Botanica

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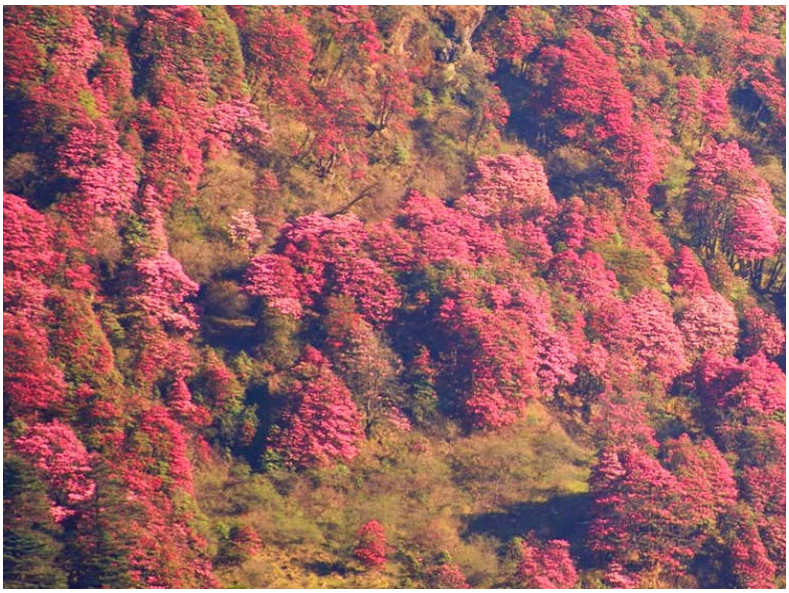

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LAYOUT DESIGN: Kuntal Narayan Chaudhuri

EDITORIAL

Conservation of Blue Carbon: A Climate Change Mitigation Strategy

Blue carbon ecosystems comprising of mangroves, tidal and salt marshes, and sea grasses, are highly productive ecosystems with the capacity to sequester carbon within plants and in sediments below over millennia. These are a key component of nature-based solutions to climate change.

A steady rise in global temperatures primarily due to human-induced changes in atmospheric levels of green house gases, especially CO_2, is a major challenge faced by today's world. As Earth's climate has warmed, more frequent and more intense weather events have been observed, reflecting changes in the natural climate processes. The net effect is an irreversible damage upon almost all aspects of the natural biological diversity. Deforestation and change in land-use patterns are considered as the second-largest source of CO_2 to the atmosphere after fossil fuel combustion.

The major carbon pool of our planet is the organic carbon captured and stored in terrestrial forests, ocean and estuarine vegetation. The term Blue Carbon (BC) was first coined a decade ago to describe the disproportionately large contribution of coastal vegetated ecosystems to global carbon sequestration. The BC ecosystems—mangroves, tidal and salt marshes, and seagrasses—are highly productive coastal ecosystems that are particularly important for their capacity to sequester carbon within plants and in sediments below over millennia. Scientific assessments show that they can store two to four times more carbon than terrestrial forests and are thereby considered a key component of nature-based solutions to climate change. Surprisingly, they occupy only 0.5% of the total coastal area, but accounts for about 14% of carbon sequestered by the global ocean. BCs are released into the atmosphere when the coastal ecosystems are converted or damaged, leading to the release of CO_2, HCO_3^- or CO_3^{2+}, adversely affecting the ocean-atmosphere equilibrium. The ongoing carbon losses from BC ecosystems are estimated to account for up to 19% of emissions from global deforestation.

Despite their importance, coastal BC ecosystems are some of the most threatened ecosystems on Earth. They are being degraded or destroyed at four times the rate of tropical forests, and climate change threatens to accelerate these losses. Increasing population densities and urbanization of coastal areas have damaged vegetated coastal habitats worldwide due to the impacts of pisciculture, aquaculture, pollution and sedimentation. Nearly 50% of the pre-industrial, natural extent of global coastal wetlands have been lost since the 19th century. Around 62% of mangroves worldwide were destroyed between 2000 and 2016, there has been about 90% loss of salt marsh ecosystems, and seagrass carbon stocks are declining in various regions of the world. This decline continues today with an estimated loss of about 0.5–3% annually depending on the ecosystem type.

The need of the hour is global focus and mass awareness. BC ecosystems were discussed by world leaders on the High-Level Panel for a Sustainable Ocean Economy at the COP26 climate summit in Paris, in 2015. They stated that increasing protection of these ecosystems would prevent over a billion ton of carbon from entering the atmosphere by 2050. Mitigation programmes like UNFCCC's 'Reducing Emissions from Deforestation and Forest Degradation' have been proposed internationally to secure the carbon locked in natural ecosystems and prevent their emission.

Meenakshi Mukhopadhyay
Associate Professor & Editor
Teachers' Day, September 5, 2022

Workshop on Plants as Indicators of Air Pollution

THE department along with the IQAC of the college organized a State-Level Workshop entitled "Understanding the Urban Air Pollution through Plant's Responses" on May 7, 2022. The invited resource person was Dr. Abhijit Sarkar, Assistant Professor, Dept. of Botany, University of Gour Banga, Malda, who works in the field of stress biology in microbes and plants, specializing in urban air pollution and its mitigation through higher plants. At the gathering in Vivekananda Sabhaghar, Dr. Sarkar delivered a detailed talk on air pollution and its harmful effects on plants. This was followed by a hand-on session in the General Laboratory and Instrument Room of the department (see figs.).

--Eds

A Talk by Our Alumna

THE department also organized an International seminar entitled "Understanding Angiosperm Evolution: A Cytogenetics Perspective" on April 21, 2022. The resource person was Dr. Sreetama Bhadra, an alumna (batch of 2005). Presently, she is sDIV Postdoctoral Researcher at the German Centre for Integrative Biodiversity Research, Halle-Jena-Leipzig, Germany. Earlier, she had worked as post-doctoral researcher at the Xishuangbanna Tropical Botanical Garden, China, and the Central European Institute of Technology, Czech Republic. Her engaging and enlightening talk focused on the current understanding the role of genome size and polyploidy on the adaptation, distribution and evolution of plants in general, and the angiosperms in particular.

--Eds

DEPARTMENTAL NEWS

Back to the Himalayas: Tea Terrains of Pokhriabong

AFTER three years, the department once again organised an excursion to the Darjeeling hills of Eastern Himalayas, from May 11 to 15, 2022. Off the beaten track, Dr. Sutapa Kumar (Rai), Prof. Meenakshi Mukherjee and Dr. Kuntal Narayan Chaudhuri guided sixteen Botany Honours fourth semester students at Pokhriobong, Darjeeling, West Bengal.

This lush green valley of the Darjeeling hills, nested on the edge of the forested Nagri Spur, is dotted with eight tea estates, *dhupi* plantations and hamlets of tea workers. The monotony of this monoculture is broken by tracts of virgin mixed temperate forest. The rich flora of the Eastern Himalayas was documented during a field study with Mr. Dipchen Bhutia, the local guide, along a trekking trail (1,571 to 1,700 m) from Shikari Busty to Avongrove Tea Estate (see fig.). Two economically-valuable introduced species tea (*Thea sinensis*) and *dhupi* (*Cryptomeria japonica*), dominated the landscape, but a rich diversity of weeds, both native and alien, were also recorded. Many of these are valuable in local ethnomedicinal practices. Native home and kitchen gardens were found to be repositories of wild and cultivated edible, medicinal and ornamental plants. Finally, tea processing was observed during a visit to the tea factory.

--*Eds*

Obituaries: Prof. Minati Banik and Prof. Hrishikesh Chatterjee

IN a brief span of only two months we lost two ex-teachers with enormous contributions in moulding this department into what it is today. Prof. Minati Banik (née Sinha), aged 87, passed away on June 22 after battling with a terminal illness. She had graduated in Botany from Dinabandhu Mahavidyalaya, Bongaon, North 24 Parganas in 1957, and completed her post-graduation at the University of Calcutta in 1959. Although reserved and soft-spoken, she was resolute in discharging all her duties. Since her retirement in 1996, she remained in touch with the department and attended its public events despite an increasingly frail health. Prof. Hrishikesh Chatterjee breathed his last on August 27 at the grand age of 92. He was an alumnus of Presidency College (1953), Calcutta, and later University of Calcutta (1955). He was the founding Head of this department, established in 1984 after the bifurcation of the Dept. of Biological Sciences. Under his able leadership the B.Sc. Botany Honours course was initiated in 1988. A popular teacher, he continued to nurture the department until his retirement (1995). Both of these luminaries were felicitated by our Alumni Association at its first Reunion (see fig.) on February 7, 2016, for their contributions during long and distinguished careers as teachers in this department.

--*Eds*

SHUTTERBUGS

TRYST WITH NATURE

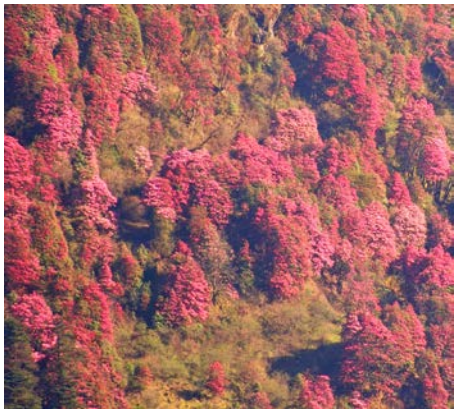
Purple Passionflower
Aryadev Sapui
Botany Hons.(Sem. 5)

Raindrops
Sohini Ghosh
Botany Hons. (Sem. 5)

The Blooming Lily
Parthapratim Kar
Botany Hons. (Sem. 5)

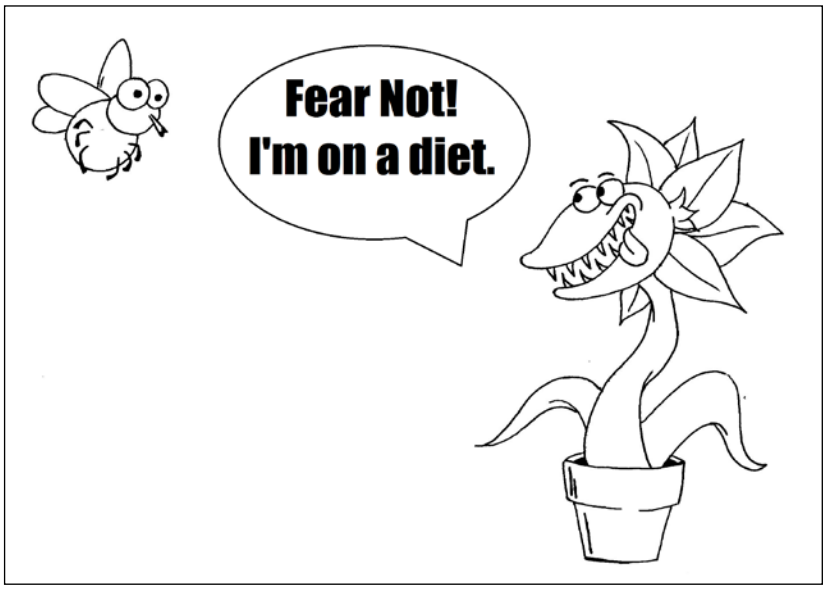
Precariously Poised
Nilesh Halder
Botany Hons. (Sem 5)

Nature's Cup
Asis Kumar Pal
Assistant Professor



A Himalayan Wildfire
Kuntal Narayan Chaudhuri
Assistant Professor

BIO-TOONS



Carnivorous Plant: A Part-Time Hunter

Upasak Majumder
(Sem. III)

REFLECTION

"How I Became A Tree"

Kuntal Narayan Chaudhuri
Assistant Professor

TREES, one of the grandest beings on Earth, are leviathans as giant as the redwoods whose colossal size can dwarf all other Earthlings. The trunks of these big woody perennials bear subterranean roots and aerial crown of leaves, flowers and fruits. Fossil lore from the pages of Earth's history bring to light how the barren Silurian terrain turned green. Early land plants grew taller in a race to reach for the sun, and their increasing girth innovated woody frames and armours of bark to transform themselves into trees thronging the Earth's first forests in Devonian times. Much later as humans emerged from arboreal simians, olden tree relics or lore betray how these Titans kept us enchanted since time unknown. Even today, in treeless concrete forests, trees still evoke an immense sense of awe and mystery.

On a personal note, my love for trees is a rather late revelation. I must confess being 'blind' to their real presence while dealing with them merely in books, handling only their twigs, sections and extracts in laboratories, and pushing them into the background during field trips. Of late, I got acquainted with Debjit Mukerjee and Sushmita Basu, who are self-taught with no formal training in botany. These dendrophiles, or *brikkhopremiks* to borrow Rabindranath Tagore's honorific for Tejesh Chandra Sen, helped me discover the neglected world of trees. In rural sacred groves and urban street shrines, dendrolatry speaks of the universal human adoration for trees among ordinary folks. Recently, Sumana Roy in her *magnum opus* "How I Became A Tree" has brilliantly sketched three famed non-botanists of the past as "kindred arborphiliac souls"—the artist Nandalal Bose, the physicist Jagadish Chandra Bose, and the poet Rabindranath Tagore. She defines their kinship with trees using the Sanskrit word *sahrydaya*, *i.e.* the soulmate. She reveals many moments of epiphany wrapping their minds like a tendril—being tree and human at the same time. The brevity of this space allows for only one example. In a letter written to Hemantabala Devi, penned on November 8, 1934, Tagore describes his return from a voyage at the onset of winter to find himself lost among the denizens of his garden. With an astute sense of humour he proclaims that the centre of attraction of this *réjouissance* was his favourite *himjhuri—Millingtonia hortensis* (Bignoniaceae)—now blanketed with white blossoms that kept falling to the ground. He then physically identifies himself at this old age with this tall tree whose summit too had turned white like his own head. Thus, the plant and human, the tree and poet, both became inseparable.

In Anthropocene, a likely reason for my disaffection with human existence, is the bludgeon of time. At the root of all my 'flaws' is the failure to be enslaved to time ticking in my wristwatch and wall clocks. I aspire to be a tree, the *axis mundi* of yore, bound only to Nature's cosmic rhythms—the "tree time" painted by the surrealist Salvador Dali in his recurring arrays of melting clocks on trees.

PERSONALITY

Rabindra Prasad Purkayastha (1935-2011): The Man of Phytoimmunology

Asis Kumar Pal
Assistant Professor

Prof. Purkayastha demonstrated the role of phytoalexins in differential resistance of rice, jute, broad bean and soybean cultivars to fungal diseases. His pioneering work on the application of immuno-serological techniques for determining the basic compatibility factor in legume hosts and their fungal parasites, and his discovery of chemically-induced resistance altering antigenic pattern of host plants and accelerating phytoalexin synthesis, led to the development of a new in vitro method for screening disease resistance/susceptible plant germplasm.

Rabindra Prasad Purkayastha was born on 31st August, 1935 at Ilashpur, Sylhet (now in Bangladesh). There, he had his early education at Raja G.C. High School. He studied B.Sc. with Botany Honours in City College, Calcutta. In 1958 he secured First Class in the M.Sc. examination of Calcutta University. After a short stay as Lecturer at Rammohan College and City College, he travelled to England in 1962 for doctoral research under Dr. B.J. Deverall at Imperial College, London. In 1965, he was awarded Ph.D. by University of London and D.I.C. by Imperial College.

After returning from England, Dr. Purkayastha continued post-doctoral research at the Dept. of Botany, Calcutta University. In 1968 he became Lecturer-in-Botany at Visva Bharati University. Next year, he returned as Lecturer to Calcutta University where he became Reader in 1977, Professor in 1986, Professor and Head in 1992-94, Sir Rashbehari Ghosh Professor in 1995, and retired in 2000. Before retirement he implemented a major research project of DBT, Govt. of India, accomplished in 2004. Earlier, he completed research projects of UGC, CSIR, DST and DOEN. He was awarded Eminent Teacher Award by the Calcutta University in 2008.

Prof. Purkayastha made significant contributions to Physiological and Molecular Plant Pathology and Mycology. The most significant is his fundamental research on phytoalexins and its role in plant disease resistance. He worked extensively on induced resistance in plants, host-parasite common antigenic relationship, molecular diagnosis and management of crop diseases. He is also well-known for his research on edible mushrooms and pioneering work on foliicolous mangrove fungi of Indian Sundarbans. He published more than 200 scientific papers in reputed national-international journals, authored five books and supervised 28 Ph.D. students. He was member of scientific bodies such as ICAR (New Delhi), UGC, DST, and ISI (Kolkata), British Mycological Society, Federation of British Plant Pathologists, International Society for Plant Pathology and New York Academy of Sciences. His visited London and Tokyo under the Bilateral Exchange of Scientists.

Prof. Purkayastha was awarded Paul Johannes Bruhl Memorial Medal by Asiatic Society, Prof. S.N. Dasgupta Memorial Lecture Award by IPS, and Platinum Jubilee Lecture Award by ISCA. He was elected Fellow of National Academy of Sciences, Allahabad, National Academy of Agricultural Sciences, New Delhi and West Bengal Academy of Science and Technology. This eminent scientist and academician breathed his last on 19th January, 2011.

DO YOU KNOW?

Epidendrum ibaguense: The Dobsonian Mimicry

Soumyadeep Banerjee
Botany Honours (Sem. V)

MIMICRY is a behavioural adaptation with an organism evolving to resemble another physically or chemically to increase its Darwinian fitness. The Dobsonian mimicry, named after the botanist Calaway H. Dobson, involves flowers and fruits to lure pollinators or seed dispersers. The 'copycat' plant species exploits its reproductive similarity with another one living in the same territory to its own advantage. *Epidendrum ibagueuse* Kunth in H.B.K (Orchidaceae), is a species of epiphytic orchid which occurs across Trinidad, Venezuela, French Guiana, Brazil and Colombia. Its small flowers resemble *Lantana camara* L. (Verbenaceae) and *Asclepias curassavica* L. (Apocynaceae), and these and are pollinated by monarch butterfly (*Danaus plexippus*), without receiving any nectar in return.

The Giant Bamboos: Wonders of the Plant World

Mita Basu
Graduate Lab. Instructor

BAMBOOS are unique grasses of giant stature that have been taxonomically assigned to the subfamily Bambusoideae in the family Poaceae. These are the fastest growing plants on Earth. A young bamboo can grow up to a metre in just 24 hours. Found in the tropics and subtropics, these giants have hollow stems that can reach a height of up to 30 m. Because of its light weight, yet extreme strength, the bamboo is an excellent building material used by people across the globe in making diverse products from huge scaffoldings to tiny gramophone needles, from rulers to aeroplane 'skins'. It can be used to start a cooking fire in a rainforest, its ash is used to polish jewels, its charcoal is used to make batteries. It can also be used to make bicycles, windmills, musical instruments and paper. Giant bamboos are truly wonders of the plant world.

Araucaria araucana: The Monkey Puzzle Tree

Anubhav Sinha
Botany Honours (Sem. III)

THE monkey puzzle tree, *Araucaria araucana* (Molina) K.Koch (Araucariaceae), is an unusual, attractive and extremely interesting plant. This coniferous tree is native to central and southern Chile and western Argentina, South America. It was first brought to the United Kingdom in 1795. Eventually, it became incredibly popular during the Victorian and Edwardian eras, and is now widely planted as an exotic ornamental tree across parks and gardens. The common name 'monkey puzzle' was coined during the mid-1800s when Charles Austin, a noted barrister, on seeing the tree for the first time humorously commented that an attempt to climb up the array of spine-laden spiralling branches of this conifer would be a puzzle even for even an arboreal simian—a monkey.

HERBAL HEALER

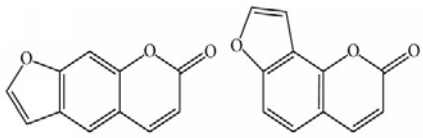
Psoralea corylifolia: The Destroyer of Leprosy

Sutapa Kumar (*Rai*)
Associate Professor

PURPLE fleabane, *Psoralea corylifolia* L. of the family Fabaceae, an endangered indigenous medicinal plant native to tropical and sub-tropical South Asia, is found throughout the plains of India, especially semi-arid regions. It is a small, erect, annual herb (up to 120 cm); stem grooved, glandular; leaves simple, elliptic, serrated margin, mucronate apex, glandular, with white hairs on both surfaces; flowers borne in 10-30 flowered axillary racemes, yellow-bluish purple, appearing from August to December; fruit small, sub-globular, compressed; seeds brownish-black, oblong, flattened. The plant is propagated by seeds and grows in the wild in grasslands. It is commonly called *babchi* or *bakuchi* in Hindustani.

The root, leaves, fruit and seeds of *P. corylifolia* are medicinally useful. This is reported in the Indian, Chinese, British and the American pharmacopoeias. In traditional system of medicines such as Ayurveda, Unani and Siddha, in India, as well as Traditional Chinese and Korean Medicine, it is well-known for its magical effects in the cure for various skin diseases. Root is effective in dental caries, leaves are antidiarrheal and fruit has laxative effect. Seed oil is of immense therapeutic importance and has been widely used through centuries against skin diseases including leprosy, leukoderma and psoriasis. In Ayurveda, it is called *kushtanashini* (destroyer of leprosy). It is also used to treat, vitiligo, a skin pigmentation disorder. It is also effective in case of inflammatory diseases, alleviates boils and skin eruptions, and used to treat itches, eczema, ringworm and scabies. Seeds are also traditionally used as herbal remedy for scorpion-sting and snake bite.

P. corylifolia is known to harbour major active constituents in the form of flavonoids, coumarins and meroterpenes. Seeds contain flavonoids such as corylifol and neo-bavaislflavone, and the coumarins psoralen and isopsoralen (see figs.).

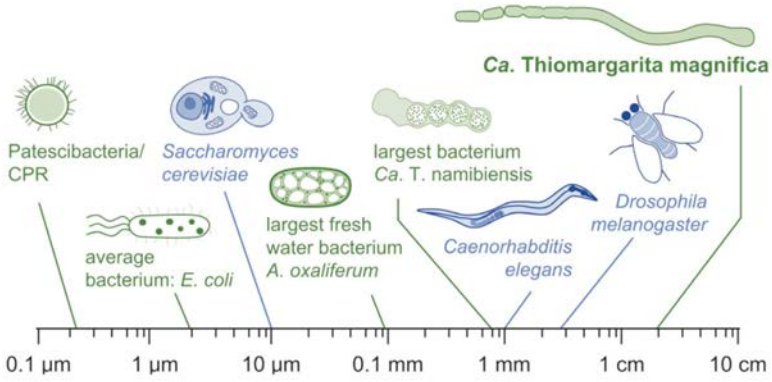


Antimicrobial, antioxidant, immuno-stimulatory and even antineoplastic effects of *P. corylifolia* extracts and active constituents are well-established. The active principle psoralen makes the skin temporarily sensitive to long-wave ultraviolet light. This UV-A is readily absorbed by the skin tissue and reaches its living cells and energizes psoralen to interact with DNA molecules via intercalations or cross-linkings, arresting overgrowth of skin cells and remove skin plaques produced by the autoimmune skin disease called psoriasis.

Although the commercial demand for this medicinal plant has recently skyrocketed, its conventional cultivation faces bottlenecks such as poor germinability of seeds. Its wild populations have also gradually declined due to overexploitation. Thus, biotechnological approaches are required for the *in vitro* propagation and *ex situ* conservation of this wonder herb. Protocols are available for its rapid, efficient micropropagation. The commercial production of its commercially-valuable pharmaceuticals through cell culture is also being explored.

Thiomargarita magnifica: A Bacterium that is not a Microbe

Ashutosh Mukherjee
Assistant Professor



BACTERIA are microscopic prokaryotic organisms. However, Jean-Marie Volland and his colleagues published a paper in the journal *Science* (2022) on the discovery of a new bacterial species, *Candidatus* (*Ca.*) *Thiomargarita magnifica*, nearly a centimetre long and visible to the naked eye. They observed seasonal 'bouquets' of long white filamentous *Thiomargarita* cells attached to the sunken leaves of the mangrove plant *Rhizophora mangle* in shallow mangroves from Guadeloupe, Lesser Antilles. The cells are stalk-like for most of their length except at the constricted apical end. Notably, DNA and ribosomes appeared to be membrane-bound and the authors proposed to name this organelle as pepin. The bacteria also shows polyploidy with numerous genome copies per cell. The genome as large as *Saccharomyces cerevisiae* (12.1 Mb) has up to 11,788 genes (more than the model fungus *Aspergillus nidulans*). Genome analysis suggested increased number of cell elongation genes coupled with the lack of key cell division genes that may be responsible for the unusual length of the bacterial cells. *Ca. T. magnifica* challenges our concept of a bacterial cell.

Bioengineering Photosynthesis: Increase in Food Crop Yield

Namrata Dhar Gupta
Botany Honours (Sem. V)

FOR the first time bioengineering of photosynthesis increased the yield of a major food crop. Recently published in the journal *Science* (2022), Amanda De Souza and others in the team of RIPE (Realizing Increased Photosynthetic Efficiency) researchers at the University of Illinois, fine-tuned a DNA construct harbouring three genes coding for proteins of the xanthophyll cycle—a pigment cycle involved in the photoprotection of plants in full sunlight. But once in the shade, it takes several minutes for to switch this off that costs time that could been used for photosynthesis. The over-expression of the three genes in target plant cells accelerated the process. Each time a transgenic leaf turns from light to shade, the photoprotection turned off faster to allow more time for photosynthesis. Its cumulative effect throughout the cultivation season resulted in 20% increases in the crop yield. These researchers first tested this idea in the model tobacco plants due to the ease in carrying out genetic transformation followed by field trials. Once successful with tobacco, they moved on to the task of trying this in a major food crop, soybean. Success with both the crops suggests that this has universal applicability. However, the next challenge would be to ensure the stability of this gain across diverse agroecosystems.