

Volume: 1, Issue: 2, April 2023



দুধনৈ মহাবিদ্যালয়
Dudhnoi College

Estd: 1972



Rongali
Bihu Special
Issue

Nature Trails



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

Editorial Board

Advisor: Dr Dipali Deka

Associate Professor & HoD
Department of Botany
Dudhnoi College

Editor: Dr Shahadev Rabha

Research Scholar
CSIR-NEIST, Jorhat
Alumnus, Dept. of Botany, Dudhnoi College

Board Members:

Mr Surjya K Swargiary

Associate Professor
Department of Botany
Dudhnoi College

Mr Soumin Nath

Assistant Professor
Department of Botany
Dudhnoi College

Mrs Anuradha Rabha

Guest Faculty & Alumna
Department of Botany
Dudhnoi College

Contents

Editor’s Page	1
Notable Aromatic Plants of Industrial Importance from North-East India	2
Rongali Bihu: Traditional Beliefs and Biodiversity Conservation	5
Career Options after B.Sc. Botany	7
Native Bogori Species of Assam.....	8
Few Ethno-Medicinal Plants in the Dudhnoi Area	9
Crispr/Cas9 Genome Editing Technology – a Valuable Tool for Genome Editing	12
Flora	15

Editor's Page

~Shahadev Rabha

At the very outset, I would like to express my warm greetings and wishes to all the members of the Alumni Association of Botany Department, Dudhnoi College, the Dudhnoi College fraternity and all our well-wishers and readers on the auspicious occasion of Rongali Bihu and the Assamese New Year 1430 shakabda. May this Bihu and the New Year bring happiness, peace, prosperity and success in everyone's life!

This year Assam's traditional Bihu dance enters the Guinness Book of World Records with the participation of more than 11,000 performers, including drummers and dancers at the Sarusajai Stadium in Guwahati., This is, undoubtedly, a proud moment for the people of Assam.

Bihu, an inalienable part of Assamese cultural identity, is, however, not only of dance and performance but also traditions, rituals and beliefs. Bihu is celebrated at the beginning of the New Year and when nature also changes its phase from old to new. Bihu is celebrated in harmony with nature. Bihu itself has such a great Ethnobotany that, perhaps, no other festival in the world has. From musical instruments to vegetables, natural colours to tradition and worship, plant plays a major role in the Bihu festival.

However, the impact of modernization and globalization is not far from affecting the traditional Bihu of Assam. Therefore, there is huge scope to work on the Ethnobotany of Bihu, which will help preserve the tradition of Bihu as well as the conservation of nature.

Happy Rongali Bihu



Notable Aromatic Plants of Industrial Importance from North-East India

Dr Dipali Deka

Associate Professor and HoD, Dept of Botany, Dudhnoi College

North East India is dominated by aboriginal communities and the whole area is very rich in biodiversity. There are about 10,000 flowering plant species belonging to this region which represents 50% of the total flora of the country. North Eastern region is endorsed with a rich resource of medicinal and aromatic plants, many of which have been used generation after generation, especially by the aboriginal communities in the promotion of health, preparation of drugs and use of fragrance materials. Though adequate attention has not so far been paid to these resources, still, there is a good scope for developing agro-based industry in the northeastern region based on the local resources of medicinal and aromatic plants.

Those plant species which contain aromatic compounds, basically essential oils that are volatile at room temperature are called aromatic plants. These essential oils are strong-smelling, volatile, hydrophobic and highly concentrated compounds, which can be obtained from flowers, buds, seeds, leaves, twigs, wood, bark, fruits and roots.

As it is known to, all of us 'Perfume' or 'Aroma', which we use to smell, has been a less known subject or a neglected subject of discussion and common people have an impression that a mysterious veil is surrounding this matter. In the recent few years, it has been observed that science has torn off this veil and deals with the various aspects of perfumery.

In India, the demand for essential oil is from a few consumer industry products broadly grouped under fragrance, flavour and aromatic chemicals. Shampoo, toothpaste, cream, mouthwash, telcom powder etc are the products of 'fragrance type'. Soft drinks, processed food, chocolates, confectioneries, beverages, ice cream etc are the products of 'flavour type'. Pharmaceutical formulations and drugs other than bulk are the products of the 'aromatic chemical type'.

The northeastern region shares the bulk of production of 3 particular types of essential oil in the country. Commercially produced essential oil yielding the main 3 plant species in the northeastern region are – 1. Java citronella 2. Lemon grass and 3. Plamarosa.

The cultivation areas of aromatic plants in the northeastern region during the year 2008-09 may be mentioned as follows:

State	Location	Area (hectare)
Assam	Boko, Rajapara, Bongaigaon, Dhubri, Mankachar, Golaghat, Khoirabari, Makum, Pengeri, Dibrugarh, Goalpara, Nalbari, BTC areas	3403
Arunachal Pradesh	Changlang, Tawang, Pasighat, Lumla, etc.	62
Meghalaya	Borapani and adjoining areas, Garo Hills (Adokgiri)	45
Total area		3510

Nature Trails, Volume: 1, Issue: 2, April 2023

A few important essential oil yielding plant species having industrial importance, which are growing/cultivating in North East India are mentioned as follows:

Sl.No	Scientific Name	Local Name (Assamese)	Family
1.	<i>Acorus calamus</i> L.	Boch	Araceae
2.	<i>Ageratum conyzoides</i> L.	Gondhowa bon	Asteraceae
3.	<i>Alpinia galanga</i> (L.) Willd.	Tora goch	Zingiberaceae
4.	<i>Ammomum aromaticum</i> Roxb.	Soru-elachi	Zingiberaceae
5.	<i>Aquilaria agallocha</i> Roxb.	Agor	Thymeliaceae
6.	<i>Callicarpa arborea</i> Roxb.	Bon-mala	Verbenaceae
7.	<i>Cinamomum camphora</i> (L.) ness and Eberm	Korpur	Lauraceae
8.	<i>Cinamomum tamala</i> Ness and Eberm	Tejpat	Lauraceae
9.	<i>Cinamomum zeylanicum</i> Blume.	Dalchini	Lauraceae
10.	<i>Citrus aurantirum</i> L.	Komola tenga	Rutaceae
11.	<i>Citrus limon</i> L.	Gol nemu	Rutaceae
12.	<i>Citrus decumana</i> L. syn. <i>C. maxima</i> L.	Robab tenga	Rutaceae
13.	<i>Curcuma amada</i> Roxb.	Am ada	Zingiberaceae
14.	<i>Curcuma aromatica</i> salisb.	Bon halodhi	Zingiberaceae
15.	<i>Cymbopogon flexuosus</i> (Ness ex Steud). Wats var. <i>sikkimensis</i> Stopf.	Gondh-birina (Lemon grass)	Poaceae
16.	<i>Cymbopogon nurdus</i> DC.	Citronella	Poaceae
17.	<i>Cymbopogon martinii</i> (Roxb.) J.F.	Citronella (Palmarosa)	Poaceae
18.	<i>Chromolaena odorata</i> L.	Jarmani-bon	Asteraceae
19.	<i>Eucalyptus citriodora</i> Hook	Eucalyptus	Myrtaceae
20.	<i>Glycyrrhiza glabra</i> L.	Jastimodhu	Fabaceae
21.	<i>Hedychium coronarium</i> Koenig.	Bogi-champa	Zingiberaceae
22.	<i>Homalomena aromatica</i> Roxb.	Gondh-kochu	Araceae
23.	<i>Houttunia cordata</i> Thunb.	Mosundori	Saururaceae
24.	<i>Leucas aspera</i> (Roth.) Spreng.	Doron	Lamiaceae
25.	<i>Litsea subaba</i> Pers.	Mejangkori	Lauraceae
26.	<i>Matricaria chamomilla</i> L. var. <i>recutita</i>	Chamomile	Asteraceae
27.	<i>Mentha arvensis</i> L.	Pudina	Lamiaceae
28.	<i>Mentha piperita</i> L.	Pudina	Lamiaceae
29.	<i>Michelia champaca</i> L.	Champa phul	Magnoliaceae
30.	<i>Ocimum basilicum</i> L.	Bon-tulosi	Lamiaceae
31.	<i>Ocimum gratissimum</i> L.	Ram-tulosi	Lamiaceae
32.	<i>Ocimum sanctum</i> L.	Tulosi	Lamiaceae
33.	<i>Pandanus odoratissimus</i> Roxb.	Keteki	Pandanaceae
34.	<i>Pinus roxburghii</i> L.	Pine	Pinaceae
35.	<i>Syzygium aromaticum</i> L. (Clove plant)	Long	Myrtaceae
36.	<i>Pogostemon auricularius</i> (L.) Hassk.	Sukloti	Lamiaceae
37.	<i>Pogostemon cablin</i> Benth.	Patchouli	Lamiaceae
38.	<i>Rosa indica</i> L.	Golap	Rosaceae
39.	<i>Zanthoxylum oxyphyllum</i> Edgew.	Mezenga	Rutaceae
40.	<i>Zingiber officinale</i> Roxb.	Ada	Zingiberaceae

During the year 2019, India produced a total of 15,990 MTA (Million Tons Per Annum) essential oil from *Mentha* species, *Basil* species, *Eucalyptus* species, *Cymbopogon* species

and Sandalwood. Assam shares about 88% of the total area of N.E. India under cultivation of aromatic plants, Arunachal Pradesh 0.61 and Meghalaya 0.7%. Some Citronella cultivation areas are also observed in Manipur, Nagaland, and Mizoram.

According to recent data, the total area under aromatic plant cultivation in the North Eastern region is estimated to be 4000 hectares (Citronella 90% and lemon grass and others 10%). The production and turnover of essential oil per annum are 750 MT and Rs. 25 crores per annum. More than 25,000 families are employed in this activity. There are at present 300 processing units under the operation of 700 kgs per batch capacity. Other varieties of minor products are- 1. Patchouli, 2. Mentha, 3. Eucalyptus and 4. Palmarosa.

Essential oils are the basic raw materials in perfumery, flavour and cosmetics industries and are used in a wide range of products like soaps, detergents, cosmetics, agarbattis, disinfectants, deodorants, mosquito repellants, flavouring of food, soft and hard drinks, pharmaceuticals, tobacco products, variety of perfumery products and also used as fixatives and for blending purposes. Apart from these common applications in different types of industrial products recently essential oils have become popular in 'Aroma therapy' in many developed countries like Japan. Some recent applications of essential oils are- antifeedants, repellants, bio-insecticides, natural herbicides and growth boosters in agriculture.

Providing superior strains along with advanced procedures, designing efficient extraction methods and evolving proper marketing procedures, the essential oil industry has a vast scope of development in the coming days in North East India. Efforts on making value-added products, which have enormous export potential, can make it a more profit-oriented industry, which will improve the socio-economic status of our farming community.



Ocimum gratissimum L.



Pogostemon parviflorus Benth.



Ocimum basilicum L.



Ocimum sanctum L.

Rongali Bihu: Traditional Beliefs and Biodiversity Conservation

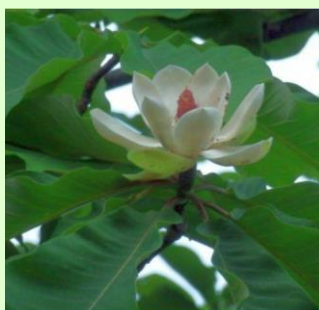
Dr Reetashree Bordoloi

Nature Environment and Wildlife Society

Assam is endowed with multi-linguistic and multi-ethnic communities spread over areas in upper, middle and lower Assam. Peoples of the state celebrate spring-time festival following their own traditions and customs with enthusiasm. The word ‘Bihu’ has become identical with all spring – time festivals prevalent in Assam. Ritual is an inevitable part of social existence. Ritual in the context of Assam usually brings into mind the images of different festivals, traditional beliefs, and age-old practices. Bihu, and its integral association with agriculture and fertility, is of utmost significance to the culture and heritage of Assam. People in a society are united by certain values and elements received through inheritance. So, it is essential to understand how rituals have contributed towards wellbeing and sustenance of the social health of a community. Various plant species are associated with the numerous festivities and rituals of this Rongali Bihu. Jetuka (*Lawsonia inermis*) and barhamthuri (*Magnolia sphenocarpa*) are natural colours widely used during Rongali Bihu. Although jetuka paste is applied throughout the year, applying it on fingernails, hands, feet, etc., during Bihu, especially on the day of Goru Bihu, is believed to have medicinal effects. It is especially considered to be effective against skin diseases and chicken pox and barhamthuri serves as a natural lipstick. On the first day of Bohag, leaves of nahar (*Mesua ferrea*) trees are hung on the doorway or roof of the house which is believed to protect the house against storm. Kopou Phool (*Rynchosylis retusa*) without which Bohag Bihu can’t be imagined. It adorns the buns of young damsels and Bihu dancers and is considered to be the ultimate expression of love. Hence, among all flora used during Bihu, kopou phool occupies a prime place. Deeghloti (*Litsea salicifolia*) and Makhiyoti (*Flemingia strobilifera*) leaves are used for patting the cow on the first day of Bohag bihu is a age old tradition and is believed that doing this protects the cows against various insects, which has been scientifically proven as well. Green leafy vegetables always form an important component of Assamese cuisine.



Lawsonia inermis



Magnolia sphenocarpa



Flemingia strobilifera

During Bihu, especially on Goru Bihu or Saat Bihu, there is a ritual called Satsaki a special dish is prepared from seven, 12, 100 or 107 green leafy vegetables depending on the area and community. It is popularly believed that consuming the dish helps in prevention of several diseases throughout the year. Some of the green leafy vegetables used in preparing

Satsaki are *Diplazium esculentum*, *Clerodendrum colebrookianum*, *Piper sylvaticum*, *Paederia foetida*, *Vitex negundo* (L), *Curcuma longa* (Salisb), *Houttuynia cordata*, *Centella asiatica*, etc. are having the rich sources of essential nutrients. Along with their own traditional beliefs, scientific studies too have proved the importance of these plant species. Which shows that they are concerned about traditional ecological knowledge and the live ritual activities and beliefs of the people are also keeping the plant diversity preserved since time immemorial? Efficient conservation can be possible only when the technical expertise is combined with an understanding and consideration of the cultural practices of local communities. Ritual beliefs of the indigenous people are one of a prominent tool to understand the local communities and aid the nature conservation. Conserving biodiversity based on cultural and religious faiths is often more efficient and sustainable than based only on governmental legislation or regulation. Traditional conservation ethics are capable of protecting species diversity in particular and the environment in general as long as the local people have a stake in it. Hence, we seek to emphasize traditional belief as an alternative view of conservation.



Litsea salicifolia



Mesua ferrea



Rynchosyilis retusa



Clerodendrum colebrookianum



Paederia foetida



Houttuynia cordata

Career Options after B.Sc. Botany

Anuradha Rabha

Guest Faculty and Alumna, Dept. of Botany, Dudhnoi College

Botany is a noble branch of biology, which deals with the study of plants. It is a very beautiful subject, and people who are interested in plants related studies or who love nature, naturally choose this subject as an honour for their bachelor's degree. Choosing a career in botany ensures a person a wide choice of career opportunities, a fair salary and an exciting life. If one prepared themselves with a good education and a positive attitude, they will be well on their way to becoming a successful botanist.

Nowadays, apart from studying botany as a classical origin, the education department has introduced many vocational options to it. For example, the new CBCS (Choice Based Credit System) course at Gauhati University has introduced many Elective and Skill Enhancement papers for the students of each department. The elective papers, which are known as BOT-HE for the students of the 5th and 6th semesters and include – 1. Natural Resource Management, 2. Horticultural Practises and Post-Harvest Technology, 3. Industrial and Environmental Microbiology, 4. Analytical Techniques in Plant Sciences and 5. Project Work /Dissertation with options for anyone. The Skills Enhancement papers, which are known as BOT-SE for the students of the 3rd and 4th semester and include – 1. Biofertilizers, 2. Nursery and Gardening, 3. Herbal Technology, 4. Floriculture and 5. Intellectual Property Rights with options for choosing any one. With the help of these subjects, the students can go for farming, nursery, laboratory handling, gardening etc. and become self-employed. Our Dept. of Botany also had taken the benefit of the new course and organised training and certificate course in Vermicomposting and Mushroom Cultivation.

Job opportunities after B.Sc. Botany	Higher Education options after B.Sc. Botany
IFS (Indian Forest Service)	M.Sc. Botany
Conservationist	M.Sc. Life Science
Forest Ranger	M.Sc. Microbiology
Forester	M.Sc. Biotechnology
Forest Guard	M.Sc. Bioinformatics
Laboratory Assistant	M.Sc. Environment Sciences
Nursery Business (self-employed)	M.Sc. Molecular Biology and Biotechnology (MBBT)
Farming (self-employed)	M.Sc. Forestry
Mushroom cultivation (self-employed)	M.Sc. Horticulture
Bio-fertilizers Production (self-employed)	M.Sc. Agriculture
Bio-pesticide Production (self-employed)	MBA in Pharmaceutical Management

After completing M.Sc. degree, one can go for research, and become a scientist, specialist or professor.

Native Bogori Species of Assam

Prosanto Marak

Alumnus, Dept. of Botany, Dudhnoi College

Bogori or 'Bagari' is the common name of *Ziziphus* in the Assamese language. *Ziziphus* which belongs to the family Rhamnaceae is named after the genus *Rhamnus*. *Ziziphus* presents about 38 species worldwide (Identified to date), out of which about 12 species are found in Assam. Among them some are edible and some are not. The common species of *Ziziphus* found throughout Assam and some other parts of India are- *Ziziphus andamanica*, *Ziziphus apetala*, *Ziziphus brunoniana*, *Ziziphus funiculosa*, *Ziziphus incurve*, *Ziziphus mauritiana*, *Ziziphus oenopolia*, *Ziziphus rugosa*, *Ziziphus xylophora* etc. Among them, the *Ziziphus mauritiana* is the most frequently found species in Assam. These species prefer open, plain, and scrubby jungles as their habitat, and drupes are their fruit.

It was frequently discovered in the aforementioned habitat about ten years ago. But due to human activities, it is now rare to find the indigenous species of *Ziziphus*. Instead of native species, people are now using to cultivate the hybrid or Genetically Modified (GM) species of *Ziziphus* which produce higher yields and bring them higher profits. Which is leading to the decline of the native species. Another factor is the destruction of habitat by many human activities. According to sources, almost 19% of this species' entire habitat is reportedly declining. The continuous occurrence will lead to the extinct the native species. Not just the *Ziziphus* but many other indigenous species such as *Oriza* (Rice) also contribute to the loss of our native species by destroying their habitat and being replaced with GM species. Our native species should be protected rather than letting it go extinct.



Native species of *Ziziphus*



Hybrid species of *Ziziphus*

Few Ethno-medicinal Plants in the Dudhnoi Area

Meser Ali

Alumnus, Dept. of Botany, Dudhnoi College

In our country, the traditional system of medicines plays an important role in the health care of rural people for all types of ailments. The healing power of traditional herbal medicines has been realized and documented since Rigveda and Arthabaveda. Since then plants and their extracts have been used therapeutically and even today plants based medicines continue to play an essential role in world health care. India has about 45000 plant species and more than 35000 plant species have been claimed to possess medicinal properties and are being used in various human cultures around the world for medicinal purposes. India is a country inhabited by a large number of people having a diverse ethnic group. There are over 400 different tribes and other ethnic groups residing mostly in rural areas in India and most of them are still living in remote forest areas, which depend to a great extent on the indigenous system of medicines. However recently it seems that this type of knowledge on traditional medicine is vanishing from modern society since younger generations are not interested to carry on this tradition. In India it is reported that traditional healers use 2500 plant species of plants that serve as regular sources of medicine.

Assam one of the seven states of North-East India has a strong base in indigenous herbal formulations. The composite knowledge persisted within several tribal communities of the state and has tremendous scope to deliver the leads for modern therapeutics.

The major percentage of (85%) of the total population of Dudhnoi, Goalpara district of Assam is shared by Rabha tribal communities as- Pati Rabha, Rangdhaniya Rabha etc., (According to their local). Dudhnoi was also declared the “Rabha Hasong Autonomous Council” (RHAC) in 2005.

The aboriginal communities of Dudhnoi always prefer natural methods of treating diseases using medicinal plants which are considered to be more reliable on one hand and most of the plants are readily available on the other. Tribals of Dudhnoi live in harmony with nature. These tribals have their ways to use many plant species against different diseases. Since the ancient period, these people have been using plants and plant parts to solve different kinds of diseases such as bone fracture, skin diseases, reproductive diseases of males and females, fever, jaundice, diarrhoea, dysentery and many other common diseases.

1. *Aloe barbadensis* (Liliaceae)

Local name: Sal konwari

Part used: Leaf

Medicinal use: The juice of roasted leaves is given with honey for cough and cold. The leaves are crushed and the paste is layered on the skin for curing skin burn. It is used as natural skin care for women. The juice of aloe Vera its curing mild fever. People have also used the juice of Aloe Vera as a tonic for digestion. It may even improve blood, and sugar control. It also helps to cure jaundice, if taken in a pulp of 2-3 leaves ground with 50 gm talmisri and taken with 250 ml milk for 6-7 days.

2. *Azadirachta indica* (Meliaceae)

Local name: Neem

Part used: Leaf

Medicinal use: Neem has a remarkable effect on chronic skin conditions. Acne, psoriasis, eczema, ringworm, and even stubborn warts are among the conditions that can clear up easily when high-quality, organic neem oil is used. Sometimes it is also used as a pain killer.

3. *Euphorbia hirta* (Euphorbiaceae)

Local name: Gakhirooti

Part used: Whole plant

Medicinal use: *Euphorbia hirta* is often used traditionally for female disorders, respiratory ailments (cough, cold, bronchitis and asthma), worms, the infestation of children, dysentery, jaundice, pimples, gonorrhoea, digestive problems and tumours.

4. *Ocimum sanctum* (Lamiaceae)

Local name: Tulsi

Part used: Leaf

Medicinal use: Tulsi also treats heart disease and fever. Tulsi is used for treating respiratory problems. Tulsi is used to curing fever, common cold and sore throat, headache and kidney stones. Tulsi helps in treating asthma and cough.

5. *Marraya koenigii* (Rutaceae)

Local name: Narsinha

Part used: Leaf, roots

Medicinal use: In Ayurvedic medicines use powder dry curry leaf mixed with honey and betel nut juice as anti-periodic. The leaves of these plants are used externally for application to bruises, burns, eruption and treatment of diabetes mellitus. *Marraya koenigii* is currently being used as a stimulant and dysentery. It is also used for the treatment of poisonous animal bites. They are also used in curing piles, and allaying body heat, thirst, itching and inflammation.

6. *Mentha viridis* (Lamiaceae)

Local name: Podina

Part used: Whole plant

Medicinal use: in addition food flavouring agent, mint is well known for its traditional medicinal uses, particularly for the treatment of colds, coughs, jaundice and digestive problems.

7. *Eryngium foetidum* (Lamiaceae)

Local name: Man dhania

Part used: Whole plant

Medicinal use: *Eryngium foetidum* has been used in traditional medicine in tropical regions for burns, fever, hypertension and asthma

8. *Leucus aspera* (Lamiaceae)

Local name: Doron

Part used: Leaf

Medicinal use: The plant is used traditionally as an antipyretic and insecticide. Medicinally, it has been proven to possess various pharmacological activities like antifungal, antioxidant, antimicrobial, antinociceptive and cytotoxic activity. We can use it as digestion juice. Its leaves are used as a vegetable for many medicinal purposes.

9. *Mirabilis jalapa* (Nyctaginaceae)

Local name: Gadhuli gopal

Part used: Leaf, root

Medicinal use: Mirabilis plants may be used as a diuretic, purgative and for vulnerary (wound healing) purposes. The root is believed to be aphrodisiac as well as having diuretic and purgative properties. It is also used in the treatment of dropsy. The leaves are reduced inflammation.

10. *Carica papaya* (Caricaceae)

Local name: Omita

Part used: Fruits, roots, bark, peels and seeds

Medicinal use: *Carica papaya* is used for the treatment of numerous diseases like warts, corns, sinuses, eczemas, cutaneous, tubercules, glandular tumours, blood pressure, dyspepsia, constipation, amenorrhoea, general debility, expel worms and stimulate reproductive organs and many as results common diseases.



Leucus aspera



Eryngium foetidum



Ocimum sanctum



Mentha viridis

CRISPR/Cas9 Genome Editing Technology – a valuable tool for genome editing

Kuldeep Daimary

*PhD Scholar, Gauhati University
Alumnus, Dept. of Botany, Dudhnoi College*

Genome editing is a group of technologies that give scientists the ability to change an organism's DNA. It allows the genetic material to be added, removed or altered at particular locations in the genome of an organism.

Prokaryotic organisms including many bacteria and nearly all of the archaea have an odd structure in their genome. A portion of their DNA consists of many short, distinctively repetitive base sequences, interspersed with other short, variable “spacer” sequences. Biologists called this structure CRISPR for clustered regularly interspaced short palindromic repeats. Adjacent to it is a CRISPR-associated system (Cas) of genes for enzymes that can cut DNA. CRISPR/Cas9 genome editing tool is currently creating a buzz in the science world. It is faster, cheaper and more accurate than previous techniques of genome editing and has a wide range of potential applications.



Fig. Nobel laureates, Emmanuelle Charpentier (left) and Jennifer Doudna (right), Inventors of CRISPR/Cas9 genome editing technology. (Image source: www.britannica.com)

The development of a method for genome editing based on CRISPR/Cas9 technology was awarded The Nobel Prize in Chemistry in 2020, after the discovery of all principal molecular components of the system. For the first time in history a Nobel Prize was awarded to two women, Jennifer Doudna and Emmanuelle Charpentier who made key discoveries in the field of DNA manipulation with the CRISPR–Cas9 system, so-called “genetic scissors”. Compared with the traditional gene-editing technology, CRISPR–Cas9 has a higher gene-editing efficiency, lower off-target effect, and no DNA integration, so it is considered as an ideal gene-editing technology.

The CRISPR/Cas9 genome editing technology takes advantage of DNA repair mechanism. A bacterium, when infected by a virus (e.g. Bacteriophage), it uses a Cas9 protein to snip off a piece of viral DNA known as a protospacer. This fragment is stored in the bacterial genome with fragments from other viruses that have previously infected the cell as an immune memory. These viral spacer fragments are placed between repeated palindromic sequences.

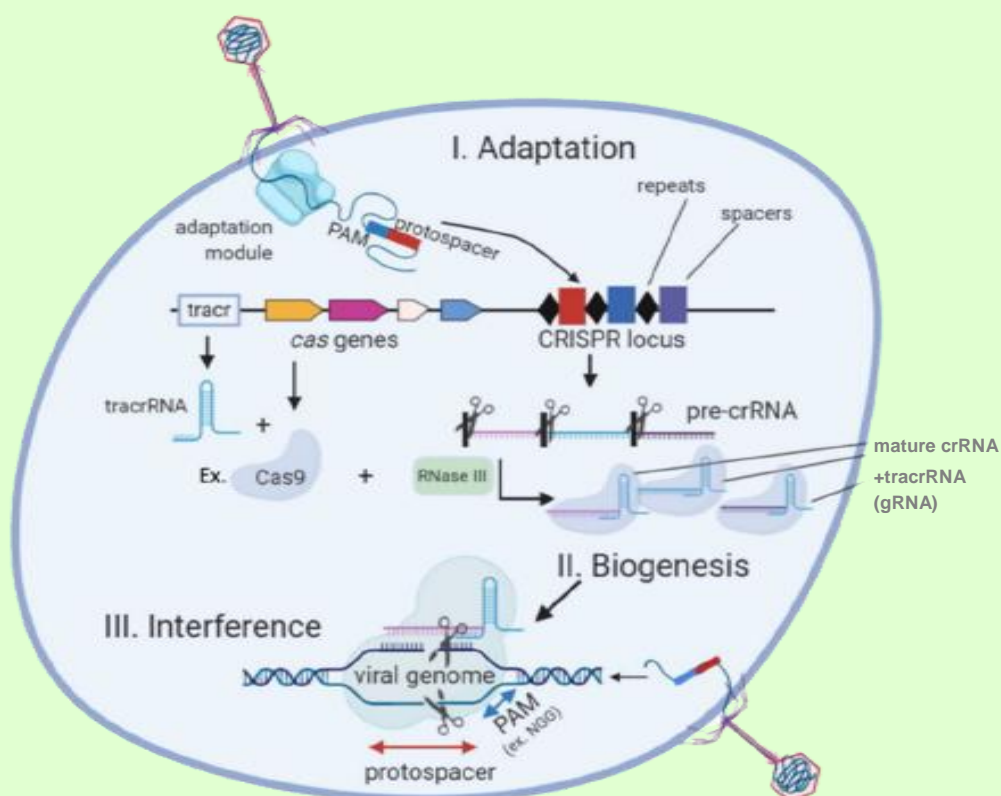


Fig. General Mechanism of CRISPR (Arroyo-Olarte, et al. 2021).

The general mechanism of CRISPR/Cas9 works in three distinct phases -

Adaptation: During this phase Bacteria develops a weapon against foreign invading DNA (viral or plasmid DNA). It involves cutting up a piece of foreign invading DNA, called protospacers and integrating it between two adjacent repeats in the CRISPR locus. The invading DNAs are directionally integrated, as new CRISPR spacers, into a CRISPR array

that is separated by repetitive sequences, thus it creates memory of the foreign invading genetic elements.

Biogenesis: During this phase the CRISPR locus is transcribed into a pre-CRISPR RNA (pre-crRNA) when the desired sequence (i.e. protospacer) from the invading DNA is integrated into the loci of CRISPR. CRISPR loci are transcribed from an upstream promoter located in the AT-rich leader sequence. The pre crRNA is then processed into mature crRNAs, each containing a transcribed spacer sequence joined to the partial repetitive sequence.

Interference: During this phase complex formation takes place between crRNA and Cas proteins. The crRNA of the crRNA-Cas complex makes base pairing with the protospacer of the foreign invading DNA. Finally, crRNA-directed cleavage of invading DNA occurs by Cas proteins at protospacer, a site complementary to the crRNA spacer sequence.

CRISPR/Cas9 has been rapidly developed and successfully applied in plants to alter their metabolic pathways and enhancement of their quality by gene mutation, gene silencing, and transcriptional regulation etc. It has great potential for transforming agriculture by making plants tolerant to biotic and abiotic stresses, improving their nutritional value and yield. It has the attributes that are necessary to meet the demand of an increasing world population. CRISPR/Cas9 is a revolutionary tool that can impact science, society and food production. In order to use this technology effectively and durably in crop improvement, the scientific community needs to address the various biosafety and societal concerns about it. There is also a need to re-evaluate the regulations of genome edited plants and to educate the general public about their properties.

Reference

- Ma, Y., Zhang, L., & Huang, X. (2014). Genome modification by CRISPR/Cas9. *The FEBS journal*, 281(23), 5186-5193.
- Jiang, F., & Doudna, J. A. (2017). CRISPR–Cas9 structures and mechanisms. *Annual review of biophysics*, 46, 505-529.
- Arroyo-Olarte, R. D., Bravo Rodriguez, R., & Morales-Ríos, E. (2021). Genome editing in bacteria: CRISPR-Cas and beyond. *Microorganisms*, 9(4), 844.
- El-Mounadi, K., Morales-Floriano, M. L., & Garcia-Ruiz, H. (2020). Principles, applications, and biosafety of plant genome editing using CRISPR–Cas9. *Frontiers in plant science*, 11, 56.
- Kumar, P. *Molecular Biology Techniques*.
<https://www.britannica.com/biography/Jenifer-Doudna#/media/1/2033401/204855>
<https://www.yourgenome.org/facts/what-is-crispr-cas9/>
<https://crisprtx.com/gene-editing/therapeutic-approach>
<https://www.quantamagazine.org/2020-nobel-prize-in-chemistry-awarded-for-crispr-to-charpentier-and-doudna-20201007/>

Flora

Rupathi Khakhalary

Alumna, Dept. of Botany, Dudhnoi College

They say I am beautiful,
They say I am astounding
They say I am magnificent

They say they like me
Then why, then why?
They kill me to pleasure themselves!

They say I made them look fetching
Then why, then why?
They pluck my soft pretty petals!

They like my purity and divinity
Then why! Then why?
They wound my green leaves i adore most!

Am I not worth of their care?
Am I just a subject to their rapacity?
Or maybe I am not just enough!

I, I just want to bloom happily,
I just want to float freely
I just want to dance with butterflies merrily!



BOT

P O B T N

DEPARTMENT OF
BOTANY