MANAGEMENT OF OROBANCHAEAE IN TOBACCO

BY: Dr. D. K. ROY
Sr. Scientist cum Assoc. Prof.
Dr. Rajendra Prasad Central Agricultural University
INTRODUCTION

• Tobacco (Nicotiana spp.) is an important cash crop.
• Belongs to family Solanaceae and is a herbaceous annual plant.
• Smoked as pipe, cigar, cigarette or hookah, and also used as snuff or chewed as a liquid in various forms.
• India ranks third in the world tobacco production and second in the flue-cured tobacco exports.
• In Bihar, tobacco is generally grown in few districts like Samastipur, Muzaffarpur and Vaisali.
• Produces nicotine sulphate which is used as an insecticide.
• Most commonly used as a drug.
• Tobacco seed contains 35-38% nicotine free oil. It is used in making soap and colours. Its cake is used as a cattle feed.
# COMMON WEEDS OF TOBACCO

<table>
<thead>
<tr>
<th>BROAD LEAVED WEED</th>
<th>GRASSES</th>
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</thead>
<tbody>
<tr>
<td>Orobanchae sp.</td>
<td>Dactyloctinum aegyptium</td>
</tr>
<tr>
<td>Trianthema portulacastrum (L.)</td>
<td>Cynodon dactylon</td>
</tr>
<tr>
<td>Parthenium sp.</td>
<td>Panicum repens (L.)</td>
</tr>
<tr>
<td>Commelina beghalensis</td>
<td>Echinochloa colonum (L.)</td>
</tr>
<tr>
<td>Amaranthus viridis (L.)</td>
<td>Chloris barbata SW.</td>
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</table>
OROBANCHAE: MOST PROMISING WEED

- Commonly known as broomrape.
- The Orobanche genus includes six species that are of agricultural importance and cause devastating yield and quality losses to many agricultural crops around the globe.
- Orobanche aegyptiaca is the most dominating one in India; however, localized infestation of two other species namely O. cernua and O. ramosa has also been observed to some extent.
- In most cases O. cernua and O. ramosa attack the crops of Solanaceae family like Lycopersicon esculentum, Nicotiana tabacum, Solanum tuberosum, Solanum melongena and cause the yield loss of more than 75 percent (Kamel F.2005).
- Infest the field at the topping stage or at the later stage of crop growth.
- Found to be attached with the tobacco roots.
- Totally parasitic weed of tobacco.
- Observed on many host plants according to their species.
OROBANCHAE INFESTATION IN TOBACCO

Infesting as root parasite
WEED CONTROL IN TOBACCO:

• As the parasite takes in all the necessary water and nutrients from the host root through a fragile connection called haustoria, the host plants get stunted in growth, leading to a heavy yield loss.
• Depending upon the time of emergence of the parasite and favourable weather condition, yield loss ranges from 25 to 75 percent (Krishnamurthy et al., 1976).
• While reviewing the weed control in tobaccos Hears (1971) laid more stress on *Orobanche* control.
• Knowledge of all aspects of the life-cycle of *Orobanche* is of prime importance.
LIFE CYCLE OF OROBANCHAE:

AERIAL PHASE

- Flowering
- Emergence

UNDERGROUND PHASE

- Nodule Development
- Establishment
- Seed Germination
- Non-germinated Seed
- Seed Dispersion
CONSTRAINTS TO CONTROL OROBANCHAE

• The parasite produces large quantities of tiny seeds.

• The seeds remain viable in the soil for long periods, possibly up to 20 years (Puzzilli, 1983; Linke et al., 1989)

• In general, parasitic seeds only germinate if a suitable host is present; germination is being triggered by compounds exuded by the host's roots (Koch, 1887).

• Because broomrape can infect the host from a depth of 30 cm, a great volume of soil must be considered for treatment.

• The farmer's awareness of the problem arises only when the parasite is emerging.

• Removal of the parasite by mechanical means is difficult. Hand pulling of broomrape is not very effective in heavy infestations, because only emerged broomrapes are removed and shoots of the parasite will continue to emerge over a long period.
CONTROL MEASURES:

• **Preventive measures:**

  • A management or eradication program must aim at reducing this seed bank, while minimising the production of new seeds and their dispersal to new sites.
  
  • Quarantine is therefore essential.
  
  • Proper phytosanitary measures in and around the field are necessary to reduce the spread of *Orobanche*.
  
  • Farm equipment and machinery should be cleaned prior to their use in uninfested fields. Special care must be applied to disinfection and cleaning of field machinery and harvesters, and avoid trucks going from infested to non-infested fields.
  
  • *Orobanche* shoots should be removed prior to flower opening. The collected shoots should be burnt or disposed off properly.
  
  • Grazing animals should be forbidden to enter un-infested fields after grazing infested areas (Panetta and Roger, 2005).
PHYSICAL CONTROL:

- **Hand weeding**: 
  - Prevents seed production and further build-up of a seed bank.
  - Systematic hand weeding for 3 - 7 consecutive years completely eliminated the *Orobanche cernua* infestation on tobacco (Pal and Gopalachari, 1957; Krishnamoorti and Krishnan, 1967).
  - Yet it is very expensive, time-consuming and may cause injury to the crop plants.
  - Implements like spear to cut the parasite up to 5 cm deep or more beneath the soil surface at any time between the emergence of the parasite and before the onset of flowering. Later, minispear or leaf pusher for air cured tobacco.
• **SOIL SOLARIZATION**

  • Soil solarization has been proven to be the most effective methods in controlling broomrape in open crops fields (Haidar and Sidahmad, 2000).

  • Solarisation is a technique of control, not eradication. Solarisation may be more effective if combined with added nitrogen fertilisers; this can dramatically improve the kill of *Orobanche* seed at greater depths.

  • The temperatures of 48-57°C kill *Orobanche* seeds that are in the imbibed state; therefore soil must be wet at the time of treatment.
CULTURAL CONTROL:

SOWING OR PLANTING

• Late planting may control *Orobanchae* in several crops but in tobacco it is not feasible due to reduced soil moisture.

FLOODING OR IRRIGATION

• Kills the parasitic weed seeds either by preventing the germination and infection or by suicidal germination.

• Short-term flooding or irrigation may induce dormancy, enhance already existing dormancy or prevent conditioning of the seed, thus enhancing the chance of seed decay before germination can occur. Proper irrigation schemes can therefore also control *Orobanche* spp. to some extent.

• Seeds soaked in water for one month lost their viability (Marudarajan, 1950).
SOIL TILLAGE

• Deep ploughing in summer reduced the broomrape incidence on air-cured tobacco by 30% in sandy loam soil and deep ploughing in summer also resulted in a significant increase in the tobacco yield (Khot et al., 1987).

• While deep ploughing in the monsoon season reduced it by 26% - 36% as compared with only harrowing (Krishnamurthy et al., 1987).

• Zero tillage has also been suggested as a control measure (Van Hezewijk 1994). Zero tillage can keep the seeds above the layer where attachments occur.
CROP ROTATION:

- Crop rotation with non-hosts/trap crops is a feasible method to control the parasite only in a long rainy season, or wherever supplemental irrigation facilities are available.

- A long rotation with tobacco grown once in 3 years preceded by chilli (*Capsicum annuum*) reduced the level of broomrape infestation considerably (Marudarajan, 1950).

- Growing sorghum, maize and paddy before tobacco seem to have a controlling effect on broomrape in the succeeding tobacco.

- Chilli, Deccan hemp, wild Moong, Sorghum, Niger, Greengram, Bengalgram, Chicory, Horsegram, Cowpea, Redgram, Blackgram, Soybean, Cotton, Linseed, Lucerne and Castor crops were identified as trap crops (Krishnamurthy and Chandwani, 1975; Krishnamurthy et al., 1977).
USE OF RESISTANT OR TOLERANT VARITIES:

- An attractive approach for tackling the broomrape problem.
- Breeding efforts showed that one should not be optimistic about developing resistant tobacco varieties (Puzzilli, 1983).
- Krishnamurthy et al. (1982) screened 49 tobacco varieties for resistance against broomrape and found no resistant type.
- Genetic engineering can help to develop resistant cultivars (Gressel et al. 1994).
**OTHER HERBICIDES & FUMIGANTS:**

- **Pre-planting or pre-emergence** destroys the seed bank, prevents the germination and disrupts the germinating seeds or advanced stages of the parasite before emergence.
- Application of post emergence selective herbicides before flowering of the parasite may reduce the multiplication of the parasitic weed seeds.

**Pre-emergence Application**
- Pesticides such as nemagon, dazomet, methomyl, metham sodium, brestan, thiram, tridemorph, dinocap and carboxin reduced the emergence of the parasite (Krishnamurthy et al., 1979, 1982).
- Since soil application is involved, the high cost, pesticide residue problems and environmental problems are discouraging to farmers.
POST EMERGENCE APPLICATION:

- Spraying of 0.1% allyl alcohol on young broomrape shoots led to 66% mortality and soil application of the same chemical at planting points 2 or 4 weeks after planting tobacco suppressed the emergence of broomrape (Pillai and Murty, 1968).

- Fluchloralin and alachlor (2 kg/ha) reduced the incidence of broomrape on air-cured bidi tobacco (Palled, 1979).

- Glyphosate is a systemic herbicide found effective in controlling broomrape either before or after emergence of the parasitic shoots.
MANAGEMENT OF OROBANCHE IN TOBACCO

- Neem cake 200 kg/ha at sowing fb soil drenching of metalaxyl MZ 02.% at 20 DAP was found effective in controlling *Orobanche* shoot and producing the highest tobacco yield (23.92 q/ha) and fetching the highest net return (Rs. 342600/ha) and B:C ratio (2.20).

<table>
<thead>
<tr>
<th>Herbicides</th>
<th>Number of Orobanche / tobacco plant</th>
<th>Tobacco Yield (t/ha)</th>
<th>Gross return (Rs/ha)</th>
<th>Net Return (Rs/ha)</th>
<th>B:C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 DAP</td>
<td>90 DAP</td>
<td>At harvest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neem cake 200 kg/ha at sowing fb soil drenching of metalaxyl MZ 02.% at 20 DAP</td>
<td>5.1</td>
<td>8.12</td>
<td>12.05</td>
<td>2.39</td>
<td>478400</td>
</tr>
<tr>
<td>Imazethapyr 30 g/ha at 40 DAP</td>
<td>10.88</td>
<td>13.95</td>
<td>16.75</td>
<td>1.71</td>
<td>341000</td>
</tr>
<tr>
<td>Glyphosate 0.2 g/L at 20 DAP</td>
<td>9.10</td>
<td>11.93</td>
<td>15.18</td>
<td>1.89</td>
<td>377400</td>
</tr>
<tr>
<td>Soil drenching of metalaxyl MZ 0.2% at 20 DAP</td>
<td>6.95</td>
<td>5.80</td>
<td>14.70</td>
<td>1.98</td>
<td>395000</td>
</tr>
<tr>
<td>Weedy check</td>
<td>22.35</td>
<td>25.75</td>
<td>26.85</td>
<td>1.53</td>
<td>305000</td>
</tr>
<tr>
<td>S. Em±</td>
<td>0.21</td>
<td>0.61</td>
<td>0.70</td>
<td>0.05</td>
<td>4121</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>0.65</td>
<td>1.83</td>
<td>2.12</td>
<td>0.15</td>
<td>12365</td>
</tr>
</tbody>
</table>
BIOLOGICAL CONTROL:

- Biological control is an effective method since it is relatively cheap, specific to the target organism and not harmful to the environment.
- Prevention of build-up of the seed quantity in the soil can be through prevention of the formation of seeds or the removal of viable seeds.
- Including trap crops (non-hosts) and catch crops (hosts) in the rotation may help to reduce the parasitic weed seed quantity in the soil by inducing suicidal germination or destroying the structures before reproduction.
- Generally effective for a long period, relatively cheap and without harm to the environment, can be very specific to the target organisms and can therefore control the weed without any harm to the crop plants.
- Biological control of broomrape has been attempted by means of the insect *Phytomyza orobanchia* Kalt (Diptera, Agromyzidae), of which the adults feed on the inflorescence of the parasite (Nemli and Giray 1983). This insect is the most important pest of *Orobanche*. 
• *Fusarium lateritium* has given promising results for control of *O. ramosa* and *O. mutelh*, both affecting tobacco (Bozoukov and Kouzmanova 1994).

• Promising results on biological control have also been obtained with the fungi *Rhizoctonia solani* (on *O. ramosa*) and *Alternaria* spp. and *Sclerotinia* sp. on *O. crenata* (Duafala et al. 1976, Al-Menoufi 1986). Linke et al. (1992) isolated as many as 16 fungus species of the genera *Alternaria*, *Fusarium* and *Ulocladium* from *Orobanche* plants as potential biological control agents.
CONTROL PRACTICES IN OTHER COUNTRIES

• Control measures used in China include hand-pulling, trap-cropping, use of resistant and tolerant varieties, directed spraying with glyphosate and some biocontrol by Fusarium. In Jordan, hand-pulling is the only control measure in potato fields infested with Orobanche cernua.

• In Israel, control measures include some fumigation and solarization, but the high costs limit the latter technique mainly to farmers growing organic crops.
Thank You