BROOMRAPE or Orobanche is a complete root parasite in mustard. Parasitic weeds are those flora which require growth stimulants for seed germination and a host plant to support their growth, development and complete life cycle. Parasitic weeds are gaining importance in recent times in view of their wide spread agro ecologies. Many of them are host specific and difficult to manage. Parasitic weeds have certain specific characteristics like prolific seed production potential, competitiveness and aggressiveness with the host crops, prolonged seed viability, pernicious habits etc. Parasitic weeds depend on host plant for stimulants for germination, photosynthates, minerals, etc.

Parasitic weeds are two types based on dependence on host plants – complete parasite which depends on host plants entirely for its survival and semi-parasite which depends on host plants for physical support, nutrients, water, photosynthates, minerals, etc. Parasitic weeds are two types based on occurrence on – a) root parasite like Striga being partial parasite occurring on sorghum, maize, sugarcane, and Orobanche being complete parasite occurring on tobacco, tomato, brinjal, potato, mustard, etc; and b) stem parasite like Cuscuta being complete parasite occurring on Lucerne, fennel, niger, bengal gram, plantation crops, hedge plants, etc. and Dendrophthae being partial parasite occurring timber crops, fruit trees, plantation crops, etc.

Status of Orobanche

Broom rape, Orobanche belongs to family, Orobancheceae and has 130 species. Out of this, only four species are parasitic occurring on various crop plants in the world. Only two species namely O. cernua and O. aegyptica are predominantly found in India. The broom rape is serious in Eastern Europe, Russia, and Mediterranean countries.

- **Orobanche cernua** Loefl

  (Orobanche cumana Wallr.): This species occur mainly on tobacco, sunflower, tomato and brinjal in the world. The parasite is devoid of chlorophyll and has stem of brown or yellowish brown coloured flowers growing to height of 60 cm on the host plant during its life cycle.

- **Orobanche crenata** Forskal: The main host plants are carrot, tomato and peas. The stem is devoid of chlorophyll with whitish purple coloured flowers growing to a height of 50 to 100 cm on the root of host plants.

- **Orobanche ramosa** L.: This species is reported to occur on carrot, cabbage, cotton, tobacco, sunflower and tomato crops. The stem is light or deep bluish coloured flowers growing to a height of 10 to 30 cm on the roots of host plants. The stem is devoid of chlorophyll.

- **Orobanche aegyptica** Pers.: The reported host plants for this species are cotton, cucurbits, brinjal, potato, tobacco and tomato. The stem is devoid of chlorophyll with light to deep green leaves and hence depends on host plants for photosynthates, while the latter have green leaves and synthesize photosynthates on its own for its survival. Parasites are of two types based on occurrence on – a) root parasite like Striga being partial parasite occurring on sorghum, maize, sugarcane, and Orobanche being complete parasite occurring on tobacco, tomato, brinjal, potato, mustard, etc; and b) stem parasite like Cuscuta being complete parasite occurring on Lucerne, fennel, niger, bengal gram, plantation crops, hedge plants, etc. and Dendrophthae being partial parasite occurring timber crops, fruit trees, plantation crops, etc.
crops can be seen. Seeds are dark brown, oval and very small (0.35 x 0.25 mm) and viable in soil up to 5 - 20 years. Seed production potential of this weed is 5000 to 5,00,000 per shoot in a growing season. Thus seed to seed duration is about 90 days (45 days below the soil after germination and 45 days above the soil till drying of the shoot).

The broomrape seeds disseminate by wind, birds, farm animals, implements, water, seeds, etc. They can remain dormant in soil for 2 - 20 years.

Stem: Solitary, 10-40 cm long, round, thickened at the base; stems arising from a common base, brownish yellow, covered with small acute scale leaves which are boat shaped with yellow base and dull brown tips.

Inflorescence: Cylindrical fleshy spike bearing many bluish flowers.

Flower: Bluish, long and curved. Flower size 20 x 5 mm.

Bract: Single, ovate, boat shaped 15x5 mm size.

Calyx: Two sepals, separate, each sepal is bifurcated either deeply or shallow at its tip, sometimes not bifurcated, 15x4 mm size, both sepals equal in length and the tips are bluish.

Corolla: Long, curved and tubular, 20 x 5 mm size, 5 united petals (2 upper big lips + 3 lower small lips), corolla tips are deep-bluish while the base is whitish.

Androecium: Stamen 4, epipetalous attached to corolla at mid height, di-dinamous 2 + 2, filaments pale yellow with stout base, attached at a mid point dorsally to the anthers. Anther dithecus, lobes pointed at the base, pale yellow, placed slightly below the stigma, rarely in level with stigma, anthers extrose, also introse, anther lobes after dehiscence boat shaped.

Gynoecium: Ovary superior, unilocular, bicaudate, syncarpous, yellow, normal in size with ovules on parietal placenta, numerous ovules, stigma bifid, tridi and tetra, fruit is a capsule containing many reticulate brown seeds, seeds are oval in shape.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Yield loss (%)</th>
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<tbody>
<tr>
<td>Tomato</td>
<td>30-50%</td>
</tr>
<tr>
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</tr>
<tr>
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<td>30-70%</td>
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### Biology of Weed

Broomrape is an annual, host specific parasitic herb propagated by seeds and gets germinated if the host root exudates reaches the seed for one week and if the seeds lie within 10 mm distance from host fibrous roots. The parasite seedlings then infect the nearby host roots forming haustoria on them. Soon thereafter the broomrape emerges through the soil as pale shoots, devoid of chlorophyll around 45 to 55 days after planting host crops. It starts flowering a week after emergence, fleshy shoot grows up to 20 to 30 cm and dries up in 30 to 40 days. Each shoot can produce as high as 6.0 lakh seeds and as high as 20 to 30 shoots/plant of tobacco or tomato crops can be seen. Seeds are dark brown, oval and very small (0.35 x 0.25 mm) and viable in soil up to 5 - 20 years. Seed production potential of this weed is 5000 to 5,00,000 per shoot in a growing season. Thus seed to seed duration is about 90 days (45 days below the soil after germination and 45 days above the soil till drying of the shoot).

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### Management of Orobanche in crops

Broomrape being infesting crops also infests weeds like *Parthenium hysterophorus*, *Solanum kasianum* and *Physalis minima* and thus perpetuate by forming numerous seeds. Therefore, integrated efforts of preventive, physical, cultural and chemical approaches should be adopted to destroy these weeds before they set seeds.

The use of seeds from infested areas and clean seeds; deep plowing incorporates seeds well below root zone and prevents the contact of the stimulants of host crops with the parasite seeds; soil solarisation with the use of 0.05 mm thick white polyethylene sheets for 30 to 40 days during hot summer, though expensive can lower the menace by 60 to 80%; flooding of the field during germination of parasite (i.e. around 20-25 days after planting); physical removal of emerged shoots of parasite and burning them; repeated directed application of 1 to 2 drops of mineral oils – diesel, kerosene or plant oils – coconut, neem, castor, cottonseed, gingili or linseed on emerging shoots before flowering would desiccate them and prevent seed formation; passing spear or iron blade below the host plant would cut young shoots of parasites followed by manual removal of shoots with in the rows, collecting and burning them; use of trap crops – pepper (*Capsicum annum* L.), Amaranthus, cowpea, green gram, black gram, pigeon pea, Dhaninch for 3 to 4 seasons before taking up main host crops in sick fields (Acharya et al., 2002); use of suitable intercrops in areas having lower infestation of parasite; soil application of analogue of Strigol – GR-24 or GR-7 at 0.3 kg/ha in acid soil to 1.5 kg/ha in alkaline soil about 6 weeks before sowing of host crops induce suicidal germination of the parasite; use of pre-emergence herbicides relevant to the host crops will delay and lower the emergence of broomrape; use of ammoniacal or urea based fertilizers
at 2 mg/liter of water lowers the emergence and length of the radicals of the parasite; directed spraying of glyphosate at 0.1 to 0.2% on the lower side of the host plants around 50-55 days after planting, use of neem cake at 150 to 200 kg/ha in rows at planting, soil drenching with 5% copper sulfate around host crops between 45 to 55 days will lower the emergence of broomrape.

Mustard could be made free from Orobanche infestation with post emergence application of glyphosate at 25 and 50 g/ha at 30 & 55 DAS, respectively but at harvest some minute panicles were observed exhibiting 85% control of Orobanche aegyptiaca over control. Although application of glyphosate 50 g/ha at 55 DAS and 25 g/ha at 55 DAS gave 75.3 % control of this weed but about 10% suppression in crop growth was observed. Maximum seed yield of mustard (1674 kg/ha) was observed with use of glyphosate 25 and 50 g/ha at 30 and 55 DAS, respectively which was at par with all glyphosate treatments. Presence of Orobanche throughout crop season caused 24.5% reduction in seed yield of mustard as compared to use of glyphosate at 25 and 50 g/ha at 30 and 55 DAS, respectively.

**Best management methods**
- Soil solarization by using 0.01 mm (10 micro meter) thick polythene sheet for 40 days during summer.
- Deep ploughing during summer, which causes the desiccation of the seeds of the parasite and incorporates the seeds below the root zone, which prevents the germination of the parasite, and further devastation.
- In areas infested with tobacco, grow the trap crops like sorghum, pearl millet, chilli, cotton, castor, sesameum, niger, soybean, linseed, Amaranthus, turmeric, green gram, Bengal gram, horse gram, cow pea, red gram, black gram, lucerne and sunhemp. These trap crops produce the root exudates and cause the suicidal effect for broomrape, but cannot find attachment to root system of the trap crops. The identification of trap crops for tomato, potato and brinjal are to be made.
- Growing of tomato, brinjal and potato or any other susceptible host plants needs to be discontinued for at least 5-10 years. Use trap crops continuously or alternatively to exhaust the seed bank of the parasite.
- When the Orobanche inflorescence emerges from the soil, remove before flowering and burn them to avoid seed production and dispersion.
- Swab the inflorescence with kerosene or vegetable oils, which makes the parasite to desiccate, by which the pollination and seed formation is prevented. This restricts further perpetuation of the parasite.
- Isolation of the sick field is a must. Sufficient care has to be taken to prevent the spread of the weed to the neighbouring fields through irrigation water, avoid movement of humans, animals and implements from the sick filed to the neighbouring fields.
- Feeding to cattle is also prevalent in some of the areas as it stimulates the milking of milch animal.
- Recently, availability of glyphosate-resistant crops has provided an alternative in broomrape infested areas.

**SUMMARY**

Orobanche, or broomrape is a complete root parasite in mustard, tobacco, tomato, brinjal, potato etc. Various management practices are available to stop the menace of this parasite to check a huge economic loss of the crop.