workshops and awareness programs to educate individuals about the benefits and techniques of mushroom cultivation through interactive sessions. He imparts knowledge on the nutritional value of mushrooms, the environmental advantages of fungal farming, and the economic opportunities it presents.

Mushroom cultivation stands out as an eco-friendly agricultural practice, requiring minimal space and water compared to traditional crops. Chenaisri emphasizes the importance of incorporating such sustainable methods to mitigate the environmental impact of conventional farming. He advocates for organic and low-input farming, aligning with global efforts to promote more sustainable and nutritious food production. Chenaisri firmly believes that empowering youth with practical skills not only enriches their lives but also contributes

to community development. By demystifying the intricacies of mushroom cultivation, he enables young minds to envision a sustainable and profitable future in agriculture.

The Department of Botany at Dudhnoi College is actively contributing to community development by offering certificate courses in mushroom cultivation in association with KVK, Dudhnoi, from 2022. The initiative aims to empower students with practical skills, enabling them to explore entrepreneurial opportunities and share their knowledge within their communities.

The steps taken by the Department of Botany at Dudhnoi College to spread knowledge of mushroom cultivation are commendable. The department not only provides certificate courses in mushroom cultivation to students but also, starting in 2022, offers the Skill Enhancement Course for first-semester botany honours students and sixth-semester botany regular students, covering Mushroom Cultivation Technology and Mushroom Culture Technology topics, respectively. This reflects the botany department's commitment to providing holistic education and preparing students for diverse and relevant career opportunities. By fostering expertise in mushroom cultivation, the botany department aims to create a ripple effect of employment generation, fostering suitable growth in the local community.

Small-scale mushroom cultivation offers several benefits, particularly in areas like Dudhnoi where most families are closely tied to farming. The cost-benefit effect of mushroom cultivation is high, as raw materials are often readily available at home, reducing the need for extensive investments. Mushrooms can be grown using agricultural waste, creating a sustainable and environmentally friendly process. Additionally, the short cultivation cycle of mushrooms allows for quicker turnover and income generation for local families, contributing to economic stability in the region. Small-scale mushroom cultivation in Dudhnoi presents a promising avenue for sustainable agriculture and economic development. The journey into mushroom cultivation holds the potential to transform Dudhnoi into a hub for sustainable and nutritious food production.■

Nobel Prizes for Research in Physiology or Medicine during the 21st Century

Joeta Paul
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The Nobel Prizes are 5 separate prizes that, according to Alfred Nobel's will of 1895, are awarded to "those who, during the preceding year, have conferred the greatest benefit to humankind". Alfred Nobel was a Swedish chemist, engineer, and industrialist most famously known for the invention of dynamite. He died in 1896. In his will, he bequeathed all of his "remaining, realisable assets" to be used to establish five prizes which became known as "Nobel Prizes". Nobel prizes were first awarded in 1901.

In the Prize ceremonies, each recipient (known as a "laureate") receives a gold medal plated with 24 Karat gold. All medals have some differences in design (except physics and chemistry which look the same) but they all are "a gold medal bearing the image of the testator and an appropriate inscription". The front side of all medals features a portrait of Alfred Nobel in the left profile on the obverse. The medals for physics, chemistry, physiology or medicine, and literature have identical obverse, showing the image of Alfred Nobel and the years of his birth and death. These Prizes as established by his will are

i) The Nobel Prize for Physics,
ii) The Nobel Prize for Chemistry,
iii) The Nobel Prize for Physiology or Medicine,
iv) The Nobel Prize for Literature, and
v) The Nobel Prize for Peace

Nobel Prizes are widely regarded as the most prestigious awards available in their respective fields. A Prize may not be shared among more than three individuals, although Nobel Prizes are not awarded posthumously, if a person is awarded a prize and dies before receiving it, the prize is presented.

The Nobel Prize in PHYSIOLOGY or MEDICINE is one of the Nobel Prizes which were created by Alfred Nobel. This award is decided by the Karolinska Institute, a major medical centre in Sweden. The Prize is given every year to a person, or persons who have done excellent work in the area of medicine (treating or stopping disease) on physiology (the way the body works).

Nobel prizes winners for research in Physiology or Medicine during the 21st Century

2000	Arvid Carlsson, Sweden, Paul Greengard, US, and Eric Kandel, US, for their discoveries about signal transduction in the nervous system.
2001	Leland Hartwell, US, Tim Hunt, UK and Sir Paul Nurse, UK, for finding the main controls in the cell cycle.
2002	Sydney Brenner, UK, H. Robert Horwitz. United States, and Sir John Sulston, UK, for their findings on the genetic controls of organ development and programmed cell death.
2003	Paul Lautenbun, United States, and Sir Peter Mansfield, United Kingdom, for inventing magnetic resonance imaging.
2004	Richard Anel and Linda Buck, US, for finding small receptors and the organization of the olfactory system, (how we smell things).
2005	Barry Marshall and Robin Warren, Australia, for finding the bacterium Helicobacter pylori that causes gastritis and peptic ulcer.
2006	Andrew Fire and Craig Mello, United States, for finding how RNA interference can switch genes on or off.
2007	Mario Capecchi, US, Sir Martin Evans, UK, Oliver Smithies United States, for

	finding a way to switch off genes in mouse embryonic stem cells. This leads to genetically changed mice.
2008	Harald zum Hausen, Germany, for binding the human papillomaviruses causing cervical cancer. Francoise Barine-Sinoussi and Luc Montagnier, France, for finding the human immunodeficiency virus.
2009	Elizabeth Blackburn, Australia, Carol Greider, US, and Jack Szostak, England, for their work on chromosomes.
2010	Robert Edwards, UK, for the development of in vitro fertilization.
2011	Bruce Beutler, US, and Jules Hoffmann, France, for their discoveries about how innate immunity is activated. Ralph Steinman, Canada/US, for the discovery of dendritic cells and their role in adaptive immunity.
2012	John Gurdon, UK and Shinya Yamanaka, Japan, for the discovery that mature cells can be reprogrammed to become stem cells.
2013	James Rothman, Randy Schekman, US, and Thomas G. Sudhof, Germany for discovering the molecular basis of neurotransmitter release.
2014	John O'Keefe UK/US, May-Britt Moser and Edvard Moser, Norway for discovering the cells that make a positing system in the brain.
2015	William C. Campbell (1/4) / Satoshi Omura (1/4)/ Tu Youyou (1/2) for therapy against roundworm parasites and malaria.
2016	Yoshinori Ohsumi, Japan for autophagy.
2017	Michael Rosbash, Michael W. Young and Jeffrey C. Hall, all US, for their discoveries of molecular mechanisms controlling the circadian rhythm.
2018	James P. Allison, US, Tasuku Honjo, Japan for the discovery of cancer therapy by inhibition of negative immune regulation.
2019	William Kaelin Jr. US, Peter J. Ratcliffe, UK, Gregg L-semenza, US, for their discoveries of how cells sense and adapt to oxygen availability.
2020	Harvey J. Alter, US, Michael Houghton, UK, & Charles M. Rice, US, for the discovery of Hepatitis C virus.
2021	David Jullus and Ardem Patapoutian, US for discoveries of receptors for temperature and touch.
2022	Svante Paabo, Sweden for for his discoveries concerning the genomes of extinct hominins and human evolution.
2023	Katalin Kariko, Hungary and Drew Weissman, US for discoveries concerning nucleoside base modifications that enabled the development of effective RNA vaccines against COVID-19.

The Nobel Prize remains the most prestigious and respected award for scientific research. It is one of the most important prizes in the world. Winning a Nobel Prize creates lasting, multi-fold impacts for the individual and the affiliated organization. Our opinion is that we are for this celebration because all researchers in any domain deserve the praise of this accomplishment, we would like to keep it that way and it never will stop.■

Photo Story

1.

Mushroom cultivation at Dept. of Botany, Dudhnoi College and skill training to the students.

2.

Honourable Ex-MLA of Dudhnoi Constituency Mr Dipak Rabha purchased one quintal of Vermicompost, a product of Dept. of Botany, Dudhnoi College on 4th December 2023.

Honourable MP of Guwahati constituency Mrs Queen Ozha purchased 80 kg of Vermicompost, a product of Dept. of Botany, Dudhnoi College on 26th December 2023.

3.

Retd. Col. Mr Ranjan Dutta and Dr (Mrs) Smita Dutta Roychoudhury purchased 25 kg of Vermicompost, a product of Dept. of Botany, Dudhnoi College on 14th January 2024.

4.

Present status of the Horticultural Garden cum Nursery maintained
by Dept. of Botany, Dudhnoi College

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