Anthesis

Volume 10: 2014 -2015

PLANT SURVIVAL

Annual Publication of Gargi College Botanical Society

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

Anthesis

Volume 11: 2015-2016

Special Focus: Plant Survival

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Cover Photo by Dr. Gita Mathur

Special Focus: Plant Survival

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From the Principal's Desk

Dr. Shashi Tyagi

I am happy to learn that Gargi College Botanical Society which is called **Taru** is bringing out the next issue of its annual publication called **Anthesis**.

The theme for this year is **'plant survival'.** Our planet is home to millions of plant species even before we humans started colonizing it. They are found all over the place. Be it rocky mountains, arid deserts, temperate, tropics, or oceans they have adapted to each and every type of environment. They are very resilient beings which unlike animals cannot move to protect themselves from harsh conditions. So, to survive and flourish they have developed some very unique survival instincts over the course of time. The main focus of this issue is to highlight the interesting mechanisms of plant survival.

I am sure students have more to say about the topic. I am very much attached to my botany students and believe me, nothing gives me more happiness and joy than my delighted students. I'm keenly looking forward to read this issue.

I congratulate the entire editorial team for their hard work. I wish good luck to all the students.

Dr. Shashi Tyagi

Principal

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From the Editor's Desk

Tammineni Rajitha
Botany (Hons.) III year

I am glad to say that Anthesis has successfully completed its long journey of eleven glorifying years with the release of this issue. Anthesis serves as a platform for both students and teachers to express their views and write something on what interests them in plant science. Volume 1 to Volume 5 of Anthesis were published as hard copies and later from Volume 6 onwards it is being published in electronic form. This year also we have continued the norm of publishing the magazine in electronic form which is not only easily accessible but also eco- friendly. Publishing the magazine in electronic form is a small step towards conserving our mother earth by minimizing the wastage of papers and in turn trees. Few other advantages of publishing Anthesis in electronic form are:

- Paperless environment friendly distribution of copies
- Has a far reaching impact which translates into a large readership as it overcomes the bottleneck of limited printed copies
- Economical as it saves the cost of printing
- Skill development and confidence building in students
- Gives our students edge over peers
- Convenient and hassle free writing and editing of articles
- Value addition in the form of photographs
- Copyright issue awareness among students

This year our magazine focuses on "Plant Survival". Plants have been the most underestimated living beings on earth. Just because they cannot move, talk or express themselves like human beings and animals, man once had the audacity to call them non-living. Although, it is now an expected fact that plants are as living as any other organism on our planet still because they are so ubiquitous that sometimes we tend to underestimate them. Plants because they don't have the privilege of locomotion to prevent themselves from adverse conditions have developed unique survival instincts

over the course of time. They can survive in harshest of conditions and for longest of times. This issue of Anthesis contains some very well written articles highlighting some of the mechanics behind plant survival and states some very interesting examples of plant survival like the 400 year old Big Banyan Tree.

Beside these, the magazine also has 'In The News' section in this year's issue for the first time which includes some very interesting ecological news that made headlines in recent times. This year, 'Eucalyptus' is our famous plant and C.C.Ranukiaer-one of the pioneers of plant ecology is our famous botanist.

In its next section it covers all the departmental news including the semester toppers, the executive committee of GCBS (Gargi College Botanical Society), various competitions and trips organized by the department and Botany Department faculty and lab staff. This section of Anthesis also mentions the achievements of Gargi alumni and their life after graduating from Gargi. At the end we have kept a fun section that includes poems and a crossword puzzle which readers will definitely enjoy. Answers of the Crossword are hidden in the magazine itself.

We have hyperlinked each head in the content list to provide easy access to any of the section that a reader wishes to read. We have also provided at the end a summary of our decade long journey and a medium to contact us. Readers are welcome to drop their opinions and suggestions about this issue and request for previous electronic volumes on the mentioned email id.

Finally, I would like to acknowledge the constant guidance and support provided by our teacher advisor Dr. Gita Mathur. It would have been impossible to come up with this issue without her as the driving force behind Anthesis. Also, I would like to give a hearty thanks to all the members of editorial board. This volume of Anthesis is a result of their efforts and dedicated work. Also, I would like to give special thanks to our principal ma'am Dr. Shashi Tyagi for providing us an opportunity to publish this magazine. At last, I would like to thank all the teachers and students for their articles and contributions to this issue.

Tammineni Rajitha

Editor
Anthesis Volume 11

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Weeds: The Resilient Ones

Drishti
B.Sc. (Hons.) Botany, II YEAR

"Look deep into Nature
And you will understand everything better"
-Albert Einstein

Photograph: *Poa* in its natural habit
Source: Self-Clicked

Taking a silent walk in my garden, admiring the soft carpet of grass and watching them keenly, I saw the grass *Poa*, a weed which indicates that the spring has arrived. I then looked around and spotted *Stellaria, Chenopodium and Amaranthus* which have taken over my Garden. They were not so pretty but somehow mesmerizing to the botanist in me with their unique, glabrous, and luxuriant leaf shapes. Although I haven't planted them and haven't cared for them, still growing by themselves so luxuriantly they caught all my attention.

Every spring and monsoon where I keep the space reserved for my pretty and colourful Calendulas, Salvias, *Phlox* and *Verbena* these annual guests (weeds) crop up all over the reserved space and occupy my garden. They are the resilient intruders which show up without my permission every year in my garden and I want to pluck them away so that my *Calendula and Hibiscus would* get proper nutrition, be healthy and keep blooming but this year the botanist in me wouldn't let me do so.

The botanist in me reasoned that they do provide variety to my garden and although they are not that pretty, they have a beauty of character. They show tenacity and ardour which inspires me. Being a "botanist in the making" I would like to unleash the secret behind it and throw light on the reason behind their resilient character.

What makes these weeds so resilient?

Weeds are resilient, hardy, determined, thriving almost in any condition. They never die. When the conditions get unfavorable, they simply withdraw and next time when the conditions get suitable they come back mocking the gardener whose flowers were not able to survive the hot weather and he has to buy new seeds to plant those flowers again. So what are the special features which make them survive in such unfavorable conditions?

They require minimal resources to produce and due to their fecundity, abundance and persistence in the landscape, weeds offer sustainable foraging opportunities.

Morphological special features

Photograph: Grass grows in any type of soil
Source: Self-Clicked

- In grasses, silica is present due to which the leaves are hardy and determined which makes the weeds resilient.
- The seed coat is hard for protection and hence they are able to remain dormant for a long time until favourable times arrive.
- Weed plants have deep, brittle roots which are left behind in the soil when weeds are plucked. From this new plants soon come up.
- Dense hairs on the leaves are present to slow down the herbicide uptake.
- They are quite adaptive to herbicides after a long time use and moreover they "harden-off" prior to herbicide application maintaining their determination and thus growing in tough environments.
- Taproot is deep enough to penetrate soil, thus increasing their ability to take up water and nutrients which makes them competitive. .
- They have large fibrous roots to absorb water.
- Barbed hooks on seeds are present to aid in dispersal to long distances.
- The stem is hardened to resist damage. Weeds are adaptive to low sunlight conditions too and can survive on arid and semi-arid land.
- They release poisonous exudates that prevent animals from eating them.
- They are adaptable to all land types and exhibit special ability to survive in soil for years.
- They can grow in soil lacking nutrients needed for the favoured plant.

Photograph: *Digiaria* growing in low sunlight and arid condition
Source: Self-clicked

Maintaining the above special morphological features weeds sustain their resilience.

Anatomical special features

They have vegetative perennial structures. The following structures allow perennials to spread (not all present in each species).

- Stolons are above ground horizontal stems that root at the nodes to spread the weed.
- Rhizomes below ground are thickened stems that grow horizontally in the upper soil layers.
- Tubers are enlarged rhizomes with compressed internodes located at the ends of rhizomes.
- They have environmentally controlled induced dormancy.
- They have ability to store excess energy for later use and have exploitative root system.
- The cells are resistant to growth regulators.

Disease resistance

Weeds are resistant to a number of diseases. They have ability to resist

- Sudden Death syndrome
- Grey leaf spot
- Common leaf spot
- Cyst nematode
- Brown stem rot
- *Phytophthora* infection
- *Pythium* infection

Genetically,

- Weeds have ability to hybridize,
- There is large amount of genetic variability within a population,
- They can cross pollinate, and
- They have the ability to self fertilize.

What are weeds doing in my garden?

Weeds are not such villains as people think. They have some ecological significance too:-

Photograph: *Argemone mexicana* showing inflorescence and leaves. Source: Self-clicked

- Weeds add organic matter and nutrient to soil

Luxuriant and glossy green growth of leaves of weeds acts as green manure. When buried in soil they add organic matter to soil and enrich soil with plant nutrients.

- Weeds check wind and soil erosion

Weeds growing on desert lands reduce the affects of fast blowing winds thereby preventing soil erosion and protect

environment.

•Reclamation of alkali soils

Application of powder of weed *Argemone mexicana* contain sufficient amount of nitrogen, potassium, phosphorus: elements which can help in reclamation of the alkaline soils.

- Weeds support biodiversity in crop fields

Weeds are the direct or indirect sources of seeds eaten by birds. It mainly includes species of *Stellaria, Chenopodium, Poa* and *Polygonum.*

- Weeds control nematodes

Weeds do have nematocidal properties. When incorporated in soil, they help to control nematodes.e.g. *Parthenium, Calotropis, Crotolaria.*

• Weeds can be used for paper pulp, biogas and manufacture of edible proteins.

Not only ecologically, weeds exhibit some economic importance too.

Photograph: *Amaranthus*, leaves used as vegetable.

Source:Self-clicked

• Weeds are medicinal treasures

Weeds show their efficiency in Homeopathy, Ayurveda and other therapies.

1. *Argemone mexicana* acts as antihelminthic and destroys worms.
2. *Eclipta erecta* functions against cough and as hair oil.
3. *Leuclas aspera* is used in snake bite.

•Economic importance

Weeds are used for making essence sticks (agarbatties) e.g. Nutgrass/Nutsedge.

•Weeds have aesthetical value as well

Some weeds also being ornamental plants, beautify the surrounding. E.g. *Portulaca spp.*

•Some weeds are used as fodder for animals

Due to palatable taste of some weeds, they can be used as fodder. For example- *Amaranthus* is cultivated as leaf vegetable and a pseudocereal too.

What if weeds are not there????

If weeds would not be there then the ecological set up be disturbed. Soil or a land without weeds is just a dead land with no salinity tolerance, winter hardiness, production potential soil pH tolerance, drought tolerance and livestock suitability. Thus weeds are crucial and important plants of our ecosystem.

Although these plants are unwanted weeds for the world but for me, a botanist, I value these weeds truly. This article is an attempt to share their much developed survival instinct which remains unnoticed by the common people and in ignorance they call

these plants to useless. But it should not be so.

All insects are not pests, there are butterflies too, similarly all wild plants are not weeds, and they have their role in the ecosystem to which they belong. Just let them grow.

I propose the next time you notice a weed, either while you are driving or dealing with them-up close, pause, admire them and discover the undiscovered virtues of these plants.

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Photographs: Some commonly found weeds in Delhi.
Picture Credits: T.Ramya, Botany III year

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Seeds That Sleep Well Learn To Survive

Joyita Deb
Batch of 2005-2008

From finches to flowering plants, the entire life-cycle of an organism is, quite literally, a means to an end. The 'end' here is, at a micro-level, the birth of progeny and at a macro-level, the survival of the species. But what if the progeny enters a world not suitable for it to survive? The obvious strategy would be to move to a more favourable place. But what if it couldn't move? What could it do to ensure it survives? Its best bet would be to wait, patiently, until the conditions are just right for it to thrive.

If you think the latter strategy is the better one- Congratulations! You think like a plant and have chosen a strategy that will ensure world domination, well almost! This strategy, which enables the progeny of a plant -the seed- to decide when to germinate, is called Dormancy. A dormant seed is much like a sleeping human. While asleep, the brain of a human enters different depths of activity alternating between shallow states to deeper ones. During shallow sleep, it would be easier to wake you up (just the smell of freshly brewed coffee would do for me!) but during deep sleep, you might need cold water splashed on your face for the same outcome. In a similar way, the depth of seed dormancy varies cyclically; in the deeper states, breaking dormancy might require multiple strong dormancy breaking treatments, while in the shallower ones, a single dormancy breaking factor might suffice. So, for example, giving seeds a cold treatment during imbibition- called stratification would be enough to break dormancy in less dormant seeds. But more dormant ones might need stratification along with the application of hormones such as gibberellic acid, which is a potent dormancy breaker.

If dormancy cycles within a seed, does that mean that it acts as a natural rhythm, like a biological clock? There is some evidence that suggests it might, but this theory is still an on-going debate among seed biologists. The common consensus is, however, that changes in dormancy levels are controlled by the environment a seed experiences. As the seed experiences different conditions in different months, these conditions gradually 'peel away' the layers of dormancy inside the seed until there is a perfect match of the right environment and the right level of dormancy to progress to the germination phase.

These oscillating dormancy states can be monitored molecularly inside a seed. I

mentioned earlier that gibberellic acid (GA) reduces dormancy levels in the seed; the evil counterpart of GA is abscisic acid (ABA), also a hormone, which induces dormancy in a seed. A balance of both these two hormones determines the dormancy state. We know this from laboratory experiments having standardised, easy-to-interpret conditions. But what happens outside the lab, in the field, is quite amazing. We find that the effect of these hormones changes with the months. A seed is more receptive to ABA during the winter months, while during the onset of summer, it is more receptive to GA. Depending on the species this might mean that during winter, the seed is deeply dormant, while in the summer, it is less dormant and ready to germinate.

So plants and their progeny are like big-data processors with the unique ability compute both space and time simultaneously. It is easier to translate this assimilative-ability of plants into a question: “How do plants collect and retain ecological information through time?” This is one of the major questions in plant biology today. To date, what we know is that histones, the proteins which are a part of nucleosomes and control the packing of chromatin, are involved in this data assimilation process. Imagine a gene that increases the deep dormancy phase in a seed by increasing the level of ABA. As we enter the winter months, the chromatin around the gene is unpacked gradually as the season progresses. This unpacking occurs because the histones around it are systematically modified (acetylated) enabling the unpacking process. Chromatin unpacking allows the transcriptional machinery (RNA polymerases, transcription factors etc.) to transcribe the gene at higher rates, so the expression level of the gene is higher. As the gene’s expression is higher, ABA levels increase and the seed becomes more dormant. The opposite occurs in the summer; the chromatin around the seed becomes densely packed so the gene’s expression levels are low. This causes a decline in ABA levels and the seed gradually progresses into the shallow dormancy phase, ready to germinate. The number and the nature of the modifications on the histones around a gene act as seasonal markers. But we still don’t clearly understand how seeds or plants, for that matter, collect this information.

How can we humans assimilate all this information and make use of it? One approach is much like personalized medicine for seeds and could help farmers make more informed farming decisions. If we discover the major players in the collection-retention mechanism for different crop varieties, we could manipulate the conditions the seeds are exposed to, to our benefit. Taking a step further, we could combine all this information and formulate mathematical dormancy models. This way a farmer would plug-in values for the different parameters in the formula and could then use the estimates to decide when best to sow seeds and which seeds to sow simultaneously to make maximum use of his land. This is just an example, with more advances in biological research and computing technology, more accurate and detailed models could be imagined. Our strategy for world domination has not worked out very well for us; perhaps learning from the masters in this area might be the better option!

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Big Banyan: The Survivor

Dr. Gita Mathur

Banyan trees are very big, massive and many years old, we have all read this in school books. When I read this as a schoolgirl and saw the picture of 'The Great Banyan' growing in Botanical Garden, Calcutta, I tried to imagine what it would feel like standing under that canopy. Some dreams do come true. I recently visited Bangalore and was able to visit 'The Big Banyan' growing there.

Banyan is *Ficus benghalensis* of family Moraceae. It is considered as a sacred tree and is worshipped along with Peepal which is *Ficus religiosa.* Banyan has the capacity to produce aerial roots which arise from branches, are positively geotropic and enter the soil, functioning as strong supporting pillars hence also called stilt or prop roots. At the same time, they also absorb water and minerals from the soil. This helps the tree to spread its canopy.

Famous banyan trees of India are:

Thimmamma Marrimanu, listed as the world's largest Banyan tree in the Guinness Book of World Records in 1989, situated in Anantapur district, Andhra Pradesh, spread over 5 acres and is 530 years old.

The Great Banyan in the Acharya Jagadish Chandra Bose Indian Botanic Garden near Kolkata, 200 years old with a crown circumference of over 330 meters; 25 meters tall with 3300 aerial roots covering 4 acres.

Giant Banyan tree at Adyar in Chennai is 450 year old.

The Big Banyan Tree at Ramohalli, Bengaluru, also called Dodda Alada Mara.

The Big Banyan at Bangalore is about 400 years old. Its canopy is spread over more than three acres with a crown circumference, which is continuously increasing, of more than 250 meters. The main trunk is not there anymore and the center of the tree appears as a big space while numerous, more than 1000 pillar-like prop roots form the vertical system and the stems make the network of horizontal branches which bear leaves. The roots and stems are nearly same in diameter, to differentiate them I had to see the bark on the stem and the branching pattern. Amazing formations, absolutely thrilling for a botanist to experience and observe this unique survival strategy of a tree.

The management had put metal fencing around the tree, but the tree is now extending beyond the fence on all sides. The hanging roots are being encouraged to enter soil, for this metal mesh filled with soil and leaf litter has been placed under the roots. This may help the tree to become more stable.

However, the tree being a special attraction has become a picnic spot for people from adjoining areas. As a result the ground could be seen littered with plastic bags, biscuit and chocolate wrappers etc. This has attracted a lot of monkeys and people enjoy feeding them with tit-bits, without realizing the impact on the tree. The monkeys jump around and branches are breaking under the pressure.

The tree is a majestic beauty. Standing below the massive canopy is an unexplainable thrill. It feels as if you are in a wonderland forest. This tree has seen many generations of people; hope it will see many more generations to come. This is a living witness to the evolution of Bangalore from the era of bullock carts to the present Silicon city. The sprawling canopy of this tree has many secrets about longivity in its folds.

Futher Reading:
https://en.wikipedia.org/wiki/
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The Anthesis Volume 11 cover picture is of this tree.

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THE GREEN GUARDIANS OF DELHI

Surbhi Nautiyal
BSc(Hons) Botany, III year

The alarmingly high levels of pollution have made New Delhi one of the most polluted places in the world but it does have its own factory of fresh air for the folks of Delhi. Delhi ridge does that name ring a bell? It is the northern extension of the ancient Aravali range and marks its presence in four distinct patches in and around the capital – the Northern ridge, Central ridge, Southern and South central ridge, including the Asola-Bhatti Wildlife Sanctuaries as well. Commonly known as the green lungs of the capital the ridge is home to over 120 plant species, supporting many species of mammals, birds, amphibians, and reptiles.

Clockwise from Top: Dhak Tree in Flowering, Dhak Flower, Neem Tree, *Prosopis*

It is the only natural forest in Delhi. Some of the plant species that exist in the ridge forest are – *Acacia nilotica* (Babul), *Caparis decidua* (Karil), *Butea monosperma* (Dhak), *Salvadora persica* (Pilu), *Prosopis juliflora* (Kikar), *Azadirachta indica* (Neem), *Acacia modesta*. Shrubs include *Adhatoda vasica* (Bansa), *Capparis sepiaria* (Heens), *Carissa spinarum* (Jangli karaunda) etc. and trees like Hingot, khair, kumttha, dhak, phulai and kareel are examples of some species which are adapted to the harsh ridge conditions and are difficult to find in rest of Delhi. With the changing environmental conditions and human encroachment, species like Hilal and other delicate native ones are now lost forever from the ridge. Some of the animals supported by the ridge are Nilgai, Indian hare, Mongoose, Foxes, Jackals, Rhesus Macaque, Indian bull frog etc.

Being home to a wide variety of flora and fauna the ridge forest also serves many other valuable ecological functions. It is well regarded as the green lungs or the lifeline of Delhi, helps in climate moderation by shielding the city from the hot winds from the deserts of Rajasthan which brings down the temperature in this region. Preventing soil erosion, enriching the groundwater level and maintaining the water table of Delhi, controlling the level of pollution, purifying the air are some of the important functions served by the ridge forest.

The lush green expanse of the ridge also gives Delhi the distinction of being the second most bird rich capital city after Kenya's, Nairobi with almost 200 bird species. Some of the bird species found here are Flycatchers, Rose Finch, Green Herons, Barbets, Leaf Warblers, Crested Serpent eagles, Booted eagles, Great Horned owls, woodpeckers and many more.

But sadly the integrity of ridge forest was sacrificed on the altar of Delhi's booming population by the Delhi administration. The forest area was encroached for the development of infrastructure in Delhi. Be it roads, underground water pipelines, hotels or malls, each construction was done in ignorance of the ecological fragility of Delhi ridge. Since the administration itself was responsible for its decline, the responsibility to save the forest was taken up by the residents of Delhi.

In 1979, about 300 students and many concerned citizens organized a rally spearheaded by the NGO Kalpvriksha, protesting the Delhi administrations plans for construction in the ridge area, their efforts bore fruits and as a result a large area of the Ridge forest was declared protected. But, the legal protection given was weak and the illegal construction activities continued.

Then again in 1993, the NGO's working towards this cause came together as the Joint Ngo Forum to save the Delhi Ridge forest. Pressure from this forum and many concerned denizens finally led the Delhi administration to declare in 1996, the ridge as a Reserve Forest under the Indian Forest Act, 1927.

The forest department of Delhi has also set up a Conservation Education Centre to encourage awareness and also provide information about the rich biodiversity of the

Delhi Ridge. In order to increase the areas under conservation of the Ridge, the Delhi government in association with the Delhi Development Authority (DDA) has developed the Aravalli Biodiversity Park on the south- central ridge covering an area of 692 acres. The park has a wide spectrum of native tree species and birds.

The ridge is natural treasure trove with a rich diversity of plant and animal species, it has proved to be a haven for nature lovers but the mushrooming encroachments, increased levels of pollution, deforestation and illegal construction activities have invaded the natural beauty of this place. The inability of the Government's agencies to prevent the area from being used for developmental purposes has further degraded the ecological balance of the forest. Strict action must be undertaken by the concerned authorities to conserve and nurture the backbone of Delhi.

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Surviving Together

Bhawna Lalit
Botany(Hons.) 1st Year

Plants are the key to our survival on the Earth. They continually renew the environment. The canopies of trees provide shade. Many plant roots, stems and leaves are of high medicinal value. Their timbers have added to the comforts of man. The soothing fragrance and the beauty of flowers attract insects, birds, animals and men equally. Millions of plants cover the earth. Many plants are yet to be discovered! The complexities of plants are so great that many a people have spent their lifetime studying a single group of plants and yet could not fully decipher them!!

The plants provide for the needs of fellow living beings. Be it the humans, the animals or the insects, each organism have its own set of needs fulfilled by the members of plant kingdom. In return, the plants use these organisms for their own survival. Thus in nature the plants have developed some unique interactions with other categories of living beings along the way. One such interaction is coevolution. It is a very crucial survival mechanism that the plants have adapted to in tandem with the other species belonging to Animal kingdom.

So what is this coevolution that the plants have become so adept at?

As the term itself suggests coevolution is a collective term used to describe mutual changes in two or more species usually one following the other as a result of their interactions. Coevolution reciprocally induces evolution and results in diversification and speciation. It was first observed by George Engelmann in St. Louis (1872) that the plants pollinated by insects and these plant-feeding insects show much increased rate of diversification over the course of evolution. This is thought to be

the result of coevolution. Coevolution occurs at various biological levels. It can be a result of correlated mutations between amino acids in a protein or covarying traits between different species in an environment.
This phenomenon is most prominently seen in Angiosperms and their pollination vectors and thus can be best understood by studying some of the unique interactions happening between these species in nature. The following examples highlight these interactions and explain the significance of coevolution in the survival and proliferation of these species.

1. Interaction between *Ficus* and Fig Wasps

Interaction Mechanism

Around 900 species of *Ficus*(Fig) are distributed around the world. Figs are defined by a unique enclosed inflorescence which is called as syconium, which is also the arena for interactions with Agaonidae (fig wasps).
Agaonidae includes various species of wasps which pollinate the fig. In turn wasps depend on fig for reproduction because their larvae feed on fig seeds. Interaction of figs and wasps dominate the lives of both as each relies on the other for reproduction.
The female wasp enters the syconia through ostiole and pollinates the flower. After this wasp larvae and fig seeds develop together for several weeks. After the maturation of male flower, wasps acquire pollen before dispersal. The wingless male wasps bite holes through syconium wall enabling the females to disperse and search for new receptive syconia.
Each fig has its own specific wasp and each wasp species pollinates a specific fig species.

This unique relationship has developed between fig species and wasp species because of the process of coevolution, where both organisms underwent morphological changes to give rise to such highly specific relationships at such a large scale. Each cannot survive without the other. The plant is of as much importance to the survival of wasp as the wasp is to the survival of plant

2. *Yucca* and Moth

The *Yucca* moths belong to the Prodoxidae a basal family within Lepidoptera of 78 described species (Davis,1998;Pellmyr,2002). *Yucca* plant shows mutualism with moth and has no ability to reproduce without moth. The relationship between *Yucca* and moth was given by George Engelmann in St. Louis in 1872.

Mechanism of Interaction

The ovary of the flower contains three chambers known as carpels in which eggs are present. Two locules are present in each carpel.
The female moth has special mouth parts called palps through which it gathers pollen from the anthers of the flower. It converts the sticky pollen into a pollen balland carries it between its tentacles and thorax. The pollen ball is then stuffed into stigma of the flowers on which it visits. The female moth lays its eggs into two or more of the six locules through her ovipositor. After the eggs hatch, the larvae feed on *Yucca* seeds.

A true Yucca moth *Tegeticula yuccasella* is found in east Rocky Mountains and is responsible for pollination in *Yucca whipplei*. These species exhibit coevolution as they evolved together to become interdependent on each other for survival.

3. *Ophrys* Coevolution

Ophrys belongs to family Orchidaceae. The orchid family is mainly known for its enormous diversity of pollination mechanisms. There mechanisms include deceptions like food deception, floral mimicry, brood site imitation, psuedoantagonism and so on. The genus *Ophrys* is also pollinated by sexual deception. Pollinators of this genus are mainly bees or wasps and two beetles.

Mechanism of Pollination

Ophrys are pollinated by a special kind of mechanism called sexual deception of male insects. These flowers imitate the virgin females of its insect pollinators to attract male insect to pollinate the flower. The male insects try to copulate with the putative female which results in the transfer of the pollens to the flower thereby pollinating the flower.
These flowers resemble female insect only in shape and color. The males are deceived due to floral odor.

Chemical nature- The compounds which attract male

insects for pollination are made of unsaturated and saturated hydrocarbons.
In *Ophrys sphegodes* besides the pollinator attracting hydrocarbons, the floral odor also contains a number of non-hydrocarbons like aldehydes.

The bouquet of these compounds varies from flower to flower to avoid habituation.
In this the flower shows the phenomenon of mimicry and to survive it evolves to resemble the female insect so that it can attract the male for pseudo copulation. Thus the phenomenon of coevolution is driven by the female insect, as it evolves so does the flower to ensure its survival.

Coevolution can occur if the part of environment experienced by a species is influenced by a specific set of genes of other species. Only if intensity and frequency are high we can expect highly specialized interactions to coevolve. Many fruit eating birds especially in tropical rain forests are coevolving with the plants whose fruits they eat. The birds get their nourishment and in return plant gets digestion resistant seeds. Coevolution results in variations in plant species and animal species which are interdependent on each other for their survival. These variations help the species to survive.

We must not disturb the balance in nature. We must conserve plants as their survival results in our survival.

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INCONSPICUOUS FLOWERS

BHAWNA
BSC(H) Botany II Year

Flowers are the most attractive part of a plant. The flowers perform a major function in survival of a plant i.e., reproduction, which is enhanced by pollination and dispersal of seeds.

We always enjoyed their bright colour and fragrances, but from biological point of view, flowers have only one purpose- to get pollinated so that seeds can be produced. For this, first they have to get attention of an appropriate pollinating animal, usually with colour and fragrance, and lure it into the flower. Second, they have to carry out the reproductive process using pollen deposited by the visitors.

But there are many plants around us which possesses very small, tiny flowers which are not showy; such flowers are called inconspicuous flowers. These are true flowers. Inconspicuous flowers are small, not showy and difficult to see. So an individual flower is not capable of attract pollinators. For this purpose of attraction there are specialized organs (bracts, wings) present around the flower that are not part of the flower at all.
In some plants, inconspicuous flowers are generally more or less crowded in terminal or lateral clusters, the form of the inflorescence varying widely according to the manner of branching and length of pedicels. A cluster of flowers give a collective visual signal to pollinators.

Inconspicuous flowers are devoid of much attraction by insects. Their pollen is smoother and smaller and better adapted for pollination by wind. Such plants grow as dense populations in range lands or forests. Here are some examples of plants having inconspicuous flowers.

Scientific name: Bougainvillea
Family: Nyctaginaceae
(Bougainvillea)

It’s not the flowers that make this plant so colourful, it’s actually the magenta bracts. The flowers are just tiny and white. The bracts can be seen in all shades of pink and purple, and also red, yellow, white, salmon and orange.

Scientific name: *Syzygium cumini*
Common names: Jamun, Java plum, Malabar plum and Portuguese plum
Family: Myrtaceae


Scientific name: *Lawsonia inermis*
Common names: Hina, the henna tree, the mignonette tree and the Egyptian privet
Family: Lythraceae

Scientific name:*Ehretia laevis*
Common names: Ajaan, Chamrod, Dant-Rang, Vadhvarni, Chamror
Family: Boraginaceae (Ehretiaceae)

Scientific name:*Morus nigra*
Common names: black mulberry,blackberry
Family:Moraceae

Flowers are inconspicuous due to their size.

Scientific name: *Polyalthia longifolia*
Common names: False Ashoka, the Buddha Tree, Indian mast tree, and Indian Fir tree

Family: Annonaceae
Flowers are inconspicuous due to their colour.

Scientific Name: *Pennisetum glaucum*
Synonyms: *Pennisetum typhoides*
Common Names: Pearl millet (bajara)
Family: Poaceae - Grass family
The tiny flowers are hidden in long, narrow cylindrical and upright to arching, feathery pink or purplish aging to white inflorescence on tall slender stems above the leaves.

After observing some of the examples it is concluded that plants with inconspicuous flowers are generally wind pollinated and a few are pollinated by birds and insects(eg., willows have inconspicuous flowers which produce abundant nectar). Mostly though they are self pollinated. Such flowers lack petals but have specialized organs to attract animals (eg.Bougainvillea)

Flowers mostly occur in clusters, to increase the visual display to pollinating insects. Also these flowers generally open up in succession over many days. This longer lasting display encourages pollinators to visit the same plant day after day achieving more consisting pollinating success and higher overall yields.

Pollens are smoother and smaller. They produce enormous numbers of relatively small pollen grains.

Seeds of some plants are winged.

SIGNIFICANCE

Less energy and material is invested in each flower, so if some are damaged or fail to get pollinated, it is a much smaller loss to the plant.

Inconspicuous flowers exist because small plants cannot afford large flowers and their accompanying large seeds, which are very expensive. Also a large flower with many ovules is a big risk- if it is found and eaten, a major reproductive investment has been lost; however damage to a small flower with only a few ovules is less significant.

Thus, we can say that having inconspicuous flowers is a unique survival strategy of the plants to conserve their energy for other life sustaining processes rather than expend it in producing flamboyant and attractive flowers.

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A Unique Story of Survival: *Ficus*

Dr. Gita Mathur

Species of *Ficus*, members of the fig family, are very interesting trees for Botanists. Many of them are very big trees which have been living on Earth for hundreds of years. Have you wondered “How they manage to face the world for so long?” They have amazing adaptations for survival.

Some common ficus or fig trees are: Peepal, *Ficus religiosa*; banyan, *Ficus benghalensis;* Indian Rubber Tree, *Ficus elastica*; edible fig, *Ficus racemosa* and goolar, *Ficus glomerata.* All these trees have massive canopies which produce a dense shade, big stems and very strong root systems. These trees grow fast and show typical deciduous habit.

Figure1. **A.**Young adventitious roots of ficus are pink when tender. **B**. Mature roots which have got anchored in the soil and are also acting as support or stilt roots

The trees have the capacity to produce adventitious roots which hang from the stem in many species, prominently in *Ficus elastica* and banyan. They may reach the ground and get established as stilt roots. As the tree spreads, these absorb water and nutrients and supply them directly to the branches they have originated from.

Another ficus which produces adventitious aerial roots is 'Pilkhan', Botanically called *Ficus infectoria.* This is seen with roots clinging on to the main stem as they arise at the point of branching. This is a very common tree on Delhi roads. Look around and observe.

On very hot days when the rate of transpiration is very high, strong transpiration pull increases water uptake by the efficient root system. As these trees are very tall, water may reach the leaves by night when the stomata close. The vein endings have openings called hydathodes which release water droplets. This is the reason for ground becoming wet under the peepal tree on hot summer nights.

Seeds of *Ficus* are very small and remain suspended in air, falling on walls, other trees and even on rooftops. Seeds are also dispersed by fugivorous birds and bats who spread them with their droppings. Even on a small amount of soil the seeds produce small plants which quickly get established. The result of this is visible everywhere around us.

Ficus glomerata shows cauliflory which is production of flowers and fruits on old stem instead of young branches.

Figure 2. **A.** Seeds of *Ficus religiosa* germinated and formed plants in small amount of soil collected on another tree stem. **B**. Cauliflory in *Ficus glomerata*

Some species of ficus are called as strangler figs. These grow on other trees. Their seeds germinate on or near another tree. Their roots remain in the soil but stem grows around the stem of the other tree. They keep growing and in the process surround the other tree choking it till it dies.

Strangler figs are not parasitic as they do not take nutrients from the tree on which they are growing. This is probably competition for space for survival in trees found in dense forests. Amazing survival instinct!

Figure 3. **A**. Strangler fig stem growing on a palm tree stem.(Dehra Doon, 2004). Note how the stem branches overlap each other and fuse together. **B**. The ficus has killed the palm tree on which it was growing, palm leaves are dead while ficus tree has healthy green leaves. Its stem has become solid and can survve without support.

Another survival strategy of ficus is association of specific wasp species for pollination of every ficus species. This is a special case of coevolution (read more about it in

another article, dedicated to coevolution in this volume of Anthesis).

In the Lalbagh Botanical Gardens in Bangalore, stands a tree of goolar, *Ficus glomerata.* It is a big tree with a very unique feature. It has a massive branch which has come down to ground level and has produced roots into the soil. The branch has been growing and proliferating for years. It continues to remain attached to the main tree. The tree and the branch both produce flowers and fruits. The authorities of Lalbagh have put metal fencing to keep the sprawling shoots protected from the visitors. This ficus tree is a special attraction of the Botanical garden.

So, we can see that species of *Ficus* have developed many types of adaptations which are their strategies for survival. Strong aerial roots which become supporting stilt roots, mechanism for seed dispersal, very minute propagules, method for release of excessive water absorbed by roots, establishment of seedlings in minimal soil, production of flowers and fruits on older parts of tree, cauliflory, for easy access of pollinators and seed dispersers, specific wasp association to ensure seed formation, strangler mechanism for competition and high rate of regeneration and establishment. This no doubt is the secret of high longivity of ficus trees.

Plants have an uncanny ability to survive and keep growing and proliferating.

Figure 4. *Ficus glomerata* tree at Lalbagh Botanical Gardens, Bangalore. **A**. Photographed in June 2015, in the rainy season when tree had lush green foliage. **B.** Photographed in January 2016, the dry season with leaf fall. Note the fencing to protect the big growing branch from enthusiastic visitors to the garden.

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Evolving for Survival: The Angiosperms

T.Rajitha
Botany(Hons), III year

Plants, the seemingly still organisms have a history greater than any greatest ruler of the world. Living on a different time scale than us human beings they have managed to evolve and adapt to the most diverse of environments. They colonized earth long before any of the mammals came into being and evolved to conquer almost every nook and corner of the planet earth. What started from a single cell, evolved into autotrophic multicellular organisms, then seedless plants and suddenly the world which was dominated by the Gymnosperms saw a proverbial 'floral big-bang' with angiosperms taking over majority of biosphere by mid-Cretaceous period.

Now the question that has given many a scientist sleepless nights is how the Angiosperms managed to not only survive but take-over almost all the ecosystems starting from tropical to temperate and some in even higher latitudes in such a small period of time, also, why the flamboyant angiosperms were chosen by the Mother Nature over less energy expending flowerless Gymnosperms, Pteridophytes and Mosses. These questions plagued the most brilliant of life scientists including Charles Darwin, so much so that he called the origin of flowering plants an abominable mystery, a perplexing phenomenon and some botanists even consider it as the 'Holy Grail' of plant science.

Solving the mysterious origins of flowering plants would unveil not only the secret behind their success on the planet but will add a new leaf to the book of evolutionary process. Where Darwin considered evolution to be a slow and steady process the flowering plants seem to have defied this theory with an abrupt origin some 200 million years ago and highly accelerated rate of diversification. Presently, there are two threads available to the modern scientists for unraveling the nature's best kept secret. One is a fossil of *Archaefructus* found in Yixian Formation in northeastern China and the other a living plant Amborella trichopoda endemic to the island Grande Terre of New Caledonia. After some extensive studies done on Archaefructus and later on Amborella using advanced molecular and bioinformatics tools, it has been hypothesized that two whole

genome duplication (WGD) events, one 392 million years ago and the other 192 million years ago in the ancient plant lineages is the most probable reason behind origin of flowering plants. The WGD events gave an extra set of chromosomes for the nature to play around with which eventually led to the development of flowering genes and to the angiosperms as we see now.

We got a peak into the birth of Angiosperm lineages through Amborella genome but clues to another major question mentioned above about Angiosperm survival and take-over are provided by their own general morphology and anatomy along with their genome. These clues are as follows:

1. **Flowers:** These are the most striking features of Angiosperms. They are much evolved reproductive organs of plants which granted angiosperms the ability to reproduce more successfully and rapid speciation. This faster speciation enabled the Angiosperms to adapt to a wider range of ecological niches.
2. **Stamens:** Overtime the male reproductive system of the flowers adapted to various specialized pollination syndromes and evolved to prevent self-fertilization thus enabling rapid diversification and adaptation.
3. **Endosperm:** The presence of nutritive tissue for the growing embryo in the seed has ensured maximum chances for plant propagation and survival.
4. **Fruit:** Fruit formation ensures that the seed travels to far off distances and offers extra protection and nutrition to the embryo.

These factors might have played a major role in the great angiosperm radiation in mid-Cretaceous period, the result of which is more than 400,000 species of angiosperms occupying the major chunk of planet earth and dominating major eco-systems of the world.
With the advent of advanced molecular and bioinformatics techniques the solution for Darwin's abominable mystery seems to be closer than ever. Still it requires much more detailed studies and understanding of the nature of extinct seed plants and some missing evolutionary links to uncover the mystery behind sudden appearance, rapid diversification and such success in survival of the angiosperms on earth.

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Zoo Helpers For Plant Survival

Ruth Abraham
Botany (Hons.) I year

The bright beautiful flowers of different shape, size, and color are pleasant and refreshing. Have you ever wondered about the secret behind these beauties? Are they meant to adorn a bride's hair or to decorate a dining table or to be placed on a funeral pyre? NO!!The flowers are not there simply to fascinate the mankind but are actually their means of survival!!

Lily showing stigma and anthers

The flowers are the means to produce the next generation. In fact, they bear the reproductive structures (pistil and stamen) of angiosperms. Even though they are unconscious living beings, they have well developed adaptations to disperse the pollens to different flowers. The various adaptations in plants to enhance their pollination rate by specific pollination vectors are collectively called as pollination syndrome.

The following lines take you on a tour of the different types of pollination syndromes.

❖ BIOTIC POLLINATION SYNDROMES

Biotic pollination syndromes are amazingly variable and mind blowing. Most of the ornamental flowers are pollinated by biotic means. These flowers have multiple ranges of size, shape and coloration.

One might think that all aquatic plants are pollinated by water but it's not true. The interesting fact is that in many aquatic plants like Nymphaeaceae members (water lilies), *Nelumbo nucifera* (lotus) the flowers rise above the water surface rather than being submerged in it! The secret behind this is insect-pollination.

→The sweet scented diurnal flowers

Bees are active during daytime. As a result the flowers they pollinate are diurnal and produce fragrance during the day time. The pollination carried out by **bees** is termed as **melittophily**.

- Bees can easily identify colors like ultra violet, blue and green. Therefore, mellitophilous flowers are yellow or blue. Some red flowers have ultra violet nectar guides to guide the bee to itself.
- Like Helicopters, bees too need landing pads. Hence, often these flowers have lobes serving as landing pads.
- As a pollination reward, the flowers provide nectar, pollen (shed during daytime) or sometimes both in different quantities to the bees. In tubular flowers the anthers are usually located on the top to rub the bee as it enters with pollen grains.

Honey bees: In the beginning of monsoon the coffee (*Coffea*) flowers bloom. Almost the entire high ranges of Kerala turn from lush green to white. The sweet scent of blooming coffee flowers and the buzzing of bees fills the air. Bees searching for nectar unknowingly pollinate these flowers.

Coffee flowers in full bloom

Buzz pollination: In certain flowers pollen grains are released in the anther itself. In these flowers only buzz pollination (Sonication) is applicable. It is carried out by **bumble bees** which can sonicate.

There sits Mrs. Bee! The Mediterranean orchid (*Ophyrus*) flower looks similar to the female of a bee species in shape, size and color. The male bees are enticed to 'pseudocopulate' with it and in the process they are rubbed with orchid pollen grains. The male bees are fooled again and again to 'pseudocopulate' with different *Ophyrus* causing the pollen grains to be transferred to the stigma of orchids. Thus, the 'sexual deceit' results in pollination.

→Flowers growing INSIDE fruits!

- Ever heard of flowers growing INSIDE fruits? Believe it or not, this is the degree to which **fig** (*Ficusglomerata*) is adapted to be pollinated by wasps!! The immature fruit of fig, called as syconium contains inflorescent flowers - male flower, long-style and short-style female flowers.
- The queen wasp enters the fruit in search of a safe place to oviposit. It lays eggs in the short style flowers

(gall flowers).The long-style flowers get pollinated by the pollens brought by the queen wasp from her original host fig.

→The butterfly pollinated blooms.

The pollination brought about by **butterflies** is called **psychophily**. Sarpagandha (*Rauvolfia serpentine*) - an angiosperm of high medicinal value is pollinated by butterflies.

- These flowers are large and attractive with pink or lavender colors. They are scented and mostly have landing pads for butterflies.
- Pollination reward is more nectar than pollens. To allow the long tongue of butterflies to get the nectar easily the nectaries are present deep inside narrow tubes.

→The night flowers

Phalaenophily is the pollination of flowers by **moths**. It is carried out by two types of moths.

- Hawk moths: the flowers they pollinate are mostly large with white color. Pollinating moths are basically nocturnal. Therefore, **ANTHESIS** is during night. Strong fragrance is produced in the evening, night or dawn. The flowers produce large amount of nectar to fulfill the high energy requirement of moths (they show rapid wing-beats to hover in front of flowers).
- The flowers pollinated by slow flying moths are usually small and often aggregate in heads.

Nocturnal anthesis of Jasmine

The sweet scent of Jasmine (*Jasminum sp.*) enchants everyone in the evening but never in the day time. I always thought that the scent is prominent only in the evening due to the larger amount of air pollutants during day time. However, it turns out that I was wrong. This anthesis during night is a result of pollination syndrome to attract nocturnal moths.

→Producers of sex pheromone boosters

Myophily is the pollination of flowers by **flies**.

- Myophilous flowers are purple, violet, blue or white. They are nectar producers. Strong scent is absent. The petals are arranged in dish or tube form.
- Some wild orchids do not produce nectar instead they emit certain floral attractants (chemicals acting as fly's sex pheromone booster) to attract male fruit flies and get pollinated.

→The stinking flowers

- Certain flowers like *Rafflesia* (World's largest flower) produce foul odor of rotting meat to entice its pollination vector (**flies**).
- Some sapromyophilous flowers do not produce nectar and in few cases fly traps are present. Pollination of the stinking flowers by flies is called as sapromyophily.

→Bird pollinated flowers!!

Certain flowers like Semal (*Bombax ceiba*) and Dhak (*Butea monosperma*) are pollinated by **birds** (**Ornithophily**).

- The diurnal tube flowers pollinated by Humming birds are red or orange in color. They produce dilute nectar. They are usually odorless.
- Flowers pollinated by Sunbirds, honeyeaters etc. have landing pads and generally are not tubular.

→The bell flowers

These flowers are adapted for **Chiropterophily**(Pollination by **bats**).

Bell-shaped banana flowers

- Bats are active during night. ANTHESIS occurs during night, in the flowers they pollinate. The flowers are in white or dull colors. They are large and **bell shaped**.
- They produce very strong odor. Nectar is produced for a long time. The pollens are large.

Theobroma cacao (from whose seeds mouthwatering chocolates are made) flowers are often pollinated by bats.

Coco flower and a bud

Many of you might be surprised hearing that few wild bananas (*Musa*) are also pollinated by bats!

→The beetle-proof flowers

The pollination carried out by **beetles** is known as **cantharophily**.

- These flowers are greenish or off-white. Flowers are large with petals arranged in disc or dish shape. They produce different kinds of strong odors.
- The ovary has high degree of protection to avoid injury by the beetles. The pollens are easily accessible.

❖ ABIOTIC(wind or water) POLLINATION SYNDROMES

→Inconspicuous flowers

Most of the inconspicuous flowers are pollinated by **wind** (**anemophily**).

The best example of anemophilous pollination syndrome is seen in grass.

- The flowers are small and inconspicuous. They do not produce scent or nectar. They are usually green (bright colors are absent because they do not have to attract insects or other animals).Often these flowers are packed together into an inflorescence.
- The long stamens protruding out of the flower bear anther at their tips which produce large number of small pollen grains.

Large and feathery stigmas are present to catch the pollens.

Certain flowers like *Plantago media* (Hoary plaintain) are pollinated by both wind and insects. These flowers are called ambophilous flowers.

→H_2O pollinated flowers

Water currents, like wind currents carry pollen grains to suitable stigma (**hydrophily**).
In aquatic plants such as *Vallisneria*, the female flowers reach water surface by a long stalk in order to get pollinated by the pollen grains brought passively by water currents.
Other examples are *Hydrilla*, *Zostera*, etc.

Vallisneria

Daisy

The wide range of adaptations for plant survival in angiosperms makes me marvel. It's a wonder that my life time enemy- Mr. bee- was actually working towards the survival of my precious Daisy (*Bellisperennis*).The fact that the sweet scent of *Jasminum sp.* (Jasmine) and rotten meat smell of *Rafflesia* both fall in the same category-Pollination syndrome- is hard to admit.

Looking around, we find flat flowers, tube flowers, bee shaped flowers, etc. We can find flowers with various colors of our choice (including GREEN flowers!!). They may be large or small. Their odor may either draw or drive us! They can be conspicuous or inconspicuous. The False Ashoka (*Polyalthia longifolia*) gives everyone a false notion that it is a non-flowering tree; however, the fact is that it bears beautiful star-like inconspicuous flowers! All these variations are a result of pollination syndrome.
Thus, pollination syndrome is one of the biggest reasons behind the survival of flowering plants.

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EVOLUTIONARY ARMS RACE FOR SURVIVAL….

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"Nothing in biology makes sense except in the light of evolution"
- Theodosius Dobzhansky.

Plants constitute the majority of the earth's living environment. Directly or indirectly, they sustain the entire life on this planet as they make up all the food on which humans and all animals rely upon. Whether cultivated or wild, they proliferate and grow well till the soil provides them with sufficient amount of nutrients and moisture, enough light reaches their leaves, and the temperature remains within a certain "normal" range. However, plants also get sick. Sick plants grow and produce poorly, they exhibit various types of symptoms, and, often, parts of plants or plant as a whole dies off.

The agents that cause disease in plants are the same or very similar to those causing disease in humans and animals. They include pathogenic microorganisms, such as viruses, bacteria, fungi, protozoa, and nematodes, and unfavorable environmental conditions. Plant parasites such as nematodes have evolved sophisticated strategies for exploiting plants for their own benefit. Rarely, their association does not harm the plant but usually it drastically affects the plant's normal growth and development.

Pathogens attack plants because during their evolutionary development they have acquired the ability to live off the substances manufactured by the host plants, and some of the pathogens depend on these substances for survival. Pathogens may either live and complete their life cycle inside the host plant known as endoparasites or they may be restricted to the plants' surface only which are referred to as ectoparasites. One of the most intriguing questions is how these pathogens are able to modulate or circumvent the host's defense system?

Well, the answer to this question is that, to infect a plant, pathogen must be able to make its way into and through the plant, obtain nutrients and neutralize the defense reactions of the plant. Pathogens accomplish these activities mostly through secretions of chemical substances that affect certain components or metabolic mechanisms of their hosts. Though some pathogens may use mechanical force to penetrate plant

tissues, the activities of pathogens in plants are largely chemical in nature.

Now, plants do fight back!!

Plants have to stand their ground when pathogens attack. There's simply no running away. In general, plants defend themselves against pathogens by a combination of weapons. Plants also possess the ability to recognize pathogen and trigger defense mechanism. There is a pre-existing defense that includes structural and chemical barriers such as cuticle, waxes, glandular secretions etc that prevent the entry and growth of the pathogen. Secondly, it also possesses the induced – innate immunity. This is triggered by effector molecules released by the pathogen during invasion.

The susceptible plant does not possess the R gene or the resistance gene, that could trigger the defense response upon being attacked by the pathogen and thus is easily infected.

However, the resistant host plant carries one or few resistance genes (R) per pathogen capable of attacking it, while each pathogen carries matching genes for avirulence (Avr) for each of the R genes of the host plants. Thus, avirulence gene of the pathogen serves to trigger the host R gene into action. This then sets in motion a series of defense reactions that neutralize and eliminate the specific pathogen that carries the corresponding avirulence (Avr) gene. This type of defense or resistance is known as race-specific, hypersensitive response (HR).

The interaction between the R gene of the host and Avr gene in the pathogen is explains one of the mechanisms via which organisms from different kingdoms communicate with one another.
This plant – pathogen interaction represents a classic case of co evolution – one that is often but not always mutualistic. Here, the two species reciprocally affect each other's evolution. Both Avr gene in pathogens and R gene in host plants are undergoing evolutionary changes rapidly during the course of time. Pathogen is trying to produce a different Avr gene product, that is not recognisable by the products of R gene, and plant is producing different R gene products that can in turn recognize the modified Avr gene product (effector molecules). Thus, an evolutionary arms race is going on between a plant and a pathogen for survival.

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Competing For Survival: Allelopathic Intractions

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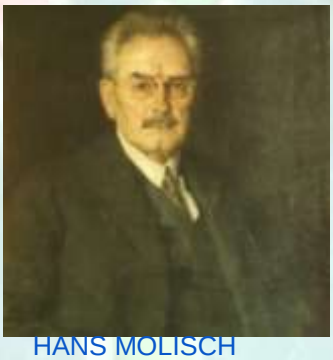
So many seeds fall under a tree and in a very small area around it. Yet there is no overcrowding and only few of them germinate and not all. Don't you think there should be some mechanism behind this which leads to the growth of some plants and suppress the growth of rest. What can that process be??

The answer to the question lies in a phenomenon called **allelopathy**.

Allelopathy is a bio-chemical phenomenon by which an organism produces chemicals to alter the growth and survival of other organisms in its vicinity. The allelo-chemicals produced by plants may have positive or negative effect on the target organisms. These chemicals prevent the growth of species growing near them. Surprisingly, these allelo-chemicals are secondary metabolites of allelopathic plants (i.e. the plant doesn't need them for their own growth , reproduction etc.) . Allelopathic inhibition involves different chemicals like phenolic compounds, terpenoids, steroids, alkaloids etc.

Casuarina equisetifolia completely suppresses germination of understory plants.



HANS MOLISCH
Source: Wikipedia

The earliest observation of Allelopathy was done by Theophrastus in 300 BC. He noticed the effect of pigweed on *Alfalfa.*
The term Allelopathy was given by Hans Molisch in 1937.

Allelopathic plants use allelopathy as a mechanism to increase the chances of their survival by inhibiting the growth of other plants.

RESOURCE COMPETITION AND ALLELOPATHY

Plant and plant interference is the combined effect of allelopathy, resource management and many other factors. It is quite difficult to separate allelopathy from resource management .The process by which plant acquires more of the available resource from the environment without any chemical action on the adjacent plant is called resource competition. Resource management is not negative allelopathy although both processes can together enhance the survival rate of plant species.

NATURE OF ALLELOPATHY

The nature of allelopathy include reducing seed germination and seeding growth. Allelopathic inhibition is complex and involve the interaction of different groups of chemicals such as phenolic compounds and alkaloids. These allelochemicals can remain in soil, affecting surrounding plants.
EXAMPLE- *Leucaena leucocephala* , the miracle tree promoted revegetation ,soil and water conservation and livestock nutrition in
India. It is a toxic ,non protein amino acid in its leaves that inhibits the growth of other tree but not its own seedling. Allelopathy doesn't always show negative impacts and could be beneficial in many ways for plants as well as for humans as this phenomenon is being used in sustainable agricultural practices.

POSITIVE EFFECTS OF ALLELOPATHY

Current studies have shown the usage of allelochemicals as growth regulators and natural herbicides as a means of promoting sustainable agriculture. *Callisto*, for example, is widely used as weed suppressor (natural herbicide).
Another example is rice allelopathy. Rice doesn't allow growth of weeds and also promotes the growth of plants of its own species. Japonica rice is more allelopathic than Indica rice and helps in weed management.
Callistemon citrinus exudate mesotrione allelochemical which is very effective in agricultural field as it control broadleaf weeds in corn & controls crabgrass in lawns So in these cases allelopathy has proved to be beneficial.

SOME EXAMPLES OF ALLELOPATHY

Maple Leaves

Researchers at New York's Colgate University have found that the red colour of maple leaves is created by processes other than those in chlorophyll breakdown. When the tree is not able to cope with the energy demands of a changing season, maple trees are involved in an additional metabolic expenditure to create anthocyanins. These anthocyanins create the visual red hues and have been found to help in interspecific competition by stunting the growth of nearby saplings. Thus demonstrate allelopathy.

Blackbutt Eucalyptus tree

The Blackbutt Eucalyptus tree (Eucalyptus Pilularis) spreads chemicals through the soil so that any seed near the parent plant does not germinate. The Eucalyptus tree uses these allelochemicals to prevent plant competition and suppress the growth of nearby plants.

Black Walnut

- The most well-known allelopathic plant is the black walnut (*Juglans nigra)* tree. All parts of the tree like roots, bark, leaves, nuts, and even rainwater that falls off a leaf ,release an allelopathic substance called juglone which does not allow the nearby plants to grow.

Rice

It is the main food crop in Asia and the staple food of the majority of the population all over the world. Hence it becomes important to produce it in large numbers to satisfy the needs of the population . Hence allelopathy is used to increase its yield . The allelochemicals released from the rice plants get incorporated into paddy soil and play a crucial role in inhibiting the paddy weed growth. Many weed growth inhibitors identified from *M. sativa, Piper methysticum, A. indica* (neem), *A. conyzoides*, *O. sativa*, and *B. pilosa* belong to phenolic acids], fatty acids], lactones, and amino acids]. These compounds inhibit the paddy weed growth at low concentrations Reducing weed growth by exploiting the allelopathic properties of rice might be the most important goal of researchers all over the world.

Visible detrimental effects allelochemicals include:
Prevention of Seed Germination
Deformed and Blackened Roots
Slow Growth
Poor Reproduction

Visible beneficial effects allelochemicals include:
Enhanced Growth and Survival
Strong, Pleasant Aroma
Suppressed Weed and Pest Populations
Enriched Soils

RESEARCH STRATEGIES AND POTENTIAL APPLICATIONS

The approach used in allelopathic research for agriculture crops is due to their capacity to suppress weeds .Allelochemistry may provide basic structures for developing new synthetic herbicides as discussed above .An allelopathic crop can be used to control weeds by plantings a variety with allelopathic qualities.
EXAMPLE – An allelopathic plant's water extract was mixed with atrazine , a significant amount of weed control was achieved in wheat with reduced usage of herbicide.

CONCLUSION

Allelopathy is a new science and potential area of research for future. It is environmentally safe and reduce the problem of synthetic chemicals. Some of the trees inhibit seed germination and growth of other plants by means of producing allelochemicals that can kill useful plants also. But altogether it is a very USEFUL. At National &International level Weed Management strategies are developing with the help of Allelopathy. In biotechnology, genes are being produced that can be helpful for nearby growing plant or crop in agricultural field. Allelochemicals with negative effect are helpful in defence against herbivores. Allelochemicals are used to promote sustainable agriculture.

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Phytoindicators

Jyoti Yadav
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"There is no better indicator of the status of a species or a system than a species or system itself"

Plants are wonderful beings that are found all over the earth. Though we have millions of plant species growing in different parts of the world, it is noteworthy that not all types of plants can grow in all types of conditions. Generally our these green friends are choosy about the places they thrive in, that is, plants grow only in certain conditions that are suitable to them. This habit of plants is very helpful for us as they tell us about the environmental conditions in the place of their growth. Such plants which indicate about certain factors are known as "**plant indicators**".

They are the primary targets for most of the processes that threaten biodiversity: grazing, clearing , weed invasions, inappropriate fire regimes & global changes, all act most directly on the composition & structure of plant communities growing in a particular area. Presence or absence of certain plants indicates the combined effects of all factors prevailing in an environment. For example, hydrophytes indicate the presence of water in that area. Also, the vegetative life in an ecosystem can provide important clues about health of the environment. Plant indicators are also called as bio-indicators/phyto-indicators as they indicate the presence of nutrients, minerals, ions in soil which works as an indicator of productivity and acts as a measure of environmental conditions. Plants reflect physical environmental variables such as climate, topography & soils. Their response to physical environment flour on to influence biophysical variables such as biotic richness & flammability, colour change , shrinkage etc.

On the basis of distribution, indicators can be "steno" species that indicate the narrow limits of tolerance or "eury" species which are used to indicate the wide limits of tolerance. The relationship between different communities often provides more working indicators than single species.

Now, it's time to think that how do these plants indicate something??

1. Indicators for Agriculture:-Presence of a type of plant species greatly influences the fate of soil & the fate of soil determines the fate of type of agricultural crops that can be grown in that area. For instance, an area having small grasses and plants indicate poor soil fertility whereas area where tall trees like*Tectona*, *Mangifera*are growing havefertile soil for agricultural crops. (Wow!! Now I can determine whichplant I can grow near my house!!!)

***Saccharum officinarum* grows in highly fertile soil**

2. Indicators for Groundwater:- Some plant communities points out the depth of groundwater & the salt level of groundwater.For example,

Euphorbia cadrcifolia in Indian deserts indicates depth of groundwater at about 12-18 m.

Euphorbia cadrcifolia

3.Indicators for Over – Grazing :-
The presence of weeds in an area generally indicate over grazing in that area, for example, *Chenopodium* plant indicates over grazed area, whereas some plants showpoor or no grazing (example:- *Opuntia*).

Opuntia

4.Indicators for Humus & Moisture:- Presence of certain species like, mushrooms indicates presence of humus in the soil as they grow only in humus and moisture rich conditions, whereas plants growing in arid areas pointout low moisture content (example- *Acacia*).

5.Indicators for Soil Type :-Plants require specific type of soil to able to grow well

and thus they indicate the soil type in the area they are found. Some examples are:- *Casuarina equisetifolia* shows presence of sandy soil, *Saccharum munja* grows in sandy loam, *Vetiveria zizanioides* shows presence of clayey soil &Cotton grows in black soil.

6.Indicators for specific minerals and metals:- Some plants indicate the presence of specific elements in the earth. Some famous metal indicators are:-
*Vallozia candida*grows in presence of diamond in Brazil.
*Equisetum*species indicates presence of Gold.
Eriogonium ovalifolium indicates presence of silver metals in soil.
Allium (as seen in the picture) indicates that soil is rich in sulphur minerals etc.

7.Indicators of Petroleum :- Plants that grow in burnt/ fire / highly disturbed areas indicates presence of petroleum deposits like *Agrostis hiemalis* , fungus *Pyronema*etc. They contain high level of hydrocarbons in their molecular weight .They are known as " petro-plants" . These plants mostly belong to Euphorbiaceae. The members of the family can be used either to get diesel fuel or after their conversion high quality liquid fuel.

Allium cepa

8. Indicators of Pollution:-
When species grows in polluted areas they become very much sensitive to pollutants than humans. Many chemicals, fertilizers, pesticides , fossil fuels release toxic substances into the environment that are taken up by the air, water & soil. Such conditions cause plant diseases like chlorosis , discolouration , necrosis or even death of entire plant . These situations are used to indicate the response of plants to pollutants .Plants that are used as pollution indicators are lichens , mosses, plankton algae,some angiosperms .

Plants indicate many of the pressures acting on rangeland but it is also true that plants are not sensitive to all threats . Thus , although a set of related indicators should be an important component of biodiversity monitoring framework for the rangelands , it cannot be rendered sufficient for all purposes.

Conclusion:- One can easily understand what kind of geographical area it is by the study of vegetation in that area . Secondly, where we see pollution indicated plants we need to decrease the pollution of that particular area by growing more and more plants . Thirdly, determination of soil can be easily done , one need not to do much experiments

all the time as our green friends give us an idea about it merely by their presence.

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Fireweeds (Rising from ashes)

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"Fireweeds" as the name suggests growing from ashes ".
How it looks like when you listen that a bright pink flower growing in a recently burned forest?
It sounds a little strange but that pink flower is a fireweed. More specifically, fireweed is a pioneer species .It's tiny seeds rides the wind like parachutes and begins new life where fate carries them. Even in clear-cuts, roadsides and burns, fireweed plants itself rises up – stately, steadfast and strong. It rarely stands solo. In summer, rose to violet-colored flowers bring immeasurable beauty to stark landscapes. They are so papery thin that they appear luminescent. They remind us of the tender blaze of love, or a sweet encounters that leaves us breathless and awed. Fireweed grows in the acidic soil after a forest fire , hence its name!

Figure 1:
https://natureofthehills.wordpress.com/2012/08/02/fireweed/c_kilpatrick2012-7357/

Chamerion anqustifolium (fireweed) a great willow-herb or rosebay willowherb is a perennial herbaceous plant in the willowherb family Onagraceae. The most distinctive thing about fireweed is its gorgeous pink to purple coloured flowers. They occasionally create secondary branches of flowers – especially when grazed by deer or other foragers. The leaves of fireweed are unique in that the leaf veins are circularand form circular loops . This feature makes the plants very easy to identify in all stages of growth (as seen in picture below).

When fireweed first emerges in early spring, it can closely resemble several highly toxic members of the lily family; however, it is easily identified by its unique leaf vein structure.

So what's a big deal about a little pink flower that is the first species to grow back after a disturbance?

Forest is known as the climax community (i.e. the stable one) suppose due to lightening forest catches on fire, animals flee, trees burn and forest is transformed. Now it may take time but eventually pioneer species begin to inhabit the region. These include pioneers such as fireweed, grasses, alder & willow.

HOW IT ADAPTS TO THE SITUATION?

1. Fireweed fruits are long and very narrow. They spit open to release hundreds of seeds, each with a white feathery tuft that easily flies in the wind.
2. Once established, the plants also spread extensively by underground roots, an individual plant eventually forming a large patch.
3. Purplish-red stems grow up to seven feet tall and are covered with leaves .

Its rhizomes can extend to about 45 cm. deep, knitting and holding the soil, preventing erosion while other more slowly growing vegetation can become established. The rhizomes are so tenacious they often survive forest fires.

4. Seeds can survive up to two years – they do not go dormant – and can travel from 100-300 kilometres on their plumes in the right conditions.

Figure 2: http://wildfoodsandmedicines.com/4/wp-content/uploads/2012/07/fireweedusgs.jpg

USES

1. As the plant matures the leaves become tough and somewhat bitter.They are peeled and eaten raw.
2. When properly prepared soon after picking they are a good source of vitamin C and pro-vitamin A
3. Fireweed is also a medicine of the Upper Inlet Dena'ina, who treat pus-filled boils or cuts by placing a piece of the raw stem on the afflicted area.
4.It is an important source of nectar for honeybees and hummingbirds, and food for moose, deer and hares.
5. candies, syrups, jellies, and even ice cream are made from fireweed.
Monofloral honey made primarily from fireweed .
6.In Russia, its leaves were traditionally used as a tea, before the introduction of tea from China starting in the 17th Century.

Figure 3: https://natureofthehills.wordpress.com/2012/08/02/fireweed/c_kilpatrick2012-7353/

CONCLUSION

As pioneer species are first to grow their presence increases the biodiversity of a region .
Fireweeds helps to establish plant growth in a damaged region.
Fireweed's natural variation in ploidy has prompted its use in scientific studies of polyploidy's possible effects on adaptive potentialand species

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Botanical Carnivores: A Unique Way of Plant Survival

Avi Mendiratta
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Forget ghosts or vampires. Nature has the most bizarre yet most exciting plants: The BOTANICAL CARNIVORES. 'Carnivorous plants are plants which are adapted to attract, capture and digest small animals primarily insects. 'Their main purpose is to derive some or most of the nutrients (but not energy) from the animals.
Although these adaptations are a horror to the prey, they are life saving factors for the plants. Carnivorous adaptations help the plants to grow in places with high light but poor nutrient rich soil, such as acidic bogs and rock outcroppings etc**.**
Some facts about the life saving predating mechanisms of plants are discussed below.

Adaption No.1 (Death traps)

PC: www.thinglink.com

Admirable adaptive trapping mechanisms: There are **many interesting gifts** in the form of prey catching mechanisms- which **these PLANTS** have received from nature.

a) Pitfall traps- E.g. –***Heliamphora chimantensis***. Pitfall is a simple trapping mechanism in carnivorous plants. A leaf is highly modified to form **a simple bucket-like receptacle**. The prey falls or slips into the digestive fluid present in the trap. It then extracts nutriment from the capture.

b)Snap traps- E.g. –***Dionaea muscipula*** (Venus Fly Trap).

They mislead the prey in a trap made of leaf lobes.
c) Lobster Pot- E.g. –***Sarracenia psittacina.*** They have a chamber that is easy to enter but difficult to exit.
d) Flypaper traps- E.g. –***Drosera capensis.*** Sticky mucilage is used to trap the prey.
e) Bladder Traps-E.g. –***Utricularia sandersonii*** **(**Bladderworts)–Many bladder like organs are present along the root system. When prey touches minute trigger appendages,flap is quickly opened and the prey is sucked in.

Adaption No.2 (preys get lost)

Preys don't find a way out!!

In *Darlingtonia californica* also called the Cobra Lily, flies enter from the bottom, drink the nectar and then try to fly off. However, flies are not easily out because the opening faces the darker ground. It gets deeper and deeper into the plant in search of an exit until it drops down the Cobra Lily's stomach.

Adaption No.3(fast and furious)

They are competitors of AK-47!!

Pc: www.iflscience.com

Plants are thought to live in slow lane because they cannot walk but carnivorous plants are an exception. For instance, all Utricularia are carnivorous and capture small organisms by means of bladder-like traps. Terrestrial species tend to have tiny traps that feed on minute prey such as protozoa and rotifers swimming in water-saturated soil. The traps can range in size from 0.2 mm to 1.2 cm. Aquatic species such as *U. vulgaris* (common bladderwort), possess bladders that are usually larger and can feed on more substantial prey such as water fleas (Daphnia), nematodes and even fish fry, mosquito larvae and young tadpoles. Bladderworts are faster than the blink of an eye. These "bladders" have minute appendages - essentially triggers - next to a closed flap. On the inside, the bladders are evacuated to a much lower pressure than that of the surroundings. When prey touches the trigger organs, the flap is quickly opened and the prey is sucked in. Their Sucking& trapping mechanisms occur in less than a millisecond. Thus are the fastest movements in the entire plant kingdom.

Adaption No.4

They surprise the prey to such extent that the prey's eyes popout!! The sundews usually trap preys by wrapping leaves around them, but the ***Pimpernel sundew*** uses an additional trick-catapult-to throw the insects to glue-covered leaves' center. The leaves then wrap around the struggling victim and digest it.
The prey might be trying to protect itself from the usual trap being unaware of the extra trick.

Adaption No.5

Venus Fly Trap: Any insect that enters the trap triggers the plant. The only way out-the leaves- snap shut and theinsect is caught. The leaves are **like bars for the prey. It struggles to come out and undergoes great pain.**

These carnivorous plants are a unique invention of nature which are devil on one hand and helpful on the other hand. They are not reckless killers.These preying mechanisms are an adaptation for their survival in case of emergencies when they can't meet their energy requirements by just photosynthesis.They are great balancers of nature. They manage the food web by keeping the prey population in check.

Like most of the carnivorous animal s, these botanical carnivores also predate only when required. .Their preying mechanisms help it to survive even in dire conditions where the plant's main source of food-photosynthesis- is not sufficient. And this alternative source of food is the secret behind the survival of these carnivores of plant kingdom!

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Biodiversity of Assam

Jutismita Pathak
Botany (Hons.) 1st year

A kuccha road inside a dense Assam forest on a foggy winter morning

Ecology is the scientific study of organisms and their interactions with abiotic and biotic components of the environment. It includes the study of plants and animals, their distribution, abundance, populations, their interactions and so on. To structure the study of ecology into an understandable framework, the biological world is organized into a hierarchy of organization ranging from single cells to the vast biosphere, teeming with life. Various flora and fauna species occupying the space, the climatic and geographic conditions of the place and the resulting interactions between these factors together constitute the ecology of a place. Through this article I have tried to give a glimpse of the ecology of a glorious Indian state called Assam.

ASSAM

Assam is a northeastern state of India which covers a major portion of Himalayan Biodiversity region. It is one of the biodiversity **'hotspots'** of our country. The climatic conditions and physical features of this region have resulted in a great variety of forests, wetlands, etc. which harbour a wide population of flora and fauna. Assam is one of the 25 **mega diverse regions** on planet earth.


Deciduous forests and Grasslands of Kaziranga National Park

THE BIO-SPECTRUM

The humid weather conditions prevailing in Assam supports growth of a number of plant communities including commercially important plants like banana, citrus, mango, *Zizyphus* and of course, the famous tea. These species are supported in a wide variety of forests such as the tropical evergreen, tropical deciduous, sub-tropical, littoral and even grasslands. 'Hollong', (***Dipterocarpus macrocarpus)*** the State Tree of Assam is the tallest tree found there. Few species of *Dipterocarpus*, *Anthocephalus, Dillenia* (local name- ou tenga; it is edible!!), are also found in those forests.
Assam has 23 species of gymnosperms and 3895 species of angiosperms. It also has 154 species of primitive gymnosperms known as 'living fossils'. These plants meet the demand for timber, plywood and furniture. Assam has 293 species of orchards while bamboos are widely cultivated for the variety of uses they cater to. Assam is home to a good number of plants having great medicinal uses in Ayurvedic, Unani, Homeopathic and even modern medicinal practices. More than 100 aquatic species are also identified here. Brahmaputra, the major river of India, flowing through this state makes the soil fertile and fit for agriculture. Apart from being the lifeline of Agricultue, Brahmaputra harbours rich aquatic flora and fauna such as *Cyperus, Nelumbo, and Hydrilla.*

Apart from the above mentioned there are some species endemic to Assam such as *Acacia diadenia, Acranthera tomentosa*, *Acranthera tomentos*, *Agapetes kanjilali, Agapetes variegata*, *Begonia tessaricarpa*, *Dendrobium assamicum, Euonymus assamicus* to list a few. There are altogether 165 species of such plants reported in certain pockets of the state. The IUCN has also reported few rare species. Amongst them the extinct ones are *Bambusa mastersii*, *Cyperus corymbosus, Liparis stachyrus,* etc. and 149 species are endangered, 58 species are vulnerable and 13 of them are near threatened.

FAUNAL DIVERSITY

Favourable climate, topographic and edaphic factors support luxurious growth of varied flora which inturn support a great number of fauna in this region of India ranging from mammals to moths.

The distributional extent of several Indian species including the spotted deer, the swamp deer, the hare, the pigmy hog, the one-horned rhinoceros, etc. have terminated in Assam plains. Mention of the great **Indian one-horned rhinoceros** is an important aspect here, as Assam is known for its wide abundance as well as its conservation. **Kaziranga National Park** cum Wildlife Sanctuary boasts of its largest population and a good number of them are also found in Manas and Orang National Parks. Hoolock gibbon, golden langur, capped monkey*, Rhesus macaque*, Assamese macaque, etc. are found here. Assam is one of the endemic bird areas in the world. With 950 bird species, the state is home to 53.5% of the total bird species found in the Indian sub-continent.

Assam's varied physiography and habitant conditions support a rich variety of reptilian population as well. Gangetic gharial, tortoises and species of snakes and lizards are found in the state. *Gangenophis fuller, Ichthyophis garoensis* are endemic to Assam. It is obvious that the mighty Brahmaputra leads to a great variety of fishes found here. Ornamental fish species like Chaca, Botia, Danio, etc. are reported here. Commercially important fish species include Rohu, Katla, Pabha, Chital, Magur, Singi, Sol, etc. The river systems and extensive floodplains also harbour freshwater molluscs. 10 species of freshwater snails are used as food here.

The Great Indian one-horned rhinoceros in the wilds of Assam

A free ride of Mutualism - The deer and the crow

A game of hide and seek with the Elephant

Pollination, an important form of communication between the floral and faunal world, is brought about by the beautiful butterflies. Moths, bees and wasps are also found here. Assam's trademark – Silk, is reared from these creatures. Eri, Muga, Paat are the traditional forms of Assamese silk exported all over the world. The silk caterpillar also serves as food to the Assamese people.

Therefore, we can say that this ecologically diverse state has created a genuine relationship not only between the floral and faunal world but also with the human race. And this is what ecology is all about. The nature provides employment as well as other opportunities to the people. Assam being an agricultural state, here Assam Tea plays an important role as a source of livelihood. Silk brings in cash and the rich diversity brings in tourists. All these ultimately lead to development of the state. Being an Assamese myself, I feel proud of my state which although isn't a mainstream state but is overwhelmingly beautiful with extreme natural richness. Thus, it can be rightly said that nature is above all.

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In The News

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Red rain in Kerala

The phenomenon of red rain or blood rain has been recorded at many instances since ancient times all over the world. The most recent one was reported in 2012 in the city of Kannur in Kerala. In ancient mythology blood rain has been considered a bad omen. Many theories ranging from a witch's curse, auroras to meteor burst have been given to explain this mystical phenomenon until researchers found that the rain had been in fact coloured by air borne spores of green algae belonging to the genus *Trentopohila*. A recent study completed by the Government of India in 2015 has unambiguously identified the exact species as *Trentopohila annulata*. This blood rain is in effect a curious result of the survival instinct of *Trentopohila annulata* which allows this alga to reach long distances and colonize large areas of land quickly.

Figure: Red rain collected in coconut shell in Kerala
Source: Times of India

Figure: Micrographic image of spores of *Trentopohila annulata* - Reason behind red rain
Source: Louis and Kumar's Research paper

Hemp shielding the Ellora

Figure: Ellora sculptures
Source: The Hindu

The Ajanta and Ellora caves situated in Aurangabad, Maharashtra are world famous for their sculptures and paintings which have been around for 500 years without any severe degradation. A recent study by archeology experts has claimed that the caves have a mix of **hemp** with clay and lime plaster. Through scanning electron microscope and spectroscopy *Cannabis sativa* was found mixed in the clay which helped in prevention of any insect activity and thus increased the life of Ellora caves. In contrast the Ajanta caves which had no hemp residues in its walls showed 25 percent more degradation as compared to the hemp infused Ellora caves.

Project great green wall

Figure: map showing the intended green wall planting in Africa
Source: Science alert

Sahara, the largest desert in the world located in North Africa is getting bigger each year. The various environmental factors and changing climate patterns are causing Sahara to enlarge few centimeters every year. To counter this situation Senegal is leading a twenty nation initiative known as the **Great Green Wall**. This initiative's main agenda is to make a **wall of trees** across the borders of Sahara desert to prevent further land degradation. Also, when completed it will be the largest horticulture feature in history. The initiative has gathered the support of several international organizations including UK's Royal botanical garden, the World Bank, the African Union and the UN's Food and Agriculture organization.

Mysterious fairy circles

Fairy circles are lifeless circular patches of barren land, generally occurring with striking uniformity in the grasslands of Africa since ages and have recently been reported in Australia as well. Many folklore stories of fairies dancing overnight over that patch or some say it is an extraterrestrial event. Scientists after years of study have put forth the following hypotheses for this mysterious occurrence.

1) A leading hypothesis suggests that carbon monoxide rising from the ground causes the fairy circles
2) It is hypothesized by some scientists that termites and ants chew tree roots in circular pattern which causes the formation of these barren patches of land in otherwise dense grasslands.

Figure: picture showing fairy circles in a region of Africa
Source: CNN

3) SELF ORGANISTION THEORY – According to Stephan Getzin, A german ecologist, fairy circles are formed naturally in arid regions as a result of plants' survival instinct due to which they organize themselves to obtain maximum amount of available water in drier regions.

Flowering Desert

Figure: photograph of flowering in the Atacama desert
Source: Science alert

The Atacama Desert, Chile also known as driest place on earth holds the world record for longest dry streak i.e. 173 months without rain. But its longstanding title was lost after El Nino hit the area in March 2015.The Atacama Desert usually gets 0.6 inch of rain a year but in March 2015 it poured about 9.6 inches of rain in one day which is equivalent to the rainfall it receives in 14 years. This caused the rivers to overflow. This rare rain watered the parched landscape, nourishing the flower seeds that had been buried in the ground for years. It thus resulted in a dazzling carpet of pink, purple, orange and yellow Mallow flowers as far as eye can see.

The Longest Experiment

Figure: William Beal
Source: Wikipedia

William Beal a Botanist in 1879 buried 20 glass bottles in secret spots on the grounds of Michigan State University. Each bottle was filled with sand and more than 1000 seeds in it. Beal's original vision was to test the viability of seeds. He initially planned for the bottles to be removed every 5 years and the whole experiment to be completed in a century, but seeing stable results the bottles were opened at an interval of 10 years. After each bottle was dug up the seeds were planted to seek the plants which have survived and seeds which are able to withstand such long durations of dormancy. Currently 5 of those 20 glass bottles are left buried at an unopened place. One species, *Verbarcum blattaria* continued to show growth at every plantation. The experiment provides valuable information to conservationists who hope to re-grow extinct plants from old seeds in future.

Zinnia-The Space Flower

Figure: First clicked photograph of space Zinnia
Source: Twitter

Scott Kelly Commander Expedition 46 on January 16, 2016 released the photograph of *Zinnia* flowers under the Veggie Plant Growth System aboard the ISS(International Space Station).This experiment commenced on November 16,2015 with the main objective to understand how plants grow in micro gravity. The above experiment is under a Year-long Mission in which long term effect of spaceflight on human body is also being studied. Although *Zinnia* is credited to be the first flower blooming in space, they were not the first plants. Prior to ISS, NASA's space shuttle programs were able to grow dwarf varieties of wheat. The *Zinnia* were intended by NASA as a test run for growing tomato plants on ISS in 2017 hoping to grow more fresh supplements during long space missions.

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FAMOUS PLANT:

Eucalyptus: The Blue Gum Tree

Aishwarya Singh
B.Sc. (H) Botany, IInd year

The large trees with drooping leaves and patchy canopy that we commonly see lining most of the major roadsides of roads and highways of Delhi such as that of the Lutyens Delhi and elsewhere are of *Eucalyptus spp.* The genus *Eucalyptus* comprises around 700 species, belonging to the myrtle family, Myrtaceae. Although *Eucalyptus* is native to Australia, it has been a part of the Indian flora for more than two centuries with at least 12 species and numerous hybrids growing in Indian soil. If success be measured by the quantity of land acquired by a plant, *Eucalyptus* would be one of the most successful plants in the whole world as it covers over 6.5 million hectares of the earth's surface, excluding its home turf in Australia. *Eucalyptus* species are cultivated widely in tropical and temperate regions of the world, mainly for its wood and essential oil. Many species are known as "gum trees" because of the exudates produced by their injured stem trunks. It

is the bluish stemmed *Eucalyptus globulus* which is known as the “blue gum tree” due to the presence of blue-grey waxy bloom on the bark.

The genus comprises mainly of tall evergreen trees which may grow up to a height of 300 feet, but some shrub forms are also found. The leaves bear oil glands that produce the copious oils, forming an important feature of the genus. Leaves on the juvenile shoots are opposite, sessile and glaucous whereas the adult leaves are alternate, petiolate and lanceolate. The flowers are grouped in umbellate cymes and have no petals but numerous fluffy stamens which may range from white to yellow to pink or red in colour. The fruit is a woody capsule, roughly cone-shaped and loculicidal.

From Australia, to the world….

The story of the spread of *Eucalyptus* from Australia to other parts of the world has been an interesting one. The plants belonging to this genus have been introduced in various parts of the world by man for their desirable characters such as long grained wood and oil. *E. oblique* was the first species to be planted outside the native boundaries of Eucalyptus, in Royal botanical gardens at Kew, in 1774. Since then, there have been no looking back for *Eucalyptus* and it has now become one of the major trees grown in large scale plantations worldwide. *E. globulus, E. tereticormis and E. hybrid* are some of the preferred species that are grown in large scale plantations owing to their favorable characteristics such as rapid growth, capacity to overtop weeds, being fire hardy and browse resistant and having the ability to adapt to a wide range of edaphoclimatic conditions. *Eucalyptus* is capable of withstanding very dry conditions because of the presence of its sclerophyllous leaves which also allow them to adapt to low nutrient conditions. Although these properties have helped *Eucalyptus* become a very important part of the agro forestry, they have caused a few species to become potentially invasive.

What makes *Eucalyptus* so popular in agro-forestry?

The tree has many uses that are economically exploited on large scale throughout the world. The tall trees have wood which is high in density, low in moisture and versatile for use in varied applications. The oil obtained from *Eucalyptus* is the chief product of interest and is used in medicinal, industrial, pharmaceutical, aromatherapy and many other purposes. Since it absorbs large amount of water from the soil, they have been planted in certain areas to lower water table and reduce soil salinity. They have also been reported to help in prevention of malaria as it facilitates proper drainage of water.

- **Uses of *Eucalyptus* wood:**

  The wood obtained from *Eucalyptus* serves diverse purposes. They are used as plantings in parks and gardens; provide us with timber for furniture, sleepers etc., fuel wood and also pulpwood for paper industry.
- **Uses of *Eucalyptus* oil:**

  The essential oil is extracted from fresh, mature leaves and branch tips by steam distillation. *E. globulus* is the most used species for extraction of oil as it contains high amount of eucalyptol compound. There are 3 grades of Eucalyptus oil, medicinal, industrial and aromatic.
  - Medicinal uses:
    - It is a common ingredient of many cough syrups, rubs and vapour baths for treatment of coughs and common cold.
    - Its use is recommended in gargles to soothe sore throats and treat bronchitis and sinusitis.
    - It helps in clearing nasal congestions.
    - Cineole, an antiseptic compound present in Eucalyptus oil, kills bacteria that cause bad breath.
    - Mouthwashes containing Eucalyptus oil has been shown to prevent plague and gingivitis.
    - It is also useful in treating skin conditions such as boils, sores and wounds.
    - It is used in insect and mosquito repellant preparations.
  - Industrial uses:
    - It is used in floatation process during mining.
    - Eucalyptus oil can be used as a fuel as it has appreciable octane rating.
    - It has been shown in a research that cineole based oil aids in separation of ethanol from petroleum product blends.
  - Other uses:
    - Eucalyptus oil is used in miticides and biopesticides.
    - It is an important ingredient in many soaps, detergents, perfumes etc.
    - It finds wide application in aromatherapy as Eucalyptus oil has calming and soothing effects
    - It is also used as flavoring agent in culinary purposes.

The other side of the "gum tree"…

Although there are several benefits that we derive from *Eucalyptus,* it is very important to keep a check on its ever-increasing plantations as the tree pose some very serious ecological threats!

Many species have become invasive in non-native regions where they are causing major problems for the survival of native flora and fauna. The plant shows allelopathic effects and inhibits the growth of other plants in its surrounding, which is responsible for

disappearance of many small plants and grasses. As mentioned earlier, Eucalyptus sucks large amounts of water which tremendously reduces the water table in areas of large plantations. It is a matter of concern and there is a dire need to reduce the number of Eucalyptus trees in at least semi-arid and arid regions.

The conclusion that I could draw from accessing the different aspects of the impact that *Eucalyptus* has on human life is that we need to consider the ill-effects of these massive trees before looking at the economic benefits because the ecological hazards caused by indiscriminate planting of *Eucalyptus* on long term are far more disastrous and attention seeking than the short term gains it provide us with.

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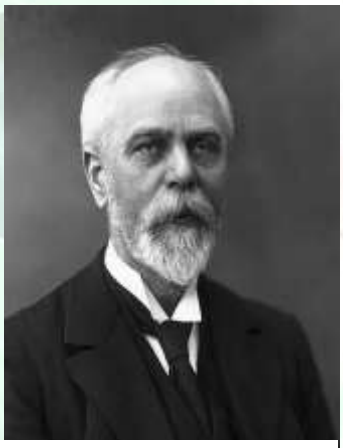
Famous Botanist

Christen C. Raunkiaer: Pioneer of Plant Ecology

Tammineni Rajitha

BSc(H) Botany, III year



Christen Christensen Raunkiær
Source: © The Royal Library

Christen Christensen Raunkiær was an early 20th century Danish Botanist who contributed immensely to the field of Plant Ecology. He is especially famous for categorizing the vegetation into various “life forms” and theorizing “frequency law”. Born on a small Danish farmland, Raunkiær grew up to become a professor of Botany in University of Copenhagen and Director of Copenhagen Botanical Garden. He did his PhD under Eugen Warming, a Danish Botanist given credit for introducing the scientific discipline of ecology.

Raunkiær had a numerical bent of mind which is obvious in the research axiom he followed i.e. everything countable in nature should be subjected to numerical analysis.

He devised a classification system for plants now known as The Raunkiær System. In it he categorized plants into different life-forms on the basis of the survival strategies they apply to overcome unfavorable season. The sub-divisions of this system are based on the place of buds during seasons with adverse conditions. These subdivisions are as follows:-

Phanerophytes: They have stems projecting into air and the buds are 25cm above soil level. They are mostly woody perennials. E.g. Trees

Chamaephytes: Their shoots are near the ground and buds are closer to ground i.e. no more than 25cm above soil level. E.g. Periwinkle

Hemicryptophytes: The buds of these plants are at or near the soil level. E.g. Dandelion.

Cryptophytes: They are below ground or under water - with resting buds lying either beneath the surface of the ground as a rhizome, corm or bulb or a resting bulb below water surface. They can be geophytes or hydrophytes. E.g. Tulip, Water-lily

Therophytes: Annual plants which complete their life-cycle rapidly under favorable

conditions and survive the unfavorable cold or dry season in the form of a seed. E.g. Geraniums

Another major contribution of Raunkiær is the “Frequency Law”. In contrast to many contemporary naturalists he strongly promoted quantitative and numerical approaches and experimentation for studying the flora of a place. So, he devised a method to quantify the abundance of plants in vegetation as frequency in subplots and used it for quantitative studies of a range of plant communities.
On further quantitative explorations of world flora in different plant communities, he gave frequency classes ranging from very frequent to very infrequent and in the process he observed that in nature at any given time and place a plant species was either very common or very rare. This came to be known as Raunkiær’s frequency law.

Raunkiær was a great naturalist of his time who did pioneering work in the field of plant ecology and his life forms, frequency analyses, and contemplations on species abundance distributions are still cited in most modern text books on ecology and biogeography.

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Photo Gallery

Figure 4: Purity of Whites by T.Ramya

Figure 5: Whites by T.Ramya

Figure 6: Pinks n Whites by Bhawna

Figure 7: Weeds of Delhi by T.Ramya

Figure 8: Arrival of Spring by Rozy Yadav

Figure 9: Blooming Gargi by Rozy Yadav

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DEPARTMENTAL NEWS

Semester Toppers

Name	Current class	Result of	Position in class	Photograph
Ruth Abraham Bhawna Lalit	B.Sc(H) Botany I Year	B.Sc(H) Botany I Year Semester I	I	
Avi Mendiratta	B.Sc(H) Botany I Year	B.Sc(H) Botany I Year Semester I	II	
Nidhi Gupta	B.Sc(H) Botany II Year	B.Sc(H) Botany I Year Semester II	I	
Drishti Garg	B.Sc(H) Botany II Year	B.Sc(H) Botany I Year Semester II	II	

Aishwarya Singh Srishti Mishra	B.Sc(H) Botany II Year	B.Sc(H) Botany II Year Semester III	I	 
Hira Fatima	B.Sc(H) Botany II Year	B.Sc(H) Botany II Year Semester III	II	
Gayatri Tripathi	B.Sc(H) Botany III Year	B.Sc(H) Botany II Year Semester IV	I	
Shreya Tripathi	B.Sc(H) Botany III Year	B.Sc(H) Botany II Year Semester IV	II	

Neha Kukreti	B.Sc(H) Botany III Year	B.Sc(H) Botany III Year Semester V	I	
Gayatri Tripathi	B.Sc(H) Botany III Year	B.Sc(H) Botany III Year Semester V	II	
Dipika Dixshit	Alumni	B.Sc(H) Botany III Year Semester VI	I	
Garima Grover	Alumni	B.Sc(H) Botany III Year Semester VI	II	

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GCBS-Taru Inaugural Lecture

Executive Committee of TARU: Gargi College Botanical Society (2015-2016)

Post	Name	Year
President	 Anukriti Bajpai	III year
Secretary	 Srishti Shekhar	II year
Treasurer	 Priyanka Saluja	
Executives	 Mansi  Aishwarya	III year

	  Tanya  Sonia Priyanchal	III Year
	  Akshama Bushra   Sonika Arpita	II year
	  Aruna Shweta  Nazrun	I year

Annual Report of GCBS-Taru

Anukriti Bajpai
Botany (H), III year

As the President of "TARU" our botanical society (GCBS), I feel privileged to write this year's annual report.

Gargi College Botanical Society was established in 1994 and christened as its name TARU in 2004. GCBS takes out an annual e-publication "Anthesis" which aims to encourage young budding scientists in writing scientific articles and share the ideas and creativity of the students. This year 11th publication of Anthesis has been published with the theme "PLANT SURVIVAL".

We all, the members of the Botanical society started this academic session with an inaugural function held on 11th September, 2015 and the hallmark of the function was a lecture delivered by Dr. Arun K. Sharma of Plant Molecular Biology Department, University of Delhi (South Campus). The lecture was based on the topic "Genetic Manipulation of Tomato for Improving the Fruit Quality". It was an interactive learning session and inspired the students very much. This was followed by badge distribution ceremony of the newly elected union members.

This year's teacher's day was celebrated on 4th September 2015, which was celebrated with great fun and frolic and enthusiasm where students of the department had planned a surprise for the teachers and the staff by dedicating the event to late Dr. Abdul Kalam Azad and inviting the retired senior teachers and laboratory staff to make the show more eventful. This was followed by the cake cutting ceremony and small get together for the teachers.

This year the union organized three competitions where the students expressed their creativity. The competitions included Poster making, slogan writing and waste-o-mania where active participation of the students was seen.

On the occasion of sports day in Spin'16, the students brought laurels to our department and actively participated in the Inter-departmental Marching competition as well.

Apart from these activities and competitions organized by the department, there was an excursion for the first year students of our department to the Aravali Biodiversity Park, where they studied about the medicinal values of the various plants and the techniques which help in enhancing their value. This was followed by a fun filled interactive session between the students and the teachers.

During Scintillations'2016 Botany Department had organized two main events one being the "The secret wall Graffiti Competition" and other being "On the spot Photography Competition".

Active participation of students was seen and on the spot theme was given to the students. Winners were given certificates and prizes.

Many students of our department are excelling not only in academics but also in the extra-curricular activities.

A glimpse at our Department achievers:

- Srishti Negi (IIIrd year): 1st position in ENLIVEN western dance society at IIT Kanpur, St.stephens, IIFT, IGDTUW, ISBF, PGDAV, HHI and 2nd position in Kirori Mal college and lastly third at the Youth nexus. Also cleared regional auditions for Hip hop and finalists for ‘Experience the Stage’.
- Laxmi Gurjar (IIIrd year): Participated in the All India Ball badminton championship and came first in the same at Miranda House and SRCC.
- Anupriya Rana (IIIrd year): First at Shivaji college, second at Matasundri college and third at Deshbandhu college and lastly the Best Speaker at Maitreyi college for Hindi Debating.
- Sneh Kunwar (III rd Year): Meritorious award (2015-16) by Faculty of Science, University of Delhi for securing 10th rank in the university. Participation certificate for short term course in sustainable development. Active participant and achiever in the sports.
- Anshu Chitkara, Sandhya and Sonia (III year): Won the Pathfinder award for the academic year 2015-16.
- T.Ramya (IIIrd year): 2nd prize in Inter-college poster competition under Science-Setu programme by DBT. 2. Published original research paper. 3. Recipient of INSA Summer Research Fellowship. Also actively participated and won laurels in annual sports day Spin'16.
- T.Rajitha (IIIrd year): 2nd prize in Inter-college poster competition under Science-Setu programme by DBT. 2. Published original research paper as first author. 3. Meritorious award (2015-16) by Faculty of Science, University

of Delhi for securing 11th rank in the University. 4. Consolation prize in poster presentation organized by Botany Department. Also actively participated and won laurels in annual sports day Spin'16.

- Priyanka singh (IInd year): First prize in the waste-o-mania competition organised by Botany department.
- Neha(IInd year): Second prize in slogan writing competition organised by Chemistry department.
- Srishti Shekhar(IInd year):First prize in departmental poster competition.
- Aishwarya singh and Bhawna (IInd year):Second prize in waste-o-mania competition.
- Drishti,Nidhi and Priyanka singh (IInd year): Won the first prize in the graffiti competition in Reverie.
- Arpita Kanungo(IInd year): Won third prize in departmental poster competition.
- Priyanka Saluja(IInd year): Won the first prize in the vigoro in Spin'16.
- Nikita Loharuka(IInd year):Won the third prize in chase her in Spin'16.

Our department members have participated in different activities of the sports olympiad held every year and have performed excellently.

In academics, our toppers have done a brilliant job by securing great positions.

Congratulations to all the young achievers and all the students of the Department.

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FOLDSCOPE WORKSHOP: A Report

Aishwarya Singh
B.Sc. (H) Botany, II year

Curiosity is the mother of invention and it is this curiosity which led to the development of instruments like the foldscope by an ultra-curious Assistant professor of Bioengineering at Stanford University

.

Foldscope is a very low costing(less than a dollar),paper origami microscope that is made by an assemblage of a micro-lens into a folded paper sheet. It is a handy and highly affordable instrument developed by Dr. Prakash to promote Frugal science and to sow the seeds to curiosity among common people, especially children. A workshop on foldscope was conducted in Sri Venketeshwara College on 16th December 2015 by the Department of Biotechnology, Government of India in collaboration with the Prakash Lab, Stanford University. The workshop was attended by students from various colleges of Delhi and India when the team from the Prakash Lab Comprising of Dr. Manu Prakash and his team Marie Bas, Tom Hata, Jim Cybulski and Laskhminarayan Iyer taught the students about

Dr. Manu Prakash demonstrating the working of foldscope to students during the workshop

the making and usage of the foldscope. All the people present at the workshop were given a foldscope which they assembled themselves and then observed various biological samples being provided to them. It was an extremely joyful event and examining anything with a paper microscope was mind-blowing and super interesting.

After the workshop at the Sri Venketeshwara College, Dr. Manu Prakash addressed students at Gargi College in the evening where he spoke about his vision of making foldscope available to every child so as to encourage curiosity in children. He stressed on the need of frugal science development in underdeveloped and developing countries where it is not very easy to have high end scientific equipments.
Attending the foldscope workshop and the lecture by Dr.Manu Prakash has encouraged me to thrive for the answers of my curiosity and also I have made a promise to myself that I'll try to ignite the lamp of curiosity in as many young souls as possible through my foldscope.

Through this handy microscope I've seen a lot of awe-striking miracles of the micro-world and I look forward to see much more!

Team of teachers and students from Gargi College at the foldscope workshop

Science Faculty and Students with Dr. Manu Prakash and his team in Gargi College

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Visit to Aravalli Biodiversity Park

A trip was organized to the Aravalli Biodiversity Park on 18th March 2016 for Botany Honours 1st year students. They were accompanied by Dr. Geeta Mehta, Dr. RenuSoni and Dr. Garima Malik. Aravalli Biodiversity Park (ABP) is located at the northwest of VasantVihar on 699 acres of land. ABP aims to create ideal settings for the vanishing flora and fauna of the region and promotes environmental awareness and conservation among students. The environmentalists here have brought back the lost biodiversity of this region.

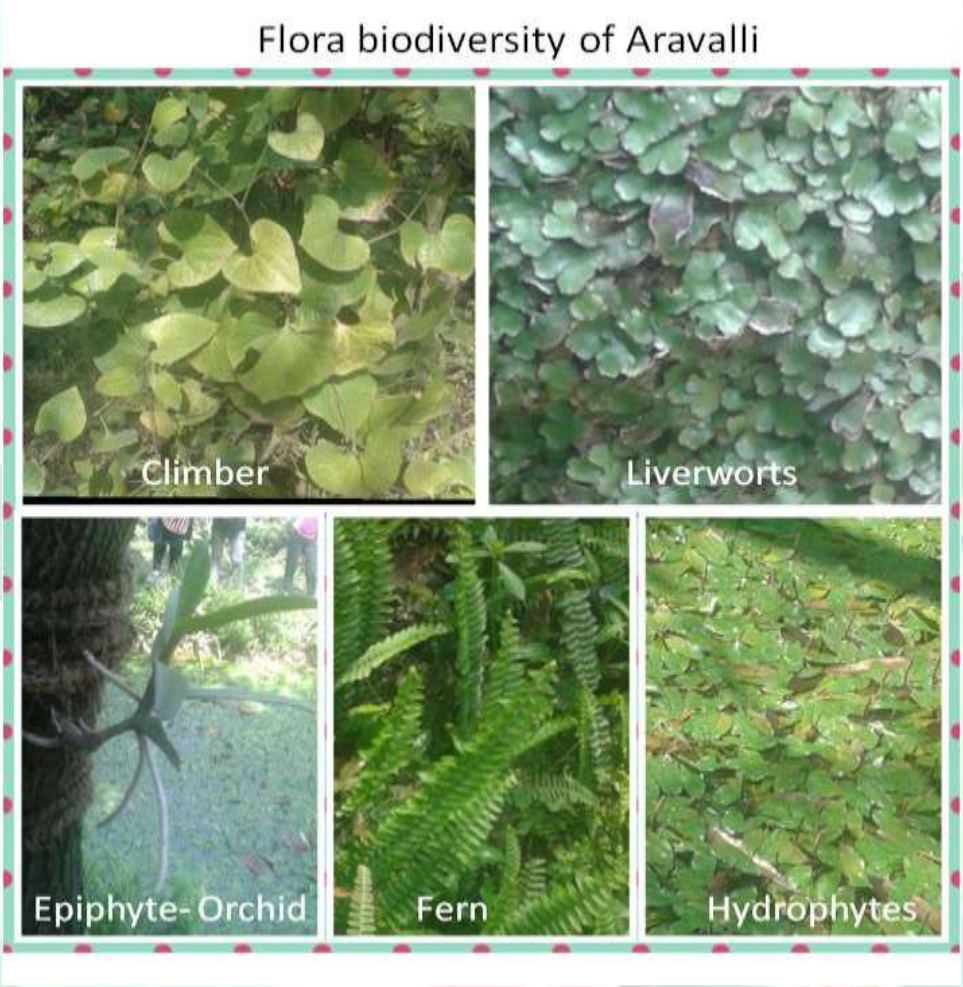
The area was highly degraded due to mining of mica and Chinese clay resulting in pits several meters deep. The area is also dominated by Prosopisjuliflora (Vilayatikikar), which is a Mexican species, introduced in this region by the Britishers. This species has had a negative impact on ecology as it reduced the water table drastically. This also makes the soil acidic, as its leaves are acidic in nature, making it unsuitable for growth of other plants. Planting of indigenous species has enhanced the recharging of aquifers.The park provides an excellent opportunity to nature lovers to understand nature. Apart from the several nature trails, ABP is divided into 4 Conservatory Zones, which are unique and create awareness for conservation of Nature. These four zones are

- **Conservatory of Medicinal Plants**: Here the indigenous medicinal plants are grown and conserved and multiplied. Information is also available on medicinal uses of these plants. Some important species grown here are Brahmi (Bacopamonnieri), Guggal (Commiphorawightii), Pipali or long pepper (Piper longum) and Ratan jot (Alkannatinctoria)
- **Conservatory of Butterflies:** Moths and Butterflies form important links in food web and they are major pollinators. About 150 species of host plant of butterflies are planted here. A total of 48 species of butterflies are recorded. Notable among them are Redpierrot, Blue Pansies, Peacock Pansies and Plain Tiger.
- **Conservatory of Orchids:** Orchids are one of important group of plants which are highly prized for their beautiful long lasting flowers. These have been brought from colder regions and grown on burnt Prosopis tree trunks. Some orchids growing there are Thuniaalba and Vanda cristata.
- **Conservatory of Ferns**: Ferns are the primitive group of non flowering plants. Mining pits in that region have been developed which have suitable climate for ferns and liverworts. Water pits also contain many hydrophytes like Hydrilla and Potamogeton.

Major Trees brought from other regions of the Aravalli range and reintroduced there are Terminaliatomentosa, Buteamonosperma, Sterculiafoetida ,Tectonagrandis, Meliadubia, and Moringaconcanensis
Mammals that are spotted in this area are Indian hare, Blue bull, Jackal, Porcupine etc. About 120 bird species have been spotted. Common among them are Paradise

Flycatchers, Warblers, Cuckoo, Bulbul,Owl, Minivetsand Kingfisher.
Indian toad, Indian flap shell turtle, Monitor lizard, Gray's rat snake and Royal snake are the common amphibians and reptiles of that region.

As budding botanists the girls were excited to see lower plants like liverworts, mosses and ferns apart from a wide variety of angiosperms like hydrophytes, epiphytes, climbers, herbs, shrubs and trees. Students not only enjoyed this visit but also realized the importance of biodiversity and its conservation.



A visit to Aravalli Biodiversity Park
B.Sc (H) First year





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Teacher’s Day: A Tribute to the Gargi’s Finest

Priyanka Saluja
Botany(Hons) II year

“Better than a thousand days of diligent study is one day with a great teacher.”

Teacher's Day is a tribute to the hard work and devotion of the teachers to educate a child. In India, teacher’s day is celebrated on 5th of September every year. It is dedicated to Dr. Sarvepalli Radhakrishnan, a zealous advocate of education and one of the greatest scholars and teachers of all times, apart from being the first Vice President and the second President of India. As a mark of respect to this phenomenal teacher, his birthday came to be observed as Teacher’s Day in the country.

Department of Botany, Gargi College on 4th September 2015 celebrated teacher’s day with great fun and frolic. It started with the surprise event in which retired senior teachers Dr. Chintamaani, Dr. Lalita Sehgal, Dr. Bharti Bhattacharya and members of the lab staff were invited to be a part of the celebration. The program was started with a devotional prayer which included a classical dance performance by Manasvi of first year. Then there was a very entertaining and enthusiastic dance performance by second year students choreographed by Sonika Sharma and her team. Teachers enjoyed this dance performance based on student's life very much.

A true teacher defends her students against her own personal influence. She inspires self-distrust. She guides their eyes from themselves to the spirit that enlightens them. This year the teacher’s day was dedicated to Late Sri Dr. Abdul Kalam Azad who was a great teacher himself and represented the voice of youth. Students made it a delightful occasion for the teachers by keeping a dress code for them as blue colour. A collection of pictures capturing some very precious moments of the teachers’ lives was projected. It added great humour to the event as they were quite amused by the pictures which were sneaked in from their profiles on social websites.
Next a very joyous game called "Act the movie" was organized by for the teachers. Teachers and lab staff played the game with full exuberance and all the students and retired teachers relished the game. Jasmeet ma’am, Aprajita ma’am, Rajni ma’am and Renu ma’am acted out the names of movies very well which was followed by cake

cutting ceremony. Gifts as token of love and respect were presented to the teachers and the lab staff. The teachers were overwhelmed by this gesture. A student of Third year Sneh Kunwar recited a self composed poem dedicated to the exquisite teachers of Botany department. They were touched by her beautiful words.

The teachers inspire us to proceed forward, to build our ethics and prepare us to withstand obstacles of our life. The teachers also impart immense knowledge and wisdom in our lives. We wish to love our teachers in the same way forever and hope that they get a more and more celebrations like this every year as they deserve each and every bit of it!

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UKIERI-Study India Program 2015

“Hasta la Vista”- Farewell’15

Bushra
Botany (Hons) II year

Farewell is a time when all the moments spent in 3 years seem like a flash back of time. It is a time when although there are smiles on lips but fear about leaving the routine and stepping out into the harsh reality of the world is always in the background; a time when we start preparing ourselves to test the knowledge gained so far. The farewell given to the batch of 2012-2015 was not just a memory but a bouquet of overwhelming feelings. The farewell had theme “Hasta la vista” which is a Spanish farewell meaning “until the next sighting”, which assuredly expresses our feeling that we will meet you soon somehow, somewhere, sometime. It’s not a goodbye from our side but a see you later.

Both first and second years participated actively in all the events performed on the day. We performed a number of events and conducted a few fun filled games. A song by first years accompanied with guitar dedicated to our seniors brought tears in everyone’s eye. An interesting game called “act-mad” was played by the seniors and enjoyed by one and all. The hilarious acting of students while advertising scientific instruments and botanical items created a hilarious atmosphere after the touching song and dance performances. Sashes were given to each and every outgoing student with a tag which tried to capture their personality in one simple word. Then almost every student was urged to share her experience in this college. It started with a hilarious atmosphere but ended with happiness and lots of tears in everyone’s eyes. Then finally a video was played which comprised of their memories of Gargi captured in a few pictures.

The celebration came to its last leg with cake cutting ceremony. Although the charming day finally had to come to an end the memories created will be reverberating in the hearts of all those present forever. The blessings showered by the teachers on the farewell batch will always be with them to help them cope and deal with every struggle in their life. At the end the hugs and the cuddles that were left and the everlasting warmth would never let this day be forgotten!!

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SCINTILLATIONS

Srishti Shekhar
BSc Botany(H), Iiyear

The science fest of Gargi College 2016 took place with much enthusiasm on 28th and 29th March. Just like any other festival, science festival is a celebration that showcases science and technology with the same flair and freshness that would be expected from an arts or music festival. Events organized had a wide range aiming at catering to the interests of all budding scientists, including guest lectures by eminent scientists and professors, research paper presentations by students who have been an active part of research projects like Pathfinder competition and Innovation project taking place at the college and University level, and many fun filled inter -college competitions like Secret wall of graffiti, scientific tambola, treasure hunt, debate, just a minute, on the spot photography, cooking without fire and many more. The core content of all was that of science, technology, and celebrating the breakthrough developments of science over myths and beliefs with proper evidences from endless researches.

Different events were taken up by different departments .Botany Department had conducted the "Secret wall of Graffiti" and "On the Spot Photography" competition.

1.**Secret Wall of Graffiti** (conducted on 28th march): Students were given topics on the spot , the topics being a]Man versus Nature and b]Vision of science .The participants were given an hour's duration to pour out their thoughts through their graffiti solely as no time for verbal explanations was given .

2. On the spot photography (conducted on 29th march): it took place in the similar manner as graffiti, students were given topics on the spot, namely: a] Science on campus and b] Mystery. They were given an hour's time to capture the best shots which portray their thoughts in the best of way and finally submit their most expressive work with a suitable caption.

Everyone was surprised and overjoyed to witness the diverse perceptions of science by different individuals as was reflected through their pictures and murals colored in the motley of strokes, which really made the events a huge success.

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Reverie 2016: Kaleidoscope of Possibilities

T. Ramya
B.Sc. Hons. Botany III year
Vice-President(Science), Gargi College Student Union

Gargi College hosted its annual cultural fest, Reverie'16 with a theme of "Kaleidoscope of Possibilties" from 24th to 26th February 2016. It was a three days celebration of talent in theatre, dance, music, photography, debate and creative writing. With lots of fun, food, dance and stalls Reverie had something for everyone. EDM Night and the Celeb night by MJ5 Dance group and Bollywood singer Keerthi Sagathia provided enough beats at the end of each day for everyone to have fun and enjoy.

Decked up with colourful decorations the first day opened with an inauguration ceremony and was followed by plethora of vibrant events like Nivacanna: stage theatre event, hosted by the stage play society, Upstage; Abhaas: street theatre event, organized by the street play society of the college, Kshitij; battle of bands and Zenith: western dance competition took place in the evening witnessing a jampacked auditorium.

The second day at Reverie was full of music with western solo and group singing competitions organized by Euphony, the western music society of Gargi College. The Indian group singing competition, Sangam organized by Samranjini, the Indian music society of Gargi College. Cursiv-iti, the choreography competition organized by Sparx, the choreography society of Gargi College saw 10 teams showcasing their productions. The day of music ended with everyone on their toes dancing to the tunes of EDM music.

The third and final day at Reverie'16 the day of dance was filled with cultural dance events organized by Nazaakat, the folk dance society of Gargi College. Alaap, the folk dance solo event saw 12 artists from around the University performing major Indian dance forms like Kathak, Kuchipudi and Bharatnatyam. The event was followed by Thumka, the group folk dance competition which saw participation from 8 teams around the University who showcased a variety of dance forms like Bhangra, Gidda, Bihu, Lavni and more.

The much awaited star night opened with the performance of MJ5 Dance group, who showed their impressive moves on many dance numbers and fusions. The night

came to an end with Bollywood singer Keerthi Sagathia who enthralled the audiences with his soulful music, performing on songs ‘Teri Deewani’, ‘Lungi Dance’ and ‘Tera Pyaar Chahida’ and many more.

Besides this all the three days were full of myriad competitions by fine arts society, creative writing society, photography society, debate societies and quiz society. These three days were the celebration of multiple shades of talent and new possibilities with lots of fun.

Gargi College Student Union 2015-2016


KALEIDOSCOPE
AABHAAS
GARGI COLLEGE
KALEIDOSCOPE
FREEDOM OF POSSIBILITIES
"GO IN THE DIRECTION OF YOUR DREAMS"
"FLY HIGH"
ROCKING THE FEST GARGI STYLE
F.L.G
REVERIE

Presidents of Gargi College Botanical Society

No. of Years old	YEARS	NAME	ADVISOR / S	TIC
Started	1994-95	Kusum Yadav	G Mathur	AC
1	1995-96	Nandini Das	G Mathur	AC
2	1996-97	Saloni Mathur	UP & GMe	LS
3	1997-98	Sarika Upadhyaya	UP & GMe	LS
4	1998-99	Ragini Rai	ST & DJ	KK
5	1999-2000	Sagarika Sarkar	ST & DJ	KK
6	2000-2001	Pinky Aggarwal	KP & AC	ST
7	2001-2002	Ishani Sinha	KP & SD	ST
8	2002-2003	Nidhi Gupta	PM & SD	UP
9	2003-2004	Swati Chugh	BB & SD	UP
10	2004-2005	Neethi V. Rao	GMa & GMe	GMa
11	2005-2006	Neena Priyanka	GMa & GMe	GMa
12	2006-2007	Madhulika & Urvashi Bhatia	KP	KP
13	2007-2008	Bhavya Khullar	GMe & AM	GMe
14	2008-2009	Yashika Sharma	AM & PK	GMe
15	2009-2010	Neha Singh	KP & SV	KP
16	2010-2011	Rashmi Sanchita	PP & LJ	AM
17	2011-2012	Nikita Singhal	IS & PP	AM
18	2012-2013	Nikita Dalal	RMS & JK	LJ
19	2013-2014	Neha Tanwar	UP & RMS	UP
20	2014-2015	Barkha Ravi	KP, LJ & RMS	KP & LJ
21	2015-2016	Anukriti Bajpai	RMS, Geeta	KP

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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. Shashi Tyagi is now Principal (Officiating) of Gargi College.

Superannuated	**Current Faculty: Permanent**
Dr. Chhaya Biswas	Dr. Shashi Tyagi
Dr. Pushpa Markandan	Dr. Usha Prasad
Dr. Ahalya Chintamani	Dr. Gita Mathur
Dr. Bharati Bhattacharyya	Dr. Kiran Prabha
Dr. Lalita Sehgal	Dr. Geeta Mehta
Dr. Krishna Kumar	Dr. Aparajita Mohanty
	Dr. Priyanka Pandey
	Dr. Leisan Judith
Voluntary Retirement	Dr. Jasmeet Kaur Abat
Dr. Kavita Walia	Dr. Renu Mundhara Soni
Dr. Asha Juneja	Dr. Vera Kapai
Dr. Deepa Jethwani	Dr. Reema Khurana
Dr. Shweta Vandana	Dr. Geeta
	Dr. Anjana Rastogi
	Ms. Ruchitra Gupta
	Dr. Garvita Singh
	Current Faculty: Temporary
	Dr. Samira Chugh
	Dr. Garima Malik
	Dr. Sachi Aggarwal
	Dr. Shweta Sharma
	Dr. Dhriti Kapoor

Dr. Gita Mathur receiving Distinguished Teacher Award by University of Delhi, 2009

Department of Biotechnology

Biotechnology Information System Network

Ministry of Science & Technology, Govt. Of India

Incentive Awards for Publications- 2014

This Certificate is Awarded to

Bioinformatics Infrastructure Facility,

Gargi College, New Delhi

for getting the second Position

in the category of BIF (Colleges)

for publication of papers in the journals of high repute in the year 2013

Suman Malik
Member, Incentive Awards Committee

Dr T. Madhan Mohan
Adviser, DBT

Dr. K. Vijayraghavan
Secretary, DBT

Laboratory Staff

Superannuated	Current
Mr. H.S. Sawhney	Mr. D.D. Sharma
Mr. Kapileshwar Pandey	Mrs. M.D. Sharma
Mr. P.D. Raturi	Mrs. Shashi Bala
Mr. J.S. Negi	Mr. Ashok Kumar Rana
Mr. Vishwanathan S.	Mrs. Rajni
Mr. Liaquat Ali	Mr. Arun Kumar
Mr. H.C. Dhirwal	Mr. Pancham Singh
	Mr. Vijay Kumar Pandey
	Mr. Deepak Kumar
	Ms. Preeti
	Mr. Jaideep
	Museum Curator: Mr. Ganga Singh

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Ongoing Student Research Projects

TITLE: Morphological and anatomical parameters of plants as indicator of air pollution in Delhi

- **Names of Candidates**: SnehKunwar, Saumya Srivastava, ShobhnaYadav, Disha Batta & Ruth Abraham
- **Course**: Botany (Hons) III & I years
- **Names of Mentors**: Dr. Geeta and Dr.Reema Khurana
- **Name of the Scheme**: Star college scheme, DBT

Delhi, the capital of India, has been facing many air pollution related problems as a result of rapid pace of development over the past few decades. To maintain ecological balance in this rapidly developing capital, there is an immediate necessity to assess the effect of the air pollutants on the plant species so that the strategies can be formulated and implemented to protect the species. The Air quality in Delhi is primarily affected by the vehicular exhausts, small scale industries, power plants and biomass burning. Air pollution has an impact on economic productivity, agricultural productivity, damages property and causes ecological changes that increase the risk of environmental calamities. In this project we will be analysing the effect of pollutants on the backbone of all the life on Earth- PLANTS**.**

TITLE: To study the effect of Silver Nanoparticles ($AgNO_3$) on the growth and biochemical content of *Trigonellafoenum* graceum.

- **Name of candidates:** Anshul, Ashi, Himani
- **Course:** Botany hons. (III year)
- **Name of mentors:** Dr. Renu Mundhara and Dr. Garvita Singh
- **Name of the Scheme:** Star College Scheme, Gargi College, University of Delhi

These days nanoparticles are being used tremendously in various fields. Understanding some adverse effects of nanoparticles in edible crop plants is a matter of concern because nanoparticles are often released into soil environments. *Trigonellafoenum*mgraceum is an edible as well as medicinally important plant. We have studied growth patterns at different concentrations of nanoparticles and estimated the biochemical content (chlorophyll and flavonoid) of *Trigonella sp.*. The observations reveal that silver nanoparticles decrease the percentage seed germination at higher concentration but not significantly. There is inhibition in root growth at lower concentration while at higher concentration, there is no such comparable change in root growth. There is increase in hypocotyl growth, chlorophyll and flavonoid content with increase in nanoparticle concentration.

TITLE: Effect of heavy metals on seed germination of *Vigna radiata* and growth of seedling.

- **Name of Candidates:** Avi Mendiratta, Jutismita Pathak, Manasvi Bhaskar, Shweta Singh
- **Course:** B.Sc. Hons I year
- **Name of Mentors:** Dr.Vera Y. Kapai**,** Dr.Samira Chugh
- **Name of the Scheme:** Star College Scheme, Gargi College, University of Delhi

Heavy metals stress is a threat to major crops. Some heavy metals are essential in minor quantities for normal growth and development while in excess may be toxic and cause inhibition in plant growth and metabolic activities. The toxicity of heavy metals varies with metal and concentration. In this study, the effects of two heavy metals, Pb^{2+} [$asPb(NO_3)_2$] and Cr^{+6} (as $K_2Cr_2O_7$) on *Vigna radiata* seed germination and seedling growth were examined. The concentrations of these salts used in the experiment ranges from 50-200µM. Different concentrations of Pb^{2+} and Cr^{6+} showed adverse effects on the per cent seed germination, shoot length and root length.

TITLE: Effect of microwaves on seed germination and seedling growth of selected plant species.

- **Names of Candidates:** Neha Kukreti, Sonia Sharma, Surbhi Nautiyal
- **Course:** B.Sc.(H) Botany III Year
- **Name of the Mentor:** Ruchitra Gupta
- **Name of the scheme:** Student research project under Gargi College Star project Scheme

In the present era, with increasing demand of cellular services and technological growth, proportion of microwaves is increasing in the environment. Microwaves are non-ionizing radiations which are the part of electromagnetic spectrum with frequencies between 300 MHz and 300 GHz. Microwaves may have both positive and negative effect on plant crops. There are evidences that microwaves produces changes in the cell membrane's permeability and cell growth rate as well as interference with ions and organic molecules, like proteins. Plants are essential components of a healthy ecosystem and have important role in the living world as primary producers of food and oxygen; therefore it would be beneficial to investigate their interaction with today's increased exposure to radio and microwave frequency fields. Experiments were conducted to investigate the effects of microwave radiation (2450 MHz, frequency used in microwave oven and wireless router) on germination and growth rate in seeds of mustard and tomato. Observations have been recorded and the results are being analysed.

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Alumni of Botany Department, Gargi College

Distinguished Alumni: Academicians

Alumni Speak

From fruit to seed: One step forward in the life cycle

Joyita Deb
Batch of 2005-2008

'There, I've finished' I say as I add the final touches to this article making sure everything ties-up together and the spell-checker hasn't missed anything. The nice thing about writing is that it has a start and a finish- not something you find in scientific research! Research is like an infinite space which expands at the same rate as the number of confounding questions that arise as you uncover more about the research problem you set yourself at the start. The only constraint here is - your CV. At the end of the 3-4 years of your PhD you must establish that you knew what you were doing all along and you know pretty much about what needs to be known about your field of study. The truth is, nobody really knows what they are doing and at the end of your PhD you'll realise how little you actually know!

Before you begin to take my words literally, let me elaborate a bit. During your PhD you acquire a repository of knowledge that qualifies you as a mini expert in the area you are cultivating and grants you exclusive membership to a club of like-minded people who are fascinated by the same research that excites you. The tentacles of knowledge arising from these research communities seem to move in unimaginable directions and you realise that we are just at the tip of the iceberg when it comes to understanding the biological world, the possibilities are endless. Which is why I said- we really don't know that much! What follows from this is that we can never assume something as being absolute, and so your questions and hypotheses will take you into territories which haven't been explored or might be contrary to pre-existing understanding. You never really know where you'll end up- although the trick is to say you knew it all along!

To summarize, knowledge is limitless but fragile and biology is beautiful but bewildering, at least that's what I learnt from my PhD studying gynoecium and fruit development. The fruits of my (and others) labour resulted in us discovering a potentially new mechanism by which the hormone auxin develops tissues, unlike what has been discovered so far. This finding has now opened up entirely new avenues of research which are being studied by colleagues in my former lab. During this time I became well acquainted to the role of plant hormones in tissue patterning and also to mechanistic aspects of how transcription factors work. Although I enjoyed exploring developmental biology, after my PhD, I decided to return to the area which got me hooked on to a career in plant research in the first place- discovering how plants sense temperature. A couple of months into my post-doctoral research, I am now studying how different temperature regimes experienced by the mother plant affect the future generation- the seed. I am learning new things, seed biology for a start, epigenetics and being reintroduced to old friends I encountered during my Masters degree- light and temperature responses of plants.

If you had asked me at the start of my PhD if I knew what I'd be doing after, I wouldn't have been able to tell you. I kept an open mind and followed my interests, and at the end I had a fair idea of what excited me the most. I can now bring my past knowledge of tissue development into my current research which makes me appreciate plants even more! So in hindsight, perhaps research and a career as a researcher are much like writing- you start off not knowing where it takes you and for all you know, it might take you in a completely different direction; but during that time you have a vague idea of how you would like to conclude. Follow that idea!

Joyita Deb
Batch of 2005-2008
Currently a Post-Doctoral Researcher at the John Innes Centre, UK
Email: joyitadeb@live.com

Gargi Days

Kimi Bhuyan
Researcher
DABUR RESEARCH FOUNDATION

Time flies so fast!! It's easy to move ahead leaving things behind but there are some moments that stay with us forever. I am proud to be a part of Gargi College Family. I'm glad that I had the opportunity to learn and grow under the guidance of such eminent professors. They gave us the best possible foundation and I'm still using Dr Gita Mathur & Dr Shashi Tyagi's notes in my research!! Dr Priyanka Pandey's guidance during my M.Sc dissertation has helped me a lot. I never thought I would get such an immense level of cooperation from all the faculties of this department even after completing my graduation. Their teachings had molded me altogether to a new horizon and that has been helping me to come up with very innovative ideas in my Cell Biology research at Dabur Research Foundation.

The constant support from our all lab staff especially Pancham Sir and Rajni ma'am motivated us a lot. Gargi College blessed me with best-friends for a lifetime and I shall always cherish those memories. I miss the Nescafe and the playground field, our favorite hanging zone where we had unlimited fun, our whisperings at the library, those pretty scoldings from mam after bunking classes!! Life at Gargi College follows me relentlessly wherever I go. All those memories will forever remain as a beautiful nostalgia in my mind.

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Botanical Fun Pages

Crossword Puzzle

Sonam Pahuja

Botany (Hons) II year

Find out the names of twenty-five ecological terms from the crossword given below.

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

Click here to check your answers

Poems

PLANETARY GARDEN

Dr. Bharti Bhattacharya

Last night while I slept,
A nice garden I dreamt.
What a beautiful garden it was
Oh! How fabulous dream it was.
Venus-fly-traps on the planet Venus,
Though unreal they were a green lush.
Mercurialis on Mercury
The little plants were grown in a hurry.
Marchantias and Marigolds on Mars,
Were green fields with yellow stars.
Junipers on Jupiter, have you ever seen?
To such a forest, indeed, I have never been.
Saturn with his rings around
Soapnuts and strawberrys studded round
Looked amazing, no doubt,
Dumbfounded, I've nothing to say about.
Nepenthes and Neptunia on the Neptune
Were like a flute's melodious tune.
Then came Uranus -----
With all Urticas together.
The dream shattered by their prick,
Further sleeping would be facing a risk!
Awake, I see the real thing,
Dahlias and Zinnias and Sunflowers in a string;
Orchids and Roses and Lilies bloom.
This is my planet Earth ___-
The Earth with flowers and trees and
birds of beautiful plume.

Melancholy of Un-Greening

Mohini Singh
Botany (Hons) II year

Flows a sound of pain and agony,
Silent and feeble in the cold zephyr.
Put your ears to the heart of an ovule,
Listen to the deepest cry ever.

Close your eyes and see the picture,
Painted with the words of nature.
Look at your green past ,grey present
And have a look at your black future.

Can't you hear the noise of machines,
And all the birds leaving their nest?
Can't you see the rushing bike,
Waking up a seedling from its rest?

Can't u hear the grassland grieve,
Holding on its chest the cement floor?
Don't you get burnt by the tears of sky,
Whose eyes now have an smoky gore?

Now glance at the flowers being plucked,
And their plants getting slaughtered.
Don't they resemble wailing mothers,
watching their kids being massacred?

The deepest regret is an unplanted seed,
The deepest sorrow to lose nature's bliss,
The deepest pain is the pain of nature,
The biggest sin- HAVING DONE ALL THIS!

The Flower

Nazrun
Botany (Hons) I year

Blooming in the morning,
One chilly winter I found you,
Doused with fresh dew,
Glittering under the rays of sun.
Bees visiting you with empty hearts,
And you filling them up with all your nectar.

With patience in your eyes
Determination in your stance
Giving the message of peace
Message to stay strong
Always smiling just to make other's life peaceful.

What should I say who you are?
An inspiration to a broken soul,
A symbol of love,
A messenger of peace,
Filled with beauty filled with grace.

You are a beautiful flower of my garden
An angel of god
And my reason to take that morning walk,
In the boroughs of nature.

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Anthesis: The Journey So Far

Anthesis: Volumes 1 to 5

Anthesis: Volumes 6 to 10
Electronic Annual Publication of GCBS

2010-11

2011-12

2012-13

2013-14

2014-15

Anthesis was first published in 2005 as a photocopied and spirally bound version; soon we got sponsorships to produce a printed version. Now Anthesis has a new avatar as we are producing e-Anthesis since Volume 6. This electronic version is proof of our concern for the environment as well as our technological advancement. Here's a look at the seven earlier volumes

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