

FLOWERING PARASITIC PLANTS

Aim: To Acquaint the students with characteristics of flowering parasitic plants

Characteristics of Flowering Parasitic Plants

- The pathogenic flowering plants, also called parasitic angiosperms can be classified as root parasites or stem parasites.
- Root parasites (witchweed and broomrape) are more common and more diverse taxonomically.
- Stem parasites include the dodder (*Cuscuta*) and mistletoes (*Arceuthobium*).
- The angiospermic parasites can also be classified as holoparasites (total parasites) or hemiparasites (semiparasites).
- The holoparasites lack chlorophyll and are totally dependent on the host for nutrition. Thus, they are obligate parasites.
- The hemiparasites contain chlorophyll and make their own food, and absorb water and minerals from their host. But, in some cases, e.g., *Arceuthobium*, the photosynthesis is negligible and the parasite draws nutrition from the host. Practically, it is an obligate parasite.

Important Genera

- There are 277 genera and as many as 4100 parasitic plant species; but only 25 genera are recognized as plant pathogens.
- Out of these 25 genera, four are more damaging to crops viz., *Striga* (witchweed), *Orobanche* (broomrape), *Cuscuta* (dodder) and *Arceuthobium* (dwarf mistletoe).
- *Striga* is more prevalent in Asia and Africa, while *Orobanche* is worldwide, but more damaging in the Middle East.
- Both *Striga* and *Orobanche* produce microscopic seeds called “dust” seeds that persist in the soil for a long time, and are difficult to control.
- Dwarf mistletoes (*Arceuthobium* spp.) are the major pathogens of coniferous trees (belonging to families *Pinaceae* and *Cupressaceae*).
- *Dendrophthoe* (*Loranthus*) and *Viscum* species are parasitic on the forest, fruit and avenue trees; and are responsible for their die back and drying in Himachal Pradesh.

Root Parasites

Striga (whichweed)

- *Striga* is an obligate root hemiparasite, although the seedlings above ground do form chlorophyll.
- *Striga* has made greater impact than any other parasitic angiosperm.
- It attacks important crops like maize, sorghum, pearl millet, rice, sugarcane and legumes (cowpea, groundnut, etc.).
- Two species, *S. asiatica* and *S. hermonthica* cause maximum damage to crops.
- *Striga* has a complex life cycle. It produces thousands of „dust“ seeds that are disseminated by wind and rain.
- The seeds after a dormant „ripening“ period of several months, respond to chemical signals exuded by the host.
- The chemical signals enable the *Striga* seeds to detect the type of host and its distance from the host.
- Seed germination of *Striga*, as in all obligate root parasites, is cryptocotylar i.e. the cotyledons remain within the seed when the radical comes out.
- The radical produces root hair like structures that glue it to the host.
- If the host is suitable, a haustorium is formed that penetrates and forms a link with the host vascular system.
- Once the parasite is established, the distinctive seedling of *Striga* is formed underground, which lacks chlorophyll, possesses scale-like leaves, and produces abundant adventitious roots that form additional haustoria, establishing more connections with the host.
- The seedlings exert great influence on the growth-regulating metabolism of the host, stimulating root production.
- Significant damage to the host occurs at this stage. The next stage is emergence of the seedlings above ground.
- Chlorophyll develops, and in due course, flower and seeds are formed. The life cycle is ready for a repeat.
- A major problem in control is persistence of the tiny seeds in the soil. Ethylene gas is introduced into the soil to induce seed germination, which becomes suicidal in absence of the host.
- Equipments and application methodologies have been developed to introduce the gas into the soil.

- Up to 90% seeds germinate by this method, and die in absence of the host.



Partial root parasite-*Striga*



Total root parasite-*Orobanche*

Orobanche (broomrape)

- This is an obligate root holoparasite, infecting legumes, solanaceous crops, carrot, cabbage, cauliflower, lettuce and sunflower.
- Total crop failure may occur in heavily infested soils. The parasite appears as whitish, yellowish or brownish stems, about 30 cm high that arise from the roots of infected host, and bear beautiful flowers, besides bracket-like leaves lacking chlorophyll.
- In general, *Orobanche* is a parasite of colder climate and need 10-20°C of temperature for seed germination.
- This is the reason why it attacks tobacco during winter in India, but fails to infect sunflower during summer in the same field.
- Seed germination requirements of *Orobanche* are different from those of *Striga*.
- It needs low temperature (10-20°C); the germinated seeds are geotropically neutral i.e. they do not grow downward in the soil and ethylene has no stimulatory effect.
- Its control is difficult due to the high longevity (more than 5 decades) of the seeds in the soil, their extremely small size (less than the thickness of human a hair), their production in extremely large number, and subterranean infection.

Stem Parasites

***Cuscuta* (dodder)**

- It is obligate stem holoparasite and is among the best known of all parasitic plants.
- Its slender, twining, orange-yellow, leaf less stems form conspicuous tangled mass on the host.
- The host range is large, though monocots are less preferred.
- Dodders are most important parasites of legumes.

- *Cuscuta campestris* is the most widely distributed among its 10 species that attack crops.
- It causes considerable damage to alfalfa, flax, sugarbeet, onion and other crops besides fruit, fodder and forest trees and shrubs . It also transmits viruses.
- The most effective means of control is seed sanitation. Several herbicides are effective on newly-germinated seeds.



Dodder (*Cuscuta* sp.)



Showy mistletoe (*Dendrophthoe*)



Leafy mistletoe (*Viscum* sp.)

Mistletoes

- Mistletoes are stem holoparasites occurring in three families of the order *Santalales* as follows:
- Family *Loranthaceae*: Showy mistletoes [*Loranthus* (*Dendrophthoe*)]
- Family *Santalaceae*: sandalwood (*Pyrularia*, *Santalum*)
- Family *Viscaceae*: Dwarf mistletoe (*Arceuthobium*), leafy mistletoe (*Viscum*)
- The showy “mistletoes” produce large and beautiful flowers that are pollinated by birds.
- The co-evolution of these parasites and the birds is also suggested by the seed dispersal mechanism operating in the birds.
- *Santalaceae*, the sandalwood family have a few members (*Pyrularia* etc.) that cause negative impact on their hosts.
- Family *Viscaceae* is called “Christmas mistletoe family”, because their shoots with the white berries are used as door festoons during Christmas in temperate countries.
- The family has seven genera, and a large number (543) of species, most of which belong to three genera, *Viscum*, *Phoradendron* and *Arceuthobium*.
- The seeds are covered with a sticky substance, called „viscin” that glues the seeds to the host surface.

***Arceuthobium* (Dwarf mistletoe)**

- *Arceuthobium* is the most important mistletoe in terms of economic losses, especially to the coniferous trees belonging to families *Pinaceae* and *Cupressaceae*.
- 11.3 million cubic meters of wood is lost annually due to the „dwarf mistletoe“ *Arceuthobium* in the US.
- It is a small (1.0-2.5 cm long) plant having green to brown aerial shoots, without secondary branching.
- Leaves are small, scale- like leaves. The major function of the aerial shoot is reproduction.
- The flowers are small and unisexual, present on same (monoecious) plants or on different (dioecious) plants.
- Pollination is brought about by insects and wind.
- Male aerial shoots are shed soon after pollination, but the female shoots persist until the seeds are formed and dispersed.
- Remnants of the aerial shoots persist as basal cups, on the host tree, where once the aerial shoots were formed.
- The seeds, which are discharged explosively from the fruit at the rate of 27 metres per second, reach up to 16 metres.
- The seed sticks to the surface by the viscin coating.
- It slides to the base of the “needle” where it germinates.
- The radicle forms a hold fast from which the haustorium emerges and penetrates the host tissue.
- Thus endophyte is formed, but it takes one year to form the aerial shoots, and 3-10 years to complete the life cycle (infection to seed dispersal).
- This long life cycle is profitably used in disease management.
- Selective removal of infected trees has been highly effective in controlling *Arceuthobium* infestation.
- Chemical control has also been successful with ethephon, an environmentally safe chemical.