



Anthesis

Volume 12: 2016-2017

Special Focus:

Recent Advances in Plant Sciences

Department of Botany
Gargi College, Siri Fort Road
New Delhi-110049



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SPECIAL FOCUS: RECENT ADVANCES IN PLANT SCIENCES

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From the Principal's Desk



Dr. Promila Kumar

It is indeed a matter of pride to pen down the preamble for the annual magazine **Anthesis** of Botany Department. The presence of this department can be felt through plants, flowers and scientific cataloguing of the flora while walking down the corridors and lawns of the college. When the environment around you is clean, you experience a higher level of awareness and it helps you to see the things more evidently.

The department is committed to provide an environment which enriches the intellectual and emotional development of students in an atmosphere that is vigorous, happy and nurturing. Their aim is to provide an education which explores and strengthens the potential which is innate in every individual but awaiting expression. Publishing a magazine is one such endeavour in this direction.

I congratulate the editorial team and contributors for this initiative and eagerly await the coming issue of Anthesis.

Dr. Promila Kumar

Principal

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From the Teacher-In-Charge's Desk



Dr. Geeta Mehta

Anthesis is a forum where we get to see the creative expression of our students. Each issue of Anthesis unleashes a wide spectrum of creative skills ranging from writing to editing and even designing the magazine. I congratulate the entire editorial team for their hard work and dedication.

I hope everyone would continue to give their full efforts to keep the momentum and standard of Anthesis, the magazine of our department, in the years to come.

Dr. Geeta Mehta

Teacher-In-Charge

Department of Botany, Gargi College

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From the Editor's Desk



Aishwarya Singh

B.Sc. (H) Botany, III year

Plants have been an integral part of our lives since time immemorial and their importance in sustaining life on earth cannot be disputed. They are a valuable creation of nature and hold solutions to most of the problems that the mankind faces. The utility of plants in almost all aspects of life make their study essential for better understanding and implementation of the useful properties hidden within them. The scope of plant sciences is expanding with every passing day and it is the reason why we decided to focus on the recent advancements in plant sciences in this volume of Anthesis.

I feel glad to say that Anthesis has successfully completed its journey of twelve magnificent years with the release of this issue. Anthesis provides a platform to the students and teachers to express and share their views on what interests them in science. With the aim of wider outreach and easy accessibility, we have continued the norm of releasing the magazine in electronic form which is also a small step towards environmental conservation through avoiding wastage of paper.

First and foremost, we pay our heartiest tribute to Lt. Dr. Lalita Sehgal, who is no longer between us. This year, Gargi College completed its 50 glorious years and the highlights of the year round golden jubilee celebrations have been put together in the magazine. The Botany department also celebrated the golden jubilee year with much enthusiasm through organizing lecture series and various competitions. In this volume of Anthesis, we have also come up with the group pictures of all the students from the three batches along with the faculty members.

This issue of Anthesis contains some very well written articles that have been contributed by students and teachers of the department and other science departments as well. The outbreak of diseases like “Dengue” in recent times led to the discovery of valuable medicinal properties of Giloy, which is the famous plant for this volume. Dr. Panchanan Maheshwari, one of the most recognized plant scientists of India and the world is our famous botanist this time. We have included several poems and pictures contributed by the students to encourage the creativity within them. The magazine also contains fun games the answers of which are also hidden within the magazine.

All the articles in the magazine have been hyperlinked for easy browsing and access. Readers can click the on the article they wish to read from the list of contents to go directly to the same and come back to contents by clicking the link at the end of every article. So, what are you waiting for? Go, explore and have fun!

Now I would like to extend my heartiest gratitude to our teacher advisors Dr. Renu Soni and Dr. Reema Mishra for being the constant guiding force throughout the making of Anthesis vol. 12. It would not have been possible to come up with this issue without their kind support and able guidance. I would also like to thank our teacher in-charge Dr. Geeta Mehta for supporting us and our principal Dr. Promila Kumar for providing us the opportunity to publish this magazine. Lastly, I want to thank all the members of the editorial board of Anthesis who worked very hard in making of this volume. Also, I thank all the students and teachers who contributed wonderful articles for our magazine. We have tried our best in making the magazine an informative yet enjoyable one for the readers and we look forward to the valuable response and feedback.

Aishwarya Singh

Editor (Anthesis Volume 12)

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In the Memory of
Late Dr. Lalita Sehgal



21.11.1942 – 12.08.2016

Lt Dr. Lalita Sehgal, Associate Professor in the Department of Botany, Gargi College had left for her heavenly abode on August 12, 2016. People like her never really die, they remain in our hearts forever because of their good deeds.

Dr. Sehgal's contribution to the Botany department and the college was immense and memorable. The college has lost a good teacher. Definitely, it is an irreparable loss to the college.

She joined the college on August 03, 1971 and was a distinguished and committed teacher.

She was member of many college committees during her long service. She took active part in extracurricular activities and field trips. She has instituted three awards. She was actively engaged in social service activities, especially for NAMI- INDIA (an NGO working in the area of Mental Illness).

She will always be remembered by her students, friends and colleagues.

Let the Almighty provide peace to the departed soul.

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Glimpses of Dr. Sehgal's life at Gargi College





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50 GLORIOUS YEARS OF GARGI COLLEGE

GOLDEN JUBILEE CELEBRATIONS

Golden Jubilee Year Inauguration



Shalini Latiyan

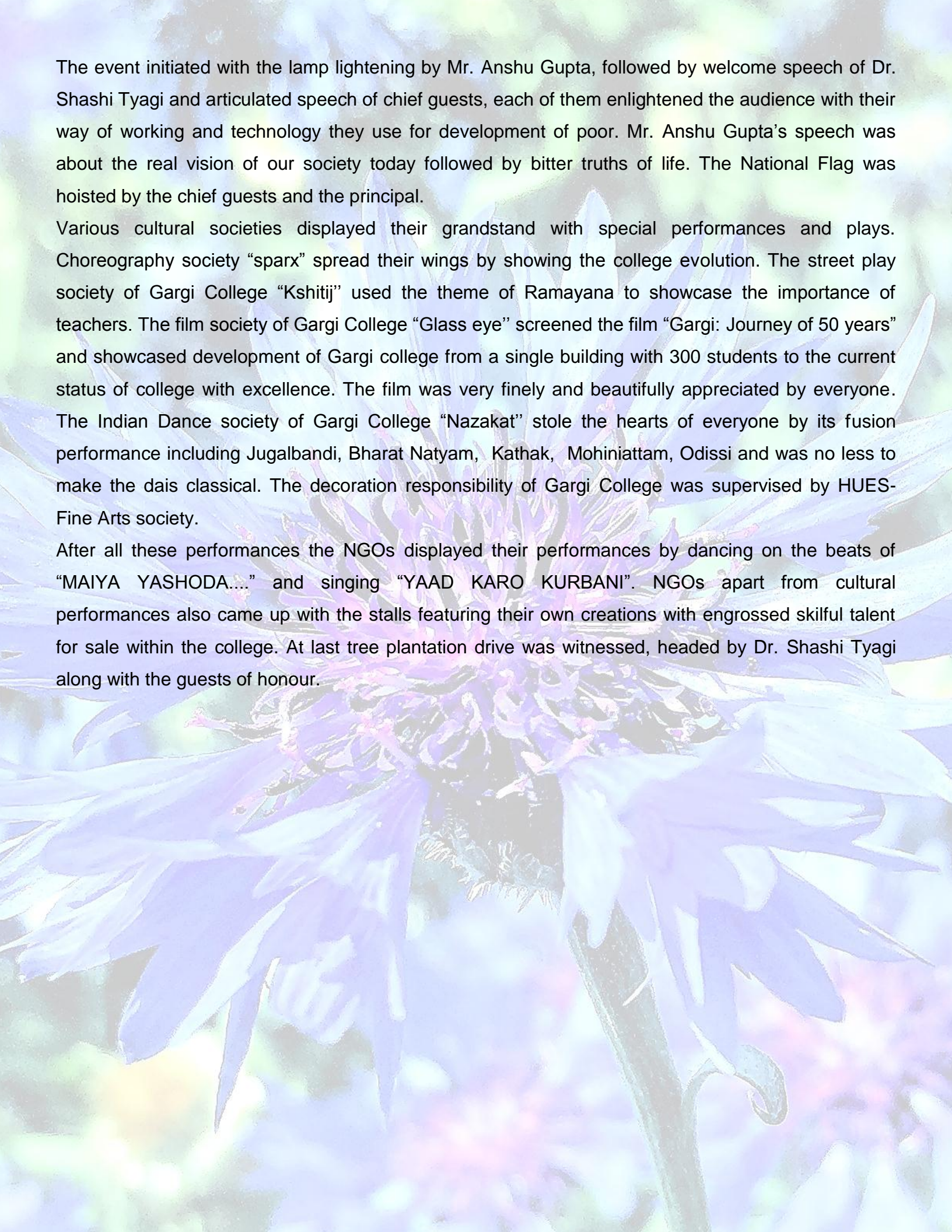
B.Sc. (H) Botany, III year

“It’s not about completing years, it’s about creating great leaders”

As I think about the fifty glorious years of existence and growth of Gargi College, my heart fills up with love, admiration and pride for the fertile soil which the college provides to under graduates, who enter its portals for the first time as young girls and then leave as responsible women. The college was established in 1967 and is definitely the most sought women’s college in South Delhi campus for Sciences, in University of Delhi. On the successful accomplishment of 50 years, the college inaugurated its golden jubilee celebration on 17th August, 2016. The celebration was a huge success. The celebrations continued throughout the academic year 2016-17 with various events at different time intervals to make the year commendably remarkable.

The inaugural event was based on the theme “**service to humanity**”. 15 NGOs actively participated in the program; some of them were Youth for Seva, Tamanna, Yodhas, AryaMahila, Jamkhat along with Cheshire and Goonj, etc. Presence of orphan students & their unique performances left me teary eyed and with a deep sense of compassion.

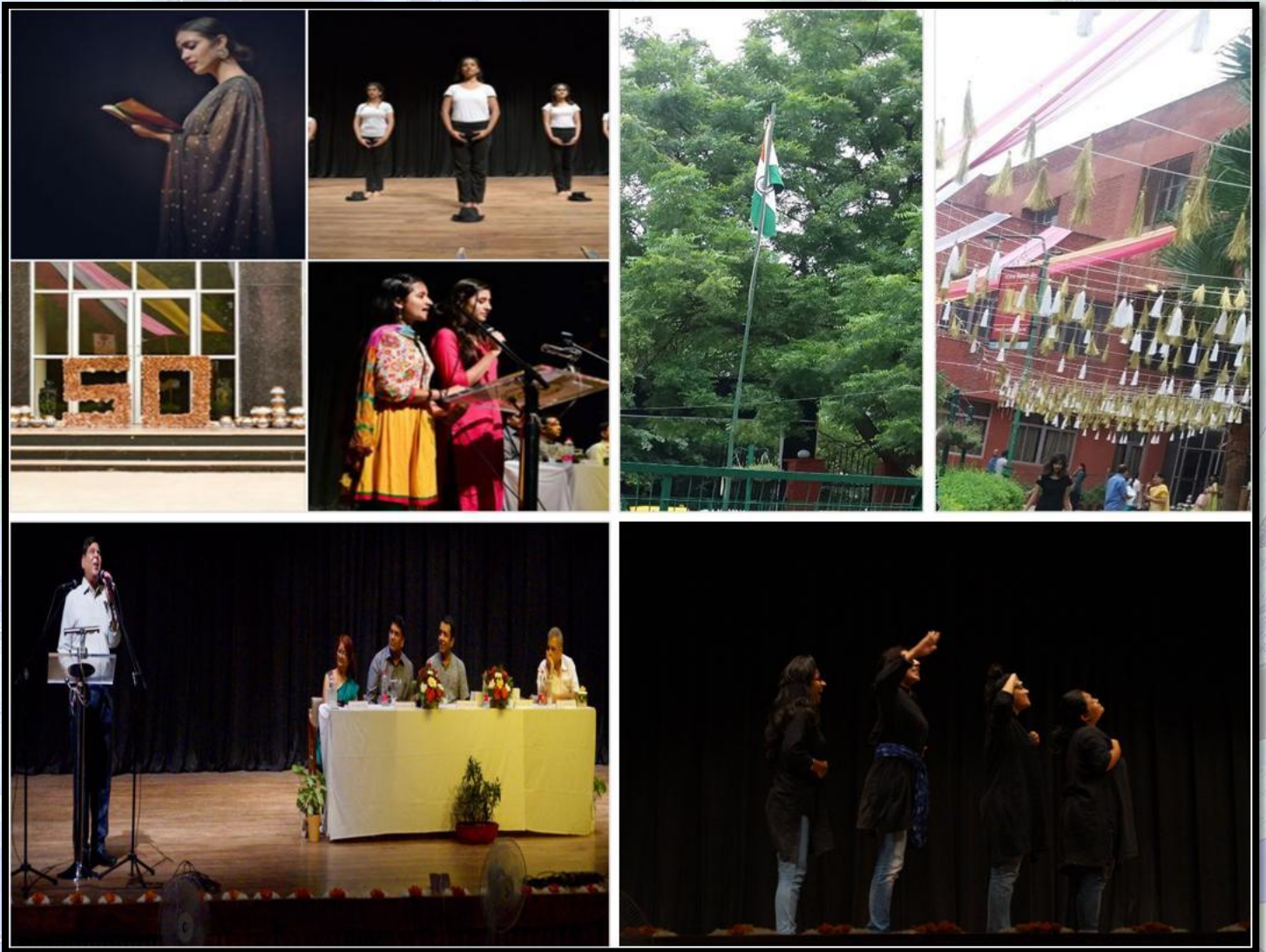
The event was sparked by the presence of chief guest, Mr. Anshu Gupta, the winner of the Raman Magsaysay Award and the founder of Goonj who works towards the sustainable development of resources for the poor. The founders of other NGOs namely Mr. Rahul Yadav, the founder of UNESCO award winning NGO Yodhas “Indians Fighting against Cancer”, Professor Anil Aneja, OSD, Equal Opportunity Cell and Mr. Atul Kotra, the Chairman, Governing Body of Gargi College were also present as the Guests of Honour along with then college principal Dr. Shashi Tyagi. They were highly welcomed and felicitated for their presence for the event and hence locating it bloom.



The event initiated with the lamp lightening by Mr. Anshu Gupta, followed by welcome speech of Dr. Shashi Tyagi and articulated speech of chief guests, each of them enlightened the audience with their way of working and technology they use for development of poor. Mr. Anshu Gupta's speech was about the real vision of our society today followed by bitter truths of life. The National Flag was hoisted by the chief guests and the principal.

Various cultural societies displayed their grandstand with special performances and plays. Choreography society "sparx" spread their wings by showing the college evolution. The street play society of Gargi College "Kshitij" used the theme of Ramayana to showcase the importance of teachers. The film society of Gargi College "Glass eye" screened the film "Gargi: Journey of 50 years" and showcased development of Gargi college from a single building with 300 students to the current status of college with excellence. The film was very finely and beautifully appreciated by everyone. The Indian Dance society of Gargi College "Nazakat" stole the hearts of everyone by its fusion performance including Jugalbandi, Bharat Natyam, Kathak, Mohiniattam, Odissi and was no less to make the dais classical. The decoration responsibility of Gargi College was supervised by HUES-Fine Arts society.

After all these performances the NGOs displayed their performances by dancing on the beats of "MAIYA YASHODA..." and singing "YAAD KARO KURBANI". NGOs apart from cultural performances also came up with the stalls featuring their own creations with engrossed skilful talent for sale within the college. At last tree plantation drive was witnessed, headed by Dr. Shashi Tyagi along with the guests of honour.



A glimpse of different activities of Golden Jubilee inauguration

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COLLEGE EVENTS

ZISTATVA – the Annual NSS cultural Mela

College celebrated Zistatva on October 27, 2016.



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LOHRI CELEBRATIONS

The college welcomed the New Year by celebrating Lohri on January 12, 2017 in the college campus.



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SPORTS DAY

College Sports Day was held on January 31, 2017.



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REVERIE 2017: GARGI'S CULTURAL FEST



Shreoshi Das

B.Sc. Life Sciences, III year



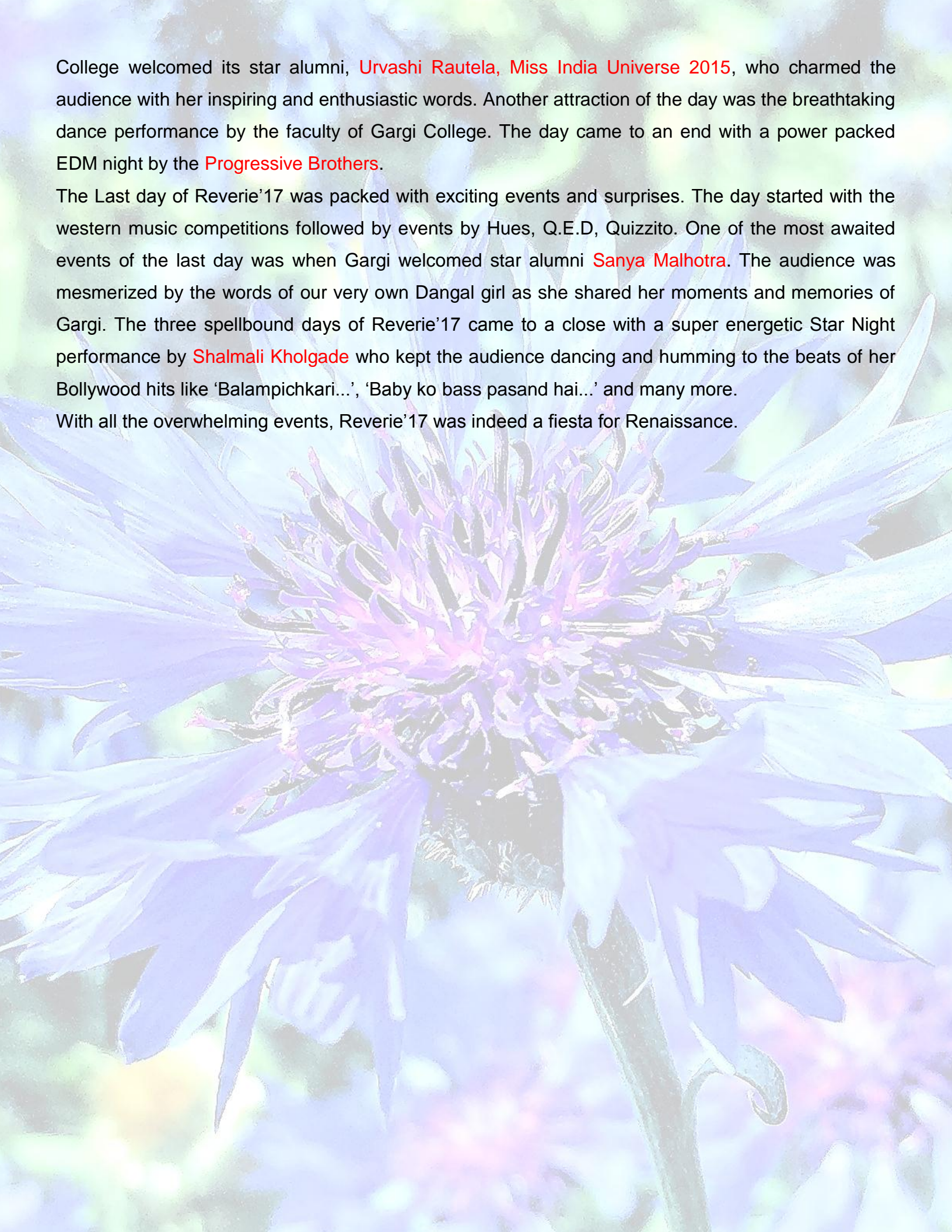
Arpita Kanungo

B.Sc. (H) Botany, III year

The annual cultural festival of Gargi College, **Reverie'17** was celebrated on the 14th, 15th and 16th of February, 2017. The fest aimed to be meliorated as its golden jubilee year and hence, the theme, **"Fiesta for Renaissance"**. The union as well as the society members had put in a lot of efforts to make it a fiesta to remember and rejoice. The college completed its glorious 50 years and needless to say, Reverie'17 had something very special and exciting to offer on all 3 days.

The fest kick started with the inauguration ceremony which was graced by the presence of the very talented actor **Mrs. Ratna Pathak Shah**, who, with her charm wooed the entire audience. The inauguration ceremony also witnessed some spectacular performances put up by the talented society members of the college. The ceremony was followed by a number of competitions– SAPTAK: the duet singing competition; ZENITH: the western dance competition; DHANAK: the folk dance competition and KHAYAL: solo singing competition. Reverie'17 had so much more to offer apart from just music and dance. There were a variety of food stalls and other merchandise stalls, attractive games and rides. The entire college decor was a treat to the sight done beautifully by HUES. The main attractions of Day 1 were the performances by the **Qawwali group – Nizami Bandhu** and **Bismil-The band**. Day 1 of Reverie kept everyone dancing and swaying to the beats of some amazingly soulful music.

Day 2 at the fest was as exhilarating as it could be. The day started with the event Indian choir followed by AABHAS-the street play competitions, one of the most awaited and happening competitions of the day. NIVACANNA- The stage play competition by upstage witnessed some bold performances by the participating teams. One of the major highlights of the day was when Gargi



College welcomed its star alumni, **Urvashi Rautela, Miss India Universe 2015**, who charmed the audience with her inspiring and enthusiastic words. Another attraction of the day was the breathtaking dance performance by the faculty of Gargi College. The day came to an end with a power packed EDM night by the **Progressive Brothers**.

The Last day of Reverie'17 was packed with exciting events and surprises. The day started with the western music competitions followed by events by Hues, Q.E.D, Quizzito. One of the most awaited events of the last day was when Gargi welcomed star alumni **Sanya Malhotra**. The audience was mesmerized by the words of our very own Dangal girl as she shared her moments and memories of Gargi. The three spellbound days of Reverie'17 came to a close with a super energetic Star Night performance by **Shalmali Kholgade** who kept the audience dancing and humming to the beats of her Bollywood hits like 'Balampichkari...', 'Baby ko bass pasand hai...' and many more.

With all the overwhelming events, Reverie'17 was indeed a fiesta for Renaissance.



Reverie'17: Annual Cultural fest

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SCINTILLATIONS (2016-17): The Annual Science Fest



Drishti

B.Sc. (H) Botany, III year

Science festivals are organized in a contemplate that every budding scientist explores and discovers the hidden potential to think passionately and enthusiastically beyond book learning and also every young mind applies scientific knowledge to the best of capability.

To fulfill this ideology, Gargi College organizes annual Science fest every year namely Scintillations. The theme for Scintillations 2017 was 'To remember Alumni of Gargi College who are no longer with us'. The annual Science fest is conducted for two days in which different streams of Science Department participate with full zeal and zest. For the year, it was conducted on 7- 8th March 2017. The inauguration of the Scintillations was done by principal madam Dr. Promila Kumar, former principal Dr. Shashi Tyagi and by the chief guest G. S Sodhi by lighting up the ceremonial lamp as a symbol of gratification and serenity. It was followed by a guest lecture delivered by eminent professor Dr. G. S. Sodhi, SGTB Khalsa College. The topic was Human Fingerprints, which basically covered fingerprinting, solving criminal cases, post-mortem cases and forensic sciences. The talk truly ignited and inspired young minds. It was then followed by presidential speech, where in president of all the departments of Science stream delivered speech about growth of their department, academics and cultural events which took place throughout the academic session.

Scintillations 2017

Botany department organized the Scientific Fashion Walk on the first day. The main motive of putting on this was to encourage the scientific side of the fashion and catwalk. The participants gave their best to put up the scientific fashion walk by using various themes like recycling, bound to nature, natural beauty and many more. Students represented fashionista scientifically. Different departments organized interesting functions such as "Beyond brush" by Zoology Department, "Scientific crossword" by Physics Department, "Science Relay" by Microbiology Department and many more.

The second day started off with another guest lecture by Dr. Maharaja K. Pandit, Dean Science, University of Delhi. His upcoming book is "Life in the Himalayas". He briefed the audience with his book. The session was interesting and thought provoking indeed. The event planned for the second day by Botany Department was Salad making competition. The participants showcased their talent onto plates to present salad menu and surely proved by displaying that salad is not a meal but a style. Different departments organized various actively brain teasing competitions like Brain-a-thion by Zoology department, Fun in lab by Chemistry Department, Scientific Pictionary by Microbiology Department and many more. The end of the Scintillations took place by prize distribution ceremony. Indeed, all the events were epitome of scientific fun.





Botany Department organized Scientific Fashion Walk



Salad making competition in procession



Botany Department organized salad making competition

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Department of Botany

Faculty



(August 17, 1932 to February 3, 2012)

DR. CHHAYA BISWAS
Founder of
The Department of Botany, Gargi College

Superannuated in 1993 as
Principal, Gargi College



Dr. Pushpa Markandan



Dr. Ahalya Chintamani



Dr. Krishna Kumar



Dr. Lalita Sehgal



Dr. Bharati Bhattacharyya

CURRENT FACULTY



Current Faculty: Permanent	
Dr. Shashi Tyagi	Dr. Jasmeet Kaur Abat
Dr. Usha Prasad	Dr. Renu Soni
Dr. Gita Mathur	Dr. Vera Y. Kapai
Dr. Kiran Prabha	Dr. Reema Mishra
Dr. Geeta Mehta	Dr. Geeta Prabhakar
Dr. Aparajita Mohanty	Dr. Anjana Rustagi
Dr. Priyanka Pandey	Ms. Ruchitra Gupta
Dr. Leisan Judith	Dr. Garvita Singh

Voluntary Retirement	Current Faculty: Temporary
Dr. Kavita Walia	Dr. Samira Chugh
Dr. Asha Juneja	Dr. Garima Malik
Dr. Deepa Jethwani	Dr. Sachi Aggarwal
Dr. Shweta Vandana	Dr. Shweta Sharma
	Ms Asmita Gupta

Laboratory Staff



Current lab Staff
Mr. D.D. Sharma
Mrs. M.D. Sharma
Mrs. Shashi Bala
Mr. Ashok Kumar Rana
Mrs. Rajni
Mr. Arun Kumar
Mr. Pancham Singh
Mr. Vijay Kumar Pandey
Mr. Deepak Kumar
Mr. Hansraj
Mr. Jaideep
Museum Curator
Mr. Ganga Singh

Students



Group Photograph: B.Sc. (H) Botany I year



Group Photograph: B.Sc. (H) Botany II year

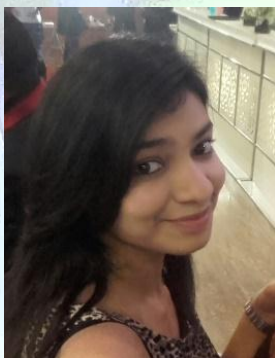


Group Photograph: B.Sc. (H) Botany III year

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DEPARTMENTAL EVENTS

Golden Jubilee year celebration



Drishti

B.Sc. (H) Botany, III year

On the occasion of golden jubilee celebrations, Department of Botany organized Golden jubilee lecture series and add-on course on the 'Role of Biotechnology in Environment Management'. Various other activities for the overall development of students were also organized throughout the year with active co-operation from all the teaching, non-teaching, retired staff and students.

Golden jubilee lecture series was inaugurated on September 01, 2016 by Dr. Richa Shrivastava Negi, Director & Chief Executive, Research & Department of Quality at Maharishi Ayurveda Products Pvt. Ltd., she is also a star alumni of Botany department, Gargi College. She works on operations related to research and development, product development, process validation etc. The inauguration started with lightening of ceremonial lamp followed by a melodious Saraswati Vandana sung by final year students to seek divine blessings of goddess Saraswati. Botanical rangoli made with flamboyant herbal colors was a special mark of attraction. Students welcomed the chief guest and the principal by a planter. This was followed by welcome speech by Dr. Shashi Tyagi. Then, the chief guest proceeded on with her lecture on "Ayurveda- The Science of Life".

She shared her words of wisdom regarding Ayurveda with the students that enlightened their mind with new possibilities for their future perspective and also helped students to unleash their mind and admire the beauty of nature along with treasure hidden in Ayurveda and Herbal Medicines. It was an interactive learning session. In the end of her lecture, she wished us for our bright future and became an inspiration for all of us.

The inaugural event ended with the introduction of the new members of GCBS-TARU. The "GARGI COLLEGE BOTANICAL SOCIETY" has always been a part of the Department of Botany since 1994

and was named as "TARU" which means tree, in September 2012. Executive members were presented their badges by chief guest, the Principal and teacher-in-charge.

The ceremony concluded with a vote of thanks by the president of TARU, Ms Srishti Shekhar.



Inauguration of Golden jubilee lecture series

the random discoveries which were not only interesting to come across rather were immensely inspiring for the budding botanists.

He also explained the importance of taxonomical studies for research in any field, making it a subject which shouldn't and can't be ignored at any levels by students and thus, igniting a spark in the students for taxonomy and the dire need to realign priorities.



Lecture by Prof. Arun Kumar Pandey

Compiled by Srishti- III year (Botany Hons.)

Next lecture in the series was organized on January 18, 2017 by Prof. **Vipin Chandra Kalia**, Chief Scientist, CSIR- Institute of Genomics and Interactive Biology on **“Plants and Humans versus Bacterial Pathogens: A never ending interactive battle”**. He has been awarded with Fellow of Academy of Microbiological Sciences, India (FAMSc)-2012 and Fellow of National Academy of Sciences (FNASc). Sir holds the position of emeritus scientist, professor at A-CSIR, IGIB. Dr. V.C. Kalia has 11 patents under his name granted in U.S. and U.K. and has more than 100 publications. Sir has been awarded various fellowships and has written many books on quorum sensing and quorum quenching and on microbial factories. He is the Editor-in-Chief of Indian Journal of

Microbiology and Academic Editor of PLoS ONE. He is the visiting professor of many national and international universities.

He acknowledged the idea of how bacteria defends against antibiotics and resists the effect of antibiotics. He also focused on biofilms in which cells of micro-organisms stick together and adhere to a surface and its applications. Also, about the recent studies in 2003 which states that the immune system supports bio-film development in the large intestine.

The lecture was very interactive and was filled with lots of knowledge and facts and in all was a great success. The lecture ended with the introduction of the new members of **Anthesis** our annual magazine. Executive members were presented their badges by Prof. V.C. Kalia and the Former Principal Dr. Shashi Tyagi.



Lecture by Prof. V.C. Kalia

Compiled by Shweta- Botany (H) III year

Badge Distribution Ceremony

Anthesis– Annual Publication of Gargi College Botanical Society

ANTHESIS



Fourth lecture under the Golden Jubilee lecture series on February 28, 2017 was given by another star alumna of our college, Ms. Shubhra Bansal, Founder-Director Apprentiice Learning Solutions on “Pharmaceutical Research and Career Prospects”. She has been in Pharmaceutical Research Industry for 17years with depth of experience. She holds a Master of Science in Medical Elementology and Toxicology from Hamdard University, New Delhi. Starting from basics of Clinical research as a Clinical Research Associate, she had reached to the position of Director, Asia Pacific Clinical Management in a Multinational Organization.

She started the lecture on a friendly note by interacting with the students and questioning us about pharmaceuticals. She explained the students that pharmaceuticals is a huge branch of science which




includes the study of various formulations of chemicals/drugs and how various chemical formulae are prepared keeping in mind about safety and efficacy of the drug so that it doesn't have any adverse effect on the patient. She made us clear about the various steps involved in pharmaceuticals from manufacturing to clinical trial which is needed before a drug is marketed. Her lecture was an inspiring as she emphasized on various opportunities available in the world of medicines. Her institution offers a variety of online courses enabling us to select the courses of our choice. She also explained the need to select an appropriate course based on our interests and how to get access to these courses.



Lecture by Ms. Shubhra Bansal

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**Executive Committee of TARU: Gargi College Botanical Society
(2016-2017)**

POST	NAME	YEAR
President	 Srishti Shekhar Bhagat	III year
Secretary	 Shweta Choubey	II year
Treasurer	 Pratibha Bishnoi	II year

**Student
Coordinator**



Aruna Vashisth

II year



Bhawna

**Executive
members**



Priyanka Singh



Shweta Sharma

III year



Rozy Yadav



Sapna

II year



Surbhi Saraswat Ankita Vikram Singh



Amisha Sharma Sushila Mor



Vandana Khurana

I year

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Annual Report of GCBS- Taru



Srishti Shekhar

President –GCBS

Before proceeding with the highlights of the year I would like to walk back in time and put forth some glimpses of the Department as we are all glad to be a part of the commemoration of 50 glorious years.

Department of Botany dates back to be established in the year 1967.

G.C.B.S i.e., Gargi College Botanical Society TARU was established in the year 1994.

Taru meaning Vriksh or tree in our Devanagiri script signifies our botanical society and its morals to the utmost, as here we are taught to: Stay grounded like a tree and to connect to our roots. We are also taught to turn over a new leaf and to bend before we break. It instills in us the knack to enjoy our innate unique natural beauty and most importantly teach us to keep growing and striving persistently towards excellence with full zest and zeal.

Every year the department conducts various field and institutional visits, educational excursions, invited guest lectures and many more events aiming at catering to the interests of all the students of the department. The main focus of this year were

1. The Golden Jubilee Lecture series

2. Add-on course on Role of Biotechnology in Environmental Management under DBT- star college scheme for the session 2016-17.

Along with these academic activities, we also organized inter-college competitions like the vegetable painting, doodling, designing of cover page of our annual magazine ANTHESIS, teacher's day celebration, alumni meet and the list continues.

Now focusing on our highlights:

We had a Golden Jubilee Lecture series. Realizing the importance of lectures as probably the best teaching method in many circumstances for many students; especially for communicating conceptual knowledge in the form of mutually-beneficial 'collusion' between class and lecturer, we interacted with various eminent speakers.

The first lecture was on a booming and interesting topic of **“Ayurveda: The Science of Life”**. It was delivered by our star alumna, Dr. Richa Srivastava Negi, Director Maharishi Ayurveda.

The next interactive session was with Prof. Arun Kumar Pandey, Department of Botany, University of Delhi on **“Taxonomy and Biodiversity: The need for realigning priorities”**.

The series was taken forward by a lecture on **“Plants and Humans versus Bacterial Pathogens: A never ending interactive battle”** by Prof. V.C. Kalia, Chief Scientist, CSIR- Institute of Genomics and Interactive Biology.

The next lecture was again delivered by one of our star alumni, Ms. Shubhra Bansal, Founder-Director, Apprentiice Learning Solutions who enlightened the students on **‘Pharmaceutical Research and career prospects on February 7th, 2017.**

We also had an interactive Add-on course on Role of Biotechnology in Environment Management under DBT- star college scheme for the session 2016-17.

This was an interdepartmental course which was inaugurated by Prof. Indu Shekhar Thakur, from School of Environmental Sciences, JNU. Sir delivered the inaugural lecture on **“Environmental Sciences and Biotechnology for Bio-protection and Biomaterial: the Sustainable way ahead forward”**

Also **Dr. Radhey Shyam Sharma**, Department of Environmental Studies, DU visited our department for a lecture and spoke on **“Role of Biotechnology in Ecosystem Restoration and Sustainable Development”**.

The lecture series was carried further by **Dr. Vandana Mishra**, Department of Environmental Studies, University of Delhi and **Dr. Faiyaz A Khudsar**, Scientist in-charge, Yamuna Biodiversity Park on **“Bio prospecting and restoring floodplains”** respectively.

This was followed by the lectures by **Dr. A P Dimri** and **Dr. Pooja Ghosh**, who is also one of our star alumni.

Alongside cultural events were organized:-

Vegetable painting competition (in which **vegetables** can be cut lengthwise likewise to make beautiful patterns according to their ideas by the students) and doodling competition (**doodles** are simple drawings that can have concrete representational meaning or may just be abstract shapes) were conducted on September 16, 2016 to celebrate world ozone day.

Teacher's Day was celebrated on September 5th, 2016 to praise the undying efforts of our Pygmalion's the ones who have been here through batches n batches of students without fading away of their passion towards their subject. Emphasizing on the same we had invited some alumni who were more than enthusiastic to bask in the warmth of their professors once again and wish them on the day that is solely theirs.

This was followed by a cleanliness drive on September 15th, under the Swacch bharat abhiyan.

The next set of competitions was the Anthesis Cover page designing and newspaper crafting on January 29th, 2016.

Following these was the much awaited alumni meet organized on March 4th for the first time. The huge numbers in which the alumni turned up symbolized the love and bonding they shared with the department and the teachers. Superannuated teachers and lab staff were a part of this gathering along with the alumni from varied batches. We were all elated to have Dr. Suman Govil, Advisor Department of Biotechnology, Government of India amongst us, who was from the first batch (1973) of the department and has been associated with the department since almost half a century.

The events for scintillations were the scientific fashion walk and salad making competition where students came up with their creative and healthiest best in the utmost innovative manner.

The students of the department have left a mark and excelled in whatever field they chose to work in.

Aishwarya Singh and Shweta Sharma from B.Sc. (H) Botany III year participated in B.M. Johri rolling shield paper presentation contest held at Department of Botany, Delhi University on 28 March, 2017.

Research Projects:

- Akshama Singh and Srishti Shekhar (3rd year) orally presented their research paper in the International Conference held in Jawaharlal Nehru University (JNU).
- Aishwarya Singh, Akshama Singh, Drishti Garg, Garima Negi and Srishti Shekhar (3rd year) have been a part of the Innovation project (IP-305).
- Shweta Choubey, Pratibha Bishnoi and Bhawna were also a part of the Innovation project.
- **Rozy Yadav, Ankita Kumari and Shivani Sharma won the Pathfinder award for the academic year 2016-17.**
- Ruth, Disha and Shobhna are also part of ongoing research projects.

Sports:

- Jyoti Yadav (3rd year) was selected for Badminton Junior Nationals.
- Surbhi Saraswat (1st year) has been a member of the college Basketball team and the team won Gold medal in the NDIM Tournament. She even secured Second prize in relay race in Spinz'1(Gargi College Sports day)
- Sonal Ghildiyal (2nd year) is the member of college cricket team.

- Priyanka Singh, Aishwarya Singh, Bushra (3rd year) secured 1st position in Pithugram and Vigoro in Spinz'17.
- Drishti and Garima Negi won gold medal in Tug-of-war.

NCC:

- Anamika Saini, Rupal Singh, Neetam and Marisha (1st year) have been an active member of the NCC team of college.
- Neetam bagged 2nd position in the NCC Drill competition.

Participation in other societies:

- Nikita Loharuka holds the post of event coordinator in the NSS union of our college.
- Aishwarya Singh is the co-convenor of AVNI-the environmental club of Gargi College.
- Purvi Singh has won various accolades being a member of the Western dance society of the college 'Enliven'.
- Reetika Lomora is a member of QED (English Debating Society).
- Supriya is an active participant of Women Development Cell.

Miscellaneous Competitions:

- Shivani Dalai (1st year) secured 2nd position in Doodling competition.
- Bushra and Priyanka Singh bagged the 2nd position in Mehfil-e-shayari competition conducted by the Hindi department.

Winners in Scintillations'17:

- Brain-a-thon: Upma Garg (1st year) secured 1st position
- Slogan writing competition: Shivani Dalai (1st year) bagged the 3rd position
- Beyond the brush: Shalini Sharma (1st year) secured 3rd position
- Rangoli competition: Ankita and Marisha (1st year) won 2nd position
- Scientific Fashion Walk: Jyoti Yadav (2nd year) secured 2nd position.
- Salad Making Competition: Bushra and Priyanka (3rd year) won 3rd prize

Aishwarya Singh and Shweta Sharma from B.Sc. (H) Botany III year participated in B.M. Johri rolling shield paper presentation contest held at Department of Botany, Delhi University.

Looking at the timeline, the year was a trove full of varied events, and with these events and the preparations the year seemed to have passed by in a blink, but its affects have been far embossed. Thanks to the efforts of many people, much has been done on each front throughout the year. This surely couldn't have been possible without the battery of mentors who guided the G.C.B.S union to sail through with least efforts and conduct the events. The Anthesis team was also of great help to this.

I wish to express gratitude to my teachers, the lab staff and members of the G.C.B.S., who had entrusted me with administrative responsibility on various occasions and supported me fully throughout.

Thank you once again!

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Golden Jubilee Year Lecture Series

Lecture Series by Gargi College Botanical Society –TARU by various eminent professors.

1. Dr. Richa Srivastava Negi, Director Quality and Research, Maharishi Ayurveda on **“Ayurveda: The Science of Life”**.
2. Prof. Arun Kumar Pandey, professor Department of Botany, University of Delhi on **“Taxonomy and Biodiversity: The need for realigning priorities”**.
3. Prof. V.C. Kalia, Chief Scientist, CSIR- Institute of Genomics and Interactive Biology on **“Plants and Humans versus Bacterial Pathogens: A never ending interactive battle”**.
4. Ms. Shubhra Bansal, Founder, Director Apprentiice Learning Solutions on **“Pharmaceutical Research and career prospects”**.



Dr. Richa Shrivastava Negi



Dr. Arun Kumar



Dr. V.C. Kalia



Ms. Shubhra Bansal

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A DAY FOR TEACHERS
TEACHERS' DAY CELEBRATION



Meenakshi Sinhmar
B.Sc. (H) Botany, I year

“SOMEONE WHO UNDERSTANDS OUR THIRST FOR KNOWLEDGE,
SOMEONE WHO ACCEPTS THE CHALLENGES REGARDLESS OF OPPOSITION
SOMEONE WHO COULD SEE THE BEST IN OTHERS IS THE ONE WE CALL TEACHER”

5th September is celebrated as a Teacher's day in the birth memory of DR. SARVAPALLI RADHAKRISHAN who was the first vice president of India and no doubt the greatest teacher ever known. It has become a day of celebration for all the teachers where students show adoration towards their teachers.

Students and teachers are incomplete without each other. They have a bond of knowledge and understanding between them. To show gratitude and admiration towards the teachers, the students of the department of botany celebrated the teacher's day that made an indelible impression of 5th September in hearts of all the botany teachers.

All the faculty members were warmly welcomed with a short video showing the wonderful time spent by the teachers in the college down the memory lane which made them peep back into time.

“Tujo mila toh hog aya mei kabil”

This beautiful song was dedicated by the super talented students that really expressed the role of teachers as a cornerstone in our future. The teachers were touched deeply with our dedication and were highly appreciative of that. There was an eye-catching, funky dance performance by the students of second and third year, themed on the life of a student, which was highly appreciated by everyone.

Teachers were happily surprised when they saw the alumni students of the department who were invited to make the day more delightful and memorable. The students of the previous batches expressed their love towards the teachers and also shared their experiences when they were in the college which made the celebration even more ecstatic. The ceremony concluded with cake cutting by the teachers, the cake was then shared by everyone.

It was indeed blissful to be able to put a smile on the faces of those who play such an important role in our lives. I shall always be thankful to all my teachers for making me who I am.

“I enjoy each lesson you teach; as my role model you inspire me to dream and to work to reach. I'm thankful for all that you've done and now I just want to say, as a teacher you are my number one.



Preparations



Teachers' Day Celebration

Swacchh Bharat Abhiyaan

Botany department conducted the cleanliness drive namely Swacchh Bharat Abhiyaan on September 15, 2016.



Teaching staff



Laboratory staff



Students

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Add-On Course

Topic: Role of Biotechnology in Environment Management



Manisha Kumari
B.Sc. (H) Zoology, III year



Dr. Anjana Rustagi
Faculty, Botany

The Department of Botany, Gargi College is always intended to widen the roots of knowledge among the students. With the objective of providing extra knowledge to the students, the department introduced an **Add-on course on Role of Biotechnology in Environment Management** under DBT- star college scheme for the session 2016-17. All thanks and appreciation goes to our former principal, Dr. Shashi Tyagi who acknowledged and granted the permission making headway to the course. Students from all the science departments of the college were provided with the opportunity to get enrolled for the add-on course. The course included lectures by various eminent speakers and field trips for better learning, thus, fulfilling the motive of developing potential for excellence.

Add-On Course was inaugurated on September 30, 2016 by Prof. Indu Shekhar Thakur, Environmental Microbiologist and biotechnologist from School of Environmental Sciences, JNU. The inauguration started with lightening of ceremonial lamp followed by the welcome speech by the teacher conveners Dr. Anjana Rustagi and Dr. Garima Malik. The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, issues like economic productivity and national security, global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. Prof. Indu Shekhar Thakur delivered the inaugural lecture on "**Environmental Sciences and Biotechnology for Bio-protection and Biomaterial: the Sustainable way ahead forward**". Prof. Thakur explained about the natural detoxification mechanism and some important environmental problems such as

global warming, energy problems, pollution, and their remedies through biotechnology. He also talked about the air pollution in Delhi which is a matter of serious concern these days. Students learned about the major causes and associated remedies for the air pollution and recent monitoring systems along with bio-filters, bio-scrubbers etc. He also mentioned about the Sustainable Development Goal (SDG), climate adaptation, mitigation, biodiesel, bio-refinery, bioplastic, biofuel etc.

The second lecture of this lecture series was given by **Dr. Radhey Shyam Sharma**, Department of Environmental Studies, Delhi University on “***Role of Biotechnology in Ecosystem Restoration and Sustainable Development***”. Ecosystem restoration refers to the process of recovery of the lost and degraded or damaged ecosystem to a stable, healthy and sustainable state. Dr. Sharma explained the recovery of degraded ecosystem by the help of biotechnological means. He discussed the causes of ecosystem degradation and also explained the remedies such as phytoremediation, ecological restoration technologies, millennium ecosystem program, climate change, pollution, ecosystem contamination, habitat loss and ecosystem services such as regulating services, cultural services and various supporting services.

The lecture series was further carried over by **Dr. Vandana Mishra**, Department of Environmental Studies, University of Delhi on the topic “***Bioprospecting: A Critical Link between Environment and Development***”. She is specialized in Bio-resources and Biotechnology. She explained about the extraction of drugs and commercially valuable compounds from plants and animal species. It is well known that plants are rich source of various chemicals which are valuable for mankind and can be used as medicinal drugs. She dealt with the techniques used in Bio-prospecting, its advantages such as drug discovery and limitations like bio-piracy.

The next lecture was delivered by **Prof. A.P. Dimri**, School of environmental sciences, JNU on “***The science of Climate Change***”. He talked about various factors responsible for global climate change.

Lastly, **Dr. Pooja Ghosh**, DST-INSPIRE faculty, Centre for rural development and technology, IIT-Delhi also came to take the course further and enlightened the students with a lecture on “***Wasted waste***” in which she emphasized on proper waste management and various aspects of role of biotechnology in environmental management. The add-on course helped students from various departments to widen their knowledge about environment and proved beneficial for all.



Add-on course on Role of Biotechnology in Environment Management



Field trip to Yamuna Biodiversity Park



Field trip to CRDT, IIT-Delhi

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Competitions

During the course of Golden jubilee year celebrations, Botany Department organized a series of g, competitions such as Vegetable painting, Doodling competition enfolding Botany and Environment on Ozone Day, September 16,2016. Department also organized Newspaper crafting and Cover page designing of Anthesis- annual e-magazine of Gargi college Botanical society on 7th February 2017 where young botanists in the making worked with their hands, head and heart to architect a new cover page of Anthesis and also collaborated fun and intelligence to build up creative models out of newspapers.

WINNERS AT A GLANCE

VEGETABLE PAINTING COMPETITION

S. No.	Winners	Course	Position
1.	Drishti & Nidhi Gupta	B.Sc.(H) Botany III year	I
2.	Bushra & Priyanka Singh	B.Sc.(H) Botany III year	II
3.	Ravpreet & Shreoshi	Life sciences III year	III

DOODLING COMPETITION

S.No.	Winner(s)	Course	Position
1.	Yashika Thukral	Life science II year	I
2.	Shivani Dalai	B.Sc.(H) Botany I year	II
3.	Mansee	English (Hons) II year	Consolation

NEWSPAPER CRAFTING COMPETITION - Certificate of Appreciation

S. No.	Winners	Course
1.	Sapna & Jyoti	B.Sc.(H) Botany II year
2.	Aruna & Pratibha	B.Sc.(H) Botany II year

ANTHESIS COVER PAGE COMPETITION- Certificate of Appreciation

S. No.	Winners	Course
1.	Supriya Sen	B.Sc.(H) Botany I year
2.	Shrija Ghosh	B.Sc.(H) Microbiology III year

Winners



Active participation



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SEMESTER TOPPERS

Name	Current Class	Result of	Position in class	Photograph
Upma Garg	B.Sc.(H) Botany I Year	B.Sc.(H) Botany Semester I	I	
Anamika Saini Neha	B.Sc.(H) Botany I Year	B.Sc.(H) Botany Semester I	II	
Rozy Yadav Ruth Abraham	B.Sc.(H) Botany II Year	B.Sc.(H) Botany Semester II	I	
Shivani Sharma	B.Sc.(H) Botany II Year	B.Sc.(H) Botany Semester II	II	
Avi Mendiratta	B.Sc.(H) Botany II Year	B.Sc.(H) Botany Semester III	I	
Rozy Yadav Shivani Sharma	B.Sc.(H) Botany II Year	B.Sc.(H) Botany Semester III	II	

Nidhi	B.Sc.(H) Botany III Year	B.Sc.(H) Botany Semester IV	I	
Aishwarya Singh	B.Sc.(H) Botany III Year	B.Sc.(H) Botany Semester IV	II	
Aishwarya Singh	B.Sc.(H) Botany III Year	B.Sc.(H) Botany Semester V	I	
Vandana	B.Sc.(H) Botany III Year	B.Sc.(H) Botany Semester V	II	
Shreya	B.Sc.(H) Botany Alumni	B.Sc.(H) Botany Semester VI	I	
Neha kukreti	B.Sc.(H) Botany Alumni	B.Sc.(H) Botany Semester VI	II	

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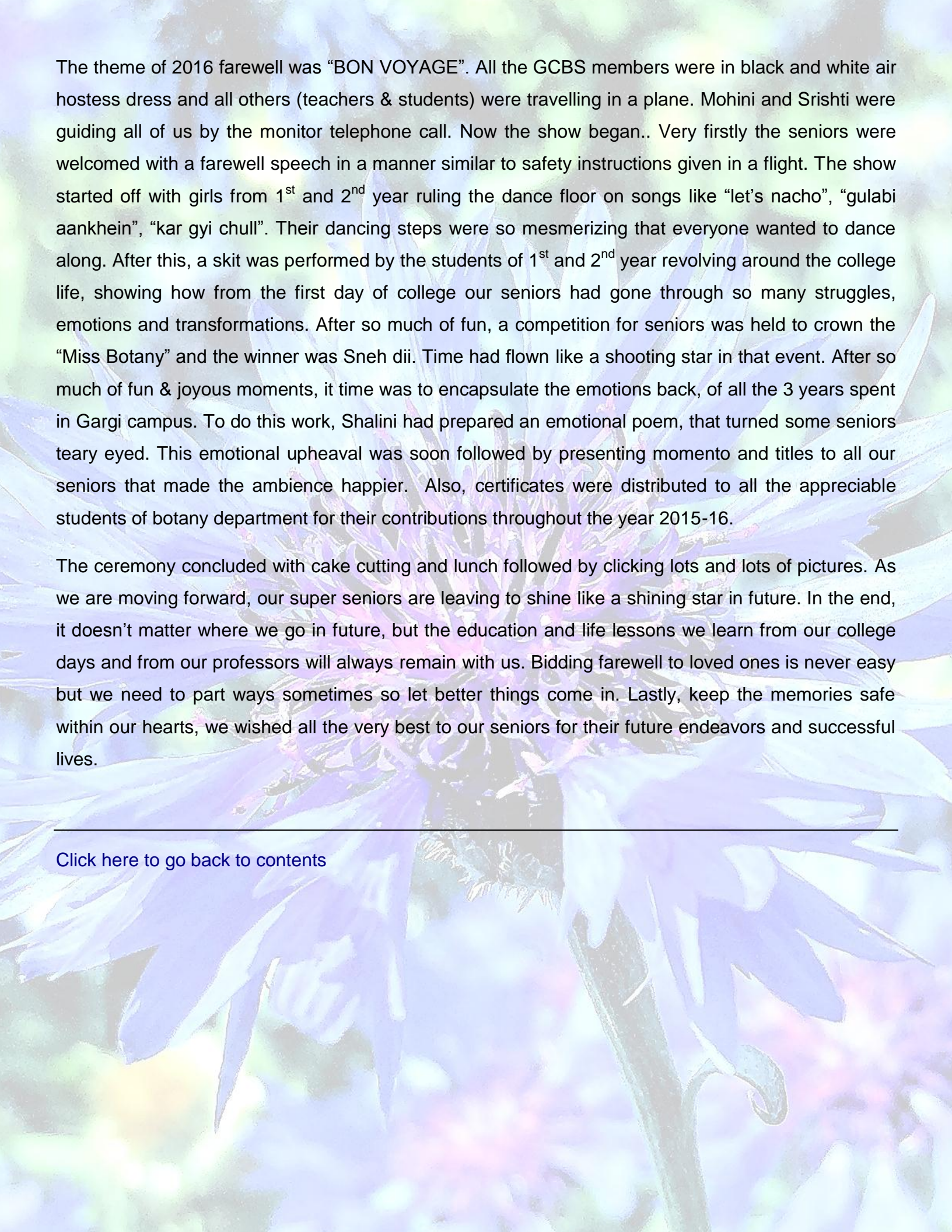
FAREWELL TO SENIORS



BON VOYAGE 2016

It is said that time never stops for anyone, it flies away at its own pace, but to me it seems to pass by more quickly when I don't want it to. The same thing happened this time around and before I could realize, it was time to 'Bid Adeu' to our beloved seniors.

It was a great day with all the botany teachers, botany students and watching our seniors moving in bright and colourful "sarees" together. All teachers were so happy with glittering eyes looking their students in such a new "avatar" from being a girl to a lady.



The theme of 2016 farewell was “BON VOYAGE”. All the GCBS members were in black and white air hostess dress and all others (teachers & students) were travelling in a plane. Mohini and Srishti were guiding all of us by the monitor telephone call. Now the show began.. Very firstly the seniors were welcomed with a farewell speech in a manner similar to safety instructions given in a flight. The show started off with girls from 1st and 2nd year ruling the dance floor on songs like “let’s nacho”, “gulabi aankhein”, “kar gyi chull”. Their dancing steps were so mesmerizing that everyone wanted to dance along. After this, a skit was performed by the students of 1st and 2nd year revolving around the college life, showing how from the first day of college our seniors had gone through so many struggles, emotions and transformations. After so much of fun, a competition for seniors was held to crown the “Miss Botany” and the winner was Sneh dii. Time had flown like a shooting star in that event. After so much of fun & joyous moments, it time was to encapsulate the emotions back, of all the 3 years spent in Gargi campus. To do this work, Shalini had prepared an emotional poem, that turned some seniors teary eyed. This emotional upheaval was soon followed by presenting momento and titles to all our seniors that made the ambience happier. Also, certificates were distributed to all the appreciable students of botany department for their contributions throughout the year 2015-16.

The ceremony concluded with cake cutting and lunch followed by clicking lots and lots of pictures. As we are moving forward, our super seniors are leaving to shine like a shining star in future. In the end, it doesn’t matter where we go in future, but the education and life lessons we learn from our college days and from our professors will always remain with us. Bidding farewell to loved ones is never easy but we need to part ways sometimes so let better things come in. Lastly, keep the memories safe within our hearts, we wished all the very best to our seniors for their future endeavors and successful lives.

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GRAND ALUMNI MEET- DEPARTMENT OF BOTANY

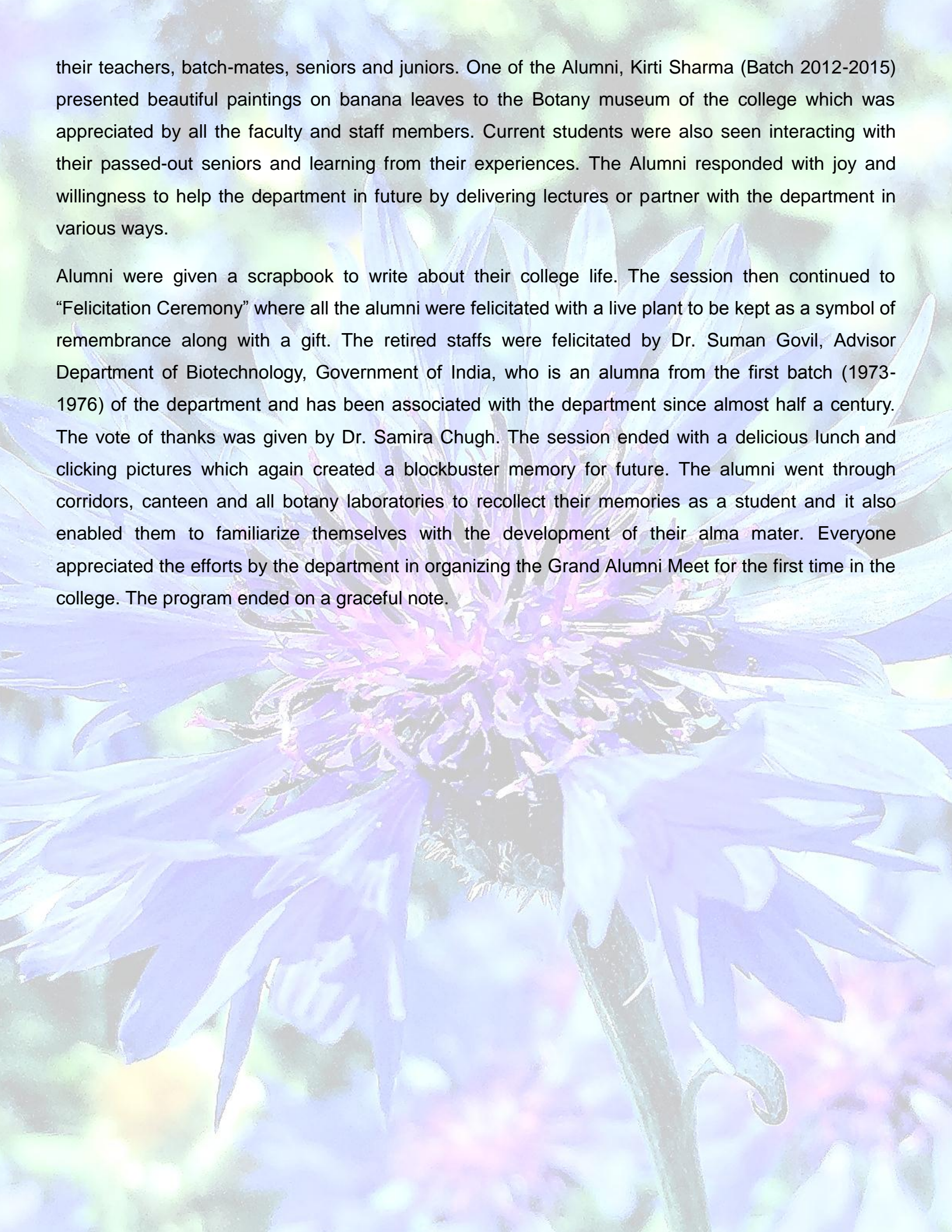
Every student who comes to Gargi College is young and naïve gets nurtured and passes out with a flight of wings adding up colours of success to one's life.

On the occasion of Golden jubilee year celebration of Gargi College, Department of Botany organised alumni meet on March 4, 2017. It was the first ever alumni meet organized by Botany Department. It was an event that celebrated, cherished and refreshed old relationships together with new relationships. This alumni reunion gave us an opportunity to meet many of our alumni after a long time.

The invitations of this meet were sent to all the alumni and the news spread far and wide. On 4th March 2017, Department of Botany of Gargi College welcomed all the alumni with great honour and happiness. The occasion was glorified by around 75 alumni belonging from various batches starting from first batch of B.Sc. (Hons) Botany in 1973 to 2016 batch. Senior retired faculty –Dr. Bharti Bhattacharya, Dr. Ahalya Chintamani together with retired non-teaching staff – Mr. Harjinder Singh, Mr. Hukum Chand, Mr. Liaquat Ali, Mr. Vishwanathan, Mr. D.D Sharma also graced the occasion by their presence. Most of the alumni were visiting their Alma Mater for the first time since their graduation, and naturally were very happy to be back in the college again.

The inauguration started traditionally with lighting of ceremonial lamp by Dr. Suman Govil, an alumna from the first Batch of 1973-1976, super attenuated teaching and non-teaching staff, former Principal- Dr. Shashi Tyagi and Principal –Dr. Promila Kumar.

Alumni were then welcomed in the seminar hall with rose petal shower. The events started with a warm inaugural address by the coordinator Dr. Renu Soni and welcome speech by the senior most faculty member Dr. Shashi Tyagi. The gathering was also addressed by our principal Dr. Promila Kumar. The welcome session was followed by cultural programme by our first and second year students. They sang melodious songs. Teacher-in charge, Dr .Geeta Mehta made the alumni feel nostalgic by taking them on a trail of flashback journey to their happiest college life as Gargi girls via a presentation. The charming face and gleaming eyes of Alumni said all about happiness. As a part of entertainment program, funny game- Quiz was organised with the rapid fire round consisting photographs of various locations in college and plants, so as to back trace Gargi days for all alumni and also a testament to be a Botanist. Winners were presented with chocolates. It was then followed by Alumni's talk – the most wonderful and cheerful moment of the day which enthralled everyone's attention. Alumni shared the treasure of their memories of Gargi life, reliving their old memories with



their teachers, batch-mates, seniors and juniors. One of the Alumni, Kirti Sharma (Batch 2012-2015) presented beautiful paintings on banana leaves to the Botany museum of the college which was appreciated by all the faculty and staff members. Current students were also seen interacting with their passed-out seniors and learning from their experiences. The Alumni responded with joy and willingness to help the department in future by delivering lectures or partner with the department in various ways.

Alumni were given a scrapbook to write about their college life. The session then continued to “Felicitation Ceremony” where all the alumni were felicitated with a live plant to be kept as a symbol of remembrance along with a gift. The retired staffs were felicitated by Dr. Suman Govil, Advisor Department of Biotechnology, Government of India, who is an alumna from the first batch (1973-1976) of the department and has been associated with the department since almost half a century. The vote of thanks was given by Dr. Samira Chugh. The session ended with a delicious lunch and clicking pictures which again created a blockbuster memory for future. The alumni went through corridors, canteen and all botany laboratories to recollect their memories as a student and it also enabled them to familiarize themselves with the development of their alma mater. Everyone appreciated the efforts by the department in organizing the Grand Alumni Meet for the first time in the college. The program ended on a graceful note.





Inauguration-Lighting of Lamp



Welcome address





Down the Memory Lane--Quiz time.



Cultural Programme



Alumni Sharing their experiences



Felicitation of Alumni



Felicitation of Alumni



Felicitation of Retired staff by Dr. Suman Govil

Back at Gargi College



Dr. Sheela Kumari
(Batch: 1979-1982)
Associate Professor
Department of Physical Education



Dr. Kavita Vasudeva
(Batch :1986-1989)
Associate Professor
Department of Microbiology



Dr. Renu Mundhara Soni
(Batch :1994-1997)
Assistant Professor
Department of Botany



Lunch Time



Office Bearers-Taru (GCBS) and Anthesis



First Alumni Reunion 2017
Department of Botany

Experience of an Alumna.....



**Kirti Sharma
Alumna (2012-15)**

Science, freedom, beauty and adventure..... what more could you ask for life?

Gargi combined all the elements I loved.

I attended Botany department alumni meet on March 4, 2017. It was a time and event for old relationships to be cherished, celebrated and refreshed and new ones to be formed. New bridges were built, remembering the good old times and memories of the Alumni and looking forward with a sense of purpose and anticipation.

I was a “nobody” when I first entered the magnificent campus of Gargi college, the great academics gifts allowed that NOBODY to become a SOMEBODY.

When I miss my Gargi days, the first thing that comes to my mind are my evergreen mentors and their motivational and friendly nature. On completion of 50 glorious years of Gargi College, Department of Botany organized a Grand Alumni meet for all the Alumni starting from the very first batch.

It was a golden chance which I wouldn't have missed at any cost. I attended the grand Alumni meet. When I entered in college, all my 3 years of memories made my eyes wet and I was feeling proud at the same time.

College was decorated in very unique way, with flowers placed in hanging test tubes. As I proceeded towards the registration desk for getting myself registered, a volunteer sitting there asked “hi Kirti di.....” I was surprised because she was unknown to me. It was very heart touching thing happened to me. She was my super junior Pratibha.

I met all my batch mates. We together entered the seminar hall and got mesmerizing welcome with rose petals shower on us by our loving juniors and G.C.B.S members.

Meeting to all my mentors was a emotional moment .Then my eyes searching for my batchmates .I was surprised to saw many unknown faces there .They all are our super-duper seniors all are now reached on different heights in their life .

We met alumni of the first batch of Botany (Hons) Dr. Suman Govil (batch 1973-1976), a scientific officer at Department of Biotechnology, DBT and many other senior Alumni of different batches.

As we all settled in our seats, our former principal Dr Shashi Tyagi welcomed us by giving a speech which was followed by our TIC Dr. Geeta Mehta.

Dr. Suman Govil also shared her memories with us and encouraged us for future life.

It was a grand event well organized by department with the help of most helpful lab staff that forms the backbone of the department and super supporting faculty members for giving us this beautiful opportunity to gather once again and meeting all our seniors and friends.

A video was also played which included pictures of all Alumni showing our cherished memories of the time we spent in Gargi. Union members performed a group song dedicated to our college life.

Some of our seniors also dedicated awesome songs to Gargi College. A small fun-filled quiz was also there about college and botany.

Then the department presented gifts to all the alumni. A cup depicting having an emblem depicting 50 years of Gargi College was also given all the alumni. The function was followed by a group photo shoot with all the alumni and mentors.

After this session we had lunch with chit chat session where we built new memories.

It was a memorable day where we all had lots of fun and gathered memories and heart touching moments .Thank you so much, Gargi, G.C.B.S , Botany faculty, lab staffs and juniors for organizing this event .

From a proud Gargi Alumna

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AWARDS



Ms Shreya Tripathi
(Sarah Thomas Memorial award)
B.Sc. (H) Botany, III year



Ms T. Ramya
(Dr. Chhaya Biswas award)
B.Sc. (H) Botany, III year



Ms Gayatri Tripathi
(Sh F. C. Sehgal Memorial award and Award of Excellence)
B.Sc. (H) Botany, III year



Pathfinder Projects Science 2016-2017

Name of Students	Title of the project	Mentor
Ankita, Rozy Yadav, Shivani Sharma B.Sc. (H) Botany II year (Winners)	Understanding the Role of Photosynthetic and Sunscreen Pigments in <i>Anabaena</i> Sp. under UV B Stress	Dr. Garvita Singh
Chahat Bhatia, Diya Kalra & Dilmeet Kaur B.Sc. (P) Life Sciences II year	Amplification and sequence analysis of a flower specific promoter (<i>OsLPS4</i>) from rice	Dr. Samira Chugh & Dr. Shweta Sharma



Winners of Pathfinder project award 2016-17

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PHOTO GALLERY



Colours of Spring

Photos by: - **Aishwarya Singh and Drishti**

B.Sc. (H) Botany, III year



A type of Brinjal grown in Bali



Capsicum within the capsicum



Dehisced fruit of Pansy

Photos by: - Dr. Ahalya Chintamani and Dr. Bharati Bhattacharya



VARIOUS ADVANCING
FIELDS

Plants can sense far more than what humans think...



Shobhna Yadav

B.Sc. (H) Botany, II year

What if you are asked a simple question. What is a plant? What answer strikes first in your mind, that plants are green in colour, prepare their own food by photosynthesis and have many more functions. Plants are considered living, so can they sense their surroundings?

Many scientists have proven that the plants can sense, learn, remember and respond to their stimuli. Plants do not have nervous system like humans but they have a more complex mechanism to coordinate signals. They can sense gravity, presence of water and any obstruction in its way.



Source: www.plantozoid.com

Plants react in a way similar to that of humans. Plants do not have nervous system but they do have a system of sending electrical signals. You will be surprised to know that even plants produce neurotransmitters like dopamine, serotonin, and glutamate similar to the nervous system of humans.

They can sense their predators. For example: When a caterpillar attacks an *Arabidopsis* plant, the mulching sound of caterpillar produces vibrations in air. These vibrations act as electrical signal for plants and start producing toxic substances. However, the signals are not transmitted in milliseconds, as in the case of humans; instead plant signals travel at a slow speed.

Plants are very sophisticated. They do interact with one another in an ecosystem. According to Scientist Wohlleben, plants have a remarkable olfactory warning system. He describes it by citing the example of Giraffes and umbrella thorn *Acacia*. He observed that when giraffes were feeding on *Acacia* plants, the leaves started producing toxic substances to get rid of large herbivores. They also

released toxic gases (specifically Ethylene) as a signal to the neighboring plants of the same species to alert them.

Plants also show mutualism similar to animals. It is seen that when plants are unable to derive nutrition due to unfavorable conditions, neighboring plants help them through their root system-either directly by intertwining their roots, or indirectly by growing fungal network around the roots that serves as an extended nervous system. These types of mutualism are even more complex. They are able to distinguish their own roots from roots of other plants. They know the benefit of being together as by being together they can withstand adverse conditions like storm, drought, high temperature etc.

Have you ever visited a forest? Did you observe the growth pattern? Plants can also sense their surroundings. They can sense overcrowding, so they grow in a well-spaced pattern. Observe the canopy carefully how beautifully and intelligently it is maintained by the tree itself. A tree grows its branches out until it encounters the branch tips of a neighboring tree of the same height. It doesn't grow any wider because the air and better light in this space are already taken. Plants do discriminate like humans. Trees also show friendship. They grow their branches in the direction where their friends are not present as they don't want to consume the nutrients of their friends.

The plant *Mimosa pudica* commonly known as *TOUCH ME NOT*, collapses its leaves on a little touch. They are also seen to have memory, when a similar phenomenon occurs with them at regular intervals and they find it harmless then they stop collapsing their leaves. So it shows that plants do not have brains but they do have memory.



Touch-me-not plant

Source: www.myscienceschool.org

A very interesting phenomenon is also exhibited by plants. As humans enjoy music, plants also respond to melodies. But in plants it depends on the type of music being played. They enjoy the classical music and hence grow faster while on other hand they have opposite effect of rock music.

Conclusion: As more and more researches are being done on plants, it is being concluded that plants also possess features that are similar to humans. They can feel pain, have senses and can show many other emotions. What if it is told to you that plants live together with their families then will you chop them down? Pseudoscience also reveals that plant growth is related to human emotions and hence they grow faster in a healthy and cheerful environment.

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GROWING PLANTS IN SPACE



Nidhi Gupta

B.Sc. (H) Botany, III year

While sensing the freshness of watermelon, the taste of scrumptious desserts, I thought about humans who happen to live in space. My mom told me that they carry lots of food packets with them and take care of their daily energy requirements abroad in a spaceship but the curious botanist within me overlooked it and wondered what if we grow plants in space?



Astronauts growing plants in space.

After reading books and surfing a lot, I got to know the answer is **YES** plants can be grown in space. In fact,

astronauts on board the International Space station (ISS) ate the space grown salad (red romaine lettuce) on August 10, 2015. As per research papers, in 1982, the crew of the Soviet's Salyut-7 space station grew *Arabidopsis*, which became the first plant to flower and produce seeds in space. A Skylab experiment studied the effects of gravity and light on rice plant. The SVET-2 Space Greenhouse successfully achieved seed to seed plant growth in 1977.

Source: BioTecNika

Why do we need to grow plants in the space?

- Research purposes on spacecraft ships
- To better understand physiological features and acclimatization of plants.

- Effect of microgravity, closed or confined environments.
- Astronaut's packaged diet.



Guelph professor Mike Dixon poses with small corn plants that have been grown in space ship.

Source: www.nasa.org

Significance of growing plants in space

- Space grown plants supplement astronaut's packaged diet with fresh and nutritious products.
- Nutritional and psychological benefits.
- Seeds are space friendly, once the plant has grown and is producing seeds, it may be possible to grow several batches of food from a single plant.
- Living plants help with stress and increase the crew's enjoyment.
- They provide the sight, smells, sensation and taste of Earth.
- Plant production on ISS has also proved valuable for agriculture on Earth, especially for water is scarce areas, infertile soil or space limited areas.

Experimental Evidences

Plant scientist at Kennedy space center in Florida, were one of the first groups to demonstrate vertical farming in which plants are grown in hydroponic trays stacked in layers, with an electric light source. It's a method now used in many countries across the globe. These experiments on the ISS have also led to the development of an air purification device which is useful in preventing mould.

Overcoming the barriers

Growing healthy, wholesome and edible plants even in a heavily controlled environment is not an easy task. In a way, just like human plants also become accustomed to the environmental conditions in which they live. Traditionally, roots grow and spread downward due to the effect of gravity, but in space, where the effect of gravity is negligible; things change and do so drastically. Roots can grow in every direction in space. Therefore, keeping this entire system intact is very important. To achieve this, a few years ago NASA astronaut Rick Mastracchio and Steve Swanson set up a special container named 'VEGGIE' (Vegetable Production system) which is specifically designed to make garden flourish in weightlessness.

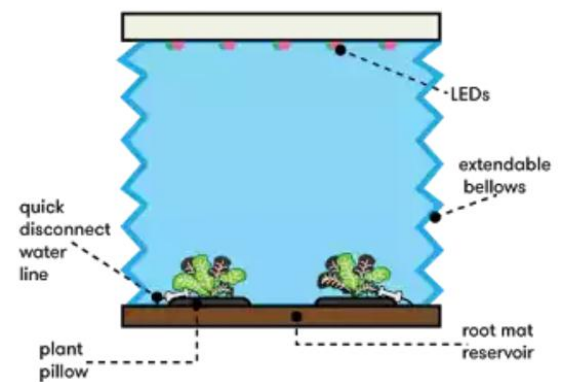
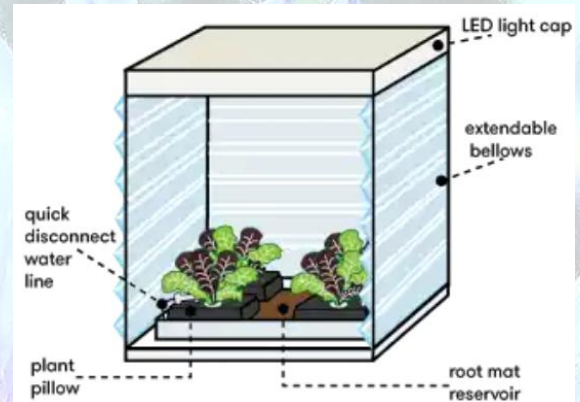
Discovering the undiscovered

Veggie is a container that gives plants a little more guidance by using 'plant pillows'. These pillows are bags of dirt, fertilizer and nutrient equipped with wicking material that soak up water. Astronauts glue seeds onto the wicking material directionally, so that the roots will grow toward the bottom of the bag and the stem will grow outward. LED light are used for photosynthesis and give the shoots a sense of direction so that they keep growing upward. The walls of the Veggie chambers can expand to make the room for the plant as it grows. LED lights have lots of advantages.



A veggie chamber

Source: www.nasa.org



Picture showing various components of a veggie chamber

Source; www.nasa.org

Advantages of veggie chamber

- Energy conservation as they use much less energy than the old school fluorescent or sodium lights.
- They can be used in a targeted way. Specific wavelength can also be selected specific plant responses.

Future strategies

In future, NASA plans to expand their orbital farm, sending up veggies like dwarf tomatoes and dwarf peppers to grow on ISS. But these plants have longer growing period a few months as compared to the 33 days for the romaine and also needs to be pollinated. So the astronaut will soon be observing planting pillows of flowering *Zinnias*, which will test their system's ability to support pollination and use water efficiently.

In last few years NASA started investigating the potential of space grown plants as a food source for astronauts. NASA plans to send a crewed vehicle to Mars in the 2030s, making the ability to grow food in transit more important to overcome transportation problems of packaged food up to long distance expedition.

The act of growing plant in space is just one part of a wider concern. Astronaut farmers need to ensure that plants grown in such artificial condition are safe to consume, don't have any side effects, provide more of energy boost in relatively small quantities, and are pleasant to eat and having that lavish barbeque.

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ALL ABOUT AUTOPHAGY



Reetika Lomor

B.Sc. (H) Botany, II year

WHAT DO YOU MEAN BY AUTOPHAGY?

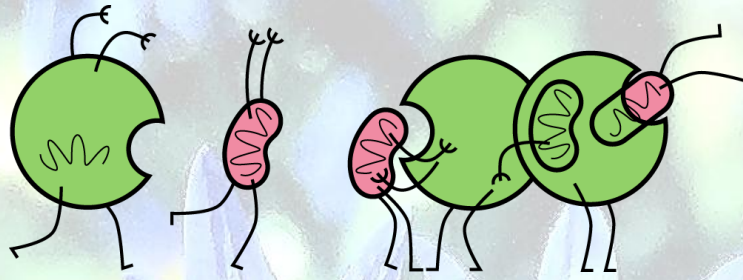


Image showing autophagy

Source- Research gate

The term “Autophagy” has been derived from a Greek word which means "self-devouring." Autophagy is a process in which cells break down their own constituents, such as proteins and organelles like mitochondria, into simpler particles such as amino acids, carbohydrates, lipids etc. and recycle them to generate energy. It is a phenomenon which helps in maintaining homeostatic functions. Under the nutrient deprivation, the cells tend to break down and thus provide substrates for generation of energy.

Autophagosomes are the organelles which mediate autophagy and are responsible for engulfing the cytoplasmic constituents thus it is a non-selective degradation system.

Autophagy can be categorized as follows: -

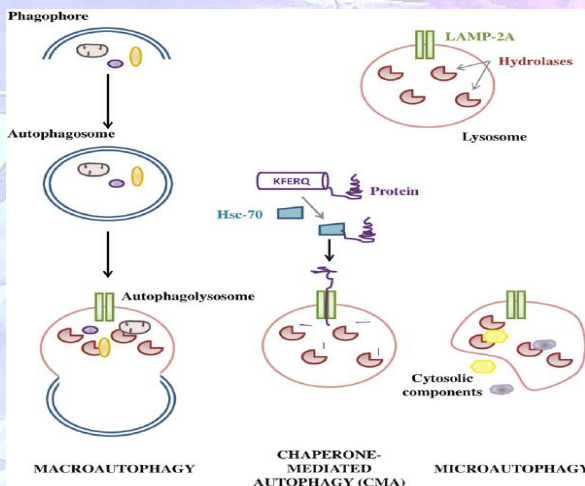


Image showing various types of autophagy

Source- Research Gate

- **Macroautophagy-** It is the most common type of autophagy in which large portions of cellular organelles and cytoplasmic material are engulfed. It is induced in response to stress.

- **Microautophagy-** In this type of autophagy the cytoplasmic constituents are directly engulfed as the lysosomal membrane folds inward

- **CMA (Chaperone-mediated autophagy) –**

In this type of autophagy the proteins which have specific recognition sites itself get translocated inside the lysosomes.

HISTORY OF AUTOPHAGY

In the early 1950's, Christian de Duve was studying about the action of insulin and intracellular localization of glucose-6-phosphatase. During his experiment, he also studied the distribution of acid phosphatase. The freshly isolated liver did not contain any enzymatic activity but when it was kept in refrigerator for five days the enzymatic activities appeared.

He concluded that the proteolytic enzymes lose their activity within a membrane structure later named as lysosomes by de Duve. With the advancements in scientific field the lysosomes were identified to be a separate organelle. Christian de Duve, Albert Claude and George Palade, were awarded the Nobel Prize in Physiology or Medicine in 1974 for their discoveries.

Later on, Christian de Duve noticed that these structures have the capability to consume its intracellular content so he coined the term Autophagy for these structures.

WORK OF PROFESSOR YOSHINORI OHSUMI

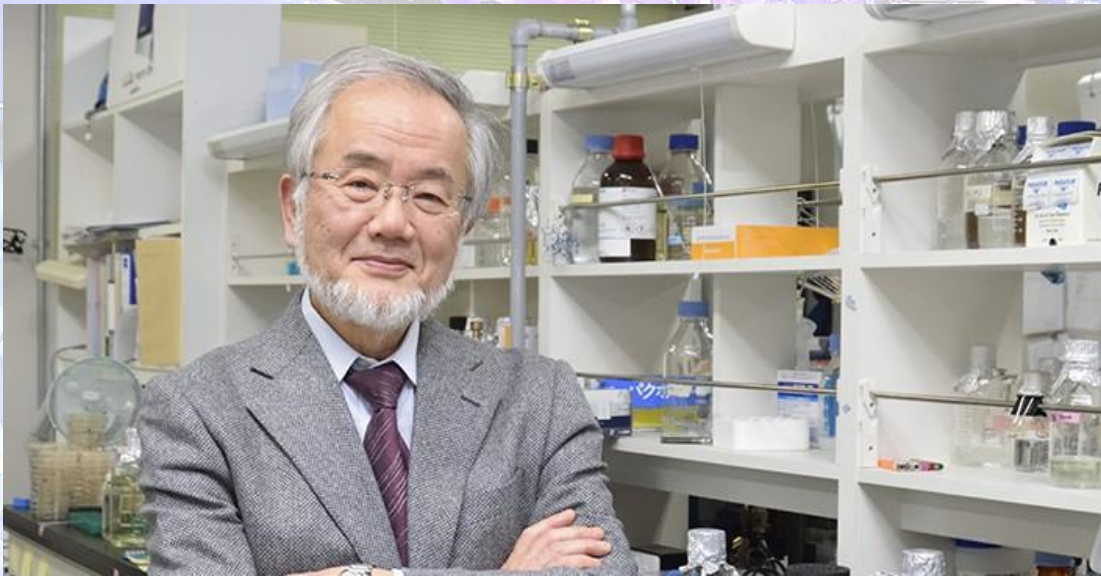


Image of Nobel Prize winner in physiology or medicine, Professor Yoshinori Ohsumi

Source-Speaking of research

Yoshinori Ohsumi is a Japanese cell biologist and a professor at Tokyo Institute of Technology. In 1988 he was studying protein degradation in the vacuole. For this he used yeast cells as a model. He came across with several problems while working on these cells. Therefore, he cultured mutated

Christian
DE DUVE
[1917 - 2013]

Cytologist who discovered
a number of organelles
and coined the term
Autophagy in 1963.



Christian de Duve (scientist who coined the term autophagy)

Source- Scientific journey-bios

yeast cells which lacked enzymes for degradation of vacuoles and simultaneously the cells were starved to stimulate autophagy.

His experiment proved that the yeast cells undergo autophagy. Through his experiment, he could also identify the genes which were involved in this process. It has become a great achievement in the field of science. In 2016 he was awarded the Nobel Prize in physiology or medicine.

After working on thousands of yeast particle she could identify 15 genes which are responsible for autophagy. The result showed that autophagy is controlled by a cascade of protein complexes, each regulating a distinct stage of autophagosome initiation and formation. (www.nobelprize.org)

His work clearly depicts mechanism by which proteins promote autophagosome formation and the role of stress signals in initiating autophagy.

FUNCTIONS OF AUTOPHAGY

- Provides rapid energy to the cells for performing various functions.
- After infection, it can help in fighting against bacterial and viral pathogens.
- Helpful in disposing off damaged proteins and cell organelles thus counteracting ageing.
- Any problem in the process of autophagy may lead to Diabetes type II, Parkinson's disease, cancer and other elderly diseases.

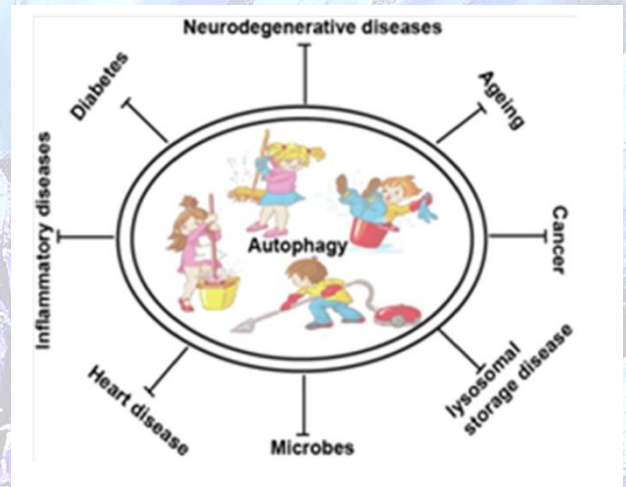


Image showing functions of autophagy

Source-Chauhan lab institute of life sciences

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PREDATORY JOURNALS



The output of any scientific research needs to be published so that it is available to the whole scientific community and also to increase the store of knowledge. To do so we need to publish it in any **Scientific Journal**. A scientific journal is a periodical publication that prints the recent or novel progress made in different fields of Science. The numbers of scientific journals are increasing day by day. The articles published in these journals are peer reviewed by the experts and are accepted only once it meets the standards of scientific validity. The world's first scientific journal is *Philosophical Transactions* and was started in 1665. The latest are the **Open Access Journals** which are available in an electronic format and can be accessed using internet by anyone anywhere. In order to publish the article in Scientific Journals mostly the author has to pay the article processing charges. There are Journals available which publishes the article without taking any charges.

Why do we need to publish our data?

There are various reasons for that

- To submit the Doctoral thesis
- To enrich to the pool of knowledge
- To become recognized in the field of their research
- Publishing the research work will also give a better job and promotion
- For self-satisfaction

The above-mentioned reasons are creating pressure on the young and inexperienced research scientists to unknowingly submit their data in so called PREDATORY JOURNALS.

What are PREDATORY JOURNALS???

Nowadays researchers face the risk of publishing in Predatory/ Fake/Pseudo/bogus Journals. The term Predatory Journal was coined by a library scientist from the University of Colorado, Denver, USA

named as Mr. Jeffrey Beall. These journals are deceitful and publish the articles without peer reviewing quickly sometimes within 3-4 days. They fool the researchers by setting up their web sites that are similar to those of legitimate online Journals. Not only that the name of the journal is also so similar to the original Journals that we fall prey in their hands. They claim to have their offices in USA, UK, Australia or Canada but they belong to Pakistan, China, Nigeria or India. They charge hefty article processing fees from authors and sometimes even bargain and reduce the amount. They also implicate to have famous scientists in their editorial board. Often after sometime they disappear and the authors are left with nothing as they paid the charges of publishing and now their publication is not available anywhere. The number of Predatory Journals has climbed from 18 in 2011 to approximately 700 in 2015. These journals are a grave threat to scientific temperament and quality research.

Why Predatory Journal are Flourishing??

Patent, publish or Perish syndrome is adding on to the growth of Predatory Journals. The research publications, poster presentations in different national or International conferences and citations of academic publications have become the symbol for academic performance. People now primarily believe in quantity rather than quality of research. They want to publish their low quality work with ease and in very less time. Tailor-made guidelines require a definite number of research publications for gaining doctoral degree or for faculty or Scientist appointments or promotions. The above mentioned factors are responsible for the escalation of Predatory Journals.

How to tackle this problem?

Many reports suggest that India is among the leading contributor of articles to these Predatory Journals. One should realize the fact that publishing articles in these journals will damage the name and reputation of scholars and even the institution. The young scholars must resist the temptation to publish their work in these journals. We should spread awareness about the menace of predatory journals like if we come to know about any such journal we should spread the information to other people of the scientific community. The mails from predatory journals should be marked as spam. Jeffrey Beall has compiled a list of such predatory journals which is available online at <https://web.archive.org/web/20161202192038/https://scholarlyoa.com/individual-journals/>, so one should consider that list before publishing. We should proactively promote quality research and education rather than the quantity. It is also the responsibility of the regulatory bodies not to consider publications of these journals during allotment of jobs, fellowships and awards.

- <https://www.enago.com/academy/tackling-the-rapid-growth-of-predatory-publishers/>

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GENETICALLY MODIFIED CROPS: BENEFITS AND CONTROVERSIES



Shivani Dalai
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Shweta Singh
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With science spreading its wings all over the world in all the aspects, coming up with absolute reasoning and advancements, from describing puddles and droplets to roaming around the whole universe finding lives and a broader scope, Global agriculture is being engrossed in the heated debate over Genetically Modified Crops, featuring scientific, political, religious and economical reasons, entering the research labs, various boardrooms, legislative bodies, newspaper, supermarkets and even to people's homes.



Image Source: www.google.com

A Genetically Modified Crop is a plant used in agriculture, the DNA of which has been modified using genetic engineering by exchanging the genes between two plants to produce offspring having desired traits. In usual plant breeding, it can take a long time to achieve desired results depending on the limitations of exchanges between the same or closely related species by inducing fertilization.

But the GM technology has helped the plant breeders to bring together a wide range of living sources in a single plant, not only within a single species but a variety of species, hence, generating a

superior plant variety. First established in developed countries, GMCs have now spread all around the world.

With manipulated genes, these plants develop several new characteristics coming up with tanks of benefits for the human race and for the environment as well.

GMCs' gentleness towards the environment has been taken as its biggest advantage due to the negligible use of chemicals like insecticides and pesticides whereas the non GMCs use abundant amount of such chemicals that emit greenhouse gases and thereby polluting the environment. These modified crops are also resistant to the diseases that end up killing them, hence, increasing the yield and decreasing the prices for the consumers, making it more and more affordable for the population. Also, these crops carry the merit of sustainability to feed the ever growing population of the world, which in the first place, was the main motive of the GMCs. Along with these, the genes can also be modified to enhance the flavour and nutritional value of the crop. Another advantage carried by the GMCs is the longer shelf life that gives the assurance of the long lasting freshness of the crop product for storage.

But with this, came up the objectionable questions, about its safety for human consumption and its effect on human body, most of the times raised due to the incomplete knowledge of the term and the product as well. The main topic for the debate over GMCs is its allergenicity. Though, there are possibilities of transferring a gene from an allergenic and a non-allergenic plant, yet no allergic effects have been found in these crops till date in the market.

The first ever genetically modified food that came across was a Tomato. In the year 1994 in US, the *Flavr Savr tomato* was introduced which was bred with a deactivating gene that stopped the production of an enzyme called *polygalacturonase*, which caused early rotting of the tomato, promising a fully ripen and long lasting tomato. The use of this tomato was on heights until the scientist who discovered it expressed his concerns about the possibility of it being a carcinogen, which led to a ban on the Flavr Savr tomatoes and many of the other GMCs.

Currently, no genetically modified tomatoes are being sold in North America or Europe.

One of the most common GM crop around us is the *Bt cotton*, which has been genetically modified to combat the effect of the bollworms, using *Bacillus thuringiensis*, that is a specific pesticide bred inside the cotton. With the advent of Bt cotton, a considerable cut back on spraying pesticides has been observed. But if the matter is more concentrated upon, this pesticide is not effective on mirid bugs, that is becoming a problem for the crops growing nearby the Bt cotton, again questioning the discovery of GMCs.

Golden rice is another genetically modified crop produced in 1999 by Peter Beyer and Ingo Potrykus in Germany to fortify the content of carotenoids and vitamin A in rice grains so as to combat the deficiency to these nutrients in populations all over the world. Its yellow

appearance due to the carotenoid content is the reason why we call this rice as golden rice. It

was later found that the amount of carotenoids produced by golden rice was still not sufficient for daily bodily need. So, scientists further engineered rice and came up with Golden Rice 2 in the year 2005, which contained vitamin A in much higher amount. It is a commonly grown plant in most African countries. Although is rather a successful GMC, critics continue to not only question the effectiveness of using genetically modified rice to improve health, but also the degree to which the nutrients persist once the rice has been cooked.

In an interview conducted by **Mr. Tsiporah Grignon** with **Dr. Thierry Vrain**, former soil biologist and Genetic scientist, Mr. Grignon said, “It is astounding that people don’t question the very idea of altering DNA. When Monsanto or others claim a genetically modified organism is “substantially equivalent” to the conventional plant, it’s illogical to me because when DNA is altered, the plant is altered. It’s not the same and it’s certainly not natural.”



Source: <http://www.foodpyramid.com/wpcontent/uploads/2014/01/golden-rice-evolution.jpg>



Bt cotton

Image Source: www.google.com

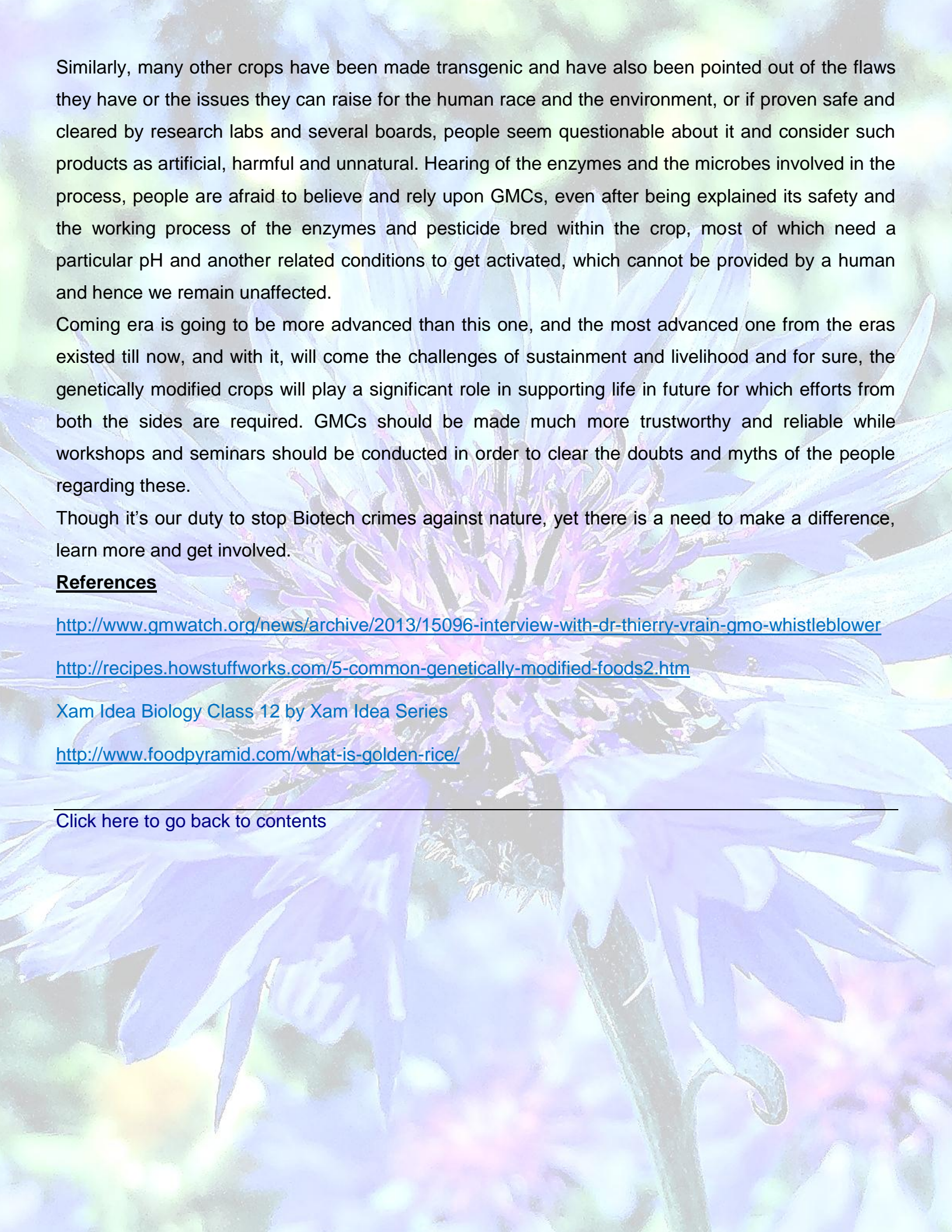
To this Dr. Vrain replied, “That depends on your view of the world. As a scientist, when you add a bacteria gene to a plant, or a plant gene to a fish, or a human gene to corn, or 10,000 acres of corn growing insulin – they consider it progress. So if a tomato plant has a bacterial gene, it still looks very much like a tomato plant. You couldn’t tell very much from the taste of the tomato so there is something easy about believing in “substantial equivalence.”

But on the other hand, Dr. Vrain also agrees

that the unintended consequences are not even looked at, in fact they are completely ignored.



Dr. Thierry Vrain, former soil biologist and Genetic scientist.
Source: <https://www.youtube.com/watch?v=RQkQXyiynYs>



Similarly, many other crops have been made transgenic and have also been pointed out of the flaws they have or the issues they can raise for the human race and the environment, or if proven safe and cleared by research labs and several boards, people seem questionable about it and consider such products as artificial, harmful and unnatural. Hearing of the enzymes and the microbes involved in the process, people are afraid to believe and rely upon GMCs, even after being explained its safety and the working process of the enzymes and pesticide bred within the crop, most of which need a particular pH and another related conditions to get activated, which cannot be provided by a human and hence we remain unaffected.

Coming era is going to be more advanced than this one, and the most advanced one from the eras existed till now, and with it, will come the challenges of sustainment and livelihood and for sure, the genetically modified crops will play a significant role in supporting life in future for which efforts from both the sides are required. GMCs should be made much more trustworthy and reliable while workshops and seminars should be conducted in order to clear the doubts and myths of the people regarding these.

Though it's our duty to stop Biotech crimes against nature, yet there is a need to make a difference, learn more and get involved.

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RECENT ADVANCES IN PLANT SCIENCES

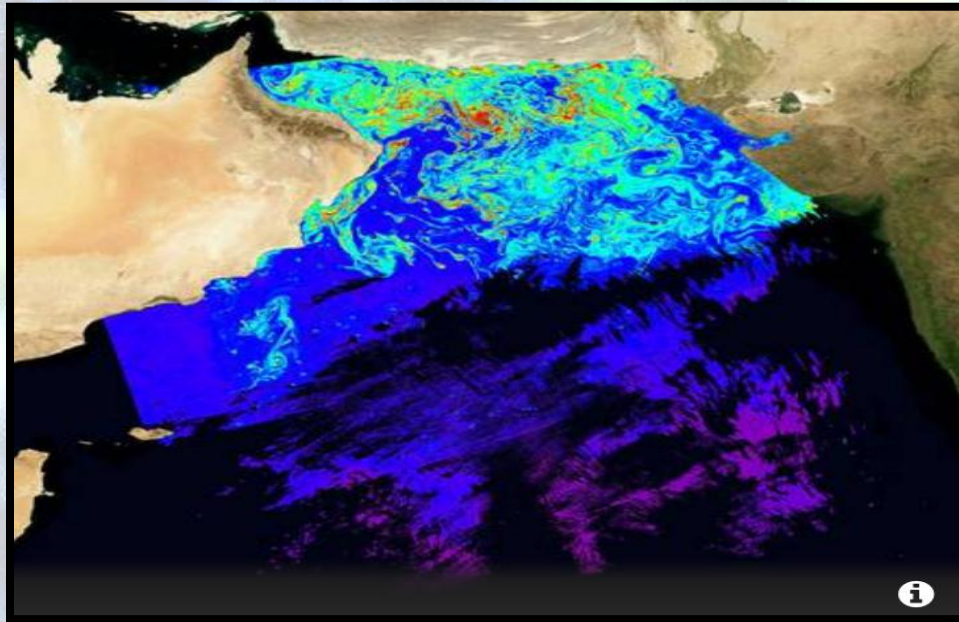


Shalini Latiyan

B.Sc. (H) Botany, III year

1. Algal bloom detection in oceans by IIT Madras

- Indian Institute of Technology (IIT), Madras has recently developed an optical system capable of detecting & monitoring algal blooms (phytoplanktons) both spatially and temporally in coastal & open ocean water. Very soon this system will be used in India by Indian National Centre for Ocean Information Services (INCOIS), Hyderabad.
- Phytoplanktons are the necessity of the living world of water. They play an important role in food web, bestow food and shelter to many organisms like for the fish community. Identifying the algal bloom locations will therefore, benefit such aquatic kingdom in locating the fertile fishing locations. Some algal blooms including “red tides” & “blue-green blooms” are a serious concern because they can pose significant threats to water quality and risks to human & animal health.
- A few field-based techniques are there for assessing algal blooms but such techniques are time consuming, labour intensive, expensive, requires a lot of space and can't be used for monitoring large water bodies.
- This system was developed by Prof Palanisamy Shanmugam and his team. It uses the ocean colour satellite data, underwater light field data and *in situ* measurements to provide information about the different algal species. This system is also capable of revealing the blooms present under water.



Source:

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2. Magical Mushrooms



Source:

<https://www.google.co.in/search?q=magical+mushrooms&source=lnms&tbm=isch&sa=X&ved=0ahUK>

- Magical mushrooms also called as Psilocybin mushrooms or psychedelic mushrooms have been shown to contain a hallucinogenic drug called psilocybin which has proved promising in treatment of depression. Psilocybin has been declared class A illegal drug in the U.K. along with heroin and cocaine. In a recent trial by researchers at Imperial College, London, 12 persons suffering from depression were administered this drug orally. They showed a lot of improvement just after one week and after 3 months 5 of the patients recovered completely from depression. The significant part of this study was that only a single dose is required rather than daily doses. The study was published recently in Lancet Psychiatry and it was proved that the drug is safe and without any temporary or permanent side effects.
- Previous studies have shown that with two sessions with psilocybin, 80 % of long term heavy smokers left the habit after six months. Also after one or two psilocybin sessions, alcohol dependent patients cut down their drinking habit.

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3. Biofortification: DRR Dhan 45

- Dr. Vemuri Ravindra Babu of the Institute of Rice Research (Indian Council of Agricultural Research or ICAR) at Hyderabad produced a zinc rich variety, named as DRR Dhan 45 (also termed IET 23832). It has 22.18 parts per million of zinc (the highest among the so far released rice varieties) and was also found to be moderately resistant to leaf blast, sheath rot and rice tungro virus. Developed using conventional breeding it is released for the states of Tamil Nadu, Andhra Pradesh and Karnataka. It has good cooking quality with desirable amylose content (20.7%).
- It is not a GM (genetically modified) crop, so it sidesteps any needless controversy. Another benefit of this variety is that it has a low glycemic index making it good for patients suffering from diabetes. Zinc has a vital role in health and its deficiency affects the immune, central nervous, skeletal and reproductive systems.
- As this variety has high zinc content it can also be used to combat zinc deficiency in pregnant women. The variety is a proof of concept for biofortification and can be used to address the unseen hunger or mineral malnutrition, thus helpful for the nutritional security of our country.



Source:

https://www.google.co.in/search?q=%E2%80%A2%09Biofortification+:+DRR+Dhan+45&prmd=vni&source=lnms&tbn=isch&sa=X&ved=0ahUKEwjnneOZ4ZzSAhWKQ48KHaBaBWcQ_AUICSgD&biw=360&bih=568#imgdii=4JRm4I5p2KjRtM:&imgsrc=injZRqUjWJMPjM:

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4. **A mother's genetics determines how clever her children are!!!!**

- In a recent study it was revealed that intelligence genes belong to the category of conditioned genes and are thought to work only when they are inherited from mother. They are found to be present on X chromosomes. Different studies on genetically modified mice showed that over expression of maternal genes led to development of bigger heads and brains but little bodies. While over-expression of paternal genes caused smaller brains but larger bodies. Scientists identified mice cells containing only paternal and maternal genes. Parts of limbic system (functions such as sex, food and aggression) showed the presence of paternal genes while they did not find any paternal genes in the cerebral cortex where functions like reasoning, thought, language and planning occurs.

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5. **Xylaria polymorpha / Dead man's fingers**

Xylaria polymorpha is nothing but a very distinctive type of saprobic fungus. It is mostly found in the deciduous forests of North America and Europe. It is called as Dead man's fingers because the fruiting bodies (mushroom) of this fungus are looks like human fingers each of which is about 1.5 – 4 inches tall. It invades dead or dying woods and damaged roots and causes soft rot. This fungus digests the polysaccharides present in the wood and leaves behind unconnected wood and lignin.



Source: <http://tywkiwdbi.blogspot.in/2016/05/dead-mans-fingers.html>

The mushrooms or the fruiting bodies formed by these gives it a typical "finger-like" or "hand-shaped" form. They are dark grey to brown in colour and with maturity get darker. They have a carbon coating which makes them less palatable and more durable. They might persevere for several months or even years there by increasing their ecological range.

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BOTANICAL CROSSWORD

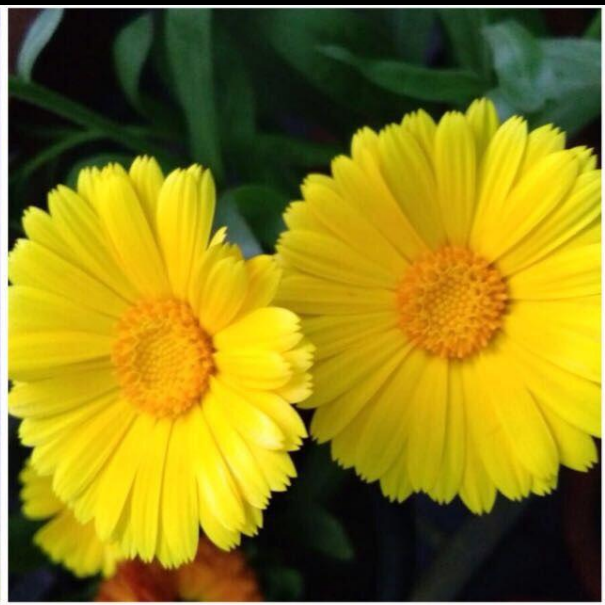
The answers of the below mentioned questions are hidden in the crossword. Go on, search for them!

1. GM food crop developed in University of Delhi.
2. The latest revolutionary gene-editing technology based on bacterial immune system.
3. The oldest algal fossils of *Rafatazamia chitrakootensis* were found in?
4. The most recent plant classification system.
5. System used by NASA to grow plants in space.
6. Location of Global Seed Vault.
7. Plant used for producing plantibodies against Ebola virus, cancer and HIV/AIDS.
8. Plant that has been modified to detect bombs.
9. Process of engineering the plants for the production of small-molecule medicines.
10. The field of bioengineering that inserts nano particles into the cells of living plants, which then alter the functioning of the plant tissue.

A	B	C	B	D	E	F	G	H	I
P	H	A	R	M	I	N	G	K	J
S	L	M	A	N	O	P	Q	R	S
C	N	Z	S	Y	X	W	V	U	T
I	I	A	S	B	A	C	D	E	F
N	C	R	I	S	P	R	C	A	S
O	O	J	C	I	G	H	G	I	P
I	T	K	A	L	F	M	N	D	I
B	I	R	J	Q	O	P	O	N	N
O	A	S	U	T	U	V	W	I	A
N	N	T	N	O	R	W	A	Y	C
A	A	C	C	B	A	Z	Y	X	H
N	D	E	E	F	G	H	I	J	K
L	M	N	A	E	I	G	G	E	V

By T. Ramya (Alumna, 2013-16)

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By Nikita Loharuka

B.Sc. (H) Botany, III year



MOLECULAR
BIOLOGY

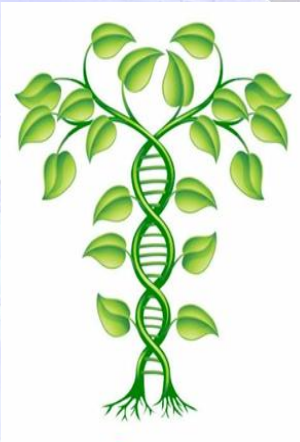
Molecular biology as a tool in taxonomy



Bhawna

B.Sc. (H) Botany, III year

Taxonomy is the branch of science that deals with the study of description, identification, naming and classification of organisms. For systematic arrangement of organisms, the morphology, behavior, genetic variations and biochemical nature of organisms are studied. It helps in identifying newly discovered species and finding its ancestry with those of already identified ones. Taxonomic studies also provide evolutionary relationship between groups of organisms and finds diversity among them.



Source:-

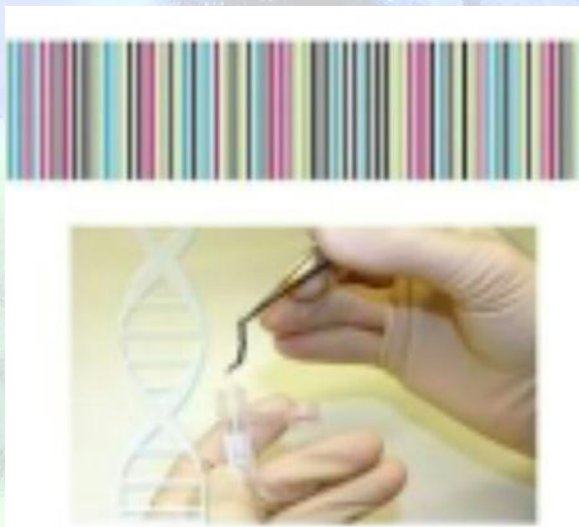
(<http://www.understandbiology.com/wp-content/uploads/2014/07/understand-biology.jpg>)

Historically, organisms were classified on the basis of observing their physical and morphological characteristics. All these organisms are connected to one another through DNA which is inherited by organisms from their ancestors, as they reproduce.

Classification at molecular level

For more accurate or fine taxonomic categorization the organisms were classified on the basis of variation in proteins and DNA. This type of study comes under the discipline molecular systematics. This study is not completely dependent on morphology.

Molecular genetic methods provide basic information for all classes of organisms as a powerful tool for identification and description of organisms. These methods are applicable to all organisms irrespective of their morphological characters, sex and developmental stages.



Source:-

<https://www.zfmk.de/en/research/research-centres-and-groups/molecular-taxonomy>

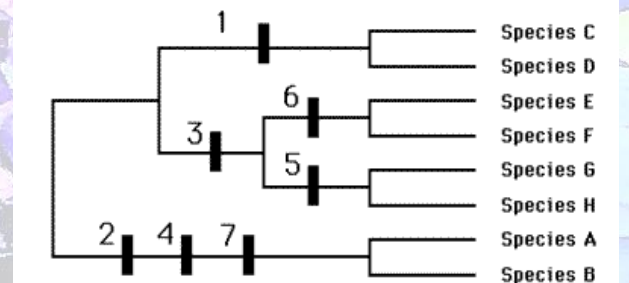
Initially molecular systematics began with micro molecules. Later Botanists used macromolecules, which are proteins and nucleic acids. Studies began to use deoxyribonucleic acid (DNA) with DNA-DNA hybridization. DNA and protein sequencing, immunological methods, DNA-DNA or DNA-RNA hybridization methods are most informative in the study of different species. The data obtained from such studies are used to construct phylogenetic trees.

Fitch and Margoliash (1967) made first phylogenetic tree based on molecular data.

The molecular techniques are rapid and less time consuming than that of the conventional methods. These methods provide sequencing of thousands of base pairs of nucleotides or polypeptide chains with hundreds of amino acids within few hours.

By comparing the base sequences of specific genes, one can determine the exact number of mutational variations. One can also find the similarities and dissimilarities in the arrangement of amino acids among the members of different taxonomic groups. The study of arrangement of amino acid sequences is very helpful in the course of evolution. It can be done by observing the amino acid sequences with chromosomal aberrations (like substitution, deletion, translocation etc.). Today a large number of proteins have been sequenced and the degree of relationship among several taxa has been inferred.

	1	2	3	4	5	6	7
Species A	ACCAGCCTGTGCATCGATG	ACCGACTAAGTGATA	ACCATAAAGACT				
Species B	ACCAGCCTGTGCATCGATG	ACCGACTAAGTGATA	ACCATAAAGACT				
Species C	ACCAGCATGTGCATCGATGCCGACTAAGTGATA	ACCATAAATGACT					
Species D	ACCAGCATGTGCATCGATGCCGACTAAGTGATA	ACCATAAATGACT					
Species E	ACCAGCATGTGTATCGATGCCGACTAAGTGATA	ACCATAAATGACT					
Species F	ACCAGCATGTGTATCGATGCCGACTAAGTGATA	ACCATAAATGACT					
Species G	ACCAGCATGTGTATCGATGCCGACTAAGTGCT	ACCATAAATGACT					
Species H	ACCAGCATGTGTATCGATGCCGACTAAGTGCT	ACCATAAATGACT					



Source:-

<http://lifeofplant.blogspot.in/2011/03/molecular-systematics.html?m=1>

Location of molecular data

For Systematic analysis molecular data can be collected from three different locations within a plant cell: chloroplast, mitochondrion and the nucleus, yielding three different types of genomic (DNA). Mitochondrial DNA (Conserved sequences) possesses a constant rate of mutation over a long period of time, which can be used for studying divergence among species. Nuclear genomes possess rapidly evolving repetitive DNA elements also.

Most studied gene sequences

- Rubisco (from chloroplast, rbcl)

- Ribosome subunits (from nucleus, 18S & 26S)
- ATP synthase (from chloroplast, atpB)

Molecular Techniques Employed In Taxonomic Studies

Nowadays, molecular biology provides basic techniques and powerful tools for determining the phylogeny identification, description, nomenclature and classification of organisms. In the molecular taxonomy, one can research both DNA and RNA, and the main techniques that have been used in the systematics comprises of restriction map construction and restriction analysis through RAPD (random amplification of polymorphic DNA), RFLP (restriction fragment length polymorphism), AFLP (Amplified fragment length polymorphisms), DNA-DNA hybridization, DNA-RNA hybridization and sequencing of DNA. The other techniques used are ELISA (Enzyme Linked Immuno sorbent Assay), Electrophoretic mobility of total protein extract ribosomal proteins pattern obtained by two-dimensional PAGE and HPLC.

Recent approaches

1) (2015) An integrative approach to understand the evolution and diversity of *Copiapoa* (Cactaceae), a threatened endemic Chilean genus from the Atacama Desert

Sequence data of three plastid DNA markers (*rpl32-trnL*, *trnH-psbA*, *ycf1*) of 39 *Copiapoa* taxa were analyzed using maximum likelihood and Bayesian inference approaches. Though 32 morphologically different species can be recognized, genetic diversity between some species and intraspecific taxa is too low to delimit their boundaries using plastid DNA markers.

(Source: -<https://www.ncbi.nlm.nih.gov/pubmed/26373974>)

2) (2011) Phylogenetic relationships and evolution of growth form in Cactaceae (Caryophyllales, Eudicotyledoneae)

Phylogenetic analyses implementing parsimony ratchet and likelihood methods, using a concatenated matrix with 6148 bp of plastid and nuclear markers (*trnK/matK*, *matK*, *trnL-trnF*, *rpl16*, and *ppc*) were performed. Evolutionary relationships in Cactaceae, mainly in lineages within subfamily Cactoideae, have been difficult to elucidate only on the basis of morphological attributes, possibly because of substantial convergent evolution, which was resolved by molecular studies. These molecular results provide solid information at the sub familial level.

(Source: -<http://m.amjbot.org/content/98/1/44.short>)

3) (2009) Molecular taxonomy of *Camellia* (Theaceae) inferred from nrITS sequences

Internal transcribed spacer (ITS) sequences of 112 species of *Camellia* were analyzed. The maximum parsimony and Bayesian trees grouped these species into eight major clades and four

isolates. The current study supported the monophyly of sections *Thea* and *Furfuracea*. The study suggested the polyphyletic nature of the sections *Camellia*, *Paracamellia*, *Pseudocamellia*, and *Tuberculata* and the paraphyletic nature of the segment *Chrysantha* but it didn't support the sectional rank of *Arhecamellia*, *Piquetia* and *Sterocarpus*.

(Source:-<http://m.amjbot.org/content/96/7/1348.full>)

4) (2017) **On the allopolyploid origin and genome structure of the closely related species *Hordeum secalinum* and *Hordium capense* inferred by molecular karyotyping**

Using genomic *in situ* hybridization (GISH) and fluorescence *in situ* hybridization (FISH), it was concluded that *Hordium secalinum* and *H. capense* share a hybrid origin involving *Hordium marinum* subsp. *Gussoneanum*.

(Source:-<https://academic.oup.com/aob/article-abstract/doi/10.1093/aob/mcw270/2964589/On-the-allopolyploid-origin-and-genome-structure?redirectedFrom=fulltext>)

Conclusion

Although it has been long recognized that evolution is based on genetic changes, only during the last two decades there have been strong evidences obtained by the analysis of genetic material using molecular systematic tools for a better understanding of evolutionary relationship. Those species that are closely related are expected to have more similarities in their genetic material than distantly related species. It is the study of molecular genetics that have helped us in clear understanding of diversity and relationships among different species.

Commonly used methods over the recent years include studies on chloroplast DNA using restriction site polymorphism (cpRFLP), analysis of chloroplast gene. The gene trees constructed from *rbcL* have great utility in the classification of angiosperms.

Morphological systematics has been important for the basic understanding of plant evolution and relationships; however, it has limitations. Molecular systematics has an advantage over morphology in two aspects:-

- 1) Homology is usually much easier to determine in molecules than in morphology.

- 2) Molecules tend to provide many more pieces of information than can be gained from morphology

A scientist studying morphology may compare one hundred traits, but a scientist using molecules will compare several hundred to several thousand traits depending on the technique. That means molecular biology provides rapid analysis of information in very less time. Multiple analyses can be done at a time, which is not possible while studying morphological characters.

Additionally, molecular entities are strictly heritable, the description of molecular character is unambiguous, there is some regularity to the evolution of molecular traits, Molecular data is amenable to quantitative treatment, and hence provide better insight in evolutionary history of an organism.

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BIOINFORMATICS: STOREHOUSE OF BIOLOGICAL DATA

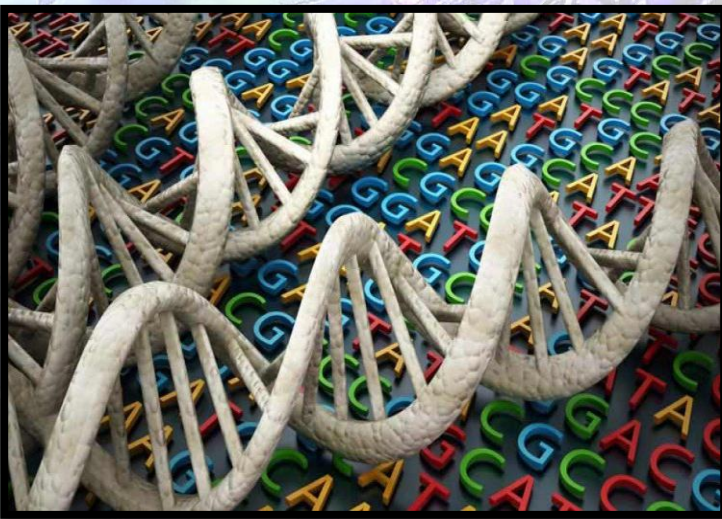


Karishma Sahu
B.Sc. (H) Botany, I year

“Biology will relate every human gene to the gene of other animal and bacteria to this great chain of being”

-Walter Gilbert

The famous quote given by the scientist Walter Gilbert gives a view into the molecular and the genetic world of biology where every living being is connected and every living being shares something similar which on decoding gives a vast amount of information.



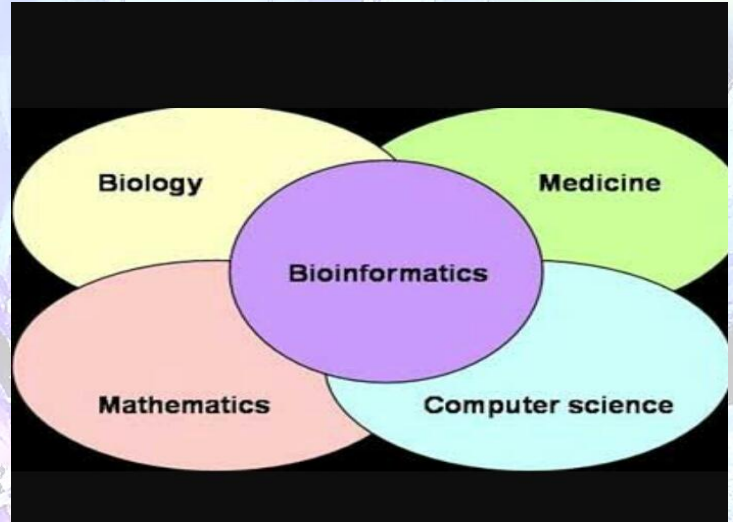
Source: www.botenika.org

Bioinformatics is an interdisciplinary field of subject under science that merges the technological world with the scientific world and more precisely with the biological world. The main aim of bioinformatics is to collect and store the immense scientific data in the form of technology which can be availed easily on the fingertips whenever required. This field helps in developing methods and software tools for

understanding biological data. It is a field of science where computer science, statistics, mathematics and engineering are mingled together to analyze and interpret the biological data.

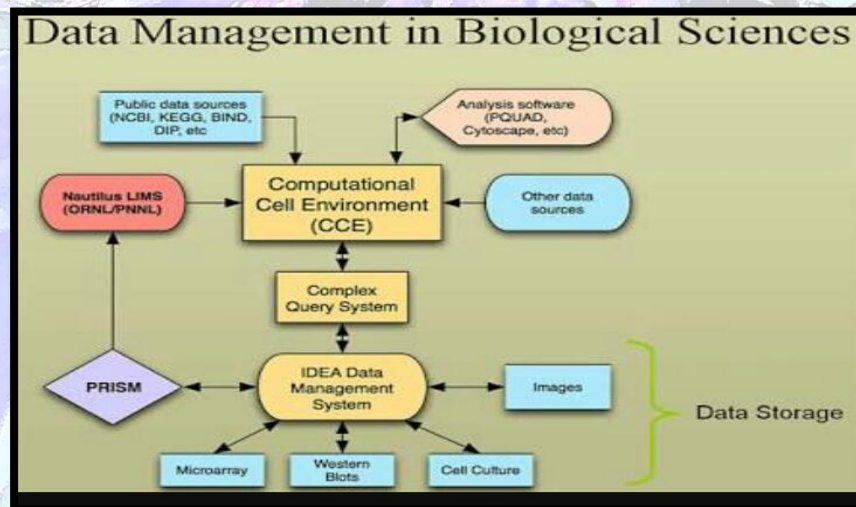
Bioinformatics has become an integral part of many areas of biology, for example, in experimental molecular biology, bioinformatics techniques such as image and signal processing allow extraction of important results from a large amount of data. In field of genetics, it helps in sequencing and annotating genomes and their observed mutations and so on. These are all possible due to the merging of technology which helps in keeping record of large amount of data in concise and in proper order. Bioinformatics tools aids mainly in study molecular biology and genetic biology where the information is large and require a proper collection of data and arrangement of the same.

Computers are very important in the field of bioinformatics because of their ability to store large amount of data. In the early years, the data was published in book but it was not feasible to keep vast information like protein and DNA sequences in books. Hence, the use of computer came out to be very helpful. The main goal was to develop and implement the computer programs that enable efficient access to use and manage various types of biological information. Development of new algorithms



and statistical measures of large data sets paved way for a better computational biology.

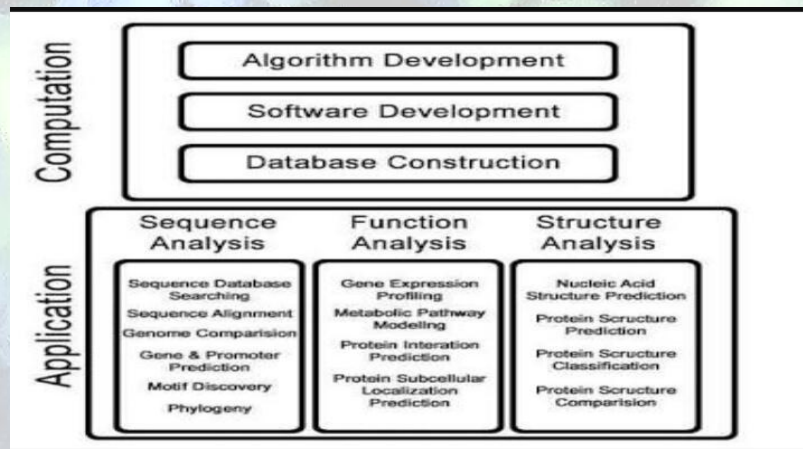
Source:<http://baqai.edu.pk/BiitPrograms.aspx>



Source:<http://www.sysbio.org/sysbio/networkbio/>

Bioinformatics is a vast field with huge amount of information and with the developing technology, molecular biology and genetics this field is expanding day by day. Hence it would be right to term it as a 'store house of biological data'.

Current Developments in Bioinformatics



Source: <http://goo.gl/images/WMIWZB>

Bioinformatics is on its way to expand annotation database and develop novel algorithms to extract biological data from genes. Also, the recent capacities of work include

- Rapid detection of selective pressure on individual sites of codon alignments.
- A universal tool for annotation, visualization and analysis in functional genomics research.
- An integrated and extendable desktop software platform for the organization and analysis of sequence data.
- Locating cliques and overlapping modules in biological network.

Drug designing by the use of bioinformatics tools and its software, also known as CADD (computer aided drug designing) helps save many years in formulating a new drug.

In plant biology, the tools of computational biology are helpful in improving crop and nutrition quality. Medicinal plants can be studied for their properties with the help of proteomics, genomics and transcriptomics. Genomics helps in providing massive information to improve the crop phenotype. Tools such as 'multiple alignment' provide a system to estimate the number of genes in the gene families and also in the identification of the previously unknown genes. The information obtained from multiple sequence alignment helps in studying the gene expression pattern in plants. Computational tools are very useful in identification of ergonomically important gene by comparative analysis between crop plant and model species. The use of bioinformatics in plant breeding for selection of suitable mating types is also becoming popular.

Bioinformatics can therefore be envisaged as a storehouse of biological data which can be retrieved anytime and it also helps in examining the data to form significant conclusions in relatively very less time as compared to past days.

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PLANT DNA BAR-CODING: TAGGING PLANTS



Upma Garg

B.Sc. (H) Botany, I year

INTRODUCTION

Before talking about plant DNA bar-coding, let's first talk about the DNA. DNA is the first 3D copier machine in the real world. DNA refers to Deoxyribonucleic acid, which makes up the genetic material of most of the living beings. Genes are the structural and the functional unit of DNA. These are responsible for all the processes that are taking place inside every living creature. It is found that 99.9% of the DNA is similar within a population and the difference between two organisms is just because of 0.1% of DNA that is different!

So what is this DNA made up of? DNA is a polymer of nucleotides. Each nucleotide is made up of a pentose sugar (deoxyribose), nitrogenous base and a phosphate group. These nucleotides are joined together by phosphodiester bonds. DNA runs in an anti-helical manner.

0.1% of the DNA that we talked about is the one that differentiates one organism from another. Scientists have now developed ways to extract the specific genes that are essential. This was made possible because of the discovery of restriction enzymes which are capable of cutting DNA strands at specific sites.

DNA Bar-coding is a technique that requires a short genetic marker in an organism's DNA which is specific to a particular species and is used for identification. This process is generally used in Taxonomy. It is different from molecular phylogeny because the main purpose is not to determine relationship patterns but to identify an unknown sample in terms of a pre-existing classification. Barcodes are necessary for the identification of the particular species.

- DNA Barcodes are short orthologous sequences. This is one of the identifying methods that



DNA barcodes for plant

Source: Nature News

uses DNA barcodes and facilitate biodiversity studies, identify juveniles, associate sexes, and enhance forensic analysis. For animal bar-coding cytochrome c oxidase 1 (COI) sequence is used but it is not useful for most species of plants because of much slower rate of its evolution in higher plants than in animals. The nuclear internal transcribed spacer region, the plastid *trnH-psbA* intergenic spacer, chloroplast genes namely *rbcL*, *matK* and *ycf1* (region of chloroplast) have been used for applying bar-coding to flowering plants.

The compilation of a public library of DNA barcodes was proposed by Paul D.N. Hebert from University of Guelph, Canada in 2003. This library would "provide a new master key for identifying species.

CHOICE OF LOCUS FOR PLANT DNA BAR-CODING

First of all, it should be short enough so that one can sequence it easily, it should be present in most of taxa and one should be able to sequence it without using species specific primers.

APPLICATIONS OF PLANT DNA BAR-CODING

Kane, Department of Botany ,University of British Columbia Vancouver, BC, Canada writes in the context of plant DNA bar-coding with the heading ,“Botany without borders: bar-coding in focus “

- Along with being a species identification tool aiding species discovery, it will also have applications in large scale biodiversity surveys for identification of a single fragment of material in forensic needs.
- DNA bar-coding provides a standardized method for studying evolutionary relationships by the use of a short stretch of DNA from a particular region of the genome to be used as a barcode for identifying species.
- Plant DNA bar-coding can help identify plant leaves even when flowers or fruit are not available.

- It can also help in identification of the diet of an animal based on its stomach contents and feces.
- DNA bar-coding has led to the oversimplification of science of taxonomy.

CRITICISMS FOR PLANT DNA BAR-CODING

DNA bar-coding has met many criticisms from some scientists, especially in systematic.

- One of the criticisms is that it does not provide reliable information above the species level.
- COI doesn't work in all groups of organisms specifically plants making barcodes non universal.
- Some suggest that recently diverged species might not be distinguishable on the basis of their COI sequences.
- Some scientists feel that the field development will compete for the funds with the taxonomists who are already given limited funds whereas others deny the facts.

DNA BAR-CODING SOFTWARES

The Barcode of Life Data Systems (BOLD) is a web based database that supports the acquisition, storage, analysis, and publication of DNA barcode records. BOLD is the most widely used bar-coding software and is freely available to any researcher with interests in DNA bar-coding.

CHALLENGES IN THE FIELD OF PLANT DNA BAR-CODING

- The DNA bar-coding for plants needs a lot of developments since the mitochondrial locus used for many animal and algal species cannot be used for plant species as well.
- Also it needs a high level of funding. Large amount of money is required for these types of projects along with the highly skilled expertise.
- With the existing technology, it also needs a lot of time and patience.
- Also the existing technology needs a lot of development. Computers and other devices are to be made that are virus and leakage proof that are more reliable ones and easier to use.

CONCLUSION

Overall in a nutshell we can say that bar-coding is an emerging field that is having both pros and cons. As the technique requires skill prerequisites, a skill oriented staff and lots of funds and technological improvements are needed. But with no doubt the technology will reduce the complicated work of taxonomists and the scientists of other related disciplines. It is to be kept in mind

that the technology uses computers for storage of databases and other things, so some confidential work are always at a risk of leakage of information or hacking. Yet the positive point that can't be denied is that it will save a lot of plants from deforestation and other natural resources from exploitation.

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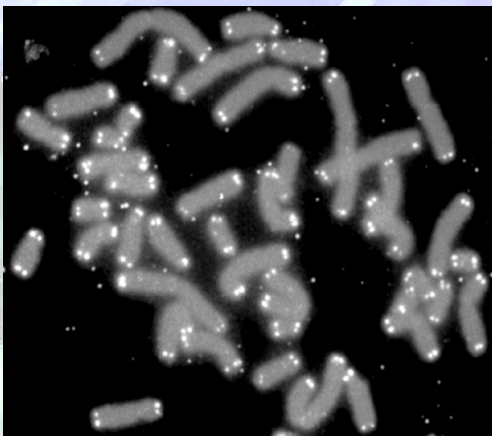
TELOMERES PLAY AN IMPORTANT ROLE IN INCREASING THE LIFE EXPECTANCY



Vishakha

B.Sc. (H) Botany, II year

In this modern world, where everyone is so conscious about maintaining their beauty and not aging too early, what can be better than knowing the fact that **“Aging is in our hands.”** The ‘MASTER REGULATOR’ of aging is present within our genetic system.



Chromosomes with telomeres at their end.
<https://en.wikipedia.org/wiki/Telomere>

WHAT ARE TELOMERES?

Telomeres are important part of human cells that effect the aging of our cells. It is a region of repetitive nucleotide sequences present at each end of chromosomes and protects the end of chromosome from deterioration and fusion with other

chromosomes. In humans the telomere sequence is TTAGGG. This is repeated about 3,000 times. Telomeres are like plastic tips that are present at the ends of shoelaces, without them DNA strands become damaged and cells cannot perform their job.

HOW DO TELOMERES WORK?

Each time a cell divides some of the telomere (usually 25-200 base pairs per division) is lost. Therefore, after each cell division telomeres become short. The cell shows senescence and loses the ability to divide when the length of telomeres reaches a critical limit. The cells are not able to divide further. So Telomere shortening is one of the major factor responsible for aging.

THE GOOD NEWS

The good news is that Telomeres can extend too. Three molecular biologists namely Blackburn, Carol Greider and Jack Szostak in 2009 won the noble prize for decoding molecular nature of telomeres. They also discovered an enzyme **Telomerase** that can restock the Telomeres. Telomerase adds bases to the ends of telomeres and as cell divides Telomerase amount reduces in the cells and cell starts aging.

Elizabeth Blackburn a molecular biologist wrote in her book :- “The Telomere effect - A revolutionary approach for living younger, healthier and longer” has cited that :- “how we eat, move, think and feel can either keep our cells healthy or put them into early retirement.”

HERE ARE FIVE WAYS TO LENGTHEN TELOMERES FROM THE AUTHOR'S LONGEVITY PROGRAM :-

1. **Telomers have a selective liking towards some excercises activity of :-** A German study published in 2015 revealed that excercise like weightlifting effect activity of telomerase slightly. Aerobic excercises likelight jogging or fast walking done three times a week for 45 minutes increaed the activity of telomerase two fold.
2. **Telomeres are not dependent on your weight :-** Rapidly increasing and decreasing weight can have a negative effect on Telomeres. Reducing excess belly fat, sugar intake and improving metabolic health have a positive effect on Telomeres.
3. **Telomeres like omega-3 fatty acids :-** Telomeres increase on fish, seaweeds and flaxseed oil diet. Another way to nourishour telomeres is to eat plenty of whole grains, vegetables, fruits and nuts and avoid sugar, processed meats, white bread and pastries, saturated fat, omega – 6 polyunsaturated fats and excess alcohol .

4. **Medidation strengthen the Telomeres, while depression, stress and anxiety harm them:-** In 2015 a study on Chinese women showed that women under stress conditions had significantly shorter telomeres than the women who were not depressed. Yoga, medidation etc are directly linked to long telomeres.
5. **Harmful Telomerase Supplements:-** The supplements that claim to boost telomerase activity like creams, injections and pills can put the health of people at risk. Adding to much enzyme can activate uncontrolled cell growth that might lead to cancer.

“We should focus on maintaining healthy habits rather than obsessing about telomere length at any one point in time.” -ELIZABETH BLACKBURN

CONCLUSION: To conclude it can be said that the relation between telomere and aging is new. Although Many studies have shown that certain factors are in favour of lenghtening of the telemore and certain factors are against it. But as of now why some factors increase its length and why some factors shorten its length? is still to be revealed....

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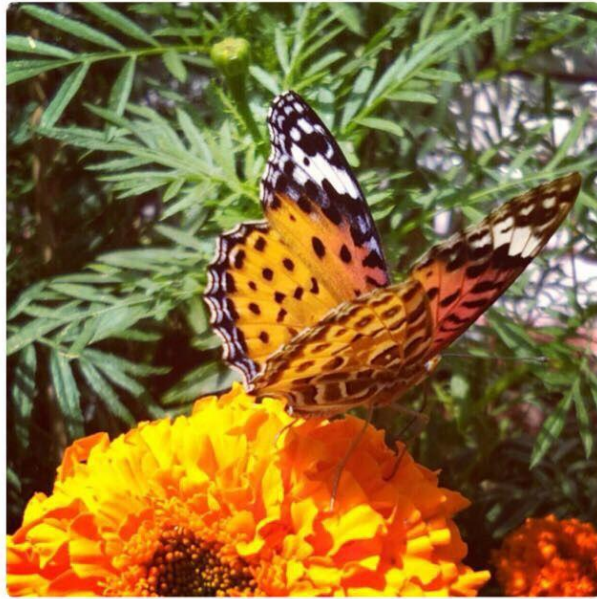
<https://www.tasciences.com/telomerase-activation/>

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Nikita Loharuka

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Nikita Loharuka

B.Sc. (H) Botany, III year



INDUSTRIAL BOTANY

BIOFUELS: ENERGIZING THE WORLD SUSTAINABLY



Aishwarya Singh

B.Sc. (H) Botany, III year

Stuck in a traffic jam on the roads of Delhi, I found myself thinking about the crowded roads and the increasing number of vehicles. The roaring engines made me wonder how much of fuel is consumed by vehicular transportation worldwide daily. The surge in the global population has led to a rapid increase in the energy or fuel demands over the past few decades. It is because of this reason that the fossil fuels, which make up the major energy source the world over, are depleting fast. The current scenario makes me question how long the geological processes inside the earth shall be able to cope up with the ever increasing human needs for these fossil fuels. I am sure it would not be long that we will run out of fossil fuels and ultimately be forced to face the outcomes of our irresponsible utilization of resources.

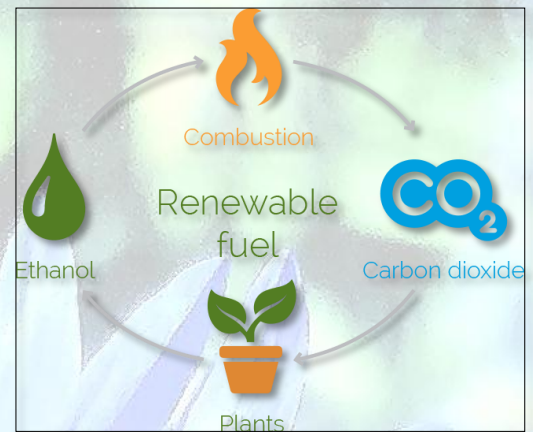
It is important that we start to fathom the need to conserve the non-renewable resources for generations to come and look out for new environmentally sustainable ways to meet the energy and fuel requirements of the world. "Bio-fuels" which refers to renewable liquid or gaseous transport fuels derived from plant or animal material – have emerged as a promising alternative to the fossil fuels. These fuels are produced mainly by biological processes such as agriculture or fermentation, rather than the geological ones involved in the production of fossil fuels. The recent development of biofuels has been driven by following global challenges:-

1) Energy security

Energy security means constant availability and supply of energy for consumers and industry. Owing to the limited availability of fuel and rising prices of imported fuel, the possibility of extracting biofuels from locally grown sources and using them is attractive.

2) Mitigation of climate change

Transport accounts for around a fourth of total greenhouse gas emissions worldwide. It is believed that biofuels, which are cleaner energy source, with proper production methods, will produce significantly fewer pollutants and greenhouse gas emissions. This will eventually help in checking global warming due to greenhouse effect.



Source:
<https://www.imaginfires.co.uk/media/wysiwyg/howtheywork/bio-ethanol-diagram-large.png>

3) Economic development

Investment in biofuels could lead to the creation of new jobs and new sources of income for farmers, hence giving significant boost to economic development, particularly in the developing countries. The global energy consumption is predicted to increase by 84 per cent by 2035, and new sources of energy, such as biofuels, may have a role to play in meeting this demand.

4) Optimal utilization of scarce resources

Using biological waste and residues from agriculture and other industries as raw materials for biofuels is an excellent approach for answering to the needs of a circular economy. Reducing the amount of waste and making the most of our valuable natural resources is crucial for survival of future generations.

Biofuels can be obtained directly from plants, or indirectly from agricultural, commercial, domestic, or industrial wastes. Renewable biofuels generally involve carbon fixation like the one occurring in plants and algae through photosynthesis. Other renewable biofuels are made through the use or conversion of biomass, which is the generic term for any kind of plant material used as an energy source, through thermal, chemical or biochemical processes. The biofuels thus produced are sustainable, and energy companies often mix these with conventional fuels such as gasoline. In other words, unlike oil, coal or natural gas, biofuels won't run out.

Corn ethanol and soy biodiesel were the first biofuels that emerged. The last decade has witnessed a lot of research into finding potent biofuel sources and commercialization of these fuels. There are two main types of biofuels that are currently in commercial production:

- **Bio-ethanol (to blend with petrol)** – an alcohol made by fermentation, mostly from carbohydrates like sugar/starch from crops such as sugarcane, corn or wheat or from cellulosic biomass derived from non-food sources such as trees and grasses.



Commercial Bioethanols

Source:http://ekofuel.org/wp/wp-content/uploads/2013/07/ekofuel_range.png



Biodiesel

Source:<https://articles.extension.org/sites/default/files/Biodiesel%20320%20x%20400.jpg>

- **Bio-diesel (to blend with diesel)** – made from oils of crops such as palm, soybean, oilseed rape, or sunflower using transesterification process and is a liquid similar in composition to fossil/mineral diesel.

These conventional biofuels, made from sugar, starch or vegetable oils are collectively known as the “first generation” biofuels. Apart from the above mentioned fuels, some other biofuels are bioalcohols such as methanol and butanol. Butanol is a green fuel that can be used right away in existing gasoline engines and is less corrosive and less water-soluble than ethanol, and could be distributed via existing infrastructure. Green diesel is another renewable energy source that is produced through refinery methods of hydrocracking biological oil feedstocks like vegetable oils but its cost of production is comparatively high.

With the advent of technology in the field of scientific research, new advanced or “second generation” biofuels are being developed from a wide variety of biomass such as lignocellulosic biomass or woody crops, algae, agricultural residues or waste. The main idea is to use the non-edible parts of crop plants for generation of energy sources so as to optimize the use of plant in all ways and thereby eliminating the competition for land and nutrients.

LIGNOCELLULOSIC BIOFUELS

Willow, Miscanthus and Switchgrass are amongst the most promising lignocellulosic crops. These crops can be grown specifically to make biofuels due to a number of advantages like having potentially high energy outputs, they do not strip nutrients from the soil and they can be bred to improve yield, water use and pest resistance. Using the waste parts of food crops to produce biofuels is another possibility. Several other species of plants that can be used to produce biofuels include soybeans (*Glycine max*), oil palm (*Elaeis guineensis*), and *Jatropha* (*Jatropha curcas* L).

1. *Jatropha*



Jatropha curcas

Source: https://upload.wikimedia.org/wikipedia/commons/6/61/Jatropha_curcas.jpg

It has several agronomic morphological traits such as high oil content (35%), drought tolerance, rapid growth, and ease of propagation at any altitude which makes it suitable to be used as a biofuel crop. Also, the plant can produce oil having good stability to oxidation, low viscosity, a low pour-point, is cultivated for more than 50 years.

2. *Miscanthus* (*Miscanthus giganteus* and other *Miscanthus* spp.)

It is a promising lignocellulosic feedstock due to its various advantages such as rapid biomass accumulation, higher oil yield, improvement of soil fertility and adaptation to low nutrient conditions.



Miscanthus sp.

Source: <http://www.biofuelstp.eu/images/miscanthus.jpg>

Giant reedgrass (*Arundo donax*)



Arundo donax

Source: <http://www.biofuelstp.eu/images/giant-reedgrass.jpg>

It shows wide adaptability *especially* in riparian or wetland systems. Several field studies have highlighted the beneficial effect of the crop on the environment due to its minimal requirements on soil tillage, fertilizer and pesticide (e.g. Riffaldi et al, 2010). Additionally, it offers protection against soil erosion, is well adapted to saline conditions, resistant to biotic and abiotic stresses and can be cultivated for 20-25 years without replanting. Giant reedgrass (Spanish cane) is considered to be one of the most promising species for biomass production in Europe.

ALGAL BIODIESEL

Algae are aquatic prototrophic organisms. Microalgae have several qualities that make them an attractive source for energy. Some algae have biomass productivity (dry weight per unit time per unit

area) much higher than those of higher plants and they have high lipid and starch contents (over 30% w/w). Microalgae are relatively easy to cultivate and grow very fast. Algae can be cultivated on non arable land or in water and thus, they do not compete for land with food production crops. However, the cost of biodiesel production from algae is very high and the production of algal biofuels is mostly at the experimental stage. Cultivating algae under rural conditions requires novel multi-tier, multi-cyclic approaches of sharing land area without causing threats to food and water security as well as demand for additional fertilizer resources by adopting multi-tier cropping (algae-paddy) in decentralized open pond systems.



Algae are a promising source of renewable energy

Source:<http://nuffieldbioethics.org/wp-content/uploads/2014/07/Algae1-492x330.jpg>

Despite the fact that microalgae could be transformed into several biofuels such as into bioethanol by fermentation of hydrocarbons and into biomethane by anaerobic digestion, transforming lipids into biodiesel could allow the reduction of oil-based diesel consumption. Many companies are using algal bioreactors for various purposes, including scaling up biofuels production to commercial levels.



Botryococcus braunii- a green alga that produces petroleum like compounds, growing in a pond.

Source:<https://c1cleantechnicacom-wpengine.netdna-ssl.com/files/2010/03/Algae-can-produce-petroleum.jpg>

Scientists have identified some *Botryococcus* spp. that have up to 50% of their dry mass stored as long-chain hydrocarbons which can be used to manufacture green fuel with the help of biotechnology. Algal strains can also be bioengineered, allowing improvement of specific traits and production of valuable co-products, which may, in future, allow algal biofuels to compete economically with petroleum.

The table below depicts current and futuristic biofuels that can be created from various types of biomass with the help of technology:

Raw material	Technique	Product	Product type
Vegetable oil and animal fat	Hydrotreatment	Biodiesel	Hydro-treated biodiesel
Algae	Fermentation, extraction and Esterification	Biodiesel etc.	Algal biodiesel
Lignocellulosic material	Advanced hydrolysis & fermentation	Biomass-to-liquids (BTL): Fischer-Tropsch (FT) diesel, synthetic (bio) diesel	Synthetic biodiesel
Lignocellulosic material	Advance hydrolysis and fermentation	Cellulosic bioethanol	Bioethanol

Taking into consideration the growing energy demands across the globe, it is necessary to look out for renewable biofuels. These fuels not only help in reducing the usage of fossil fuels but also help in restoring the ecological balance and maintenance of the environment by curbing the air pollution and global warming. With the use of biotechnology and bioengineering several oil crops are being engineered to be used as food crop as well as biofuel raw materials, for example, rapeseed, soybean, etc. Although biofuels are important but evaluation of the biofuel industry is equally necessary so that costs and benefits of biofuels are distributed in an equitable way. It should be ensured that development of biofuels does not take place at the expense of basic essentialities including food and clean water. With the agenda of providing cleaner and greener fuels, the scientific community shall soon come out with more advanced fuels. These fuels shall ensure sustainable development in true sense.

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A NEW ERA OF BEAUTY PRODUCTS: HERBAL COSMETICS



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B.Sc. (H) Botany, III year



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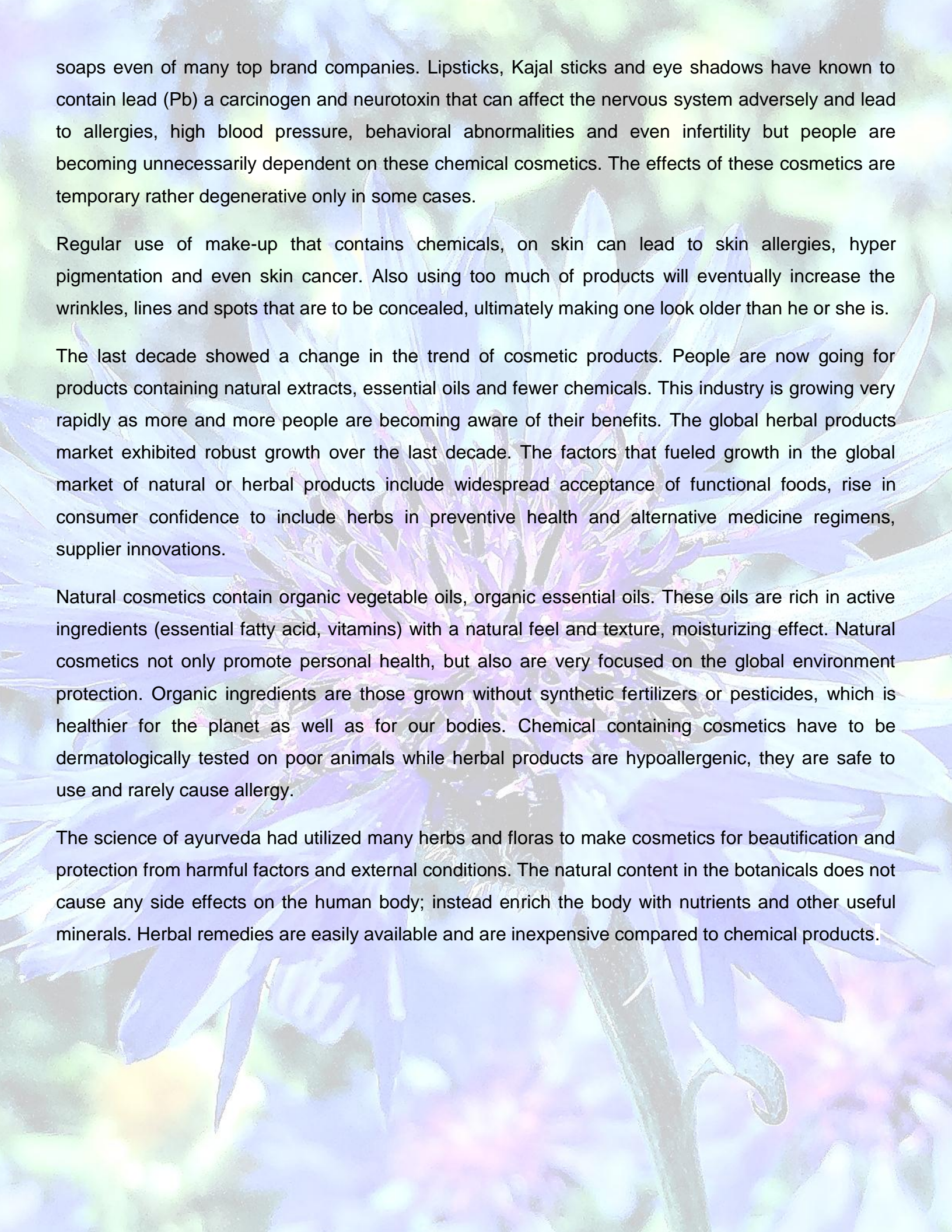
B.Sc. (H) Botany, II year

Cosmetics have been a part of human lives since time immemorial. They are mainly applied to improve one's appearance and charm. They boost people's confidence and enhance their best features. Cosmetics have become a part of our daily routine. But some imperfections of the body are not removed by these, so, to hide them many chemical based cosmetics are also being used not only for skin but for hairs as well. Our skin and hair care industries are lined up by the products that are chemical based.



Source: <https://coloursbyadamandandrea.wordpress.com>

Synthetic colors, parabens (a class of preservatives), SLS/SLES (Sodium lauryl sulphate /Sodium Laureth Sulphate) and fillers are the most commonly used harmful chemicals used in shampoos and



soaps even of many top brand companies. Lipsticks, Kajal sticks and eye shadows have known to contain lead (Pb) a carcinogen and neurotoxin that can affect the nervous system adversely and lead to allergies, high blood pressure, behavioral abnormalities and even infertility but people are becoming unnecessarily dependent on these chemical cosmetics. The effects of these cosmetics are temporary rather degenerative only in some cases.

Regular use of make-up that contains chemicals, on skin can lead to skin allergies, hyper pigmentation and even skin cancer. Also using too much of products will eventually increase the wrinkles, lines and spots that are to be concealed, ultimately making one look older than he or she is.

The last decade showed a change in the trend of cosmetic products. People are now going for products containing natural extracts, essential oils and fewer chemicals. This industry is growing very rapidly as more and more people are becoming aware of their benefits. The global herbal products market exhibited robust growth over the last decade. The factors that fueled growth in the global market of natural or herbal products include widespread acceptance of functional foods, rise in consumer confidence to include herbs in preventive health and alternative medicine regimens, supplier innovations.

Natural cosmetics contain organic vegetable oils, organic essential oils. These oils are rich in active ingredients (essential fatty acid, vitamins) with a natural feel and texture, moisturizing effect. Natural cosmetics not only promote personal health, but also are very focused on the global environment protection. Organic ingredients are those grown without synthetic fertilizers or pesticides, which is healthier for the planet as well as for our bodies. Chemical containing cosmetics have to be dermatologically tested on poor animals while herbal products are hypoallergenic, they are safe to use and rarely cause allergy.

The science of ayurveda had utilized many herbs and floras to make cosmetics for beautification and protection from harmful factors and external conditions. The natural content in the botanicals does not cause any side effects on the human body; instead enrich the body with nutrients and other useful minerals. Herbal remedies are easily available and are inexpensive compared to chemical products.

List of some commonly used plant extracts and their forms in commercial application:

Botanical Name/Part Used	Common Name	Form	Use
<i>Acacia concinna</i> pods	Shikakai	Powder	Shampoo's Soaps
<i>Acorus calamus</i> rhizome	Sweet Flag	Powder/Paste	Aromatic, Dusting Powders, Skin Lotions
<i>Allium sativum</i> bulbs	Garlic	Powder/ Paste	Promotes Skin healing
<i>Aloe vera</i> Leaf	Aloe	Powder / Paste	Radio-protective Moisturizer, Sun screen
<i>Alpinia galanga</i> rhizome	Galanga	Powder/Paste	Aromatic, In dusting Powders
<i>Avena sativa</i> fruit	Oat	Powder / Paste	Skin tonic / Moisturizer
<i>Azadirachta indica</i> leaves	Neem	Powder / Paste	Tooth Pastes, Soaps, Shampoo's
<i>Balsamodendron myrrha</i> gum	Myrrh	Powder/Paste	Soaps / Shampoo's
<i>Calendula officinalis</i> flowers	Marigold	Paste	Promotes skin care
<i>Cedrus deodara</i> wood	Deodar	Powder/Paste	Shampoo's/Soaps
<i>Centella Asiatica</i> plant	Gotu Kola	Powder/Paste	Wound Healing
<i>Cichorium intybus</i> seed	Chicory	Powder/Paste	Relieves sore eyes/Clears Skin of blemishes
<i>Citrus aurantium</i> peel	Orange	Paste	Skin creams, Soaps, Shampoos
<i>Citrus lemon</i> peel	Lemon	Powder	Heals skin, Prevents Hair Loss
<i>Coriandrum sativum</i> seed	Coriander	Powder	Anti-inflammatory
<i>Crocus sativus</i> stigma	Saffron	Liquid	Post bath massage
<i>Curcuma longa</i> rhizome	Turmeric	Powder/Paste	Skin creams & lotions Antibacterial
<i>Curcuma zedoaria</i> rhizome	Zedoary	Powder/Paste	Antibacterial, Aromatic
<i>Daucus carota</i> seeds	Carrot	Oil	Natural source of Vitamin A
<i>Eclipta alba</i> plant	Bhringraj	Powder/Paste	Shampoo's
<i>Glycyrrhiza glabra</i> root	Liquorice	Powder/Paste	Anti-inflammatory
<i>Hedychium spicatum</i> rhizome	Kapurkachir	Oil	Hair Oils
<i>Hibiscus rosa sinensis</i> flowers	China rose	Paste	Shampoo's
<i>Iris florentina</i> root	Orris	Powder	Additive to dusting Powders
<i>Lawsonia alba</i> leaves	Heena	Powder/Paste	In Shampoo's
<i>Matricaria chamomilla</i> flowers	Chamomile	Powder/Paste	Hair Tonic/ Relieves sore Limbs
<i>Moringa oleifera</i> seed	Benjamin	Oil	Hair Oils, Suntan Lotion
<i>Pterocarpus santalinus</i> bark	Red sandal wood	Powder/Paste	In Skin creams
<i>Santalum album</i>	Sandal Wood	Powder/Paste	In skin Lotion's
<i>Triticum sativum</i> germ	Wheat germ	Oil	Skin lotions, A natural source of Vitamins.

Many industrial companies have launched products with natural extracts to compete with the well-established chemical cosmetic industry. A recent rising brand is "Patanjali" started in year 2006 and commercially launched its cosmetic products in 2009 with the objective of re-awakening the long lost science of ayurveda with the latest technology. Also to list some few other brands which have entrusted herbal products are 'Himalaya herbals', 'Lotus herbals', 'Khadi naturals' etc. 'Vaadi herbals' is a perfect combination of herbal science and advanced technology. It uses finest quality of natural herb extracts at reasonable prices. 'Just Herbs' is another herbal products brand in India which is highly appreciated for disclosing the list of its all ingredients, each of their items have unique formulas

with certified natural extracts for maximum efficacy, ultimate safety and no side-effects. 'Biotique' is one of the top branded herbal companies in India and worldwide the company has gained reputation for natural therapies and biotechnology. 'Forest essentials', which uses natural extracts along with essential oils, manufactures products that contain spring water and naturally grown herbs.

In this time where people have grown so impatient where everything is possible with just one click in one second the choice between chemical based products which give results easily and in less time to herbal products which take their time to impact is rather difficult. But people are now realizing the long term benefits of this natural industry and its growth and survival in this tough marketing environment is proof of its benefactors who have bestowed their trust in it.

The best way to know exactly what goes into our skincare products is making our own. This not only will save money and packaging, but we will also get the satisfaction that no preservatives or toxic chemicals are used in the process. Making our own personal care products for daily use is really easy and simple. We just need to mix few ingredients and it's all done.

Some natural ingredients that we can use are:

GROUND EUCALYPTUS LEAF: *Eucalyptus* is a very important medicinal plant as it is a natural analgesic, deodorant and immune system stimulant which also has anti-viral, anti-bacterial, anti-fungal and anti-microbial properties. It makes Eucalyptus a great treatment for any kind of skin infection.



POWDERED LAVENDER FLOWERS: Lavender has great value in helping the skin heal itself, stimulating self-growth, reducing inflammation, preventing scarring and balancing the production of oil and perfect for fighting acne and other skin problems.

<http://www.health.com/health/gallery>

PEPPERMINT LEAF: Peppermint plays an important trick on

the nerves. It stimulates those that produce cool, soothing sensation and desensitizes pain.



<http://www.health.com/health/gallery>

GROUND ORANGE PEEL: It has an anti-oxidant content which



protects the

skin. Citric acid present in it helps to wash away oil from skin.

<http://healthbubbles.com>



<https://www.organicfacts.net/health-benefits/oils/health-benefits-of-coconut-oil>
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[25/stock-photo-herbal-tea-with-honey](https://www.organicfacts.net/health-benefits/oils/health-benefits-of-coconut-oil)

neutralizing UV lights and stimulating new cell-growth.

WHITE-WILLOW BARK POWDER: This herb has been used for millennia for natural pain relief. Its anti-inflammatory and analgesic properties make this the perfect soak for people with skin disorders such as Psoriasis, eczema and nasty sunburns.



<https://www.americanspice.com/white-willow-bark-powder>

POPPY SEEDS: Poppy seeds act as a source for a variety of minerals like Iodine, manganese, magnesium, zinc and copper. They act as a gentle exfoliator.

Essential oil uses range from aromatherapy, household cleaning products, personal beauty care and natural medicine treatments. Natural oil benefits come from their antioxidant, antimicrobial and anti-inflammatory properties.

Some amazing natural oils for our skin are:

Argan oil: - Rich in vitamin E and essential fatty acids.

Acai oil: - Rich in antioxidants which help to protect the skin from harmful free radicals and the oxidation of cells.

Flaxseed oil: - Softens skin while providing essential fatty acids.

Olive oil: - Rich in Vitamin A and E which helps in repairing and renewing skin.

Coconut oil: - It has the added benefit to reduce bacteria on the skin.



<https://www.organicfacts.net/health-benefits/oils/health-benefits-of-coconut-oil>

Avocado oil: - Rich in Vitamins, fatty acids, and antioxidants especially Vitamin E.

Tea tree oil:- Antiseptic properties help fight acne.

Grape-seed oil:- Regulates oily skin and brightens with vitamin C.

Peppermint oil:- Reduces redness through anti-inflammatory properties.



<http://www.homeremediesweb.com/grape-seed-oil-health-benefits>

Conclusion

Plants are used widely as natural ingredients for cosmetics. Basically, we can conclude that it is the formulation from simple herbs that can be more effective in tackling our cosmetic needs. With the advent of science, plant extracts are being used for formulation for cosmetics products worldwide. There are lots of researches going on to study the use of plant extracts for cosmetic products to fulfill generations' need for beautification. Plants possess significant anti-oxidant, anti-tumor, anti-inflammatory and anti-aging properties which are now proved through experimental researches. It is amazing that the plants or herbs around us have lots of uses as an ingredient of beauty products but we don't know about them. Plant products have a very profound effect on the skin if used properly.

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NANOTECHNOLOGY: AN UPCOMING REVOLUTION



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“It has become appallingly obvious that our technology has exceeded humanity”

-Albert Einstein



Image depicting nanoparticles

Source-

<http://www.standards.org.au/StandardsDevelopment/Pages/Nanotechnology.aspx>

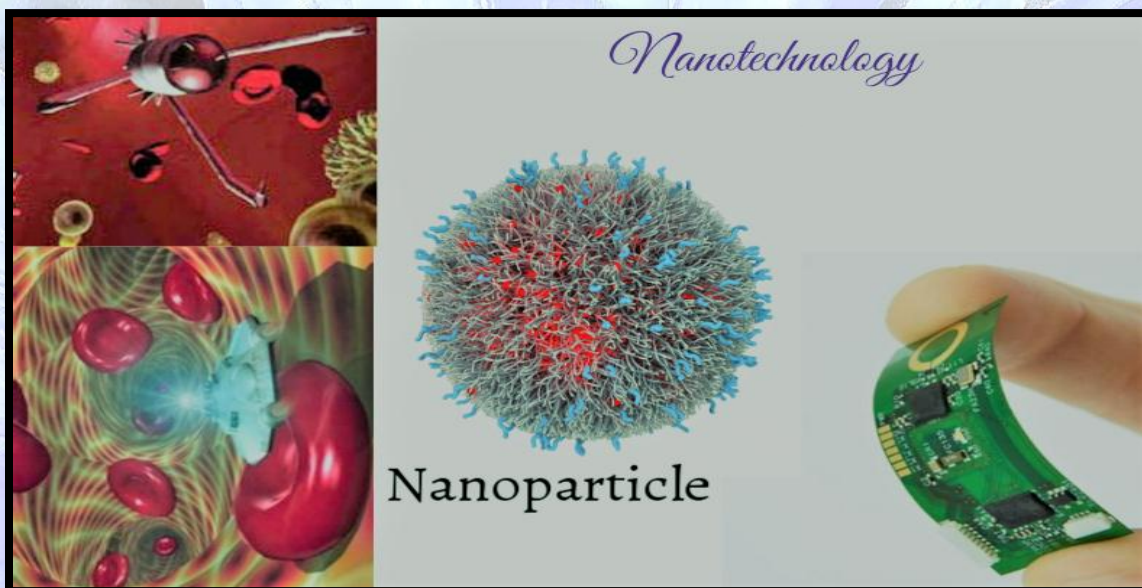
The intrication to perceive technological revolution is quite obvious; the stealth with which the technology is budding today is quite unimaginable to be described in words. Every new second, we hear about the recent advancements made in the field of science. Technological revolutions could be compared to a silent **TSUNAMI** in an open ocean that comes with a silent pace. Likewise, the wave of growing technology comes with sharpness that only a few of us are aware of. Nanotechnology has been around us for decades but it's only now that the first wave of application is starting to break. Nanotechnology might be the next big thing in science, and before long we would find ourselves completely immersed in it. But right away, the intimate dogma of nanotechnology is rather restricted.

When we talk about the dimensions, the NANO word itself tells that how small a nanoparticle is. But the question that comes to our mind is what actually nanoparticles are and how do we define nanoparticles? A nanoparticle can be defined as the tiniest entity that can still behave as a whole unit in the terms of its properties. Together, they are small aggregates of atoms and are exceedingly minute objects with dimensions measured in nanometres. It is an astonishing fact that a nanoparticle is 10,000 times smaller than the diameter of a human hair.

The science behind nanoparticles relies on the size of the nanoparticle. Nanoparticles are of great interest because the particles behave magnetically at nano scale and that is where the essential properties such as their optical and electrical properties are determined. These are the properties which have a great impact in the field of electronics, medicines, treatments and of course in agriculture.

Applications of nanotechnology

Nanotechnology is seen to have a diverse range of applications in all quarters, from commercial products to industrial manufacturing units.



Use of nanoparticles in making chips and various industrial purposes

Source: -<http://news.mit.edu/2012/cancer-particle-0404>

Few applications of nanoparticles are listed below:

- The titanium dioxide nanoparticles and Zinc dioxide nanoparticles are being used in the sunscreens, cosmetics and some food products
- Silver dioxide nanoparticle is used in food packaging
- The bioprocessing of agricultural wastes through nano-processing is pragmatic in energy generation
- Silicon nanoparticles are used in manufacture of computer chips, silicon nanowires are used for making transistors which are used in integrated circuits.
- In agriculture, it is used as nanocides, and for boosting plant metabolism.

Nanotechnology in plants and agriculture

Nanotechnology is now stemming as a boon to agricultural areas. With the growing human population scientists are working to develop new ways to meet rising global demand for food, energy and water. Nanotechnology is a part of precision farming, the nanoparticles synthesized in laboratory in place of conventional fertilizers increases plant growth. Recently, scientists have used the zinc nanoparticles to increase the yield of highly nutritious moong beans which are widely grown in Asia. Also when the plants are exposed to the carbon nanotubes, the growth and metabolism of plant is affected and they expressed a number of stress-specific genes to combat stress.



Use of nanotechnology for agricultural purposes

Source:<http://www.avensonline.org/blog/application-of-nanotechnology-in-agriculture.html>

Nano fertilizers

Use of large scale application of synthetic chemical fertilizers to increase crop productivity is not apposite option as they make the soil infertile. To tackle the problem scientists have developed nano-fertilizers which are non-encapsulated powdery or plated substances with properties like, controlled release of nutrients and chemicals which are essential for plant growth and development.

Effects of Nanoparticles in Plant Growth and Development

Following are some nanoparticles which are widely used in agriculture for better plant growth and development:

Carbon nanotubes

Carbon nanotubes (CNT's) boost up the plant growth. A research has produced '**Bionic Plants**' by inserting these tubes into plant chloroplasts, which enhance the photosynthetic rate. Carbon

nanotubes have also been quoted as potential direct delivery systems for pesticides, fertilizers and other chemicals.

Gold Nanoparticle

Gold nanoparticle (AuNP's) plays an important role in seed germination and antioxidant systems. AuNP improve the quantity of leaves, surface area of leaves, plant height, sugar content and the chlorophyll content which leads to the improved crop yield.

Several other nanoparticles such as Zinc Oxide, Silicon Dioxide and Silver nanoparticles are useful for altering the normal plant metabolism to enhance the crop yield.

Role of Nanotechnology in Photosynthesis

The chemical process by which chlorophyll utilize the sunlight for the synthesis of life sustaining organic compound i.e., glucose is briefly described as photosynthesis.

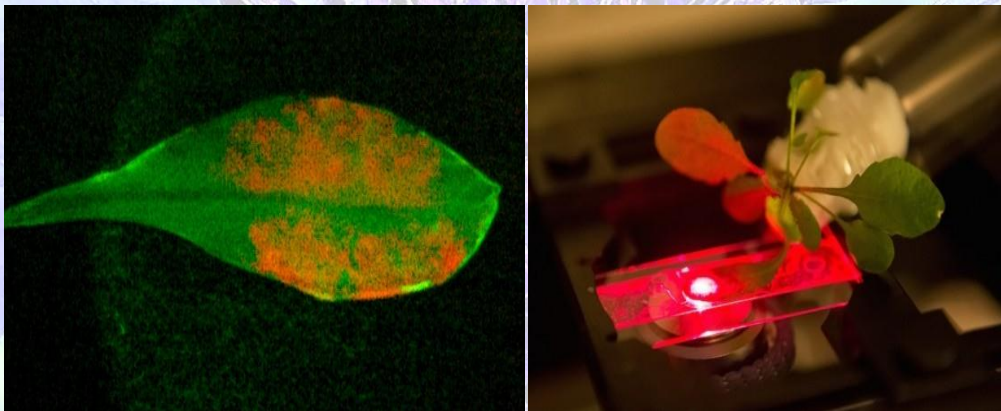


Image depicting increased rate of photosynthesis

Source: [-http://inhabitat.com/bionic-plants-use-nanotech-for-supercharged-photosynthesis/](http://inhabitat.com/bionic-plants-use-nanotech-for-supercharged-photosynthesis/)

This natural activity of plants is boosted by delivering carbon nanotubes into chloroplasts. Studies have proved that when the single walled CNT's coated with single stranded DNA is infiltrated into chloroplasts of living *Arabidopsis thaliana* leaves the nanotubes assemble around the photosynthetic proteins. Due to this the photosynthetic activity of plants increased by three times. The principle behind this change is that the SWCNT's increases the amount of sunlight captured by photosynthetic molecule.

Disadvantages of Nanoparticles

Although nanotechnology has a eloquent impact in all fields, it has impressive applications in almost every area of work but it also has some major disadvantages which can't be neglected. The use of

nanoparticles like gold nanoparticle reduces the aqua-porin functions and higher concentration of zinc oxide nanoparticles reduces the seed germination, and sometimes causes toxicity of plant organs. So, the technology needs to be handled carefully towards the human welfare.

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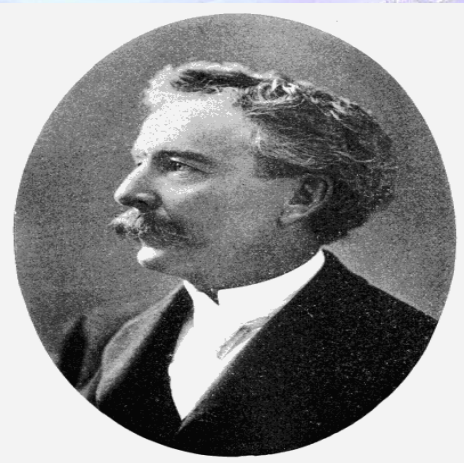
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HYBRID FRUIT OR VEGETABLE



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Luther Burbank

Source: www.google.com/images

American botanist Luther Burbank developed more than 800 varieties of plants using selective breeding methods. One such method used by Burbank was **hybridization**.

Plant hybridization is a progressing feature in Science. It has now become an essential part or we can say that it is the need of the new biological research world.

The term HYBRID is derived from a Latin word “Hybrida” which means the “offspring of a tame sow and a wild boar” that is the child of a freeman and a slave. In other words, it is the result of inter-breeding between two animals or plants of different taxa.

Hybrids between different species within the same genus are known as inter-specific hybrids or crosses. Hybrids between different sub-species within a species are known as intra-specific hybrids. Hybrids between different genera are sometimes known as inter-generic hybrids.

The concept of hybridization came into focus for the first time in the late mid-19th century by Gregor Mendel. He did breakthrough experiments using pea plant to explore and discover how genetic traits are inherited from one generation to another.

Hybrids can be either sterile or fertile. This directly affects the impact which the hybrid will have on its population when it interacts with other organisms. Many hybrid zones are known where the ranges of two species meet and hybrids are continually produced in great numbers. These hybrid zones are useful as biological model systems for studying the mechanisms of hybrid speciation.

The process of hybridization is biologically important because it increases the genetic variability (number of different gene combinations) within a species, which is necessary for evolution and speciation. If environmental conditions such as climate, habitat, etc. changes, individuals with certain combinations may be eliminated while others with different combinations will survive. Consequently, the appearance or behaviour of species gradually gets altered. Many plant species easily cross pollinate and produce viable seeds.

Depending on the parents, there are a number of different types of hybrids- Single cross hybrids, Double cross hybrids, Three way cross hybrids, Triple cross hybrids, Population hybrids, Stable hybrids.

Hybrids exist naturally in nature, but those which are man-made are more selective and effective. To develop good quality of hybrids certain characteristics are taken into consideration such as improved adaptation to environment, water quantity, humidity, soil quality etc.

Many economically or aesthetically important cultivated plants (banana, coffee, peanuts, dahlias, rose, alfalfa, bread wheat etc.) have originated through natural hybridization or hybridization induced by chemical means, temperature changes or by irradiation.

The recently developed hybrid varieties are-

1. The OLYMPIA, which is a hybrid variety of spinach preferred due to its superior characters and high resistance under high temperature and to fungal infection. It is can be harvested in about 48 days.



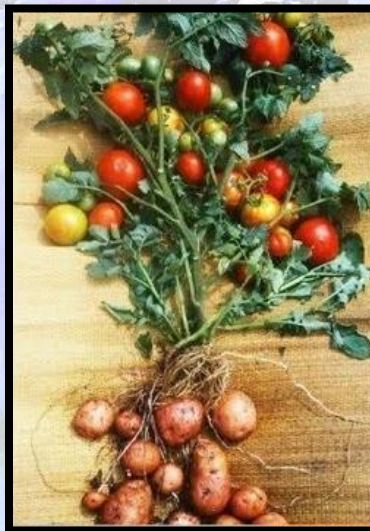
<http://www.ufseeds.com>

2. The RABBAGE, a cross between carrot and radish. It was propagated by a Soviet agronomist named Georgi Dmitrievich Karpechenko. It is similar to cabbage and has purple and greenish tinge.



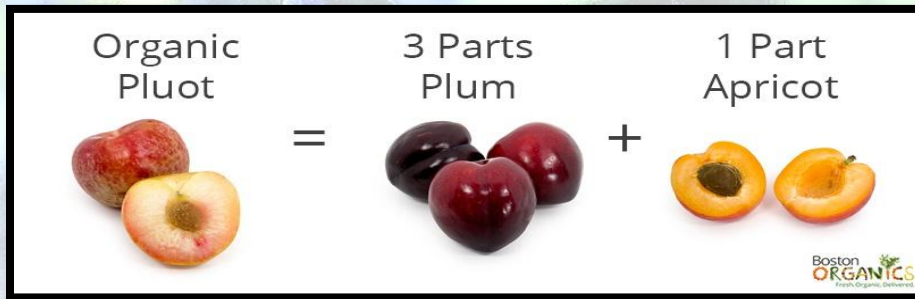
<http://luv2garden.com/rabbage.html>

3. The POMATO, hybrid formed by grafting together potato and tomato plants. The result produces tomatoes on the top and potato at the bottom.



www.google.com/images

4. The PLUOT, hybrid fruit between plums and apricot. It looks more like a plum. It has a number of different varieties. It is formed in the ratio of 3:1.



<http://blog.bostonorganics.com>

5. TAYBERRY, hybrid between blackberry and raspberry.



<http://mentalfloss.com>

Hybrid production cost up to five times more because they are time consuming and needs the expertise. But they can have up to 25% higher yield. Hybrid plants are physically uniform. This is advantageous for farmers who harvest with machines but it is usually not very important for small green house gardeners.

Hybrids often show greater vigor and faster growth. Plant hybridization is a never ending technique. Hybridization discovers the exciting Science behind creating new plants and is always challenging for a botanist to reveal the ideas creating new species further leading to evolution.

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AGRICULTURAL TECHNOLOGIES AND FOOD SECURITY IN INDIA



Dakshita

B.Sc. (H) Botany, I year

“RICH INDIA BUT HUNGRY HANDS”



<http://post.jagran.com/search/overflowing-godowns-with-foodgrains>

Millions of people derive their livelihood security from agriculture in India and it directly provides employment to nearly 52% of total workforce. However agriculture only contributes to 14 % of India's gross domestic product. Despite falling share of agriculture in national GDP, this sector remains important as it ensures food security for over one billion population of the country and provides raw material to

the agro based industries.

But now Indian agriculture faces new challenge of sustainability in terms of sustaining factor productivity and increasing profitability. Food security is a complex sustainable development issue linked to the health through malnutrition but also to sustainable economic development, environment and trade.

Still India ranked way below its South Asian neighbors Pakistan, Sri Lanka and China in Global Hunger Index 2015 released by International Food Policy and Research Institute. In this list of 118 countries, India ranked 97th. The report also points out that three countries Bangladesh, India and Timor–Leste has the highest number of underweight students under the age group of five years. India has witnessed higher economic growth in the last one decade and higher total production of food grains at the national level, despite of all this India has-

1. 29 % of 872.9 million undernourished people
2. 49 % of worlds underweight children (WHO)

3. 34 % of stunted children (WHO)
4. 46 % of undernourished children (WHO)

Food security must be seen in a continuum rather than standalone exercise. Food security is built on three pillars –

1. **Food availability** – sufficient quantity of food available on consistent basis.
2. **Food access** – Having sufficient resources to obtain appropriate food for nutritious diet.
3. **Food use**- Appropriate use based on knowledge of basic nutrition and care as well as adequate water and proper sanitation.

Government has focused essentially on growth in agricultural production, on support price for procurement and maintenance of rice and wheat stocks along with various schemes to make food grains available to poor, who do not have purchasing power. The total government expenditure for agricultural research and education increased in real terms from Rs. 11.9 billion in 1975/76 to Rs. 113.8 billion in 2014/15. Reduction in the production losses and adding the values to produce is a direct combination towards increasing total availability, lowering the cost of production and contributing in the national economy. The third point indicates the paradox. There is increase in the variety development but the reach to the marginal areas has declined!

FEATURE OF RICE VARIETY	1971-1980	1991-2000	2001-2012
Total number of varieties developed	127	257	301
Percentage of varieties tolerant to diseases	50.4	51.0	52.3
Percentage of varieties developed for marginal areas	41.7	46	33.5

In order to illustrate the combinations – **(Trends in rice are shown above)**

The problem is that there is lot of food stored in Food Corporation of India warehouses but they aren't distributed fast enough. This means a lot of food is wasted when it reaches the plate of a common man. There is a need to shift from existing expensive, inefficient and corruption ridden institutional arrangements to those that will ensure cheap delivery of quantity grains in a transparent manner. India has many policies and programmes. However food insecurity and malnutrition continue to prevail.

This problem can be combated in two major ways-

1. Enhancement of the government policies for the poor and proper implementation. For this public development sectors are also opened with joint responsibility of central and state government for storage, transportation and bulk allocation of food grains. There are network of Fair Price Shops with state government. The Revamped Public Distribution System was launched in 1992 to improve the reach of food grains in far flung, hilly, remote and other inaccessible areas where a substantial section of poor live. It becomes the responsibility of the state government to identify the families Below Poverty Line and provide them with basic necessities like ration cards.
2. Enhancement of Agricultural technologies for more production of food grains and other remedies to make profitable outcome from every inaccessible even after the net wastage. The analysis have shown that the added production of 4.23 lakh tonnes of paddy, 5.90 lakh tonnes of wheat was achieved due to improved agricultural technologies. Data further reveals that research and technology led growth has helped decline in real cost of production in the range of 1.0 – 2.3 % per annum in case of cereals, gram, cotton, rapeseed and mustard. This has helped in keeping the prices low for consumers.

Indian agriculture has stood test for time, despite facing constraints on resources to the competing goals and programmes. The economic benefits realized in the past are comparable to the country and other benefits in terms of reduction in rural poverty and leading to environment stability. And off course above all are certain governmental responsibilities to combat with the food crises in India such that it becomes place for healthy and prosperous community!!



Picture source: [Alamy.com stock photos](#)

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POEMS

The way I got educated

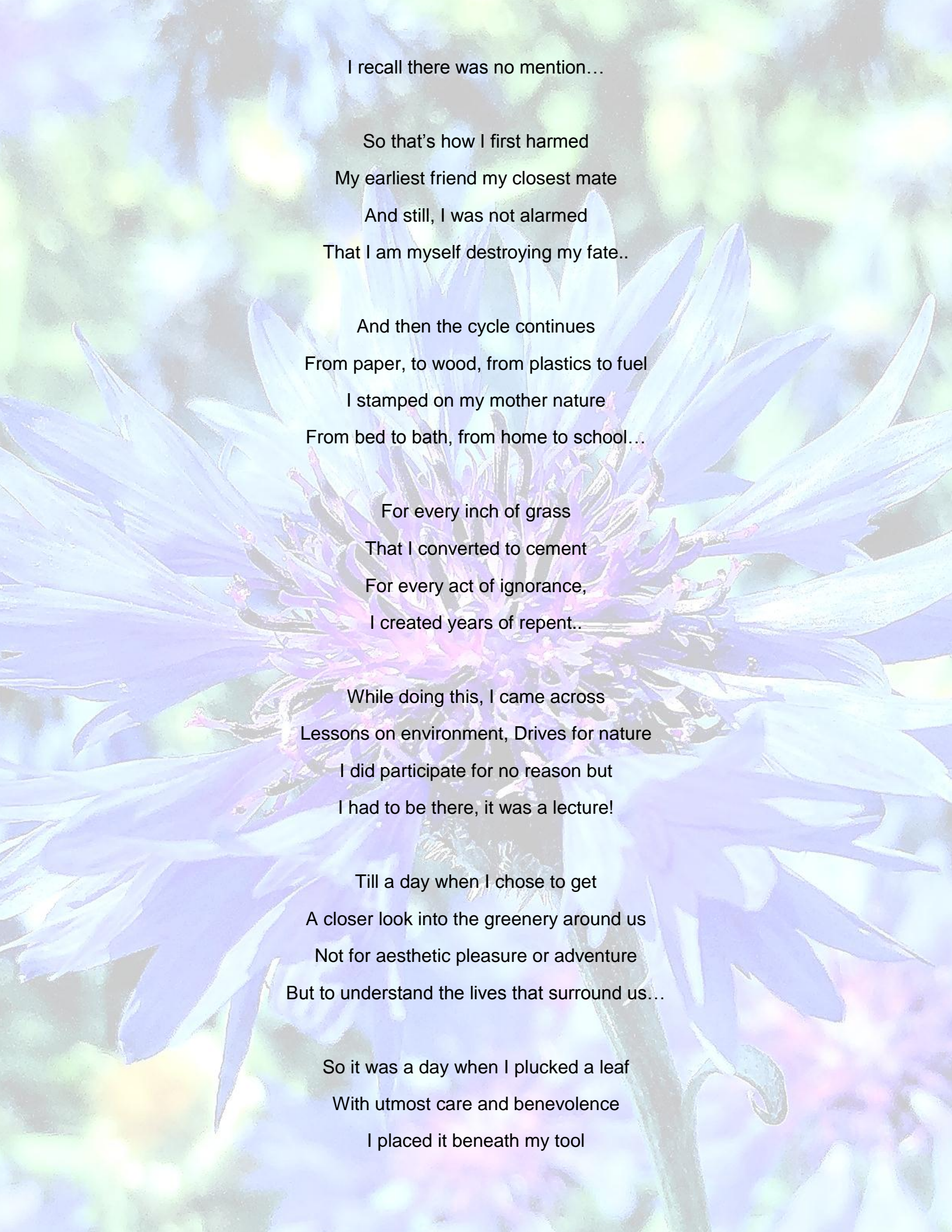


Mohini

B.Sc. (H) Botany, III year

I remember being born as a part of nature
I remember living on earth as a family member
I remember being just one another creature
I remember my fellow trees and their number...

I recall when I first ruined a piece of paper
Just for fun or to get attention
I recall no one told me not to do so



I recall there was no mention...

So that's how I first harmed
My earliest friend my closest mate
And still, I was not alarmed
That I am myself destroying my fate..

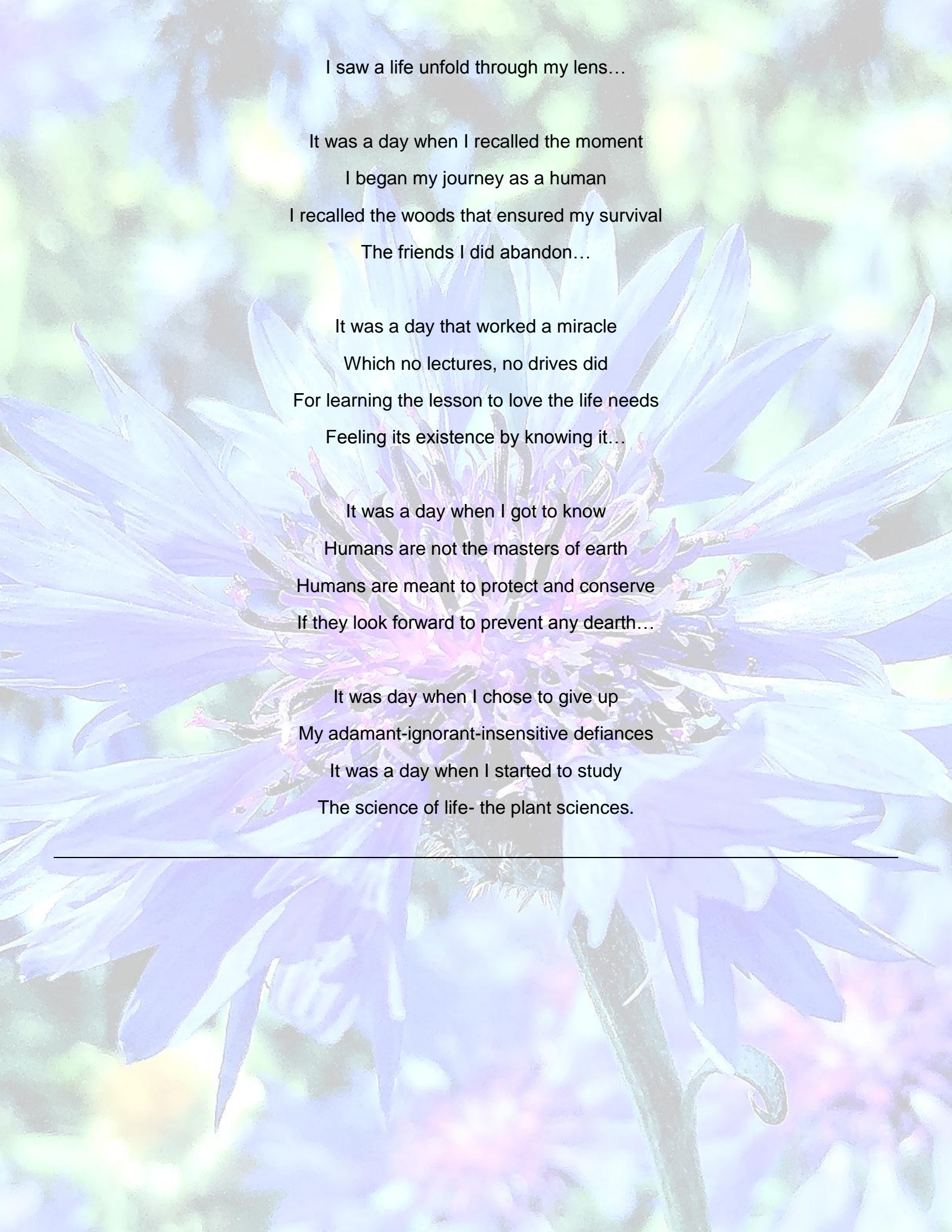
And then the cycle continues
From paper, to wood, from plastics to fuel
I stamped on my mother nature
From bed to bath, from home to school...

For every inch of grass
That I converted to cement
For every act of ignorance,
I created years of repent..

While doing this, I came across
Lessons on environment, Drives for nature
I did participate for no reason but
I had to be there, it was a lecture!

Till a day when I chose to get
A closer look into the greenery around us
Not for aesthetic pleasure or adventure
But to understand the lives that surround us...

So it was a day when I plucked a leaf
With utmost care and benevolence
I placed it beneath my tool



I saw a life unfold through my lens...

It was a day when I recalled the moment
I began my journey as a human
I recalled the woods that ensured my survival
The friends I did abandon...

It was a day that worked a miracle
Which no lectures, no drives did
For learning the lesson to love the life needs
Feeling its existence by knowing it...

It was a day when I got to know
Humans are not the masters of earth
Humans are meant to protect and conserve
If they look forward to prevent any death...

It was day when I chose to give up
My adamant-ignorant-insensitive defiances
It was a day when I started to study
The science of life- the plant sciences.

VERDURE STAYS STRONG



NAZRUN NISSA

B.Sc. (H) Botany, II year

Sometimes I accept, sometimes I wonder
Who you are?

Are you a part of nature or nature itself?

When I tried to observe you as finest art,
You mesmerized me and took me to a deeper journey,

There I went and there I thought ,
How amazing you are, when you sit in silence
How amazing you are, as you behold all the answers.

Life is hard and its seasons are unfair, we all recall how alas!

It had once taken away, a prettiest blooming flower, which was in its high
Ah! and how one day again, it had bought merry to the dull seed,

when everyone was sure it was dead and dry ..

It had twisted you like a hurricane and then it praised your petal with a light breeze
It had gifted- watered you and made you germinate, but then it got busted into thunder and try to
uproot you completely

Lo! there you stood strong, strong enough to see the beauty of the sun after every storm

You went through phases that shook your soul, but you picked yourself up

Unity, determination, courage that's what you believe in, thus you gained a spirit to fight a battle, we
call life

Which is decided by nature around you and which is run by the nature in you

That makes me understand who you are

But are you a part of nature or nature itself



MEDICINAL AND
ETHNOBOTANY

ETHNOBOTANICAL-SURVEY OF MEDICINAL PLANTS



Drishti

B.Sc. (H) Botany, III year

Walking on the lush green carpet of grass and gazing at the soul blossoming in nature, reflection of those brightly blooming inflorescence enlightened my mind and heart by enunciating the philosophical study of moral values and virtues of calmness, brilliance, upbeat and enthusiasm they depict. The reflection produced from a single ray of Sun deployed many rays of hope regarding “Advancing plant Sciences” inside me. The botanist within me asked, “How good is this plant? Followed by this, the practical focus within me asked “How good is this plant for us?” This presumed to draw a line somewhere along the continuum of direct and indirect interactions between plants and people building up a mind map of Ethics versus Botany i.e., Ethnobotany.

Ethnobotany is an aspect of advancing Science which revolves around traditional knowledge of indigenous communities surrounding plant diversity and how one can make use of indigenous plants found in different localities. It is the Science of plants and people’s interaction. Advancement brings about discovering the undiscovered plants and scrutinizing medicinal properties within each one of them.



Flowers of *Petrea volubilis* on green carpet of grass

A sound ethical reflection is obsessed by a strong social acceptability of scientific research and the advancements in Plant Science. Up-to-date information is required from different localities to club the areas of research to develop and evolve an era of modern sciences. Therefore, ethics in Science has increasingly become an issue in modern life sciences. After important discoveries in biology, ethical

reflection of scientific work and its results has come into focus .The complex bio-ethics can be prominently represented as “Ethnobotany”.

Through an ethnobotanical survey conducted, it's been proclaimed that in developing countries 25% of medical drugs are based on plants and their derivatives. The medicinal properties such as restorative tonic, appetizer, hypertension relievers, rejuvenators, etc. are well known among indigenous people in rural areas of many developing countries. Higher plants have been described as “the warriors of indisposition” by some botanists and the plants have been screened for their chemicals that are potentially potent.

A survey of ethno medicinal plants used by Koya tribes of Medaram and Narpapura villages on South of Godavari River, Warangal district, Andhra Pradesh, India was undertaken. Local people use plant parts in the form of juice, paste, powder, infusion or crude form for combating various ailments including diabetes, infections, indigestion and inflammation. Some of them are:

1) Botanical name: **Artemisia indica** (Macchapatri)

Family: Compositae or Asteraceae

Ethnobotanically,

- Leaves acts as digestive aromatic tonic, anti- malarial, anti-insecticides, anti-spasmodic
- Leaves treats nervous and spasmodic infections in asthma and brain disease, roots are anti-septic and a tonic for kidneys.



Artemisia indica showing its leaves; natural habitat.

2) Botanical name : **Solanum surattense** (Kanteli)

Family : Solanaceae

Ethnobotanically, it is used to manage edema, worm infestation, skin disease, indigestion and as diuretic.



Solanum surattense showing its leaves; natural habitat.

3) Botanical name: **Aegle marmelos** (Bael)

Family : Rutaceae

Leaves, fruits, stem, roots, are used as medicine against asthma, anaemia, fractures, swollen joints, jaundice, high blood pressure, typhoid, jaundice, diarrhoea and diabetes.

Fruit pulp is used as coolant, control loose motions and gastric problems.



Aegle marmelos showing its leaves and fruits

An ethnobotanical survey conducted among the Kanitribals in Tirunelveli hills of Western Ghats, India has been done. It quantitatively documents indigenous knowledge on the utilisation of medicinal plants particularly ethnomedicinal plants. New potential drugs were discovered from:-

1) Botanical name: ***Gymnema sylvestre*** (Gurmar)

Family : Apocynaceae

Ethnobotanically, leaves are used for

- Constipation
- Stomach ailments
- Water retention
- Liver diseases
- Regulating body weight.
- Maintaining of blood pressure and heart rhythm.



Gymnema sylvestre showing its leaves and fruits; natural habitat

Other important plants used for treatment of various ailments are reported via ethnobotanical surveys. Paliyar tribals in Theni districts of Tamil nadu and tribal practitioners of Eastern Rajasthan used plants as warriors against convulsions.

1) Botanical name: ***Centella asiatica*** (Gotu kola)

Family : Apiaceae

As surveyed, it is concluded that people use it as a tranquiliser. It helps in:

- enhancing memory and clarity
- Treatment of dysuria (diuretic nature)
- Purifies blood
- Increases the amount of white blood cells
- Allows smooth blood flow
- Useful in urinary tract disorders
- Reduces hair fall
- Safe during pregnancy and for nursing women
- Reduces female sterility
- Detoxifies Opium poisoning



Centella asiatica showing its leaves and flowers; natural habitat

2) Botanical name: ***Termanalia chebula*** (King of medicines)

Family : Combretaceae



Termanalia chebula showing its fruits and leaves; natural habitat

As surveyed, it is a mild, safe and effective laxative.

- It possess anti-bacterial, anti-viral, anti-fungal, anti-mutagenic, anti-oxidant, anti-ulcer, wound healing properties
- It forefends cardiac damage
- Doctors kidney diseases

In a nutshell, ethnobotanical and ethnomedical studies indisputably has surveyed and pointed out that instead of trying to button down the active components and pharmacological actions of plants through massive collection of plants from natural resources, it is far way more useful and valuable to look upon efficacy of plants based on their use in folk medicine. Now, the fuzzy reels are unclouded and clear, yielding the charming artistry to the eyes of a botanist by demonstrating the admirable effects of those leaves which looked so inert, insipid and odourless.

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UNSAFE DIPS IN BIODIVERSITY

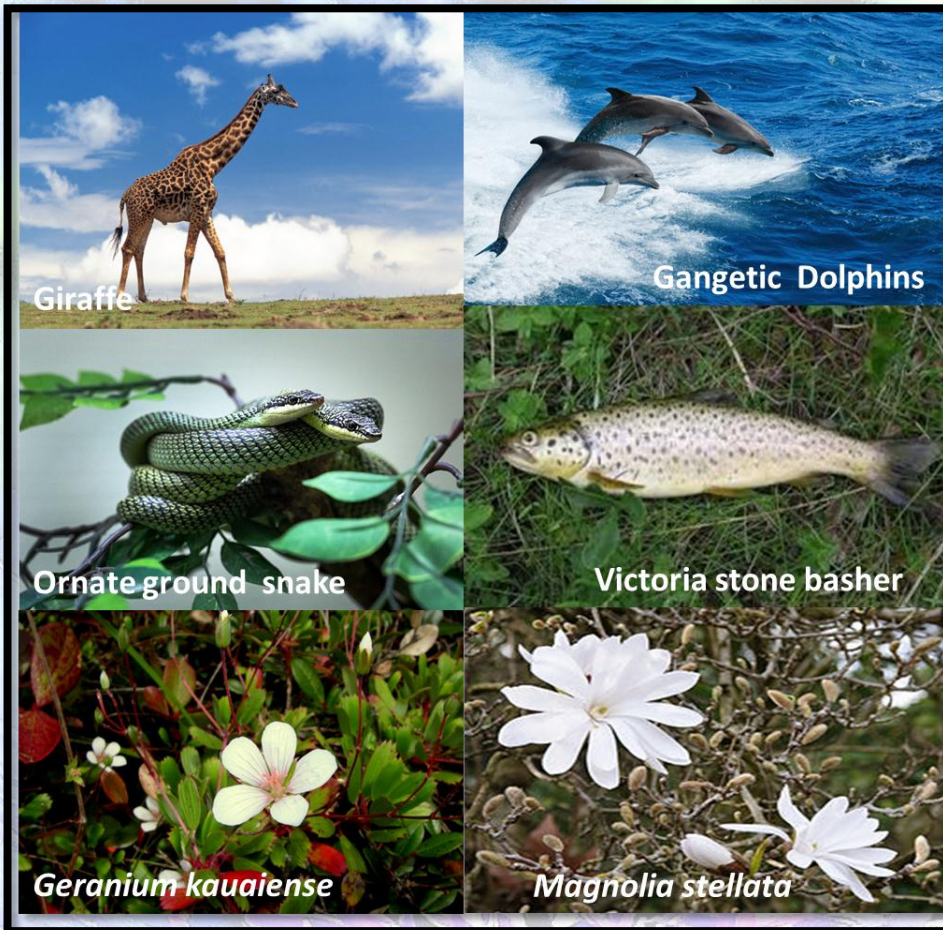


Kakul Smiti

B.Sc. (H) Botany, III year

Biodiversity is defined as the variety of organisms existing on earth their interrelationships and relationship with the environment. The exquisite view of the Nilgiri hills in Tamil Nadu, flower valley of Uttarakhand, Himalayan ranges of Kashmir, Himachal Pradesh and many more places undoubtedly captivates our mind and makes us realize the boon which nature has showered on us but, this realization fades away, as we again become indulged in the worldly matters, our urban lifestyle and careless attitude towards nature.

A recent notification of IUCN (International Union for the Conservation of Nature) is really worrying because now Giraffes have been declared to be amongst the vulnerable species!!!! Ornate ground snakes are critically endangered currently, Victoria stone basher are freshwater fishes which are at the verge of extinction and thus, are considered to be endangered. The gangetic dolphins were declared endangered by IUCN many years ago in 1996 still the practice of bottom trawling continued which lead to further decline in their population. A recent study also pointed out that olive ridley turtle, the most common sea turtle species now need man made conservation methods for ensuring their existence!!In plants *Geranium kauaiense*, *Magnolia stellata*, *Anisotes spectabilis* and *Gentian kurroo* are considered to be critically endangered and vulnerable species. Fungi species like *Withches cauldron*, *Citrine waxcap*, *marsh honey fungus* at present are considered threatened species.



Source: <https://www.google.co.in>

This year also saw a dip in the percentage of migratory birds in all the biodiversity parks. The recent release of reports by NAQI (national air quality index) further enumerated the problem which is the core reason of the entire above listed problems, i.e., our country's capital New Delhi was found out to be the most polluted city of the world. Pollution is fatal not only to human beings but also to the plants and animals.

Bottom trawling is one of the most threatening practices which affect the aquatic life. Bottom trawling is trawling along the sea floor and is also referred as dragging. The scientific community divides bottom trawling into Benthic trawling and demersal trawling. India and Sri Lanka are facing the common problems because of this. Recently both the countries have created a joint committee to look after it.

Though Indian government is working hard to develop sustainable development model but the fact is environmental problems at present are very difficult to tackle. The project "Ken-Betwa River linking project" which is the first of its kind has got clearance from all the departments. Under this project Ken River from Madhya Pradesh and Betwa from Uttar Pradesh will be linked in order to irrigate the drought prone areas. The adverse effect of this project is that it will submerge a prominent area of the

famous Panna tiger reserve of Madhya Pradesh thereby severely affecting the population of tigers present there.

Nowadays there are many cases encountered when a wild animal enters areas inhabited by human beings and then they are thronged to death by the people. Some of these incidents also account for some minor dips in biodiversity. The 1500 km gas pipeline along Haldia (West Bengal)-Bokaro(Jharkhand) passes through the bank of river Ganga in Bhagalpur area(Bihar). Bhagalpur Ganga division is home to the exquisite Gangetic dolphins. This pipeline will have impending effects on the Gangetic dolphins present there and will lead to a dip in their population which is traumatic for our diversity.

With growing population the demand of facilities increases and for keeping economy on track these necessities needs to get fulfilled and thus, we all are harnessing the natural products available to us at a dangerous pace. We are clearing forests in order to satiate the settlement problem and this leads to the extinction of certain endemic flora.

The following trends are the core contributors to the dips in biodiversity-

1. Increasing vehicular percentage and pollution.
2. Shifting of human population to the eco sensitive zones which lead to the contraction of the comfortable zone of animals and plants.
3. The construction of new waterways will affect the aquatic diversity.

We have many acts and protection measures for biodiversity conservation which need effective implementation. The following acts are-

Wildlife protection act 1972

National forest policy 1988

Biological diversity act 2002

Indian business and biological initiative

National Afforestation program

National mission for green India in ministry

International union for conservation for nature (IUCN) is paving the way towards biodiversity conservation. It has initiated certain programs to protect our biodiversity and environment.

The wildlife protection act 1972 of our country outlined some general practices to maintain our biodiversity and they include growing of exotic plants, anti-poaching campaigning should be done, desilting of the water bodies should be done.

Be it a bitter one but this is the truth. The core reason of this problem is only the growing human population. Day by day the human population is increasing at an alarming pace; the denial of precautionary measures has led to a sinister boom in population and has threatened the biodiversity. Increasing population increases the demand of space, food, and other general facilities and this will surely result in the exploitation of nature and wipe off the existing flora and fauna. Human beings should realize that the earth has been granted to all the living beings not only to them. So there is a need to control human population. This will put an end to many prevailing problems.

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***Moringa oleifera* – THE INDIAN SUPERFOOD**



Jutismita Pathak

B.Sc. (H) Botany, II Year

Moringa, native to parts of Africa and Asia, is the sole genus in the flowering plant family Moringaceae. It contains 13 species of which ***M. oleifera*** is the most widely cultivated one. It is a drought-resistant, fast-growing, multipurpose tree native to the foothills of the Himalayas in

northwestern India and cultivated throughout the tropics. Due to its Indian origin, people here have been using it for more than 5000 years. In India, an area of approximately 380sq. kms is under *Moringa* cultivation and the annual production is 1.1-1.3 million tonnes of fruit. Besides having a well-set business in its exports, *Moringa* is now cultivated in Central America, and countries of Oceania as well.

***Moringa oleifera* – THE DRUMSTICK TREE:**

Its English common names include *Moringa*, *Drumstick tree* (from the appearance of long slender triangular seed pods), *Horseradish tree* (from the taste of roots, which resembles horseradish), *Ben oil* or *Benzoil tree* (from the oil derived from the seeds). The name *Moringa* has been derived from Tamil word “murungai” or Malayalam word “murinna”.

The tree can reach up to a height of 10-12m, and the trunk can extend up to a diameter of 45cm. Flowers are fragrant, bisexual, surrounded by five unequal yellowish-white petals. The fruit is a hanging, brown capsule, which holds dark-brown seeds that are wind and water dispersed. It grows in dry regions and cannot tolerate freeze and frost. Other physical conditions suitable for the growth of the tree include altitude levels ranging between 0-2000m, rainfall of 250-3000mm, loamy or sandy soil and pH within the range 5-9. Andhra Pradesh leads both in area and production of this tree, followed by Tamil Nadu. The plant can be propagated using seeds and cuttings and rainwater can also be used for irrigation.



A drumstick tree

Source:-
<https://www.daleysfruit.com.au/forum/drumstick-tree/>

WHY IS IT GROWN?

M. oleifera is cultivated for its leaves, pods, and kernels, for food, oil extraction and water purification. The leaves are the most nutritious part of the plant, having significant sources of vitamin B, C, provitamin A, vitamin K, manganese and protein among other nutrients. They are cooked and or dried and crushed to be used in soups and sauces. The roots are shredded and used as a condiment with sharp flavours. The seeds are eaten as peas or roasted like nuts. The mature seeds yield ben-oil which is edible. The Drumsticks are the immature seed pods used in cooking.

USES AND BENEFITS:

- **Culinary uses**

Moringa is used in numerous cooking applications in the regions of its abundance. They are often used in curries, sambars, dals, soups, or eaten fried as pakoras, etc. It is an important ingredient of Thai cuisine.

- **Medicine and Research**

The bark, sap, roots, leaves, seeds and flowers are used in traditional medicine. Researches on the extract of leaves, that contain polyphenols, are going on to understand how it might affect blood lipid profiles, and how to use it for treatment of human diseases.

- **Health benefits**

- **Promotes bone health:** the presence of high quantity calcium and iron in drumsticks keep bones healthy.



A cooked dish of drumsticks

Source:-

https://en.wikipedia.org/wiki/Moringa_oleifera

- **Fights cancer:** *Moringa* is rich in antioxidants that act against the free radicals and prevents formation of carcinogens. It contains quercetin and chlorogenic acid which are powerful antioxidants.

- **Helps in lowering blood sugar levels**

- **Promotes better cardiovascular health**

- **Boosts the immunity system:** because of high content of Vitamin C.

- **Eases respiratory problems:** due to anti-inflammatory properties.

- **Promotes digestion:** good source of various Vitamin B, which play important role in digestion

- **Helps in blood purification**

- **Beauty and Wellness**

- **Clearer and youthful skin:** rich in antioxidants and omega 3-fatty acids which reduce inflammation, contribute to healthy cell production, etc.

- **Healthier hair, scalp and nails:** as it contains all the essential amino acids which are building blocks of proteins found in hair and nails, it makes them healthier.

- **Clear vision and eye health:** it is a rich source of Vitamin A

- **Increased energy:** a single serving of *Moringa* contains three times the iron of spinach, 7 folds more vitamin C than oranges, 4 times more calcium than milk, 4 times vitamin A of carrots, etc.

- **Regular, healthy bowel movements:** its oils and fibers have a detoxifying effect to help scrub our waste.

- **Water purification**

Moringa seed cake, obtained as a byproduct of pressing seeds to obtain oil, is used to filter water using flocculation to produce potable water.



Moringa leaves, seeds and powder

Source:<http://reset.me/study/study-moringa-induces-cancer-cell-death/>

- **Malnutrition relief**

Since it thrives in dry acid environments, it serves as a versatile food throughout the year and has been used to combat malnutrition since ages.

MORINGA IN AYURVEDA

There are three varieties of Moringa as explained in Ayurveda:-



A dried drumstick
Source:- Self clicked

Shyama- the black variety

Shveta- white variety

Rakta- red variety

It is also used in Ayurvedic medicine because of its analgesic, anti-inflammatory and wound healing effects.



Inside view of a cut drumstick
Source:-Self clicked

Moringa is safe when taken orally and used properly in appropriate quantities, but its roots and extracts must be eaten carefully as these contain a toxic substance. Roots, barks and flowers should be avoided during pregnancy as it causes contraction of the uterus. It can be used for headaches, fever, conjunctivitis, dog bite, gout, internal swelling, etc. by mixing its parts with other products such as jaggery, ginger, water, etc. either applied in the area of problem or consumed for cure.

TO CONCLUDE:-

Moringa is a super unusual tree, not only because it is incredibly nutritious and highly valued for its medicinal properties, but because, surprisingly, absolutely every part of it can be eaten! Called by some cultures as 'the miracle tree', it has been used for thousands of years to benefit people all over the world. It is loaded with health and beauty supporting vitamins, minerals and enzymes, making it a true "superfood" in every sense of the word. Thus, we should start using this miracle of nature in our lives without any fear of a crash!

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HERBAL DRUGS AND HUMAN HEALTH



Aishwarya Singh

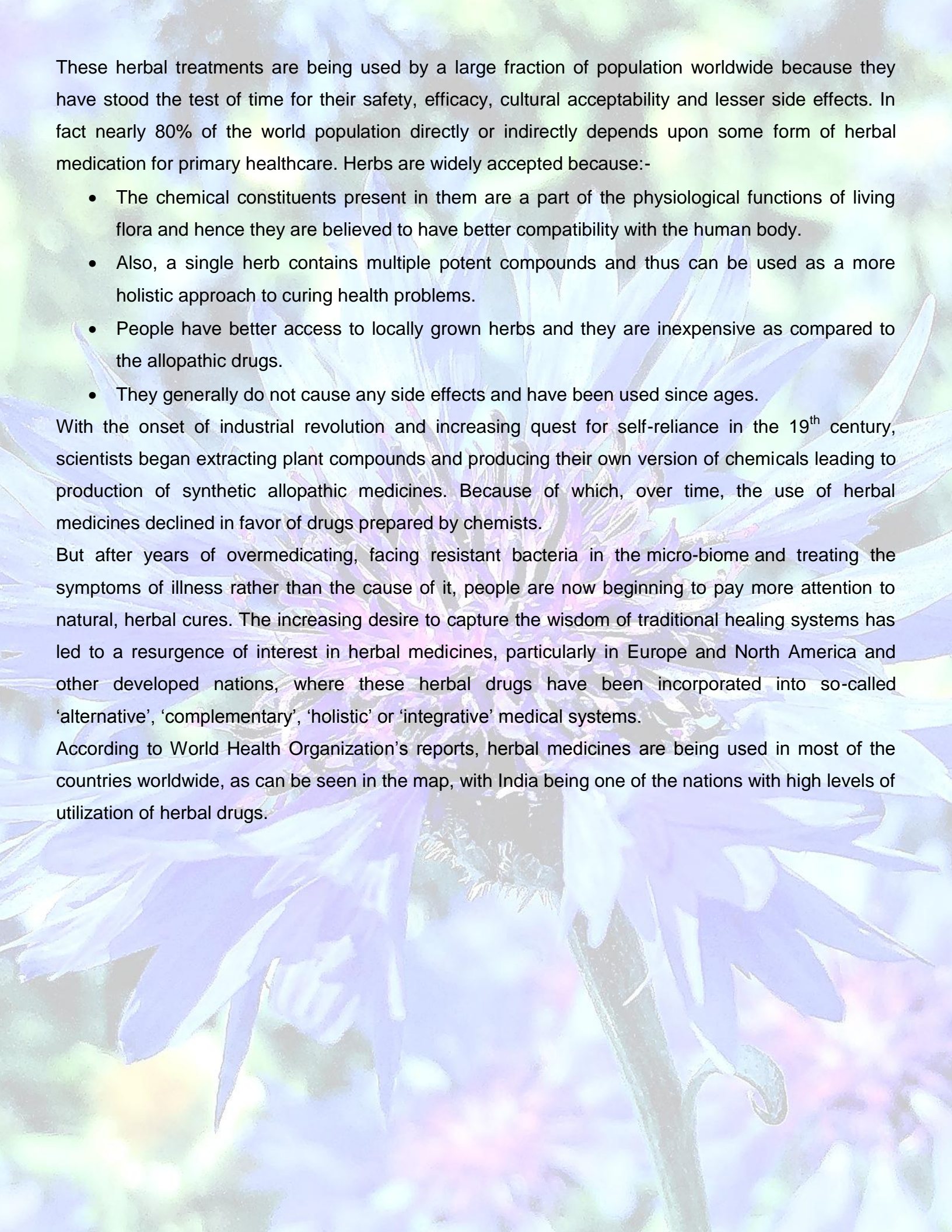
B.Sc. (H) Botany, III year

Hippocrates once said that “Nature itself is the best physician” and today when I see the cures of our ailments coming from the nature, I’m able to understand the real implication of his words.

Herbal drug or medicine, also called botanical medicine or phyto-medicine, refers to using a plant or plant parts such as seeds, fruits, roots, leaves, bark, or flowers for medicinal purposes.

Natural plant products have been used throughout human history for various purposes. In fact, written records of the use of herbal medicine date back more than 5,000 years, and for much of history, herbal medicine was the only medicine used by people. Indigenous cultures such as African and Native American ones, used herbs in their healing rituals, while others developed traditional medical systems such as the Ayurveda in India and Traditional Chinese Medicine in China in which herbal therapies were used. Even today, about 25 percent of the drugs prescribed worldwide are derived from plants. Interestingly, of the 252 drugs in the World Health Organization’s essential medicine list, 11 percent are exclusively of plant origin.

Most of us are well aware of the uses of many herbs for treatment of common health issues such as cold, fever, gastric disorders and more. Plants like ginger, garlic, turmeric, aloe vera, ginseng and dandelion have potent ingredients with therapeutic properties and are widely used in households as herbal remedies.



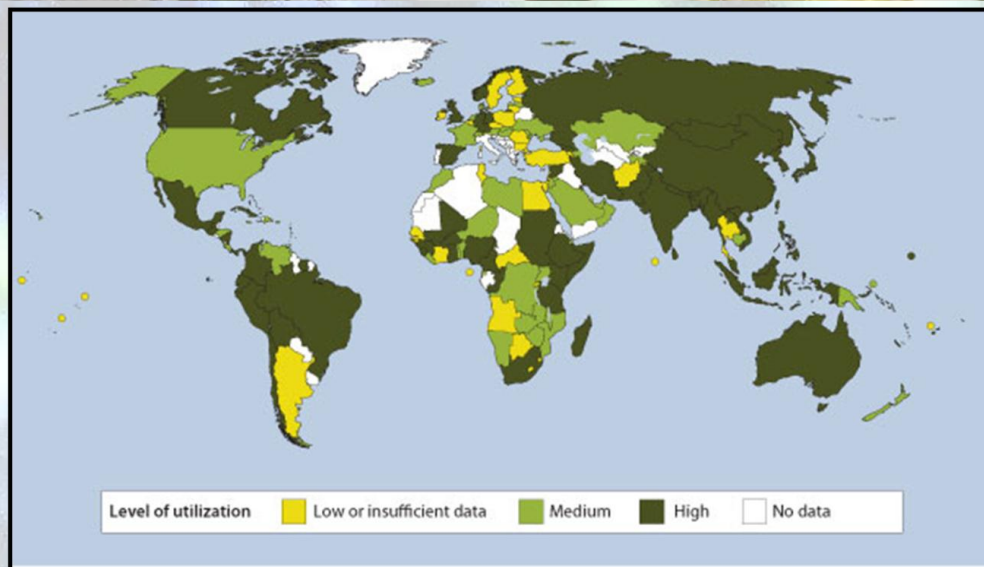
These herbal treatments are being used by a large fraction of population worldwide because they have stood the test of time for their safety, efficacy, cultural acceptability and lesser side effects. In fact nearly 80% of the world population directly or indirectly depends upon some form of herbal medication for primary healthcare. Herbs are widely accepted because:-

- The chemical constituents present in them are a part of the physiological functions of living flora and hence they are believed to have better compatibility with the human body.
- Also, a single herb contains multiple potent compounds and thus can be used as a more holistic approach to curing health problems.
- People have better access to locally grown herbs and they are inexpensive as compared to the allopathic drugs.
- They generally do not cause any side effects and have been used since ages.

With the onset of industrial revolution and increasing quest for self-reliance in the 19th century, scientists began extracting plant compounds and producing their own version of chemicals leading to production of synthetic allopathic medicines. Because of which, over time, the use of herbal medicines declined in favor of drugs prepared by chemists.

But after years of overmedicating, facing resistant bacteria in the micro-biome and treating the symptoms of illness rather than the cause of it, people are now beginning to pay more attention to natural, herbal cures. The increasing desire to capture the wisdom of traditional healing systems has led to a resurgence of interest in herbal medicines, particularly in Europe and North America and other developed nations, where these herbal drugs have been incorporated into so-called 'alternative', 'complementary', 'holistic' or 'integrative' medical systems.

According to World Health Organization's reports, herbal medicines are being used in most of the countries worldwide, as can be seen in the map, with India being one of the nations with high levels of utilization of herbal drugs.



World map showing the levels of utilization of herbal and traditional medicines in various countries

Source: World Health Organization

Furthermore, the inefficacy of allopathic medicines to treat chronic disorders, rapid rise in prices of conventional drugs and health care facilities has led to increase in the global demand of herbal medicines. With this increased demand, the global herbal drug market is booming and is expected to rise up to a sky-rocketing worth of 500 billion USD by the year 2050.

Millions of dollars are being invested in looking for promising medicinal herbs. These substantial research investments are providing scientific proofs of the age-old knowledge about medicinal values of herbs and thereby eradicating all forms of questions against efficacy and security of herbal drugs. The Herbal Medicinal Product Committee (HMPC) of Europe has registered 1320 herbal medicines and authorized more than 600 herbal drugs during 2004-14 after rigorous clinical experiments.

Researchers are developing herbal drugs against chronic and acute medical issues such as cardiac diseases, respiratory disorders, neurological ailments etc. A few of them are:-

1. Obesity

Obesity is one of the most common health problems worldwide and is on the verge of becoming a global epidemic. Many herbs such as *Morus alba*, *Poria coccus* have shown effective results in treatment of obesity and are now being marketed in form of pills. These slimming formulations are a boon for the weight conscious people, especially the women. Also, in a

Printed from THE TIMES OF INDIA

Chinese herbal medicine could treat obesity: Study - Times of India

Chinese herbal medicine could treat obesity: Study - Getty Images

An extract from a plant traditionally used in Chinese medicine may help suppress appetite and lose weight, new research says.

The findings suggest that the compound extracted from the "Thunder God" vine could be developed into a drug for treatment of obesity.

In the study, the compound was found to reduce food intake significantly and cause up to a 45 percent decrease in body weight in obese mice.

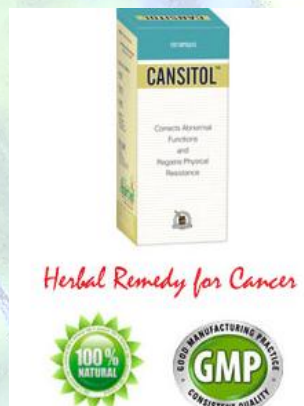
The weight-loss compound, called Celestrol, produces its potent effects by enhancing the action of an appetite-suppressing hormone called leptin, the researchers noted.

"If Celestrol works in humans as it does in mice, it could be a powerful way to treat obesity and improve the health of many patients suffering from obesity and associated complications, such as heart disease, fatty liver, and Type-2 diabetes," said senior study author Umut Ozcan from Harvard Medical School.

Activate to Go to Settings

Source: The Times of India

recent study by the Harvard School of Medicine, a compound called Celestol from the plant “Thunder God Vine”, which is used in traditional Chinese medicine, has shown potent ability in weight reduction. It was shown to cut upto 45% of bodily fat in clinical trials.



Source:
www.google.com/images

2. Cancer

Herbal drugs are also becoming popular for the treatment of cancer. A study in Spain has confirmed that hemp oil can cure early stage cancer without causing side-effects. Carctol, a herbal formulation for cancer, developed by Dr Nandlal Tiwari has come out as a promising herbal drug and is being prescribed by doctors in UK too.

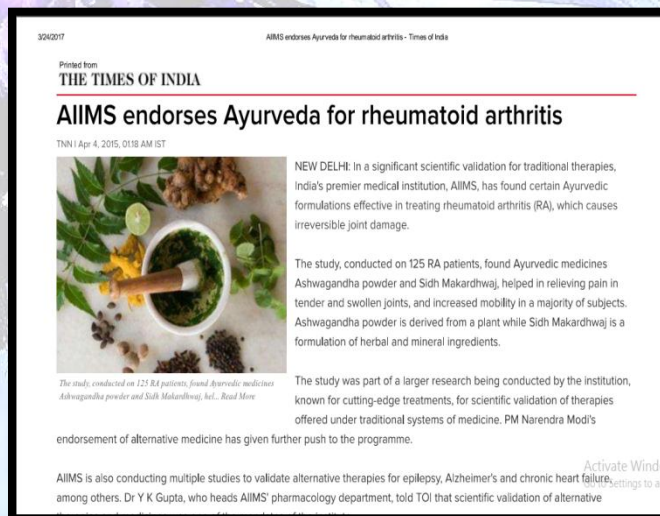
In fact, of the 177 drugs approved worldwide for the **treatment of cancer**, more than 70 percent are based on natural products or chemical imitations of natural products.

3. Diabetes

In a major breakthrough the centre for scientific and industrial research, CSIR and national botanical research institute, NBRI have recently launched a herbal pill costing 5 rupees for the treatment of diabetes mellitus.

Not only these, traditional herbal medicines are also being used to cure H1N1 flu, malaria, rheumatoid arthritis, infertility, HIV and may other diseases. The herbal drugs are particularly very useful in treatment of age related conditions such as Alzheimer's disease and Parkinson's syndrome.

Based on the startling benefits of plants, the interest in natural drugs has increased worldwide and several international journals such as “**journal of herbal drugs**”, “**journal of ayurvedic and herbal medicine**” etc are now published that evaluate the herbal medicines on scientific experiments.



Source: [The Times of India](http://www.thehindu.com)

Source: [The Times of India](http://www.thehindu.com)



Source:<http://images.financialexpress.com/2016/04/ramdev-3.jpg>

Many herbal product manufacturing companies are now coming up in the market which has made access to high quality herbal medicines very easy. Amway, Herbalife, Himalaya, Maharishi ayurveda are few mega brands producing herbal products, which are popular even in the western countries.

Even though herbal drugs are safe, self-medicating and lack of proper knowledge can lead to undesirable consequences. It is therefore necessary to provide adequate scientific knowledge and skillful training regarding rational use of herbal drugs as excess of everything is bad. It is high time that we start working in the direction of making improved herbal drugs on larger scales through the use of available scientific technologies.

Information sharing, conducting workshops on safety monitoring, general guidelines on research and evaluation of herbal medicines, provision of open access databases, and international meetings are a few ways in which different countries can collaborate for betterment of herbal drugs.

CONCLUSION

On a concluding note, it can be said that with the growing popularity of herbal medicine, the “traditional” ways of identification and preparation of herbs need to be replaced with more accurate and reproducible methods so as to ensure the quality, safety, and consistency of the product. Given the market value, potential efficacy and increasing consumer demand, regulation of production and marketing of herbal supplements and medicines require attention. More funds need to be put in research and development of these medicines and their use should be supported. These natural drugs have the ability to cure most of the human problems and the secrets within them needs to be unleashed by the scientists.

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By Aishwarya Singh and Bhawna

B.Sc. (H) Botany, III year



ENVIRONMENT
CONSERVATION

AFFORESTATION STUDIES: GROWING PLANTS AT RIGHT PLACES



Ruth Abraham

B.Sc. (H) Botany, II year

'*Each one, plant one*' is one of the popular quotes on 'Afforestation'. Yet a review on the environmental history brings up a surprising fact. Planting any tree anywhere is not afforestation. In fact, **planting trees at the wrong place might lead to the destruction of the native forest cover** causing major negative impact on the native flora and fauna, disrupting the ecosystem.

Growing plants at the right place is important, since a plant that is useful in one area might turn out to be harmful and invasive in another area. The exotic plants might show an explosive growth due to lack of competing plants. They might retard the growth of native plants by outcompeting them for resources or space. Some exotic plants produce toxic chemicals and the defenseless native plants get killed. They might even dry up the ground water and other water bodies.

In India too, the introduction of exotic species (some of which turned out to be invasive) has caused the depletion of the natural forest cover and its consequences can be seen even today. Some of the examples have been discussed in the following paragraphs.

1. *Prosopis juliflora* –a menace

An example of counter effect of planting a wrong tree is the exotic species- *Prosopis juliflora*. The political takeover of India by Britain led to an overexploitation of Indian forests. A vast area of land was left bare. To increase the green cover of Delhi and to avoid desertification, they searched and zeroed on to *Prosopis juliflora*, a native of Mexico. True to the purpose, the plant quickly propagated and expanded the green cover of Delhi. However, today the plant is a menace. It is widely known as an invasive species. The very property which led to its selection by the British has **destroyed** the native flora and fauna of India especially Delhi. It grows prominently in semi-arid and arid places.

According to a report by the Rathinam Saroja Trust, an NGO which works for environmental issues, *Prosopis juliflora* absorbs more than four liters of water to give one kilogram of biomass. It cannot provide shelter to birds as it **produces less oxygen and more carbon dioxide**.



Prosopis juliflora: Notice the dry ground and absence of any other species near the plant's vicinity.

Source: Self clicked

If it does not have sufficient water, it begins absorbing groundwater. And if there is no groundwater, it starts absorbing humidity from the surroundings. **It can also turn the groundwater poisonous.** Its water depleting property and **release of toxic chemicals from its leaves and roots** prevent native plants from growing. It is difficult to remove these plants as they are deep rooted, can regenerate from roots and produce large number of seeds which are resistant to harsh conditions.



Eucalyptus: Its water depleting property and allelopathic nature prevents other species to grow naturally near its vicinity.

Source: Self-clicked

2. *Eucalyptus* – the water sucker

'Eucalyptus trees cause a loss of ~ 20-40 liters of water per tree per day!!'

Eucalyptus trees are a common sight in India. However, it's a native of Australia. Like *Prosopis juliflora*, it was introduced in India and widely cultivated to achieve the 'goal' quickly. The 'goal' in this case was to meet the rising pulpwood requirement of the ever flourishing paper-pulp industry during the mid-twentieth century.

The *Eucalyptus* loses water rapidly through transpiration. It was used to drain the swamps to accommodate the growing human population.

Soon, the native people started feeling the negative impact of the foreign tree. The poor and rich suffered alike due to lower water supply. **The depleted water level was found to be the result of 'water**

sucking' property of the exotic species. Its water depleting and allelopathic characters prevents the local plants to thrive. Owing to this, today, much forest cover has vanished in many parts of India. In 2011, Karnataka Forest Department banned planting *Eucalyptus* in Western Ghats and surrounding districts. In 2014, Madras High Court ruled in favour of removing *Eucalyptus* trees along the Western Ghats.

2. *Eichhornia crassipes*- the deceiving beauty

Eichhornia crassipes (water hyacinth) is a beautiful free floating hydrophyte. The plant has a rosette of leaves and a single spike with purplish flowers. **Lady Hastings captivated by the beautiful plant brought it to India in the late 1700s.** Soon this invasive plant, deceiving the people by its beauty rapidly covered standing water bodies. Its rapid invasion is due to its ability to **propagate vegetatively at high rate in short period of time.** It is therefore, very difficult to eradicate it completely.



Eichhornia crassipes- the deceiving beauty

Source: Self clicked

Eichhornia crassipes drains dissolved oxygen from the water killing the fishes. Fish is the supplement food in Bengal. The mass death of fishes led to scarcity of food and unemployment.

Therefore, in India, water hyacinth is also known as '**terror of Bengal.**'

The dense mats formed by water hyacinth are breeding grounds for mosquitoes. Also these mats prevent free passage of boats through the water body.

Even though Water hyacinth was not introduced in India as part of any afforestation plan, it is one of the best examples showing the adverse effects of planting a plant in the wrong place.

On the other side of the coin, India has seen many positive effects of afforestation. Many individuals and organizations are putting in their efforts to plant trees in the right places. The positive impact can be clearly seen in the following cases.

1. Saalumarada Thimmakka- a 'bare' land to 'banyan' land

Thimmakka, an unlettered lady from Karnataka along with her husband Chikkaiah planted 384 banyan trees (*Ficus*) along the 4km Kudur – Hulikal road. She did not have children. Instead of sinking in sorrow, she did something



Source:

http://ramblings461.rssing.com/channel-6364818/all_p3.html

unique in the world history. In spite of her meager resources, she planted ~20 banyan saplings every year and cared for them until a dense green canopy was raised along the 4km expanse which had once been a dry and treeless area. The Banyan alley is the result of planting trees at the right place. The Banyan tree being a common tree in Thimmakka's village did not show any side effects and stands as a witness to the positive effect of afforestation.

2. Aravali Biodiversity Park- Afforestation in the Capital City



Aravali Biodiversity Park: Orchidarium
Source:<https://dda.org.in/greens/biodiv/aravali>

The Delhi Ridge, the forest in the Capital once covered a vast area. The increasing urbanization and introduction of exotic species led to decrease in the green cover. The Aravali Biodiversity Park (set up in the part of the Ridge which had been turned into mining land) aims to develop and restore the forest cover in the once barren land.

According to Dr. M Shah Hussain, ecologist and scientist in-charge of the park, "In approximately

eight years, since the plantation began in 2005, the biodiversity park has become a home for over 1,000 different species of plants, 190 species of birds, 90 species of butterflies and over a lakh species of insects and 24 species of reptiles."

The park includes moist deciduous forest community, *Acacia* dominated forest community, Fernary, a Conservatory of Orchids, *Wrightia* dominated community, rangelands, conservatories of butterflies and medicinal plants etc.

3. Anantapur afforestation- from desertification to afforestation

The afforestation in Anantapur, Andhra Pradesh is a typical example of planting a tree in the right place.

The land was heading towards desertification. Several afforestation drives were carried out to develop forest cover. However, none of them succeeded hundred per cent. A study carried out showed that lack of water and usage of exotic species in most



Anantapur afforestation- from desertification to afforestation
Source:<http://www.hyderabadfirst.in/?m=201304&pageid=3>

cases and consequent lack of plant growth was the reason **for these failures**.

To successfully carry out afforestation, the District Forest Officer (DFO) of Anantapur and his team planted indigenous trees like Neem (*Azadiracta indica*), Banyan (*Ficus benghalensis*), Peepal (*Ficus religiosa*) etc. They dug 1 cubic meter pits near the plants to collect rain water and remove water scarcity.

The plantation of native trees combined with water conservation has today resulted in the successful development of green cover in Anantapur.

The aim of afforestation is to revive a forest in an area which has lost its original forest cover for a long time. Careful studies must be done before choosing plants to develop the cover. As often seen, a plant in the wrong place will disrupt the growth of the few native plants. A wrong plant might stand as a block in achieving the goal of Afforestation and can even cause depletion of other resources as well. It is therefore becoming a rising field of research for botanists and ecologists to study the various aspects of a species before planting them at any place.

Instead of 'each one, plant one', it could be **'each one, plant a right one'**.

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SHRIVEL THE CARBON FOOTPRINT



Jutismita Pathak

B.Sc. (H) Botany, II year

Carbon Footprint is a growing topic in today's time, but most of us are still unaware of it. It is something which has a great effect on our environment so we must learn about it and also find ways to reduce it. Everything we do has an impact- be it positive or negative- on the environment. That's the basic concept behind Carbon Footprinting, which is one method of measuring the impact of our lifestyle on environment. It indicates the amount of carbon dioxide and other greenhouse gases that are produced as a result of our daily activities. We can reduce our personal footprint by changing the way we live our lives. Even seemingly tiny changes can make a significant difference, so in this growing technological world, we should put a step forward to improve our lives, paying importance to organic things and thus reduce our footprints.

WHAT IS A CARBON FOOTPRINT?

It is the measure of the environmental impact caused by the release of greenhouse gases by a particular organization or a business or an individual's lifestyle or his ways of performing different activities in workplace as well as home. It is measured in units of carbon dioxide, the standard being CO₂equivalent. The gases included are carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride.



A carbon footprint logo

Source :- <https://uk.pinterest.com/explore/what-is-carbon-footprint/>

A carbon footprint is composed of two parts, a **primary** and a **secondary** footprint. The primary footprint is the sum of the direct carbon dioxide emissions by burning of fossil fuels like domestic energy consumption by furnaces, water heaters and transportation like automobiles. The secondary footprint is the sum of the indirect emissions associated with manufacture and breakdown of all products, services and food an individual or business consumes.

There are methods to calculate the footprints for a particular product, service, or a country and this calculation can use a number of different techniques but the most common is to use life cycle assessment (LCA) or input-output life cycle assessment (IO-LCA). The environment is forced to face the impact of our activities, such as emission of CFC's from the industries, pollution released from our cars, etc.

These gases degrade the air quality which in turn harms not only the human society but flora and fauna as well. Earth's temperature is on an increase due to the release of such gases. Such climate change affects the growth of crops and undoubtedly the habitats of living beings.

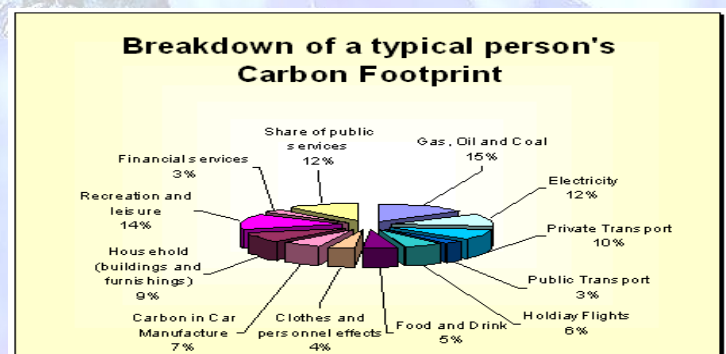
PERSONAL FOOTPRINT

A personal footprint is nothing but the environmental impact caused by one's daily activities. It has five main groups- housing, travel, food, products and services which combines all the activities of each day of an individual's life. Other than personal footprint, there is **National** as well as **Global footprints** which accounts to the emissions of greenhouse gases on a national and global level leading to deterioration of the environment in several ways.

WAYS TO REDUCE-

Since carbon emissions are degrading our earth to a great extent, we must definitely find ways to reduce it efficiently.

- **Alternatives to driving:** when possible, we should walk or ride a bicycle in order to

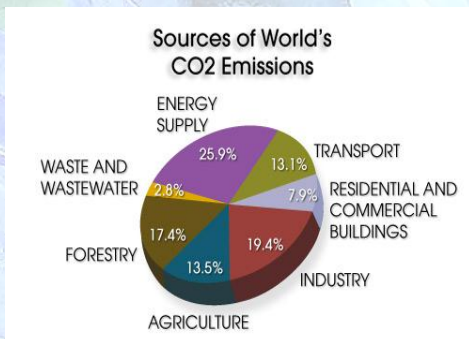


Categories of an individual's personal footprint

Source :- http://www.razorgator.com/reduce_your_carbon_footprints_use_less_plastic_disposable_razors.htm

avoid carbon emissions. Carpooling and public transports drastically reduce CO₂ emissions.

- **Avoid or reduce travelling by airplanes:** we should reduce our travel via airplanes and instead choose better environment-friendly means. On occasions where we cannot avoid such, we should travel by the economy class and not go for private jets.
- **Reduce footprints in home:** turning off lights when not in use, adding solar panels to the roof, using energy efficient products, etc. can help reduce carbon dioxide emissions.
- **Reduction in food:** eating locally produced and organic food, cutting up upon beef and dairy, can help in controlling such footprints.
- **Reduce, reuse and recycle**
- **Using water appropriately**



World's CO₂ emissions that account for carbon footprint
Source:https://sites.duke.edu/tlge_sss29/carbon-dioxide-emissions/carbon-dioxide/

Other than these, the main way to reduce carbon footprint is to **decrease our energy consumption.**

Electricity=Carbon dioxide - We like it or not, every time we plug in, we are impacting our environment through carbon emissions. Even discarded batteries from laptops or cell phones can leave a deadly impact in landfills. So we should consider unplugging for a few hours each week at least.

Clothing- We should train our bodies to tolerate warmer

temperatures in the summer and cooler temperatures in the winter months rather than using air conditioners or heaters contributing to carbon emissions.

Paper- The more we use, the more we are contributing to deforestation and carbon emissions, so we should try switching to paperless possibilities.

CONCLUSION

Knowing our footprint can show areas where we can decrease our energy consumption and in turn reduce our production of carbon emissions. Hence, carbon footprint is an important tool to study the impact of greenhouse gases on global warming and environment. By knowing all the facts and statistics, we can take better decisions thus helping in making this world a better place.

Ways to Reduce Carbon Footprint

- Buy organic and local foods.
- Not use bottled water or reuse them as often as possible.
- Unplug appliances that are not in use.



A few ways to reduce carbon footprint

Source:-
<http://slideplayer.com/slide/8768305/>

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CONSERVATION THROUGH BIODIVERSITY PARK



Bhiolina Bharadwaj

B.Sc. (H) Botany, I year

Biodiversity Park represents one of the richest diverse genetic resources. However, with the advent of cut and burn agriculture, the area development projects and the related activities of these diverse resources are on a decline at a faster pace. The overgrazing, deforestation and over exploitation of native resources under range situations have eroded the biodiversity from the unique ecosystem.

WHAT IS BIODIVERSITY AND BIODIVERSITY PARK?

Biodiversity is the variety of life. Actually, it is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ECOSYSTEMS and the ecological complexes of which they are part; this includes DIVERSITY within SPECIES, between species, and of ecosystems.

In countries with fast growing economies the present urban centers expand rapidly in terms of population infrastructure and the scenario is the natural heritage is wiped out from urban development matrix. Yamuna River itself is dead in the urban segment.

One of the innovative approaches to address the issue is to promote the creation of Biodiversity Parks that serve as nature reserves in urban matrix. Actually, Biodiversity Parks are unique landscapes of wilderness where ecological assemblages of native species in the form of biological communities are re-created and maintained over few hundred hectares of degraded or marginal land. In other words Biodiversity Parks are nature reserves that harbor natural heritage of the area and have conservation, educational and cultural values and enhance the quality of environment in urban Centre.

PRINCIPLE OF BIODIVERSITY PARK:

The underlying principle of the Biodiversity Park is to recreate self sustaining ecosystems with native flora and fauna characteristic of the area for enhancing the quality of urban environment.

Functions of Biodiversity Parks:

- i. Serve as nature reserve for the conservation of natural heritage of the city
- ii. Enhances the quality of urban environment
- iii. Serve as hub for education, cultural and conservation activities
- iv. Connect biodiversity to the city and people
- v. Promote ecotourism
- vi. Create livelihoods for local Communities
- vii. Serve as an adaptation to climate change

The Biodiversity Park Concept was implemented for the first time in Delhi by Delhi Development Authority-a land-owning and city building local government agency in collaboration with the Centre of Environmental Management of Degraded Ecosystems of the University of Delhi. The DDA has notified six Biodiversity Parks: I) Yamuna, ii) Aravalli, iii) Neela hauz, iv) Kamala Nehru ridge, v)

Tillpath valley, and vi) Yamuna river front

'Yamuna Biodiversity Park' is located close to river *Yamuna*, Jharoda, Wazirabad. It is actually 1km away from the main stream of Yamuna but still in its Basin. It was a part of the flood plain some 30-40 years back. DDA acquired land in 2001-2002 and planned Biodiversity Park in 2003. The area is low



lying gets seasonally flooded and long spell of standing water has turned soil more saline (pH=8.9). The overview of Visitor's Zone and Nature Conservation Zone of Yamuna Biodiversity Park Phase and newly created wetland on the active flood plain suggest that the ecosystems developed are fully functional. In fact, the mosaic of wetlands with diverse ecological niches and interspersed grasslands of Phase-II will soon become paradise for bird lovers, store flood Water and recharge groundwater.

Aravalli Biodiversity Park is set up to conserve the vanishing flora and fauna of the region and also to create awareness about environment. The environmentalists worked a lot on this area which was highly deteriorated because of mining and Chinese clay. It was dominated by plant which reduces the water table drastically, makes the soil acidic named as *Prosopis juliflora* (Vilayati kikar), a Mexican species introduced by britishers. They planted indigenous species which led to improved recharging of aquifers. It is divided into 4 Conservatory Zones named as **Conservatory of Medicinal Plants; Conservatory of Butterflies; Conservatory of Orchids; Conservatory of Ferns**. It also has important trees like *Butea monosperma*, *Terminalia tomentosa*, *Tectona grandis*, *Sterculia foetida*. It also has mammals namely Blue bull, Jackal, Porcupine and 120 bird species



<http://sanjeevsaikiaart.blogspot.in>

allow help conserve them for generations to come.

- Initiate, organize and participate as responsible citizen. Take action against existing or proposed activities that harm or are likely to harm local biodiversity.
- Make a list of different kinds of trees in your campus or locality. For each one find out the names, uses, flowering season, animals and birds that depends on it. Present this information in an interesting way, and put it up by the tree. Many people will stop by to read this information and know more about the tree.
- Create 'Biodiversity Registers' in communities, schools, villages. Students can maintain records of all living beings in their locality. A biodiversity register is a compilation of day-to-day observations of the

Besides the Biodiversity Park following are some conservation actions that we can take up:

- Plant trees. Grow native species of plants (trees, shrubs and climber) wherever possible, this would attract local wildlife such as birds, butterflies and insects.
- Grow local vegetables in your college garden that are not usually available in the markets. This would

immediate environment. It is a documentation of knowledge of diversity of life known to local people. It is a means of recording the wealth of biodiversity of a region.

Human should not be alien to the other life-forms. We have no moral right to destroy nature and other beings that dwell on earth. We should treat all animals and plants with compassion. Every individual can make a small and yet significant effort in the race to save our planet and conserve biodiversity.

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PHYTOREMEDIATION – CLEANSING NATURE THE NATURAL WAY!



Divya Bharti

B.Sc. (H) Botany, III year

In today's world, it is not surprising to say that man has pure joys and luxuries to buck up with life. Science creates better conditions for survival. But, the darker side cannot be overlooked, which directly or indirectly challenges and negatively impacts the human life. The point of issue in today's era is the increasing environmental pollution caused due to hazardous pollutants such as toxic organic compounds and heavy metals (Cu, Pb, Cd, Ni, Fe, Mn, Zn).

Research reports have shown that various diseases in both humans and livestock are caused due to toxicity of heavy metal. But as said, a scientist can really do wonders for better survival of mankind. Therefore, botanists have discovered techniques to save mankind along with sustainable development. Nowadays, scientists are using a technique **phytoremediation**, which refers to the use

of green plants to remove hazardous pollutants, thus making soil and water free from toxicity. It's a new generation technology which sustains both agriculture and environment thus leading to stabilization. It is considered as an eco- friendly technique that makes environment less toxic using inherent properties of green plants.

PHYTOREMEDIATION: - word splitted as: “phyto” means plant and “remedium” means to restore balance. It is the inherent properties of certain plants to hyper accumulate or degrade certain heavy metals to clean up the environment. Phytoremediation studies involve removal of inorganic pollutants using different approaches such as phytoextraction, rhizofiltration, desorption and precipitation of concentrated toxic metal thus heading towards phytostabilization.

Process of phytoremediation involves:

i) Treatment of contaminant metal:-

a) **Phytoextraction:** - it is the process where plant's roots absorb the contaminant metal and store them in their above ground parts of plant which can be easily disposed off. This process is cheap, environment friendly and it does not affect the soil fertility. The hyperaccumulator plant species (which absorb high amount of pollutant) are used for phytoextraction. Plants are grown in polluted sites to absorb the pollutants, and then they are harvested and burnt for the recycling of the nutrients. Metals that have been phytoextracted successfully by this process are Zinc, Copper, Nickel, Lead, etc. The plants used are *Brassica juncea*, *Helianthus* etc.

b) **Phytostabilization:** - Use of plants to immobilize soil and water contaminants near roots only. This technique is used for re-establishment of a community at the place of high level metal contamination.

c) **Rhizofiltration:** - In this process, contaminants are adsorbed or precipitated onto the plant roots. Sunflower was effectively used to remove radioactive contaminants from pond water in a test at Chernobyl, Ukraine.

d) **Phytostimulation:** - Stimulation of microbial population near the root zone of plant called as rhizosphere which thereby helps in degrading the pollutant. This is also known as increased rhizosphere degradation.

ii) Phytoremediation of organic polluted sites: -

a) **Phytodegradation:** - It involves degradation of organic contaminants by internal or secretory processes driven by the plant. Plant hydrolyses complex organic compounds into smaller units which are later



Experimental phytoremediation crops in Canada
(Source: Environment Canada)

absorbed by the plant. Remediation of wastes such as chlorinated solvent trichloroethane and herbicides has been done using this process.

b) **Rhizodegradation**:- also known as enhanced rhizosphere bio-degradation, phytostimulation and plant assisted bio-remediation.

c) **Phytovolatilization**: - In this process, uptake of water soluble pollutants from soil takes place, which are later released into the atmosphere by the plant through the transpiration. Contaminants in water either get modified into some non-toxic compounds during the journey through plant's vascular system or volatilize in the atmosphere. One study has shown that use of Poplar tree volatilize up to 90% of TCA it absorbs.

Phytoremediation can be used to clean up metals, pesticides, solvents, explosives, crude oil, polyaromatic hydrocarbons, and landfill leachates. It can also be used for river basin management through the hydraulic control of contaminants.

The root system of plants provides an enormous surface area that absorbs and accumulates the water and non-essential contaminants, in addition to essential nutrients. Researchers are finding that the use of trees is rather more effective than smaller plants in treating deeper contamination because roots of trees penetrate more deeply into the ground. Furthermore, deep-lying contaminated ground water can be treated by pumping the water out of the ground and using plants to treat the contamination.

Various applications of phytoremediation are being implemented in the world over. Few techniques that have been employed using the principle of phytoremediation are: -

Riparian corridors

They prevent contamination located near the river banks from entering into the river stream or ground water with the help of plants grown along stream or river bank.


Vegetative cover

A vegetative-cap, which generally consists of soil and plants growing in or over contaminated landfills, is designated not only to control soil erosion or seeping of water but also for degrading underlying material in the landfill by preventing the formation of toxic leachates.

Constructed wetlands

In the American continent, use of constructed wetlands having submerged and emergent plant species for degrading explosive contaminants such as TNT, RDX etc. in smelter and ammunition sites is being popularized. Some plant species effective in carrying out such degradation are *Elodea michx*, *Stuckenia pectinatus* and *Luziola fluitans*.

Clean-up plantations



In Kazakhstan, pesticide contaminated land areas are now phytoremediated using large scale plantations that cause phytodegradation of the chemical pesticides in the soil. International oil companies have also started using plantations for cleaning up of land near oil wells.

Soil conditioning

Salinity is a frequent trouble for crop production in arid regions as due to the high rate of evaporation combined with the demand for scarce water reserves, salt build-up occurs during the cultivation process. In a study conducted in UAE, it has been suggested that by introducing highly salt-tolerant species (i.e., *Conocarpus erectus*, *Atriplex lentiformis*, etc.) which have capacities to accumulate significant concentrations of iron, manganese and magnesium, calcium, sodium and chloride ions, and can be irrigated with saline water, higher plant and agricultural production levels in arid regions can be achieved.

Phytoremediation of Organic Polluted Sites

Plants can help lessen environmental pollution by polychlorinated biphenyls (PCBs) through *phytoextraction* or by *phytotransformation* which means enzymatic transformation of PCBs by plants by releasing a variety of secondary metabolites. Plants also enhance the microbial activity in the root zone, improving biodegradation of PCBs (*rhizoremediation*). However, the hydrophobicity and chemical stability of PCBs allow only slow uptake and degradation by plants and associated bacteria, resulting in incomplete treatment and potential release of toxic metabolites into the environment. Moreover, naturally occurring plant-associated bacteria may not possess the enzymatic machinery necessary for PCB degradation.

These limitations are overcome by introduction of bacterial genes involved in the metabolism of PCBs, such as biphenyl dioxygenases, into higher plants using genetic engineering. Transgenic plants and associated bacteria bring hope for a broader and more efficient application of phytoremediation for the treatment of PCBs.

Phytoremediation and biotechnology

Genetic modification offers a new hope as approaches of genetic alteration can be used to overexpress the enzymes involved in the existing plant metabolic pathways or to introduce new pathways into plants useful for phytoremediation.



Some of the plants used for Phytoremediation
 Source: www.google.co.in/images

Phytoremediation to Treat Metal Contaminants

Selenium: The micronutrient selenium is known to induce toxicity in the soil if present in high concentration. It is found that methylation of amino acids at specific site can result in volatilization of selenium compound. Thus a transgenic plant is constructed which has the ability to volatize the same by following the guidelines of genetic engineering and utilizing the information obtained by studying hyperaccumulators of selenium.

Mercury: Mercury can be degraded by certain bacterium due to the presence of merA and merB genes. Thus integration of these genes into certain plant genomes has seen effective mercury degradation by such transgenic plants. The genes are targeted to be expressed in chloroplasts so that after degradation into relatively less toxic form, it is volatized. Thus transgenic tobacco produced by this phenomenon was shown to exhibit mercuric resistance.

Arsenic: Certain bacterial genes present in *E. coli*, such as ArsC is responsible for reduction of arsenic and formation of a complex in the presence of glutathione (GSH). An increased amount of GSH can be produced by expression of glutamyl cysteine synthetase enzyme. These genes are isolated and transferred to form a transgenic plant which can effectively absorb arsenic and accumulate the same in its vacuoles resulting in phytoremediation.

ADVANTAGES

1. Economic, ecofriendly, aesthetic and sustainable technique for agriculture and environment.
2. Short term or less time consuming.
3. Potential for removing more than one pollutant at a time.
4. Less chances for spreading contaminant because it avoid transport of pollutants.
5. Low risk and attractive clean-up method.
6. Less labour equipment requisite.
7. A site gets cleaned up without digging and halving soil.

DISADVANTAGE

1. Condition must be specific for a particular plant.
2. Need of large scale agriculture knowledge.
3. Chances of contamination of pollutant collected in senescing tissue.
4. Contaminant solubility may lead to greater environment damage and leaching.

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ANSWERS

1. GM food crop developed in University of Delhi. *Brassica juncea*
2. The latest revolutionary gene-editing technology based on bacterial immune system. CRISPR/CAS
3. The oldest algal fossils of *Rafatazmia chitrakootensis* were found in? India, Chitrakoot region.
4. Most recent plant classification system. APG IV, 2016
5. System used by NASA to grow plants in space. VEGGIE
6. Location of Global Seed Vault. Norway
7. Plant used for producing plantibodies against Ebola virus , cancer and HIV/AIDS. *Nicotiana benthamiana*, *Nicotiana tabacum*
8. Plant that has been modified to detect bombs. Spinach
9. Process of engineering the plants for the production of small-molecule medicines. Pharming or PMF or Plant molecular farming
10. The field of bioengineering that inserts nano particles into the cells of living plants, which then alter the functioning of the plant tissue. Plant nanobionics.

A	B	C	B	D	E	F	G	H	I
P	H	A	R	M	I	N	G	K	J
S	L	M	A	N	O	P	Q	R	S
C	N	Z	S	Y	X	W	V	U	T
I	I	A	S	B	A	C	D	E	F
N	C	R	I	S	P	R	C	A	S
O	O	J	C	I	G	H	G	I	P
I	T	K	A	L	F	M	N	D	I
B	I	R	J	Q	O	P	O	N	N
O	A	S	U	T	U	V	W	I	A
N	N	T	N	O	R	W	A	Y	C
A	A	C	C	B	A	Z	Y	X	H
N	D	E	E	F	G	H	I	J	K
L	M	N	A	E	I	G	G	E	V

FAMOUS PLANT

Giloy: The Miraculous Herb



Shalini Latiyan

B.Sc. (H) Botany, III year

While passing by the backyard of my house I saw a herbaceous vine having beautiful heart-shaped leaves. I pondered what if such leaves have some beautiful function for mankind also. After 4 year or so I read about a plant that looked similar to the vine I had seen that day. After reading its importance in daily life and in medicines I thought how graceful God's creation is. That herb was giloya or Giloy or guduchi, indigenous of India, Srilanka and Myanmar. It is famous in botanical world as *Tinospora cordifolia*. It is a member of the family Menispermaceae. It is also known as "Indian tinospora" and is one of the most divine herbs to exist in Ayurveda. Because of its usefulness it is also known as 'Amrita' (nectar) or 'root of immortality'. The extract of this herb is names as Indian quinine.

It is treated as a super herb nowadays. If we look at the botanical description of this plant, it is a spreading climbing shrub with numerous twining branches. Its leaves are simple, alternate, green in colour, heart-shaped with a long petiole. Flowers are unisexual & greenish yellow in colour present on axillary and terminal racemes. Usually solitary female flower whereas male flowers are in clustered. Sepals are 6, free, in



Source:http://2.bp.blogspot.com/S73Rpu3_tgg/V4KA6Frxy6I/AAAAAAAAACV0/LumZmPkxi8gwmzbhoLtQVSBAYVZWnTMOQCK4B/s1600/Top-10-health-benefits-of-giloy-in-hindi.jpg

two series (three in each series), the outer ones are smaller than the inner ones. Petals are 6 in number and are smaller than sepals. Fruits are scarlet or orange coloured ovoid drupelets.

A study showed the presence of 29 endophytes belonging to different taxa in the samples collected from *T. cordifolia*. The extracts of the endophytic fungus *Nigrospora sphaerica* obtained from *T. cordifolia* showed insecticidal properties against the Oriental leaf worm moth (*Spodoptera litura*). After the taxonomic description of this plant let us look at the beneficial aspects of giloy. My grandmother used to tell me about the medicinal uses of giloy. Whenever me or my brother used to suffer from any kind of disease our grandmother mostly gave us the giloy juice or giloy paste. The scientists today have discovered the healing properties of giloy. The presence of natural chemicals makes it a wonderful plant with many useful properties.

Chemicals composition:-

Phenylpropene disaccharides, Columbin, tinosporic acid, tinosporaside, tinocordifolioside, palmatine, jatrorrhizine, berberine, tembeterine, choline, tinosporal

Diseases in which giloy can be used:-

Anaemia, Bacteria, Cough, Cramps, Dermatitis, Diabetes, Diarrhoea, Dysentery, Erysipelas / red patches on the skin, Spermatorrhoea Thirst, Fever, Fracture, Gonorrhoea, Gout, Hemorrhoids, Hepatitis / any non-inflammatory functional disorder of the liver, Inflammation, inflammation of the urethra, Jaundice, Malaria, Pain, Painful urination, Rheumatism, Tuberculosis, Impotence, viral infection, Dyspepsia, Water Retention.

Parts of plant used :-

Stem (mostly), fruit, root and/or leaves. It is commercially available in dry form.

Giloy can be used in numerous ways :-

1. Boiled stem of Giloy helps in treating cough, nausea and common fever.
2. A mixture of turmeric and *Tinospora cordifolia* stem extract is very useful in decreasing the hepatotoxicity and is also used in the treatment of tuberculosis.
3. Chewing of fresh leaves of giloy keeps us healthy and also gives relief from arthritis.
4. Giloy branch boiled with tulsi leaves is given to dengue patients for boosting the immunity.
5. Giloy juice mixed with neem, amla or aloe vera helps in removal of the toxins from the body and makes the skin better in just 15 days.
6. The boiled concoction of giloy leaves gives relief from chronic fever, cough and associated anorexia
7. Its juice along with butter milk is very effective in treatment of piles.
8. Its roots and bark when chewed greatly affects the respiratory tract.
9. Half a gram of giloy powder with some amla or with jaggery is helps in treating constipation
10. Its juice also helps to reduce high blood sugar levels.

11. Giloy stem along with ghee or ginger is mostly used to treat arthritis associated with chickengunya.
12. It also improves the vision when taken in boiled form.
13. It also has various therapeutic applications like anticancer, antitumor, anti-diabetic, anti-inflammatory, hyperglycaemic and anti-stress activity.

Conclusions:-

In a fast growing world, giloy can be used as a daily stuff to feed people as it does not have any side effects. Giloy is widely used as a remedy by every section of society. One can get glowing skin, be free from any kind of fever or joint pain and much more just by using the extract of giloy. Giloy juices are also available in market by many brands like Patanjali thus making its availability easier.

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FAMOUS BOTANIST
Prof. Panchanan Maheshwari



Savita Kumari
B.Sc. (H) Botany, III year

Dr. Panchanan Maheshwari, the pioneer who established India's name among the countries thoroughly involved in embryological study of plants, was one of those scientists who devoted his whole life in contributing greatly to science and research. He was a prominent Indian botanist whose work mainly dealt with the comparative embryology of gymnosperms and angiosperms, experimental embryology, plant tissue culture and the history of botany in India.

EARLY LIFE

He was born on 9th November 1904 in Jaipur (Rajasthan). P. Maheshwari got solace in books & magazines during his school days and later on he developed interest in science.



Prof.PANCHANAN MAHESHWARI

(1904-1966)

SOURCE: - www.newsnviews.online

During his college days, he was inspired by Dr. W. Dudgeon, an American missionary teacher who made him interested in Botany, especially morphology of plants. His teacher once expressed that if his student progresses ahead of him, it will give him a great satisfaction. These words motivated him to work with great passion to achieve his goals.

EDUCATIONAL QUALIFICATIONS

He got educated at Ewing Christian College in Allahabad, intending to pursue a career in medicine but changed his studies from medicine to science under mentorship of Winfield Dudgeon. He received his Bachelor of Science (1925), Master of Science (1927), and Doctor of Science (1931) degrees, all under the guidance and influence of Dudgeon. He worked on embryological aspects, especially the embryo sac of many plants belonging to more than 1000 families. He invented the technique of test tube fertilisation of angiosperms. His technique opened up new avenues in plant embryology. He popularized use of embryological characters in taxonomy. Cross breeding of many flowering plants became possible due to his techniques.

CONTRIBUTIONS IN THE FIELD OF SCIENCE

He established the Department of Botany, University of Delhi as an important centre of research in embryology & tissue culture. The department was recognised by University Grand Commission as centre of advanced study in Botany. After joining the Department of Botany, University of Delhi in 1950, he started developing a school of embryology of flowering plants which attained world status by mid 1960s. Way back in 1960, he talked about the link between embryology, physiology & genetics. He also emphasized the need of initiation of work on test tube fertilization & intra- ovarian pollination won World wide acclaim. The book "Magnum opus", introduction to the Embryology of Angiosperms was completed by him in 1950. He classified embryology into descriptive, phylogenetic and experimental aspects. In his book he articulated the progress of experimental embryology and emphasized the importance of integration of techniques from other disciplines. Delhi school of embryology initiated areas such as control of fertilization, *in vitro* culture of ovary and ovule, isolated nucellus tissue, embryo, endosperm, seed and anther culture and induction of somatic embryogenesis. He also founded an International research journal "Phytomorphology" & the popular magazine "The Botanica" in 1950. Volume on recent advancement in embryology on Angiosperms (1963) edited by Maheshwari, became a referral for researchers in embryology. In 1951 he founded the International society of plant morphologists. He devoted his life to science. Many of his well-wishers & students feel proud in naming their new findings after him, such as ***Panchanania jaipurensis*** (fungus) and ***Oldenlandia maheshwarii*** (Rubiaceae member).

ACHIEVEMENTS

The Indian Botanical society honoured him with the Birbal Sahni medal in 1958. He was the general president elect of the Indian Science Congress Association for 1966. He was honoured with fellowship of Royal society of London (FRS) in 1965, Indian national science academy & several other institutions of excellence.

His interest in science also made a significant contribution to school education in the form of textbook of Biology for secondary schools published by NCERT in 1964.

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From Retired Teachers...

Religion and Plants



Dr. Bharati Bhattacharya

(Retired Faculty, Department of Botany)

To remind students of Botany how useful plants are in our life is like carrying coal to Newcastle. Nevertheless, have we ever thought much about 'Religion and Plants'? So I will just try to focus some light on this aspect of plants.

In addition to the fact that forests provide food, medicine, energy, shelter, wood and non-wood products to sustain life, there are other uses of forest plants too in our life system. These may be termed as cultural, socio-cultural and spiritual dimensions of forest plant utility. Religious beliefs and practices affect the way plants are understood, utilized and managed. **Socio-cultural** and **spiritual values** often influence the way we perceive plants and how we value them. In Nepal it was observed that about 80 different plant species are used in socio-cultural festivals. These plants are so important in such events that one cannot imagine completing any such ritual without them. One such plant is ***Cynodon dactylon*** or doob grass not only any religious festival but even social events require this plant. Whether to welcome a new birth in family, or to usher a newly-wed couple or to bless a youngster in the family, doob with dhanya (***Oryza sativa***) is a must. In Bengal even for bidding farewell to Goddess Durga after her annual stay of four days in the month of Aashwin (September-October) the womenfolk use 'dhanya' and 'durba' to bless her and her children. She is treated as the daughter who comes to visit her parents once a year only.

Specific plant species are used for specific purposes. Frequency of requirement too varies from daily to seasonal, annual, periodic and occasional. Plants also vary from annual to perennial herbs, shrubs or even large trees. No doubt some such practices have led to near-extinction of a few plants. One example is Guggul or ***Commiphora wightii***. It is a slow-growing tree found in Gujarat and Rajasthan. The resin found in the outer cells of the stem is released only when the plant is damaged. The resin, a gum like substance when burnt gives out fragrant fumes. And in this form it is used in religious ceremonies particularly at the time of 'aarti'. It is believed that the scented fumes keep away evil

spirits from the performer's house and family members. The fumes also drive away the mosquitoes. That is why in some places it is a ritual to burn guggul at dusk so that mosquitoes are driven out. More importantly the resin is used medicinally as a key ingredient in Ayurvedic medicines. It is used in treatment of bone fractures, arthritis, inflammation and obesity. It is also used in modern medicine for its ability to decrease heart problems.

Despite its importance ***Commiphora*** is an endangered plant according to IUCN Red Data List and the Species Survival Commission (SSN). Over exploitation due to religious importance, slow growth rate, poor seeding and low germination rate are the causes. Religious practices are the main culprit because the tree has to be injured to obtain the resin. The injured plant often dies.

Sometimes, however, instead of being a culprit, religion turns out to be protector. The herbaceous plant ***Ocimum tenuiflorum*** (earlier known as ***O. sanctum***) or Tulasi/Tulsi is very important both in medicinal uses as well as in religious ceremonies. For every Hindu household, it is a 'must-grown' plant and it is rarely harvested. Its leaves only are used for worshipping Gods. The plant in total is never harmed. Even the dead wood of very old plants is not thrown away. These are made into strings of beads and used by people of Vaishnavite (those who worship Vishnu) tradition of Hindu religion for wearing as 'mala' i.e., garland or as 'japamala' for chanting mantras. So, here we notice that religion has turned out to be protector. Profuse flowering, good seed set and high germination rate also help the plant to spread.

The Sacred Groves is, however the extreme example of religious conservation. These are natural vegetation dedicated to 'deities' in return for god's various support and guidance. People of nearby localities believe that touching such lands will offend the deities present here and will bring calamities and natural disasters. Entering such 'marked out' areas/lands is therefore strictly prohibited. Many tribal folks such as Garo and Khasi tribes of northeastern India do not permit anyone to enter such groves and give full protection to the plants and animals present here. This has led to biodiversity and conservation of the plants and animals of such places.

Sacred groves are scattered all over India and are referred to by different names in different areas. They occur in the scrub forests in the Thar Desert of Rajasthan as well as in rainforests of Western Ghats in Kerala, Himachal Pradesh in the north and Kerala and Karnataka in the south of India.

Around 1000 Km² of land is protected as Sacred Groves. Some well-known groves are 'Hariyali' and 'Valley of Flowers' in Chamoli district of Uttarakhand. The 'Deodar Grove' in Shimla in about 12 km from Shimla in Himachal Pradesh, 'Mangar Bani' in Haryana, 'Kavu', 'Sarpa Kavu' in Kerala and 'Devarakadu' in Karnataka. They all serve as gene pool and are sources of rich plant and animal diversity.

Ritual Values of Plants:

Most people perform religious rituals in some form or other. Some may do in a very simplified manner and for some others these may be in an elaborate manner. In any case they themselves procure the ritual objects. Hardly there is any ritual that does not require plants and/or products of some plants. It is not only in Hinduism but also in Christianity, Islam, Buddhism and Chinese religions we find the uses of plants. They are documented in the historical scripts of these religions also.

Plants and flowers in Christianity – White Madonna lily (*Lilium candidum*) symbolizing purity is associated with Virgin Mary. Some religious communities explained that the white petals represented her spotless beauty and the golden stamens her glowing soul.

In the coastal plains, deserts, plateaus and river valleys of the Biblical Holy land, a variety of plants were growing which find mention in the Old and New Testaments, one of the oldest written records of human history. Stories of Bible were originally passed down from one generation to another by singers and story-tellers. But later these were available in written form. The prayers, poems, proverbs and sermons mentioned many of these plants – some wild and some cultivated. Date palm (*Phoenix dactylifera*), pomegranate (*Punica granatum*), fig (*Ficus carica*), Olive (*Olea europaea*), caper (*Capparis spinosa*), mint (*Mentha spicata*) are some of them. Schoenberg Temperate House of Missouri Botanical Garden in St. Louis houses a Biblical Garden where about 30 to 40 plants of the 110 mentioned in the Bible are grown. Identification of the plants has been given along with the corresponding passages from the Bible. Branches of olive trees have long been the symbol of peace and hope. The corresponding passage is “And the dove came in to him in the morning; and, lo, in her mouth was an olive leaf plucked off (Genesis 8:11)”. The tree produces abundant fruit. The extracted oil is used in making holy ointments for kings and priests, anointing the sick and also for cooking. Some other important plants include Papyrus (*Cyperus papyrus*) and crown of thorns (*Ziziphus spina-cristi*). Though there are other plants like thorny burnet (*Sarcopoterium spinosum*) to claim this title, the Christian tradition looks upon *Zizipus* as the “crown of thorns”. The plant is fairly common in Samaria and Southern Israel and very common in upper Jordan Valley.

Islamic religion

Plants and plant products mentioned in the holy Quran are quite similar to those mentioned in the Bible, as both the holy scripts were written in similar landscape and environmental and climatic conditions, though the timings were different.

A Quranic verse: “And we gave you the shade of clouds and sent down to you manna and quails.” Manna or Al-Mann, the Quranic name means a type of sugar-like food substance provided by God to the Children of Israel when they were roaming about in desert of Sinai without food and water after their exile from Egypt.

‘Mann’ is probably the sweet gum obtained from Tamarix trees (*Tamarix mannifera*). Some think it is obtained from two different plants- *Tamarix mannifera* and *Alhagi maurorum*. Some other important plants of Quran are Cedar or Lote tree which in all probability is *Cedrus libanii*. i.e., Cedar of Lebanon and Henna (*Lawsonia inermis*)

Apart from mentioned in the Quranic verses, flowers as such do not find much use in Islamic festivals. Use of flowers is seen on occasions like marriages and funerals. Upon arrival at the brides place, the grooms’ party is ushered by throwing flowers and flower petals on them. The groom sometimes wears a special head dress of flowers for the wedding.

Plants and Buddhism

Importance of Bodhi tree as a sacred plant for Buddhists is well documented. Botanically known as *Ficus religiosa* it is located at Bodhi Gaya (Bihar, India). It is said that under the friendly shade of this tree Buddha obtained the perfection of wisdom. The tree is therefore named as ‘tree of knowledge’ or

'Bodhidharma'. For the Buddhists, lotus (*Nelumbo nucifera*) flowers symbolize the most exalted state of man --- held high, pure and undefiled in the sun, his feet rooted in the world of experience. In most of the Buddhist art depictions too, lotus flowers symbolizes Buddha.

Flowers in Chinese religion

In Taoism and other Chinese folk religions flowers do not mean just beauty, but are also the symbols of life, happiness, and fertility. In Chinese culture, white flowers are the symbol of death and used only in funerals. The meaning of red in Chinese weddings is deep and powerful. Red is the love, joy, prosperity, happiness and ultimate joy in Chinese culture. Flowers like Peonies (*Paeonia* spp.), Orchids (Orchidaceae), Lotus (*Nelumbo nucifera*) and Daffodils (*Narcissus* spp.) are widely used in weddings. For the Chinese, Peony flower is a symbol of spring and red Orchid is the symbol of love and fertility. The lotus flower represents four virtues in the Buddhist religion (scent, purity, softness and loveliness). *Narcissus* flower symbolizes spring, representing change and end of hibernation.

Hindu religion

To write about plants in Hinduism is an abominable task. In India, we all adore plants not only with devotion but affectionately fondle them and treat them just as members of the family. They find mention in connection with customs, traditions, festivals and beliefs. The Hindu religion believes that the world is governed by supernatural beings (Gods) that play various roles of construction (Brahma), continuation (Vishnu) and destruction (Shiva) the trinity. The legend goes that as compared to other gods, Brahma was more lenient in bestowing blessings to his devotees. As a result the blessed ones, often the demons like Hiranyakashyap, Mahishasura and Ravana started tormenting people and several gods too. In such instances Vishnu and Shiva had to come to the rescue of troubled ones. Ultimately people stopped worshipping Brahma and offered prayers to Vishnu and Shiva. Probably, that is why there are very few Brahma temples of which the most famous is located close to Pushkar Lake in Udaipur, Rajasthan. Only the flowers of *Tabernae montana divaricata* and white lotus are offered in prayer- both being white flowers. Like this there are many dieties and their chosen plants and flowers. For offering prayer to Vishnu, tulsi leaves (*Ocimum tenuiflorum*) is a must. Lord Shiva is only too happy when flowers of datura and *Calotropis gigantea* and some leaves and fruit of *Aegle marmelos* are offered to him. For goddess Saraswati white flowers of jasmine, yellow flowers of *Jasminum humile* are generally offered. And amongst fruits *Ziziphus jujuba* is a must. Goddess Durga can be appeased with flowers of red Lotus, Sankhpushpi (*Clitoria ternatea*- the blue one), Red Hibiscus (*Hibiscus rosa-sinensis*). It is said that before starting the war with Ravana, Rama worshipped Goddess Durga with 108 Lotus flowers. This practice of offering 108 Lotus flowers to her is continued till date. Goddess Shri or Lakshmi, the consort of Vishnu is also associated with the lotus. Goddess of learning, Saraswati, is associated with white lotus and thus often referred to as *Shweta-padmasana* i.e. seated on a white lotus. Some of the ancient Hindu scriptures are The Vedas, The Puranas, and the epics like The Ramayana and The Mahabharata including the Bhagavad Gita. These are manuscripts and historic literature related to many of the diverse traditions within Hinduism. All these texts refer to large number plants. Five sacred plants/herbs mentioned in Atharva Veda are ---Asvattha (*Ficus religiosa*), Darbha/Kusha (*Desmostachya bipinnata*), a grass, Soma (a number of plants have been identified which include even the highly toxic mushroom 'fly- agaric', *Amanita muscaria*) Cannabis (*Cannabis sativa*) and Rice (*Oryza sativa*). Lord Shiva is often associated with 'Bhang' botanically named (*Cannabis sativa*).The world of plants is an

important aspect in Ramayana. This pre-historical book written in Sanskrit by sage Valmiki describes about 182 plants. They are still found in the same locations all over India. Both botanically and geographically they are correct.

Ramayana and Plants

Numerous plant names are woven in the lyrics in Adikavi Valmiki's Ramayana. A systematic study of this famous epic story would reveal the composition of forests in different geographical regions of the country during that period, distribution of trees and their flowering and fruiting seasons, and their utilization in daily life in those early days of Indian civilization. During the days of King Dasharatha, Rama, Lakshmana and Sita also the plants were useful and adorable.

Lotus (***Nelumbo nucifera***) the sacred Kamal to the Hindus is used as offerings to different Gods and Goddesses. It is believed that Sri Rama worshipped Goddess Durga with 108 lotus flowers before setting out for the Great War with Ravana to obtain her blessings. Till date this tradition is followed by people. Throughout the text of Ramayana, lotus has been used as a comparison for eyes (kamalnayan) or feet (charankamal). In Aranyakanda, when Ravana abducted Sita, it has been said that many plants, animals and birds were happy. They need not feel shy any longer as beautiful Sita was no more there. These plants were: 'Kundakali'- buds of ***Jasminum multiflorum***, lotus, pomegranate or ***Punica granatum*** and ***Aegle marmelos*** (Shreephal). To receive Lord Rama and his wife whole city of Ayodhya was decorated with various kinds of flowers and trees: ***Areca catechu***, ***Musa paradisiaca***, ***Mangifera indica***, ***Mimus opselengi***, ***Neolamarckia cadamba*** (= ***Anthocephalus cadamba***) and ***Garcinia xanthochymus***.

Ravana kept Sita imprisoned in Ashok Vatika i.e. a grove of ashok trees in Lanka. A literal meaning of the word 'ashok' is without sorrow. That is why Sita used to implore: "Oh, Ashok, why don't you take away my sorrow?" It is believed that the Rishis Jagyabalka and Bharadwaj had complete knowledge of the past, present and future as if it was a 'dhartiphala' in their hand. Dhatriphala or 'amla' is a constituent of the Ayurvedic medicine known as 'Triphala' and is a rich source of vitamin C. In Ramayana a wealth of plant names are included in the chapter entitled 'Pampavarnanam'. Around the lake Pampa were growing many types of trees such as champaka, vakula, kadamba, tamala, patala- ***Sterospermum suaveolens***, panasa- ***Artocarpus integrifolia*** and rasala.

When Rama was coming back to Ayodhya after his marriage with Sita, the queen mothers at home were preparing to welcome the bridal couple with haridra, doob, pllav, paan- ***Piper betle***, supari- ***Areca catechu***, ***Oryza sativa*** and ***Ocimum tenuiflorum***. Another product frequently mentioned in the text of Ramayana is 'agaru.' Agar is regarded as a pathological product formed as a result of a fungal disease of ***Aquilaria agallocha***- a large evergreen tree. It has also been used for making beads, rosaries and ornaments.

When King Dasharatha died, the funeral pyre was made with the wood of 'chandan' or sandalwood- ***Santalum album***. In Ayodhyakanda it is mentioned that after the death of King Dasharatha, his third son Bharat offered 'Tilanjali'. After the death of any person in the family an offering of 'tila' is made. This is known as Tilanjali or Tiltarpan. Tila (***Sesamum indicum***), is the source of vegetable oil- sesame oil or gingerly oil.

Like this, in the entire Ramayana numerous plant names are mentioned- sometimes in description of an area or sometimes in comparison with human beings, and their different organs.

Mahabharata and plants

In Mahabharata also many plant names are mentioned. Amrataka (Sanskrit) or Jungliaam (Hindi) ---- ***Spondia spinnata*** is mentioned in ShalyaParva; Arimeda (Sanskrit) or Gandh Babul (Hindi) ---- ***Acacia farnesiana*** in DronaParva; Ashpadika (Sanskrit) or Bhadramunja (Hindi) ---- ***Vallis dichotoma*** and many others like Madhumalati ---- ***Hiptage benghalensis*** (AnusasanaParva), ***Aegle marmelos*** (Vanaparva), ***Magnolia champaka***, ***Anogeis suslatifolia***, ***Balanites roxburghii*** (VanaParva), ***Capparis deciduas***, ***Berberis vulgaris***, ***Tecoma undulate*** are some of them.

Mahabharata epic was confined to the northern plains of India except the last Parva when the Pandavas went to the Himalayas. Plants mentioned are clearly from the northern belt and are from the dry deciduous part of this region.

The information remains incomplete if I do not mention the legend of the famous Shami tree. When Pandavas went to exile for 12 years, the last year being incognito, they had to hide their weaponry to avoid detection by their enemy. So they hid their weapons in a Shami tree i.e., ***Prosopis cineraria***, growing in the middle of a cremation ground. Rolled in a white cloth it looked like a dead body and nobody dared to go and inspect it. So these remained undisturbed for one year and recovered later. ***P. cineraria*** is the State tree of Rajasthan and Telangana. Found in extremely arid regions but is indicative of presence of deep water table

There are many other religious literature that mention uses of various plants.

Some Important news

Recent advancements

A new classification of **Leguminosae** has been published on February 1, 2017 in the journal **Taxon**. 54 authors from different parts of the world have participated in formulating it. The abstract is given here:

The classification of the legume family proposed here addresses the long known non-monophyly of the traditionally recognized subfamily Caesalpinioideae, by recognizing six robustly supported monophyletic subfamilies. This new classification uses as its framework the most comprehensive phylogenetic analyses of legumes to date, based on plastid matK gene sequences, and including near-complete sampling of genera (698 of the currently recognized 765 genera) and 20%(3696) of known species. The matK gene region has been the most widely sequenced across the legumes, and in most legume lineages this gene region is sufficiently variable to yield well-supported clades. This analysis resolves the same major clades as in other phylogenies of whole plastid and nuclear gene sets(with much sparser taxon sampling). Our analysis improves upon previous studies that have used large phylogenies of the Leguminosae for addressing evolutionary questions, because it maximizes generic sampling and provides a phylogenetic tree that is based on a fully curated set of sequences that are vouchered and taxonomically validated. The phylogenetic trees obtained and the underlined data are available to browse and download, facilitating sub sequence analysis that require evolutionary trees. Here we propose a new community- indorsed classification of the family that reflects the phylogenetic structure that is consistently resolved and recognizes **six sub families in Leguminosae**: a recircumscribedCaesalpinioideae DC., Cercidoideae Legume Phylogeny Working Group(stat.nov.), DetarioideaeBurmeist, Dialioideae Legume Phylogeny Working Group(stat. nov.),

Did humans turn Sahara into a desert?

Seoul: Humans may have played an active role in the transition of the Sahara—the world's largest hot desert—from a lush, green landscape 10,000 years ago to the arid region it is today, a new study claims. Archaeologist David Wright of Seoul National University, South Korea, reviewed archaeological evidence documenting the first appearances of pastoralism across the Saharan region, and compared this with records showing the spread of scrub vegetation, an indicator of an ecological shift towards desert-like conditions.

Beginning about 8,000 years ago in the regions surrounding the Nile, pastoral communities began to appear and spread westward, in each case at the same time as an increase in scrub vegetation. As more vegetation was removed by the introduction of livestock, it increased the albedo (the amount of sunlight that reflects off the Earth's surface), which in turn influenced atmospheric conditions sufficiently to reduce monsoon rainfall. PTT

Duparquetioideae Legume Phylogeny Working Group (stat.nov.), and Papilionoideae DC. The traditionally recognized subfamily Mimosoideae is a distinct clade nested within the recircumscribed Caesalpinioideae and is referred to informally as the mimosoid clade pending a forthcoming formal tribal and/or clade-based classification of the new Caesalpinioideae. We provide a key for subfamily identification, descriptions with diagnostic characteristics for the subfamilies, figures illustrating their floral and fruit diversity, and lists of genera by subfamily. This new classification of leguminosae represents a consensus view of the international legume systematics community; it invokes both compromise and practicality of use.

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Dr. Ahalya Chintamani
Retired Faculty, Department of Botany

I retired on 1st January 2004. After that I never had a chance to think about plants so deeply. I feel great that in Botany department Gargi College my young colleagues asked me to write something for Anthesis (Botany Department e-Magazine). Today I am happy that I got a chance to be “Re- tyred.”

It is difficult to name an area of our existence that is not affected by plants. Plants feed us, house us, cloth us, entertain us, generate oxygen that we breathe and cure our illness. However plants are not always to humans, plants also damage crops, cause severe allergic reactions and produce some of the most potent poisons known. Not surprisingly many have learned to recognize plants that help us and those that harm us. Plants have seen an integral part of all civilizations.

For some writing is a “musing” mystery. It is always troublesome. However trying to write is a proud and great achievement.

Some interesting excitements on lore and recent discoveries of botany are:-

- **Coffee** (An aphrodisiac)-The failure of a Turkish husband to provide his wife with coffee once considered as “grounds” for divorce.
Starbucks is named after the coffee loving first mate in Herman Melville’s classic adventure tale Moby Dick!
- **Sequoia**- the average *Sequoia* needs more than 1100 liters of water per day. The energy required to lift this water to the tree’s leaves each day is enough to launch a can of Pepsi into a low orbit of earth!
- **Sweet Potatoes**- they were considered strong aphrodisiacs. When Shakespeare’s flat staff shouted “Let the sky rain potatoes!” in the merry wives of Windsor, he was hoping for sweet

potatoes not the spuds. We use to make French fries. People have shown their fascination with plants by sculpting them into various shapes; incorporate them into logos and names. Naming their children after them (Gloria, Rosy, Kamala, Champa and many more).

- However nothing beats the story of Jay Gwaltney of Chicago who in 1980 ate a 3.4m Birch tree. It took him just over 89 hours but he ate whole potato. Botanists view of life is how are plants constructed; how do plants work; how did plant get here and how are plants important? Newton's greater ideas were triggered when he saw an apple fall from tree.
- **Cornflakes and several other breakfast cereals** can be traced to Seventh day Adventists on American religious research in 1866. They organised the Western Health reform institute in Battle Creek, Michigan. The institute was popular. Patients like Henry Ford, John. D. Rocketteller and Harvey Firestone flocked to the institute of recuperation and rejuvenation (later the institute was renamed as Battle Creek Sanatorium and due to the religious believes served only vegetarian meal). Each morning the flamboyant John Kellog (a Physician) and his quiet brother will made breakfast for the patients by running a potful of cooked wheat through some rollers to form sheet of wheat. These sheets when roasted and ground up became a sort of cereal. One night in 1895 the Kellog brothers were called away on an emergency and left some wheat soaking for more hours than usual. When they try to make their wheat sheets for next day each wheat grain formed its own flake, thus patients of Sanatorium had a new breakfast food. Later Kellog brother tried their new approach with corn added some malt flavouring. Thus first cornflakes were produced. Even today Kellog's signature can be seen on corn flake's packet. However many other companies arose in 1908 with modified forms shreds, puffs etc.
- Ancient Egyptians used dill (*Anethum graveolens*) as a soothing medicine and the Greeks knew that "dill stayeth the hickets (hiccups)." During the middle ages dill was prized against witch craft; many used dill in their spells while lesser mortals added to wine to enhance passion. Early settlers took dill to North America where it became known as "meeting's seed" because children were given dill seeds to chew during long sermons.
- Plants can also be used to determine your blood type. Lectins from Jack beans, lima beans and lotus bind to glycoproteins on the membranes of red blood cells. Because the cells of different blood types have different glycoproteins, cells of each bind to a specific lectin. This is one of the many clinical and research applications of plant lectins in human medicines.
- Valerian (*Valeriana sylvatica*) is an ancient medicinal herb whose name is derived from the Valere meaning 'to be in health.' Despite the awful odour dried Valerian root was always in the medicine bag of Canadian Indian warriors who used it as a wound antiseptic. People used

Valerian during World War I and II for shell shock and nervous stress. Valerian's old name *V. phu* could be origin of our expression for bad odor.

- The amount of CO₂ released by running a car engine is about 100kg/40 litres tank of gasoline. If 1 mole of gasoline is equivalent to the respiration of about 68 kg of glucose or the mass of average adult human. This is roughly the amount of glucose respired by 10,000 young sunflower plants during a warm summer night.
- Chlorophyll is the real "Prometheus" who steals fire from sun. Chlorophyll the pigment that makes plants green was widely popular as a deodorizer in the 1950. Odent marketed toothpaste named chlorodent in 1958 and soon after selling chlorophyll based Dig Food. Other chlorophyll based products included gum, mouth wash deodorant diapers, popcorn and cologne- and there were plans for chlorophyll based Salami and beer (may be compared these to Hari Kebab and mint mock drink).

Although the chlorophyll industry was damaged by tests done by the U.S. Food & Drug Administration showing that chlorophyll was a poor deodorizer. The folly of the craze was summarized in a magazine that pointed out that although goats eat almost nothing but green grass, they nevertheless stink. Thereafter chlorophyll returned to its every day's job! May be there are hundreds of myths about plants but they stand in highest alter!

Botany and politics

The science is a search for truth. Although truth is not affected by politics, the business of science often is! Consider for example Otto Heinrich Warburg a German Biochemist, he began his scientific career in the early 1900s and in 1924 announced his discovery of Iron-oxygenase (the oxygen carrier) that we now call as "Cytochrome Oxidase." In 1931 Warburg was awarded a Nobel Prize for his work. However less than two years later, Hitler was appointed as Chancellor of Nazi Germany. Although Warburg was half Jewish he was unharmed by the Nazis because he studied cancer indeed when Nazis removed Warburg from his position in 1941. He was personally ordered back to work on cancer by Hitler who feared of dying of cancer. He stayed in Germany because he thought that his work would be destroyed if he left Germany. Although Warburg's pact with the Nazis incensed his colleagues outside of Germany, his research was brilliant.

For example Warburg's 1935 discovery that nicotinamide is the active group of hydrogen transferring enzyme would have earned him a second Nobel Prize but Hitler forbade German citizens from accepting the award. Nevertheless Warburg continued to study cancer, photosynthesis and respiration until his death in 1970.

Nazi politics also affected other German scientists. One of these scientists was Hans Adolph Krebs from 1926-1930 to 1932 using much of what he learnt from Warburg. Krebs announced the first metabolic cycle ever to be described. However next year (1933) Krebs was fired by the Nazis Germany to Britain: only four years after working in Britain Krebs announced his discovery of the “Tricarboxylic acid cycle” a pathway used by almost all organisms to convert carbon fragments to carbon-di-oxide, water and energy. The pathway which later became to be known as the Krebs cycle earned Krebs Nobel prize in 1953. Krebs was knighted in 1955 making him Sir Hans Krebs! Krebs worked in Britain until his death in 1981.

Botanical poems

- **The curve**

A roughish young tobacco (well you know what youngsters are like)
Picked up a nasty virus from a dirty old cigar
It got into his phloem and it spread from nodes to nodes
And multiplied its genome by the old mosaic code

His buds began to shrivel and his leaves began to wilt
Till urged by irritation and perhaps a sense of guilt
He sought a plant pathologist in hopes to find a cure
Virulent chlorosis he no longer could endure

He found a large commercial plant leaves are cured and dried
They greeted him with open arms and welcomed him inside
They doctored up his Nicotine cut down his scar and finally released him
As another fat cigar into the market!

- **Prokaryotic Algae (Pond Scum)**

Forgetting you is a crime
Ignoring you is a sin
Thinking about you is my habit
Remembering you is a pleasure
And disturbing you now and then is necessity

Because I not only earned my bread and butter through you

I gained voluminous knowledge about silent living beings
Serving the whole world without uttering a word
Not complaining but teaching me to live a life usefully as it comes

- **The blushing of fungus**

There lived a little in the lower phycocene
When lands were mostly mud flats, but the seeds were fresh and green
He- X utilised the substrates most molecularly mixed
That other microorganism diligently fixed

But soon it grew less easy to get food of any kind
And free amino acids were extremely hard to find
He varied the cytology, his hyphae and his sex
But life became precarious for little fungus 'X'!

His protoplasm languished to a catatonic state
Estimation seemed to loom as his inevitable fate
Till getting hungrier and pale and very thin.
He swallowed some prokaryotes with phycoerythrin

Resisting lytic enzymes in the fungus inside
The integrated with cells and somehow multiplies
Transforming into plastids as some scientists believed
Which gave the cells and fungus 'X' on ultimate reprieve

For when the sun began to shine despite that cloudy skies
He learned to take up carbon-di-oxide and photosynthesize
His metabolic process was changed from A to Z
"I have turned into a Modophyte" the red fungus X said
He blushed a little as he spoke and added with a grin
"I would not be alive without that phycoerythrin"
This point to a conclusion as the little fungus said
Confronted with starvation one is better red than dead!

ALUMNI FORUM

AN ENTREPRENEUR IN CONSTRUCTION!!



Shubhra Bansal
Alumna (Batch 1994-97)

Ms. Shubhra Bansal, born in a hustle bustle of Delhi city is the eldest child of her parents and is a proud daughter, wife and mother of two. At age of liberation as they call it, she is skying high to see herself as budding entrepreneur in the field of Learning and Education.

Hold on for a sec!!, just realized, writing for myself so why 'her', let be "I" (believe in yourself). Now be ready to feel as if I am: apne muh miya mithhoo (praising your own self), nevertheless, I need to talk about myself so bear with me 😊

As a graduate from *Botany Hons. 1994 - 1997* batch, I have my roots of traditions and educational culture from deep inside Delhi University, Gargi College. After completing my graduation, I pursued my Post Graduation in Medical Elementology & Toxicology, from Jamia Hamadard, Delhi.

Flashing back, I have always been dynamic student entangled with super energy and technical knowledge. I have been close to my professors and has been always been a key admirer of educationists around. My family background adds a 'tadka' to my personality as both my parents have been working in field of education, super strong mother being the Principal at school in Delhi and father being a Professor & Novelist. Used to bunk classes, make faces, idle out at canteen, watch movies, laugh around- aloud, travel in DTC bus, negotiate with Auto driver, share samosa & drink, stand in photocopier queue, loads of fun in fest, taking *pangas* (tiff) during excursions and what not...and why not? Those were the days, my own days, my own time...to live the student life at fullest.

Botany Department was my life and soul in 1990s'. We a gang of 5 girls used to have studies along with loads of fun. I still remember the Botanical fest and Botanical Rangoli , I had won second prise in DU Botany fest for making the flower of Begonia. It was such an art to make Botanical Rangoli, still I

use that skill which was gift of our dear teachers who taught us how to be innovative to craft such beautiful Rangolis. Another, life changer was our excursion to Dalhousie in second year. Walking along side mountains with herbarium file, forceps, kit, file, singing dancing learning, teasing was all part of the game. It was then I realized how beautiful plants can be and how close we can be with nature. I was in just love with the mountains and till date I am hard core mountain person.

Ecosystem changes and it teaches you the next to come in your life, and so for me as well it changed and I started my career in University Research in 1999. The little glimpse of Aubergine and playing with the colors of Aubergine can be so exciting and thrilling, was the realization only when I started my research on our college garden with Dr. Gita Mathur (my dear Mathur Mam). Botany research lab had left me with several beautiful memories in my life till date.

Starting from basics of Clinical research as a Clinical Research Associate in 2000, I had reached to the position of Director, Asia Pacific -Clinical Management at PPD India Pvt. Ltd. With, wide experience of various Therapeutic areas across Asia Pacific countries, have Line Managed for the Clinical Team Managers (CTM/ APAC Project managers) across APAC for the countries including India, Japan, Thailand, China, Singapore, Malaysia Australia, Philippines, Taiwan, Hong Kong, New Zealand, and Vietnam.

I am a certified Trainer from Life Sciences Skill Sector Council, New Delhi, Member of Indian Society of Clinical Research (ISCR) and Member of Harvard Business Square. As recent as July 2016, have started my own entrepreneurial venture in the field on Online learning and Education.

Apprentiice Learning Solutions is a unique opportunity that has come straight from the supreme power to pursue my own dreams! I, strongly believe that every person on this earth should have this right to follow her/his dream that gives an individual, the courage to believe in yourself. *Believe in yourself and you can conquer the world is my motto.*



Apprentiice Learning Solutions, The Apprentiice (TA), is a new-age platform that aims to skill and empower individuals across the globe via innovative and finest training solutions. TA envisions spreading knowledge and developing expertise, that helps in *enhancing skills* leading to higher productivity and efficiency of individuals and help them excel in their career.

The *mission* is to Increase effectiveness of Young Managers & Identifying and bridging the gaps of Academic Curriculum - Industry Expectations that helps students to get their dream job.

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Below is the comprehensive list of our course and Skill Development Curriculum. For details, please visit www.theapprentiice.com or email at shubhra.bansal@theapprentiice.com

- ✚ Campus to Corporate Program for University Students
- ✚ Skill Development and Placement program for Graduates in Pharmaceutical Industry
- ✚ Lean Six Sigma Courses for University Students

As a strong advocate of Karma, I drive my philosophy and acts following Shrimad Bhagwat Gita. I would like to pass the same message to the Gen next and ask them to put their best effort in whatever they are doing. *Remember hard work is pre-requisite for success.*

कर्मणो योधा धनं वास्तु मा फलेषु कदाचन
मा कर्मफलसुखी त भवति स्वकर्मणि

*You have the right to work only but never to its fruits.
Let not the fruits of action be your motive, nor let your attachment be to
inaction.*

As a summarising note, I am very thankful to all my teachers to provide me the strength and courage to be ME and to be what I am today. With due respect to all professors at Gargi College, specifically Dr. Gita Mathur for mentoring and providing this opportunity to be able to present at this forum.

Thanking You
Shubhra Bansal

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Historia Plantarum (350 BC - 287 BC) To APG IV (2016): A Journey Worth Recounting



**T. Rajitha
Alumna (2013-16)**

I am feeling exceptionally happy typing this article for my beloved Anthesis. It's a nostalgic experience which brings back memories of my two years on Anthesis board, one as Co-editor for Vol 10:Botany as an interdisciplinary science and the other as Editor for Vol 11:Plant Survival. It had been an exhilarating experience exploring the two special topics and I'm grateful for this year's board who have given me the opportunity to explore Vol. 12 special focus: Recent Advances in Plant Sciences as well. Before I go into the science of it I want to take this opportunity to share my past experience as a student of Botany in Gargi.

My three years in Gargi have been the most remarkable years of my life till now. In three years I got the chance to sow the seeds of passion for Botany. People say it's in the hands of teachers they can make or break one's interest in a subject and I have been extremely fortunate in this department. I'll be eternally grateful to the Botany faculty, the lab staff and my peers in whose company I have managed to develop and sustain my love for the subject. Co-curricular activities like innovation project, star college project and the Pathfinder Projects have given me a remarkable boost in the field for which I have to express my profound gratitude to Dr. Aparajita Mohanty and Dr.Jasmeet Kaur Abat. Along with these projects I got to be part of the Departmental society GCBS:TARU in my very first year as secretary, then later on as Editor of Anthesis I got the chance to work on various aspects of my personality too. I have found a drastic change in my perspective as I started seeing the world from the perspective of a botanist, I started noticing things which were ubiquitous but invisible before to my untrained eye, I began enjoying the much underrated subject that is plant sciences to a major extent because of Dr. Gita Mathur whose enthusiasm for the subject has infected me for life.

One of the subjects which caught and held my interest in the field of plant sciences is plant systematics. It is sometimes called as a dying science but it is still as dynamic as ever and researchers are working in this field continuously although silently from behind the scenes. One of the

major challenges in this field is the “biological classification of plant species”. Proper classification started with **Theophrastus** who classified 500 species of plants on the basis of plant reproduction in his book *Historia Plantarum*. Then came Dioscorides who classified plants on the basis of their medicinal uses. But all these classifications were based on common folk lore. After a significant amount of time 17th century saw professionalization of Botany and scientists like **John Ray**, **Bauhin**, **Cesalpino** and **Tournefort** contributed a significant amount of work to the field of plant systematics.

But the book which revolutionized the plant systematics was *Species Plantarum*(1753) by Linnaeus. It classified around 5,940 plants. This book was the turning point in nomenclature as well, as Linnaeus used Binomial Nomenclature for the first time in it. He classified plant species into 100 Genera and genera into 24 classes on the basis of ‘Sexual System of Classification’. Then came Adanson, de Jussieu, de Candolle and Hooker, Takhtajan who continued the work in this field. Till now the classification was purely based on phenetic characters until a revolutionary theory proposed by Charles Darwin came to the forefront i.e The Theory of Evolution.

Introduction of ‘Theory of Evolution’ brought a tectonic shift in Plant Systematics as now scientists started focusing on classifying plants on the basis of their **phylogenetic relationships**. To establish the evolutionary relationship between plant species, at first plant anatomy and biochemistry were explored in detail. Later on, another major development in science gave stimulus to the field, it was the development of DNA sequencing technology in 20th Century. Mountains of sequence data collected by the end of century proved a veritable treasure trove of knowledge as they helped in establishing specific relationships between plant species at molecular level. The results were universally accepted and the proof, the sequencing data was undeniable. Thus a consensus was established on using **molecular phylogenetics** as the basis of biological classification of plants.

The impetus was provided by a landmark paper published in 1993 by Mark Chase and co-authors, which analysed the sequence data of approximately 500 plants. The data was exclusively based on genetic information of just one chloroplast gene i.e *rbcl* (RuBisCo). On analyses the family tree thus obtained was a surprising mix which challenged the classical position of many species. One example is that of lotus (*Nelumbo nucifera*) which was previously thought to be a relative of water lily (Nymphaeaceae) but as it turned out unexpectedly *N.nucifera* is in fact a member of Order Proteales closely related to Plane trees.

Over the period of next few years three compilers and 26 contributors from 5 countries pooled their knowledge and efforts to come up with a new radical system of classification called APG System (Angiosperm Phylogeny Group System) published in the year 1998. For the first time in botanical history such mass collaboration was witnessed. Over the decade APG system went through 3 revisions one in 2003, one in 2009 and latest in 2016.

Each version saw a decrease in the number of families/genera of uncertain position. The list started out with 25 families which have now come down to only 7 in APG IV system (2016).

APG IV SYSTEM (2016): This system published in 2016 is the result of an International Conference organized in **Royal Botanic Gardens, Kew** in September 2015.

1. Sequence information from large banks of genes including plastid, mitochondrial and nuclear ribosomal origin has been taken into consideration this time.

2. The broad outline of the system remains unchanged.
3. Five new orders have been included, namely, **Boraginales, Dilleniales, Icaciniales, Metteniusiales and Vahliales.**
4. Some new families have also been recognized, namely, **Kewaceae, Macarthuriaceae, Maundiaceae, Mazaceae, Microteaceae, Nyssaceae, Peraceae, Petenaeaceae** and **Petiveriaceae.**
5. Now the total number of Orders are 64 and Families are 416 in number.
6. Two additional, informal major clades are included, namely, superrosids and superasterids.
7. It uses a Linear approach (LAPG) as suggested by Hanson et al (2009). Linear approach involves arrangement of collections systematically rather than alphabetically.
8. For more detailed information about the changes refer to the given link:
<http://onlinelibrary.wiley.com/doi/10.1111/boj.12385/abstract>

Although a better version APG IV is not in any way the final version, this is a dynamic field and as the knowledge accumulates there are bound to be more changes in the classification of plant species, but, the frequency and magnitude of changes is getting reduced with each version and soon in near future we can hope for a perfect system of classification.

● **References:**

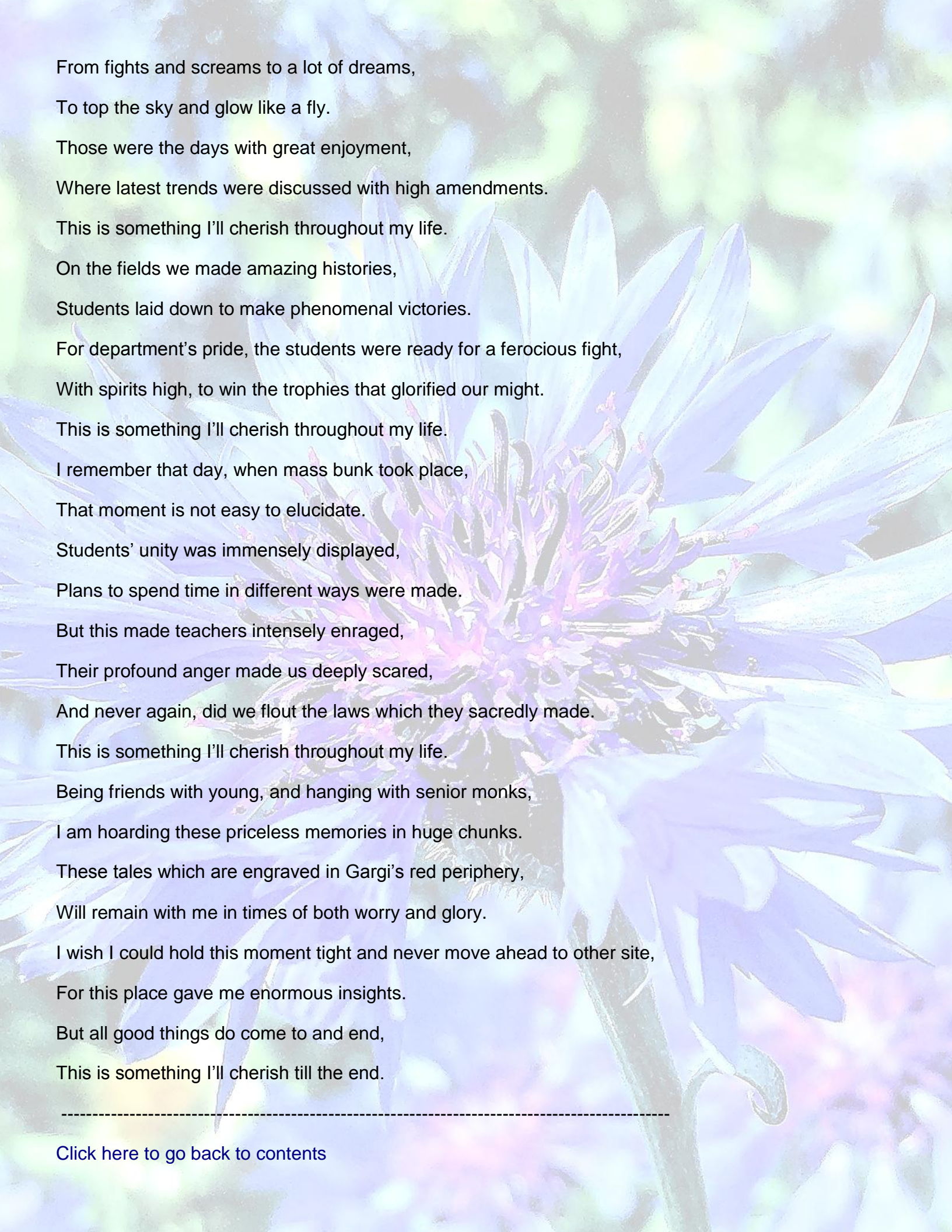
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Something I'll cherish throughout my life



Sneh Kunwar
Alumna, 2013-2016

I feel unrest to think a while,
About the time I've spent worthwhile.
To leave this moment and move ahead,
To reach new mile with an open smile.
I wish I could stop the wink for a while,
And store these memories in my cerebrum's file.
Alma mater is what I leave behind,
College days were good with memories fragile,
This is something I'll cherish throughout my life.
With Margarite bright in teachers disguise,
Their entrancing scintillate enlivened each student's life.
Their plausible words glorified the ideas of conquering the battles of life,
And they taught us well to reach the pinnacle of height.
This is something I'll cherish throughout my life.
With open eyes I look behind,
Tears that will dry with a lot of sighs,
From classroom 'Hi's' to farewell 'Byes'.
From canteen 'Treats' to examination 'Frights',



From fights and screams to a lot of dreams,
To top the sky and glow like a fly.
Those were the days with great enjoyment,
Where latest trends were discussed with high amendments.
This is something I'll cherish throughout my life.
On the fields we made amazing histories,
Students laid down to make phenomenal victories.
For department's pride, the students were ready for a ferocious fight,
With spirits high, to win the trophies that glorified our might.
This is something I'll cherish throughout my life.
I remember that day, when mass bunk took place,
That moment is not easy to elucidate.
Students' unity was immensely displayed,
Plans to spend time in different ways were made.
But this made teachers intensely enraged,
Their profound anger made us deeply scared,
And never again, did we flout the laws which they sacredly made.
This is something I'll cherish throughout my life.
Being friends with young, and hanging with senior monks,
I am hoarding these priceless memories in huge chunks.
These tales which are engraved in Gargi's red periphery,
Will remain with me in times of both worry and glory.
I wish I could hold this moment tight and never move ahead to other site,
For this place gave me enormous insights.
But all good things do come to an end,
This is something I'll cherish till the end.

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Destiny



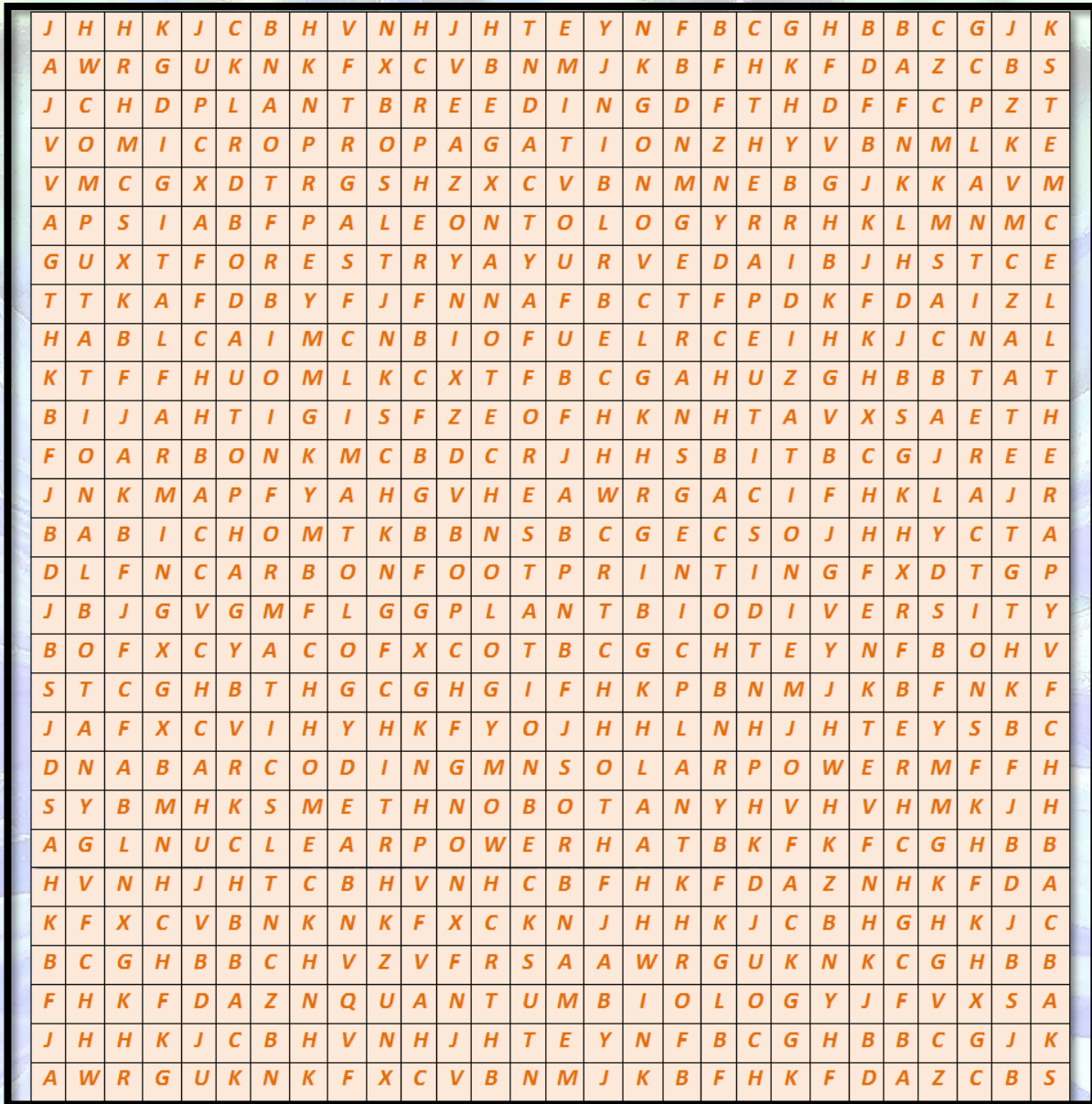
T. Rajitha
Alumna (2013-16)

Have you ever seen a tree,
A plant, be jealous of a lei?
Have you ever seen a flower,
Living on the tree forever?
Such is life, a tree having moments,
As ephemeral as blossoms,
Some bear fruits, some die,
And some become his lei.
Have you ever seen a bloom
Masking it's fragrance?
Have you ever seen a tree
Squirreling it's fruits?
Such is the generosity,
Of nature, of life.
And that is the destiny,
Of being human and humanity.

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CROSSWORD PUZZLE

Find out the "Recent advances in Plant Sciences" related twenty-five terms in the following crossword puzzle.

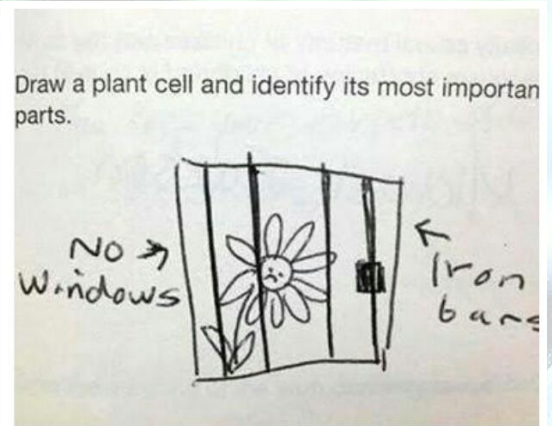
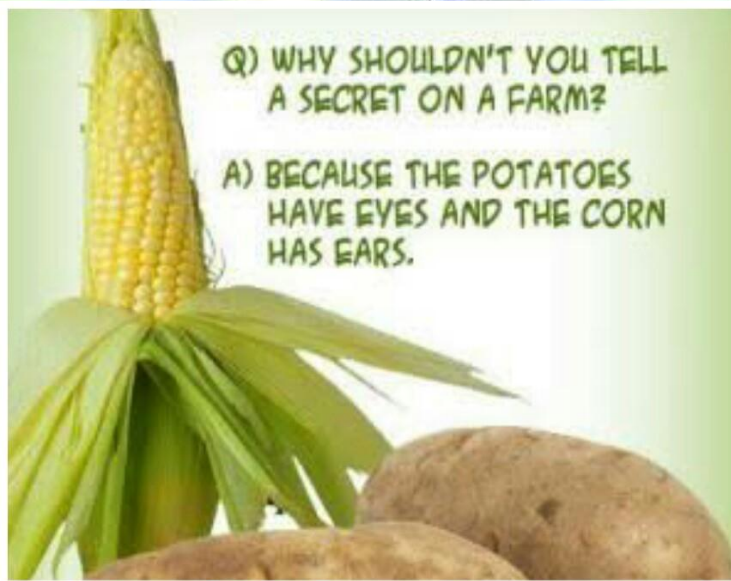


By Sonam Pahuja

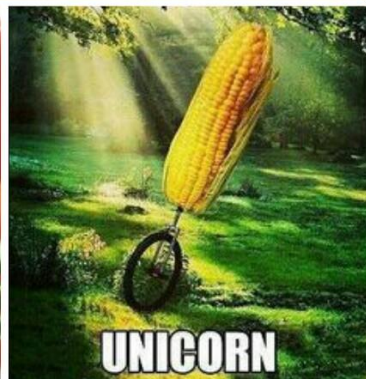
B.Sc. (H) Botany, III year

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BOTANICAL JOKES



Q: What did the male stamen say to the female pistil?
A: I like your "style"



Vaishali Panwar

B.Sc. (H) Botany, III year

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SOLUTIONS

J	H	H	K	J	C	B	H	V	N	H	J	H	T	E	Y	N	F	B	C	G	H	B	B	C	G	J	K
A	W	R	G	U	K	N	K	F	X	C	V	B	N	M	J	K	B	F	H	K	F	D	A	Z	C	B	S
J	C	H	D	P	L	A	N	T	B	R	E	E	D	I	N	G	D	F	T	H	D	F	F	C	P	Z	T
V	O	M	I	C	R	O	P	R	O	P	A	G	A	T	I	O	N	Z	H	Y	V	B	N	M	L	K	E
V	M	C	G	X	D	T	R	G	S	H	Z	X	C	V	B	N	M	N	E	B	G	J	K	K	A	V	M
A	P	S	I	A	B	F	P	A	L	E	O	N	T	O	L	O	G	Y	R	R	H	K	L	M	N	M	C
G	U	X	T	F	O	R	E	S	T	R	Y	A	Y	U	R	V	E	D	A	I	B	J	H	S	T	C	E
T	T	K	A	F	D	B	Y	F	J	F	N	N	A	F	B	C	T	F	P	D	K	F	D	A	I	Z	L
H	A	B	L	C	A	I	M	C	N	B	I	O	F	U	E	L	R	C	E	I	H	K	J	C	N	A	L
K	T	F	F	H	U	O	M	L	K	C	X	T	F	B	C	G	A	H	U	Z	G	H	B	B	T	A	T
B	I	J	A	H	T	I	G	I	S	F	Z	E	O	F	H	K	N	H	T	A	V	X	S	A	E	T	H
F	O	A	R	B	O	N	K	M	C	B	D	C	R	J	H	H	S	B	I	T	B	C	G	J	R	E	E
J	N	K	M	A	P	F	Y	A	H	G	V	H	E	A	W	R	G	A	C	I	F	H	K	L	A	J	R
B	A	B	I	C	H	O	M	T	K	B	B	N	S	B	C	G	E	C	S	O	J	H	H	Y	C	T	A
D	L	F	N	C	A	R	B	O	N	F	O	O	T	P	R	I	N	T	I	N	G	F	X	D	T	G	P
J	B	J	G	V	G	M	F	L	G	G	P	L	A	N	T	B	I	O	D	I	V	E	R	S	I	T	Y
B	O	F	X	C	Y	A	C	O	F	X	C	O	T	B	C	G	C	H	T	E	Y	N	F	B	O	H	V
S	T	C	G	H	B	T	H	G	C	G	H	G	I	F	H	K	P	B	N	M	J	K	B	F	N	K	F
J	A	F	X	C	V	I	H	Y	H	K	F	Y	O	J	H	H	L	N	H	J	H	T	E	Y	S	B	C
D	N	A	B	A	R	C	O	D	I	N	G	M	N	S	O	L	A	R	P	O	W	E	R	M	F	F	H
S	Y	B	M	H	K	S	M	E	T	H	N	O	B	O	T	A	N	Y	H	V	H	V	H	M	K	J	H
A	G	L	N	U	C	L	E	A	R	P	O	W	E	R	H	A	T	B	K	F	K	F	C	G	H	B	B
H	V	N	H	J	H	T	C	B	H	V	N	H	C	B	F	H	K	F	D	A	Z	N	H	K	F	D	A
K	F	X	C	V	B	N	K	N	K	F	X	C	K	N	J	H	H	K	J	C	B	H	G	H	K	J	C
B	C	G	H	B	B	C	H	V	Z	V	F	R	S	A	A	W	R	G	U	K	N	K	C	G	H	B	B
F	H	K	F	D	A	Z	N	Q	U	A	N	T	U	M	B	I	O	L	O	G	Y	J	F	V	X	S	A
J	H	H	K	J	C	B	H	V	N	H	J	H	T	E	Y	N	F	B	C	G	H	B	B	C	G	J	K
A	W	R	G	U	K	N	K	F	X	C	V	B	N	M	J	K	B	F	H	K	F	D	A	Z	C	B	S

1. DIGITAL FARMING
2. BIOINFORMATICS
3. CLIMATOLOGY
4. NANOTECHNOLOGY
5. AFFORESTATION
6. TRANSGENIC PLANT
7. AUTOPHAGY
8. STEM CELL THERAPY
9. PLANT BREEDING
10. AYURVEDA
11. BIOFUEL
12. CARBON FOOTPRINTING
13. NUCLEAR POWER
14. SOLAR POWER
15. ETHNOBOTANY
16. PALEONTOLOGY
17. FORESTRY
18. QUANTUM BIOLOGY
19. MICROPROPAGATION
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21. PLANT INTERACTIONS
22. PLANT BIODIVERSITY
23. DNA BARCODING
24. HYBRIDIZATION
25. COMPUTATIONAL BOTANY

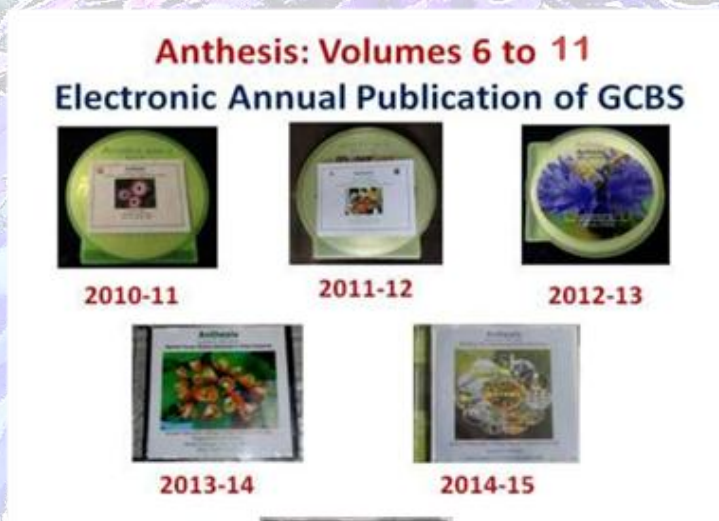
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