



“Gulmohar Newsletter”



Department of Botany

“The Secret Communication Of Plants”



FROM THE EDITOR'S DESK

**Selvamathi Kamaraj Nadar
T.Y.B.Sc.**

Welcome to the new edition of the Gulmohar Newsletter for the year 2025-26. In this edition, we have put up some fascinating articles and photographs.

In this edition, the theme is, “THE SECRET COMMUNICATION OF PLANTS”. We have included articles about the Chemical Signaling In Plants, Plant Defence Mechanisms, Underground Communications, Interaction With Other Species, The Future of Plant Communication Research, Mycorrhizal Association in Plants...and many more such intriguing topics.

Finally, yet importantly, we have some Fun Facts and a Photo Gallery to showcase the photography skills of our students.

Happy Reading!!





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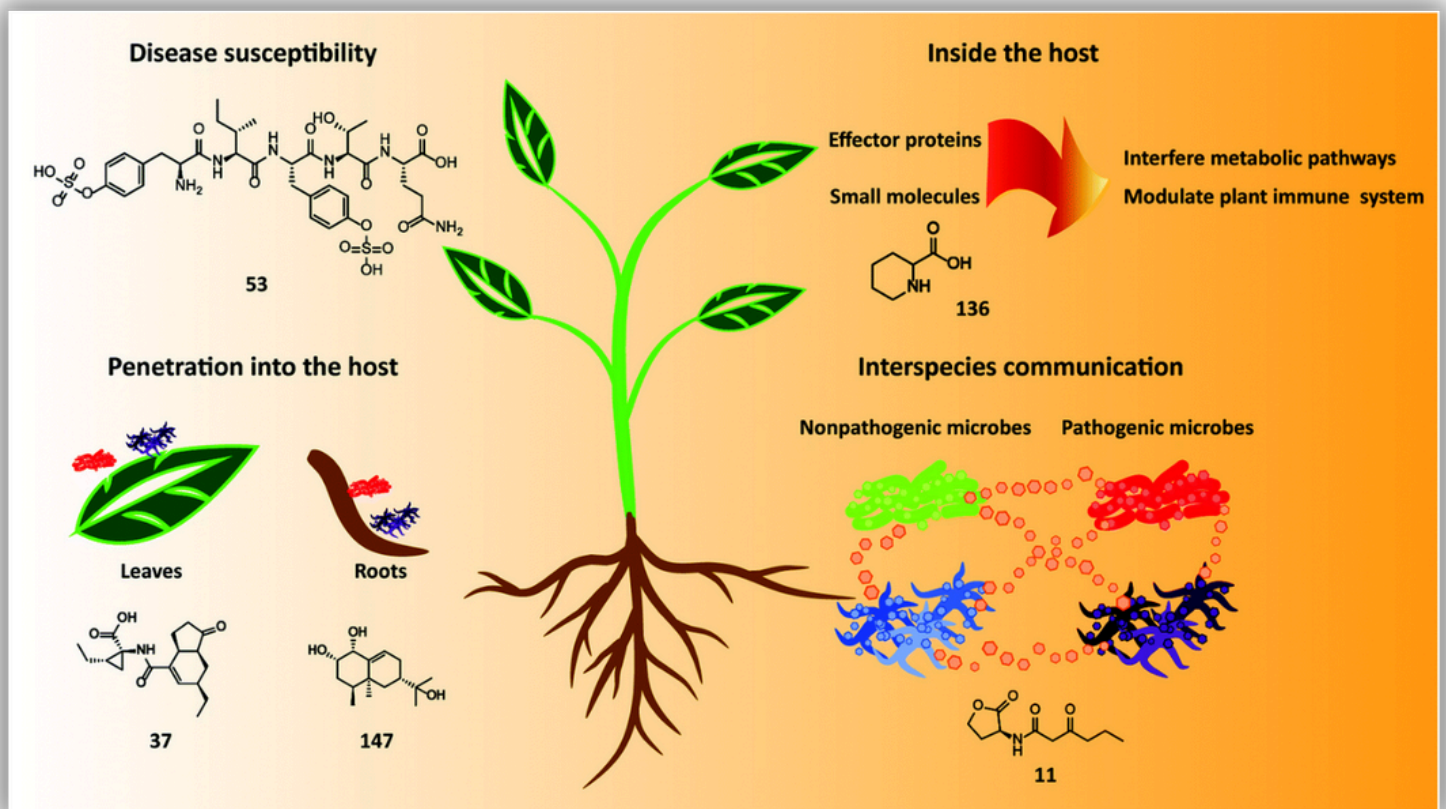


“Chemical Signaling In Plants”



BY LYNN AVILA THOMSON (S. Y. B. Sc.)

Signaling pathways employ a sophisticated network of interactions to coordinate biochemical and physiological responses like flowering, fruit ripening, germination, regulation of photosynthesis, and shoot or root development. These signals are initially perceived by a receptor and conveyed to the nucleus by a sophisticated network. A message may be conveyed to the nucleus through any of several mechanisms such as GTP binding proteins (G proteins), whose activity is modified by binding GTP, protein kinase cascades, which take turns phosphorylating and activating a series of proteins and membrane ion channels, which modify ionic properties of the cells.



The signal is expressed in the nucleus as a modification of the activity of DNA-binding proteins, which are transcription factors that specifically interact and regulate the regulatory regions of genes. Therefore, the detection of an environmental signal is communicated through a transduction pathway, and modifications in transcription factor activity can coordinate modifications in the expression of a portfolio of genes.



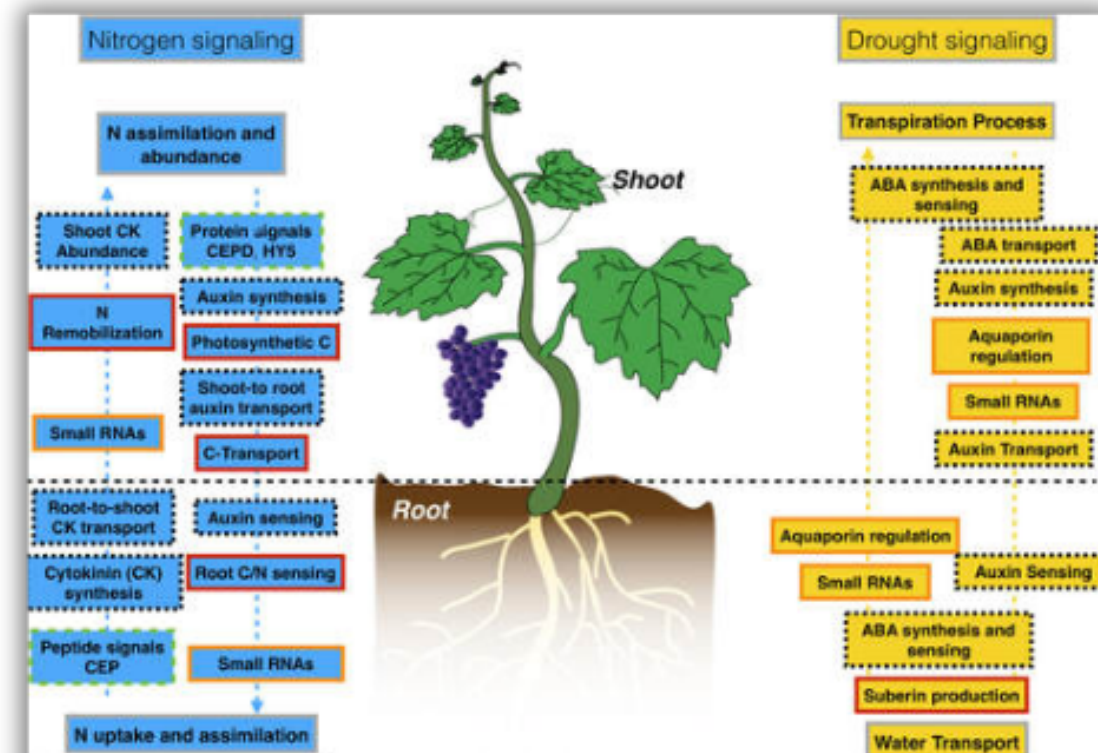


“Chemical Signaling In Plants”



BY LYNN AVILA THOMSON (S. Y. B. Sc.)

LONG RANGE CHEMICAL SIGNALING



Plants have long been recognized to coordinate their physiology and development via mobile chemical signals. Hormone auxin is the classic example where the concerted activity of membrane transporters like the AUX/LAX, PIN, and ABCBs (ATP Binding Cassette Proteins) transport auxin in a polar manner from cell to next cell. The auxin gradient subsequently relays temporal and spatial information to the plant, e.g. initiating local patterning within the emerging vegetative meristem. Besides hormones, several other regulators are also now found to similarly combine development and physiology by transferring from cell to neighboring cell. For instance, within the root, the SHORTROOT protein has to travel from where it is synthesized in the root xylem, procambium, and pericycle next to the xylem to other cells that are close by, like the phloem poles and quiescent center, where it then functions to, for example, regulate phloem development.





“Chemical Signaling In Plants”



BY LYNN AVILA THOMSON (S. Y. B. Sc.)

PLANT HORMONES IN CHEMICAL SIGNALING:

1. AUXINS

PRODUCED IN: Shoot apical meristems, young leaves.

TRANSPORT: Polar (unidirectional) transport through PIN proteins.

FUNCTIONS: Promotes cell elongation by loosening cell walls via acid growth hypothesis.

CONTROLS APICAL DOMINANCE: suppresses lateral bud growth. Guides tropic responses: bends plant towards light (phototropism) or gravity (gravitropism).
Induces root initiation and vascular tissue differentiation.

2. GIBBERELLINS (GA)

SYNTHESIZED IN: Seeds, young shoots, and root tips.

FUNCTIONS :Induces stem elongation by stimulating cell division and elongation.

DORMANCY BREAK: triggers germination.

Activates enzymes that break down endosperm for nourishment of the embryo.
Induces flowering and fruiting in some plants.

3. CYTOKININS

SYNTHESIZED IN: Root apical meristems and translocated through xylem.

FUNCTIONS: Induces cell division (cytokinesis).

Acts with auxins to regulate organ formation (more cytokinin: shoots; more auxin: roots).

Slows down senescence (aging) of leaves.

Increases nutrient mobilization and shoot initiation in tissue culture.





“Chemical Signaling In Plants”



BY LYNN AVILA THOMSON (S. Y. B. Sc.)

PLANT HORMONES IN CHEMICAL SIGNALING:

4. ABSCISIC ACID (ABA)

SYNTHESIZED IN: Roots and leaves when under stress conditions.

ACTION: Regulates stomatal closure in water stress through ion channels in guard cells.

Triggers seed dormancy and prevents germination.

Signals drought and salinity stress, coordinating water conservation.

5. ETHYLENE

PRODUCED IN: Nearly all regions of the plant, particularly upon stress or ripening.

FUNCTIONS: Induces fruit ripening (softening, color change, aroma).

Induces leaf and flower abscission (shedding).

Mediates triple response in seedlings (blocks elongation, thickens stem, induces horizontal growth).

Functions in defense signalling against pathogens and stress.

6. JASMONATES

PRODUCED IN: Wounded tissues.

FUNCTIONS: Activates defense genes in response to herbivory.

Coordinates systemic wound signalling throughout the plant.

Suppresses root growth and reproductive development under stress.

Cross-talks with other hormones (such as salicylic acid and ethylene).





“Chemical Signaling In Plants”



BY LYNN AVILA THOMSON (S. Y. B. Sc.)

PLANT HORMONES IN CHEMICAL SIGNALING:

7. SALICYLIC ACID (SA)

SYNTHESIZED IN: Infected tissues and disseminated systemically.
FUNCTIONS: Induces Systemic Acquired Resistance (SAR) to pathogens.
Activates pathogenesis-related (PR) genes.
Transmits immune signals to non-infected tissues.
Involved in ROS signalling and local cell death to limit infection.

8. BRASSINOSTEROIDS

FUNCTIONS: Regulate cell elongation and division.
Assist vascular differentiation.
Increase stress tolerance.
Interact with auxin and gibberellins to control growth.

9. STRIGOLACTONES

FUNCTIONS: Suppress lateral shoot branching.
Induce mycorrhizal association for nutrient acquisition.
Associated with parasitic seed germination (e.g., Striga).
Involved in working with auxin to control plant architecture.



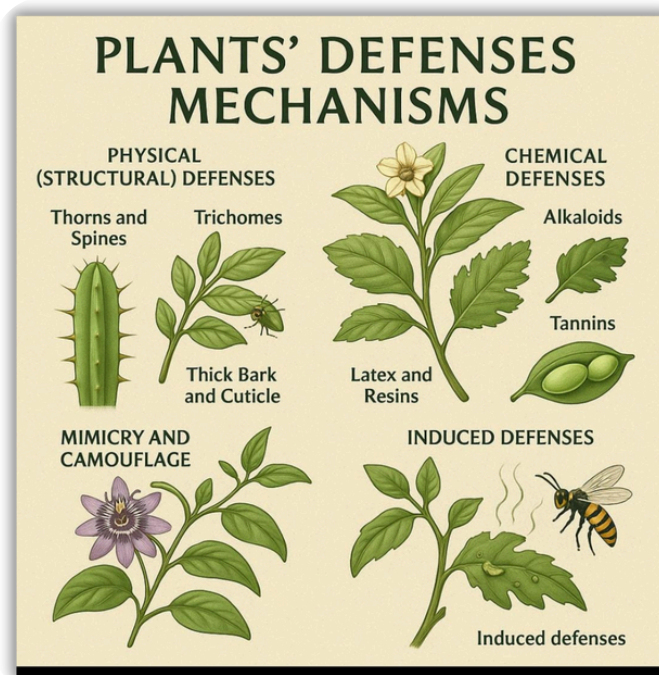


“Plant Defence Mechanism”



BY HAJRA SHAIKH (S. Y. B. Sc.)

Plants have evolved a variety of defense mechanisms to protect themselves from herbivores, pathogens, and environmental stress. These defenses can be structural (physical) or chemical, and they can be constitutive (always present) or induced (produced in response to attack).



1. PHYSICAL (STRUCTURAL) DEFENSES:

These defenses make it physically difficult for herbivores or pathogens to damage the plant.

- **Thorns and Spines:** Sharp structures that deter herbivores. **Example:** Cactus uses spines to discourage animals from eating it.
- **Trichomes:** Hair-like structures on leaves and stems that can trap or injure insects. **Example:** Tomato plants have glandular trichomes that also secrete sticky substances.
- **Thick Bark and Cuticle:** Protects against physical damage and prevents pathogen entry. **Example:** Trees like oak have thick bark as a barrier.





BY HAJRA SHAIKH (S. Y. B. Sc.)



“Plant Defence Mechanism”

2. CHEMICAL DEFENSES:

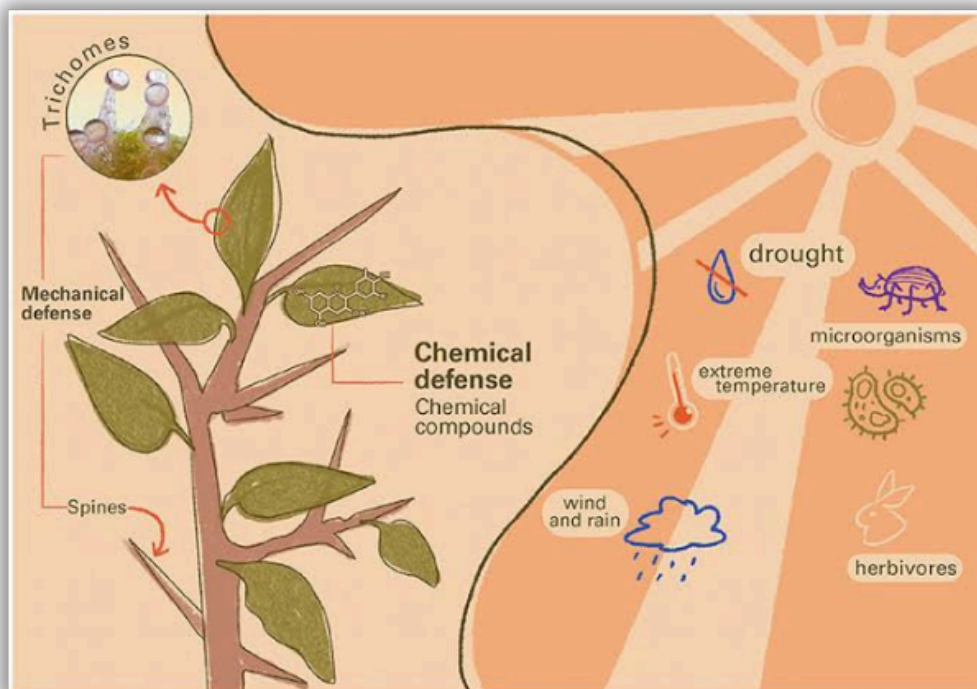
These involve production of toxic or deterrent substances.

- **Alkaloids:** Toxic compounds that affect the nervous system of herbivores. **Example:** Nicotine in tobacco is toxic to insects.
- **Tannins:** Bitter-tasting compounds that reduce digestibility. **Example:** Oak leaves contain tannins to deter grazing animals.
- **Latex and Resins:** Sticky substances that trap insects or seal wounds. **Example:** Rubber tree produces latex.
- **Phytoalexins:** Antimicrobial compounds produced in response to infection. **Example:** Soybean produces glyceollin as a response to fungal infection.

3. MIMICRY AND CAMOUFLAGE:

Plants may mimic other organisms or blend into their environment.

Example: Passionflower leaves mimic other species to avoid being eaten by butterfly larvae that prefer specific leaf types.

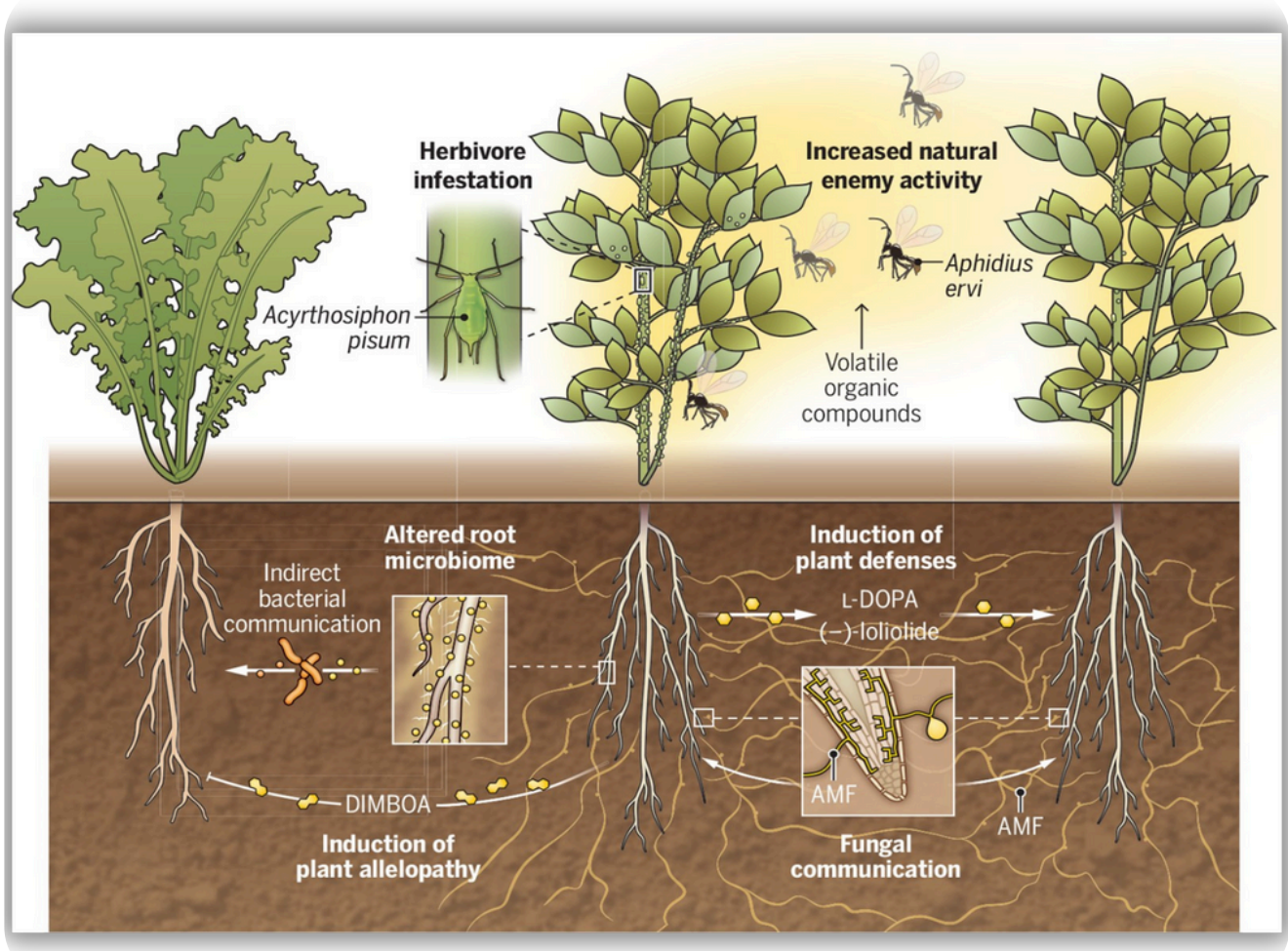


“Underground Communication in Plants”



BY SONAKSHI SANJIV KURIL (S. Y. B. Sc.)

INTRODUCTION



Communication among plants, once considered implausible, has now become a well-established concept in plant biology. While above-ground communication—via volatile organic compounds (VOCs)—has received considerable attention, underground communication, particularly through roots and mycorrhizal networks, is increasingly being recognized for its ecological importance. This form of communication plays a vital role in nutrient exchange, defense signaling, allelopathy, and the maintenance of plant community structures.





BY SONAKSHI SANJIV KURIL (S. Y. B. Sc.)



“Underground Communication in Plants”

1. ROOT EXUDATES AS CHEMICAL SIGNALS

Roots release a complex mixture of organic compounds into the soil, collectively known as root exudates. These include sugars, amino acids, phenolics, and secondary metabolites, which serve multiple communicative functions.

- **Allelopathic Interactions:** Some plants release chemicals that inhibit the growth of neighboring plants, a phenomenon known as allelopathy. For instance, *Juglans nigra* (black walnut) secretes juglone, which is toxic to many plant species (Rice, 1984).
- **Kin Recognition and Resource Allocation:** Recent studies suggest that plants can recognize genetic relatives through root-secreted signals. For example, *Arabidopsis thaliana* can alter its root growth behavior in response to the presence of kin versus non-kin (Biedrzycki et al., 2010).

2. MYCORRHIZAL NETWORKS AND THE “WOOD WIDE WEB”

Mycorrhizal fungi form mutualistic relationships with plant roots, creating extensive underground networks that interconnect different plants.

- **Nutrient Exchange:** These networks facilitate the transfer of nutrients like phosphorus and nitrogen between plants, often favoring younger or shaded individuals in a community (Simard et al., 1997).
- **Defense Signaling:** When a plant is attacked by pathogens or herbivores, it can transmit chemical signals through mycorrhizal networks to neighboring plants, priming their defense mechanisms (Song et al., 2010).

3. ELECTRICAL AND HYDRAULIC SIGNALING

Emerging research indicates that plants may also use electrical signals transmitted through root systems.

- **Electrical Potentials:** Changes in electrical potentials can propagate through roots, signaling neighboring plants about environmental stressors such as drought or salinity (Volkov & Shtessel, 2016).
- **Hydraulic Signals:** Water movement in roots in response to mechanical stress or water deficit can also serve as a form of underground communication.



“Underground Communication in Plants”



BY SONAKSHI SANJIV KURIL (S. Y. B. Sc.)

4. RHIZOSPHERE MICROBIOTA AS MEDIATORS

The rhizosphere—the narrow region of soil influenced by root secretions—is a hotspot of microbial activity. Plants can shape their microbial communities through exudates, indirectly influencing neighboring plants.

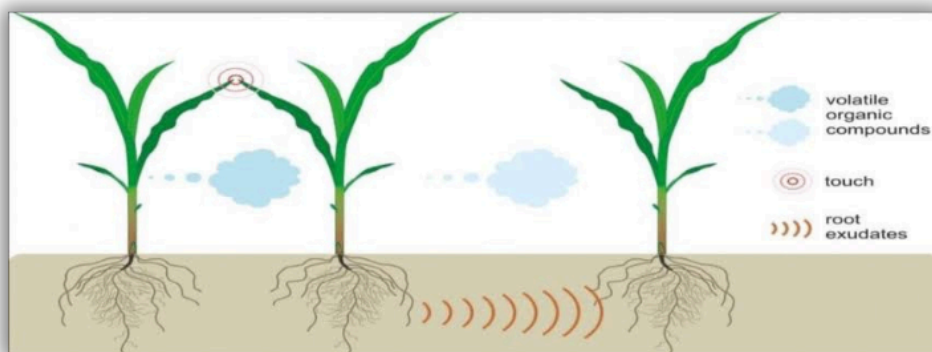
- **Induced Systemic Resistance (ISR):** Beneficial microbes such as *Pseudomonas fluorescens* can trigger ISR in plants, which may also affect neighboring plants through altered root exudation profiles (Pieterse et al., 2014).
- **Pathogen Suppression:** Communication through rhizosphere microbes can help suppress soil-borne pathogens and reduce disease spread in plant communities.

5. ECOLOGICAL AND AGRICULTURAL IMPLICATIONS

Understanding underground plant communication has significant implications for ecosystem management and sustainable agriculture.

- **Crop Rotation and Companion Planting:** Insights into allelopathy and nutrient sharing can inform practices like crop rotation and intercropping to enhance yields and soil health.
- **Biodiversity and Resilience:** Mycorrhizal networks promote biodiversity and resilience by facilitating mutual support among different plant species, especially under stress conditions.

CONCLUSION



Underground communication in plants, once hidden from scientific view, is now emerging as a key factor in plant behavior and ecology. From root exudates to mycorrhizal networks and microbial interactions, plants possess sophisticated mechanisms for interacting with each other below ground. Continued research in this field promises to unlock new strategies for ecological conservation and sustainable agriculture.



“Plant-Insect-Microbe Interactions”



BY SIDDIQUI RABIA (F. Y. B. Sc.)

Plant-Insect-Microbe Interaction: A Complex Ecological Relationship

INTRODUCTION

A Complex Ecological Relationship

Plants and Insects

Insects interact with plants in various ways. Pollinators like bees and butterflies aid reproduction, while pests such as aphids and caterpillars damage plant tissues.



Plants and Microbes

Insects carry microbes within or on their bodies. Some aid digestion or provide protection, others are harmful and may transmit plant pathogens.

Microorganisms

like bacteria and fungi can be found in soil, on plant surfaces, and within tissues.

Nitrogen-fixing bacterium

Three-Way Interactions

The interactions between plants, insects, and microbes are often interconnected, influencing defensives microbial communities, and plant health.

Plants, insects, and microbes form a deeply interconnected triangle in nature. These interactions significantly affect plant health, agricultural productivity, and ecosystem balance. Understanding how these lifeforms communicate and support (or harm) one another opens doors to sustainable and eco-friendly farming methods.

INTERACTION OVERVIEW WITH REAL-LIFE EXAMPLES

Insects play multiple roles — some, like bees and butterflies, pollinate plants and aid reproduction, while others, like whiteflies or aphids, damage plant tissues and spread disease. To protect themselves, plants have evolved defense strategies, including producing volatile compounds that repel pests or attract predatory insects like ladybugs. Meanwhile, microbes live in the soil, on roots, and even inside plant tissues — some are harmful, but many are beneficial.



“Plant-Insect-Microbe Interactions”



BY SIDDIQUI RABIA (F. Y. B. Sc.)

For example, *Rhizobium* bacteria form nodules on the roots of legume crops like peas and chickpeas, fixing atmospheric nitrogen and enriching the soil. Mycorrhizal fungi, found in association with crops like wheat and corn, improve water and phosphorus uptake, especially under drought stress. In disease prevention, *Trichoderma harzianum*, a fungus, protects tomato and cucumber plants from soil-borne pathogens like *Fusarium* by boosting root immunity. In another case, *Pseudomonas fluorescens*, a beneficial bacterium, suppresses disease-causing microbes in the rhizosphere of rice and wheat, reducing the need for chemical pesticides.

Insects interact with microbes too — some carry helpful gut bacteria aiding digestion, while others act as vectors, spreading plant viruses. For instance, the whitefly (*Bemisia tabaci*) spreads Tomato Yellow Leaf Curl Virus, causing major yield loss. But with support from beneficial microbes like *Bacillus subtilis*, plants can enhance systemic resistance and reduce viral impact.



CONCLUSION AND IMPORTANCE

The relationship among plants, insects, and microbes is not just a natural phenomenon—it’s a tool for sustainable farming. By applying beneficial microbes and encouraging natural predators of pests, farmers can reduce dependence on harmful chemicals. These biological allies improve crop health, enhance yield, and protect the environment. Embracing this natural network is key to creating resilient agricultural systems for the future.

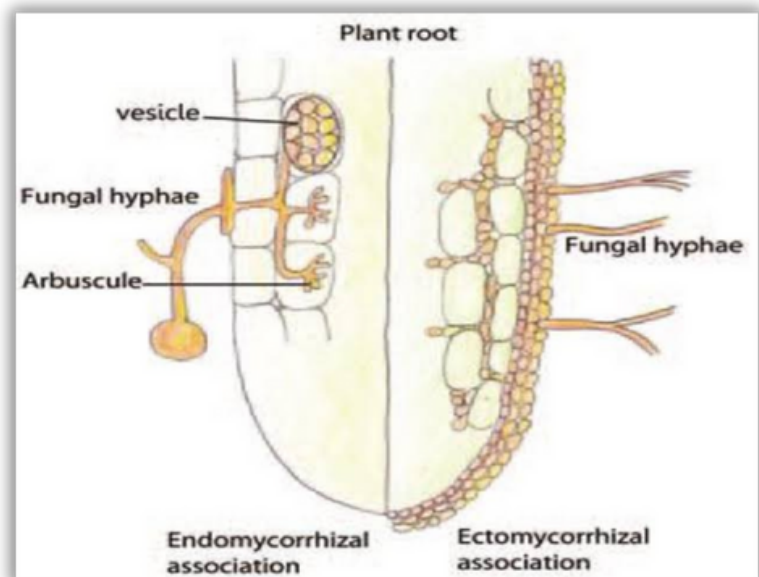
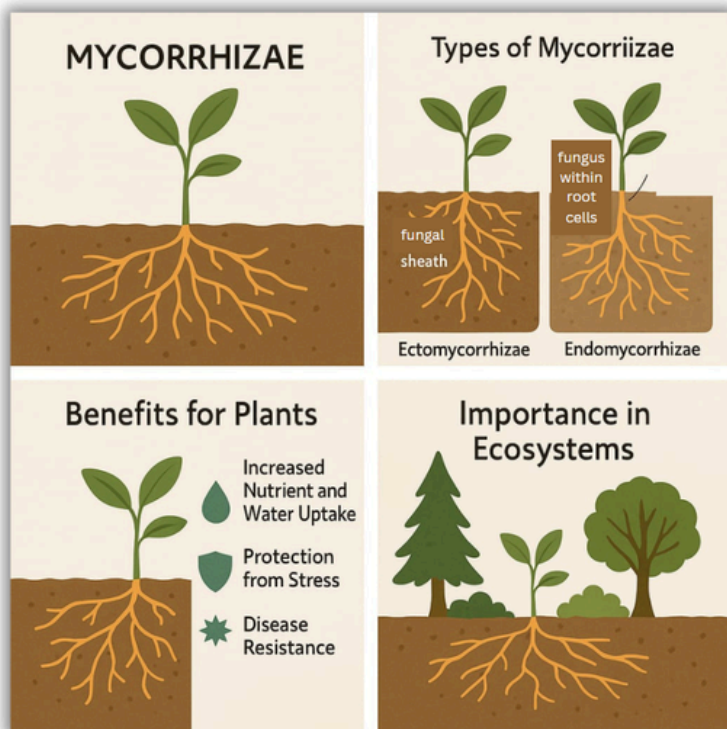


Mycorrhizal Associations in Plants



BY PRATIK GAIKWAD (F. Y. B. Sc.)

Mycorrhizae are symbiotic relationships between plant roots and fungi, found in 90% of land plants. Plants supply fungi with carbohydrates, while fungi improve water and nutrient uptake.



TYPES OF MYCORRHIZAE:

Ectomycorrhizae: In this type, the fungus wraps around the outside of the plant's roots and sends thread-like structures (called hyphae) into the surrounding soil.

Endomycorrhizae: Here, the fungus actually grows inside the root cells, while also spreading hyphae out into the soil.



Mycorrhizal Associations in Plants



BY PRATIK GAIKWAD (F. Y. B. Sc.)

HOW PLANTS BENEFIT?



Better Nutrient and Water Absorption: The fungal hyphae act like an extension of the plant's roots, reaching out further into the soil to pull in more water and nutrients.

More Nutrient Availability: Mycorrhizae help plants get access to nutrients like phosphorus, which are often hard to absorb directly from the soil.

Stress Protection: These fungi can make plants more resistant to tough conditions like drought, salty soil, and other environmental challenges.

Disease Defense: They also help plants fight off soil-borne diseases.



HOW FUNGI BENEFIT?

Food from Plants: In return for their help, fungi receive carbohydrates (sugars) that the plant makes through photosynthesis.

WHY THEY MATTER IN NATURE?



Mycorrhizal fungi are super important for keeping soils healthy and cycling nutrients. They have a big impact on the health of land ecosystems.



Mycorrhizal Associations in Plants



BY PRATIK GAIKWAD (F. Y. B. Sc.)



TYPES OF MYCORRHIZAE FUNGI:

ARBUSCULAR MYCORRHIZAE (AM):

These are the most common type, characterized by the development of arbuscules (highly branched structures) within root cortical cells. They also form vesicles for nutrient storage.

ERICOID MYCORRHIZAE:

These are found in plants of the Ericaceae family (e.g., blueberries, cranberries), where the fungus grows within the epidermal cells of fine hair roots.

ORCHID MYCORRHIZAE:

These are specific to orchids and play a crucial role in their nutrient uptake.

ARBUTOID MYCORRHIZA:

Type of mycorrhizal association that forms between certain Ericaceae family plants, like *Arbutus* and *Arctostaphylos*, and specific ectomycorrhizal fungi.



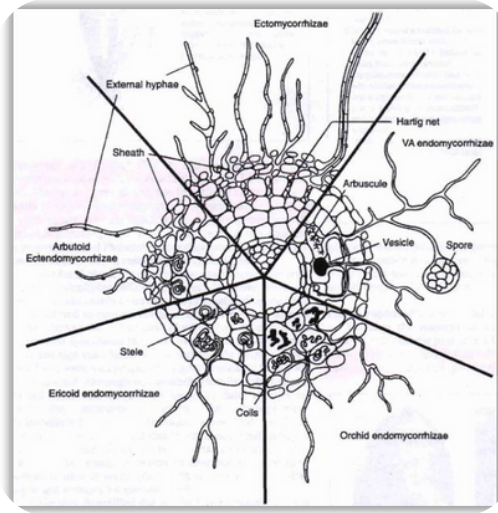
Mycorrhizal Associations in Plants



BY PRATIK GAIKWAD (F. Y. B. Sc.)

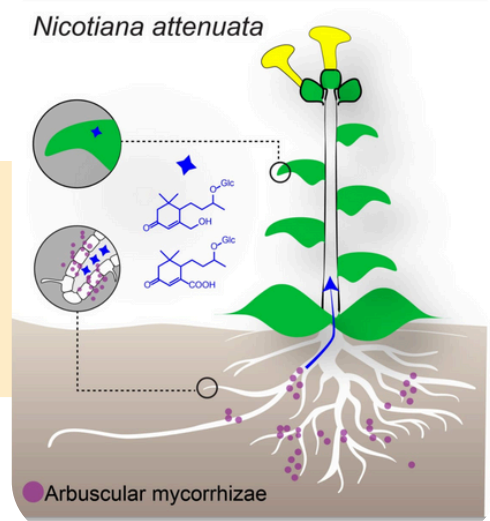
EXAMPLES:

Lots of plants—from big trees to small shrubs and even food crops form partnerships with mycorrhizal fungi.

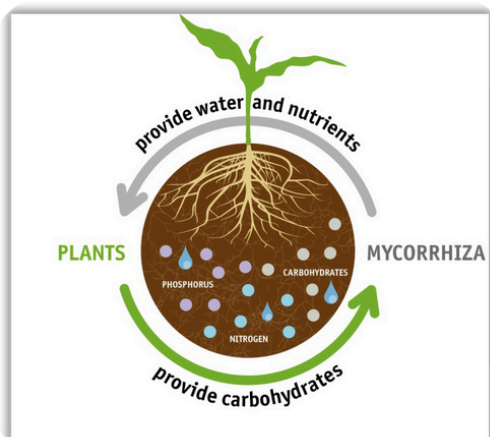


ARBUSCULAR MYCORRHIZAE (AM):

This is a very common type of endomycorrhizae. It's found in many plants, including a lot of the crops we grow for food.



USE IN FARMING:



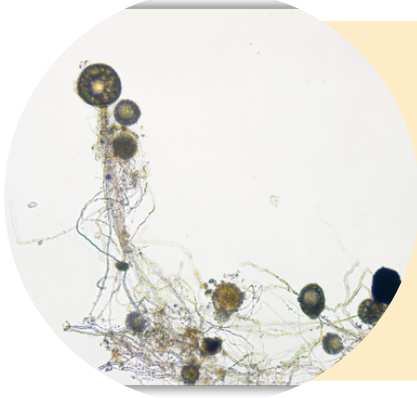
These days, farmers often add lab-grown mycorrhizal fungi to their fields. This helps crops grow better and become more resistant to pests, diseases, and changing climate conditions.



Mycorrhizal association in plant's



BY PRATIK GAIKWAD (F. Y. B. Sc.)

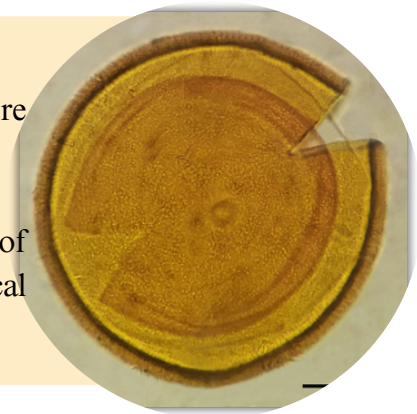


Glomus:

- This is a large and diverse genus of AM fungi, with numerous species found in various terrestrial habitats.
- *Glomus* species are known for their ability to form arbuscules and vesicles within the plant roots, which facilitate nutrient exchange.
- Examples of *Glomus* species include *Glomus aggregatum* and *Glomus constrictum*.

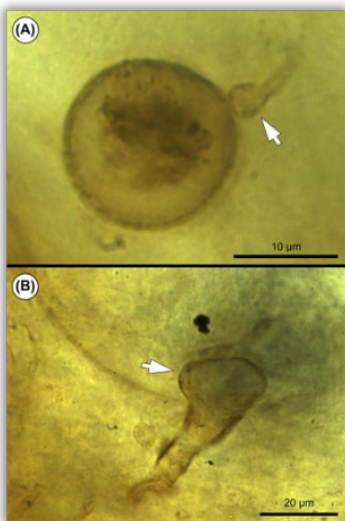
Acaulospora:

- *Acaulospora* species are characterized by their spores, which are borne laterally from a sporiferous sacculle.
- They are often found in arid and tropical environments.
- *Acaulospora* fungi can colonize plant roots through a variety of inoculum types, including spores, root fragments, and extraradical hyphae.



Gigaspora:

- *Gigaspora* species are known for their large, globose spores, often with a thick, smooth wall.
- They are commonly found in drier soils and are important for plant nutrition, particularly in phosphorus-deficient soils.
- Examples of *Gigaspora* species include *Gigaspora margarita* and *Gigaspora gigantea*.



Scutellospora:

- *Scutellospora* species are characterized by their spores, which have a distinctive scutellum (a shield-like structure).
- They are often found in a variety of soil types and play a role in plant nutrient uptake.
- Examples of *Scutellospora* species include *Scutellospora calospora* and *Scutellospora persica*.

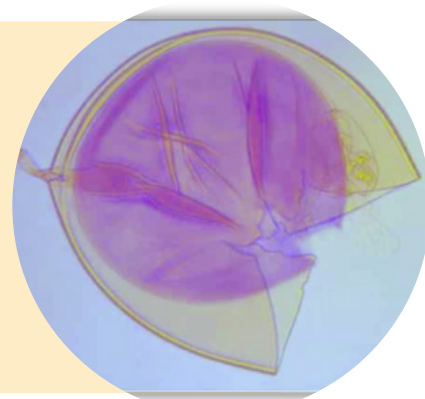




PHOTO GALLERY



Name: Hidden in Plain Sight (*Cycas revoluta*): Female Plant Showing Megasporophylls Bearing Ovules

Location: Nature Park, Babeli, Kullu District, Himachal Pradesh

Photographer: Sakshi Raj Kumar, (Assistant Professor)

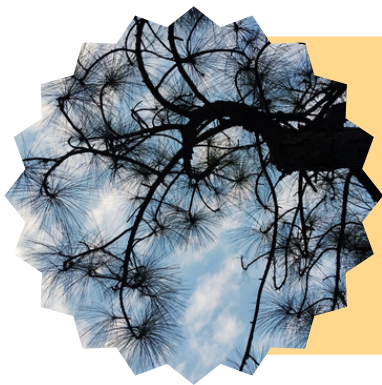
College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: Bearing the Chalice of Hope and Future: The Liverwort (*Marchantia* sps.)

Location: Eco Park, Near Mall Road, Manali, Himachal Pradesh

Photographer: Sakshi Raj Kumar, (Assistant Professor)

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)



Name: Pining for the Sky: The Indian Pine Tree (*Pinus roxburghii*)

Location: Nature Park, Babeli, Kullu District, Himachal Pradesh

Photographer: Sakshi Raj Kumar, (Assistant Professor)

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Hippeastrum striatum*

Location: Kerala

Photographer: Vrutika Chandrakant Waghela

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)





PHOTO GALLERY



Name: *Antigonon leptopus*

Location: Kerala

Photographer: Vrutika Chandrakant Waghela

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Dianthus chinensis*

Location: Byculla

Photographer: Anith Joshiea

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)



Name: *Torenia fournieri*

Location: Byculla

Photographer: Anith Joshiea

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Brugmansia suaveolens*

Location: Mahableshwar

Photographer: Anith Joshiea

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)





PHOTO GALLERY



Name: *Dianthus chinensis*

Location: Titwala

Photographer: Lynn Avila Thimson

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Clerodendrum paniculatum*

Location: Thrissur, Kerala

Photographer: Lynn Avila Thimson

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)



Name: *Centrosema virginianum*

Location: Thrissur, Kerala

Photographer: Lynn Avila Thimson

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Brugmansia suaveolens*

Location: Mahabaleshwar

Photographer: Selvamathi Kamaraj Nadar

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)





PHOTO GALLERY



Name: *Hemerocallis fulva*

Location: Mahabaleshwar

Photographer: Selvamathi Kamaraj Nadar

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Hydrangea macrophylla*

Location: Mahabaleshwar

Photographer: Selvamathi Kamaraj Nadar

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)



Name: *Pelargonium inquinans*

Location: Mahabaleshwar

Photographer: Selvamathi Kamaraj Nadar

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)

Name: *Chrysanthemum grandiflorum*

Location: Dharavi

Photographer: Selvamathi Kamaraj Nadar

College: SIES College of Arts, Science And Commerce (Empowered Autonomous), Sion (W)





PHOTO GALLERY



Name: *Doritaenopsis*

Location: Karnala

Photographer: Selvamathi Kamaraj Nadar

College: SIES College of Arts, Science And Commerce (Empowered Autonomous),
Sion (W)

Name: *Heliconia psittacorum*

Location: Rani Baug

Photographer: Sonakshi Sanjiv Kuril

College: SIES College of Arts, Science And Commerce (Empowered
Autonomous), Sion (W)



Name: *Sphagneticola trilobata*

Location: Matheran

Photographer: Sonakshi Sanjiv Kuril

College: SIES College of Arts, Science And Commerce (Empowered Autonomous),
Sion (W)

Name: *Caesalpinia pulcherrima*

Location: Karnala

Photographer: Sonakshi Sanjiv Kuril

College: SIES College of Arts, Science And Commerce (Empowered
Autonomous), Sion (W)





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