

## Three Major Diseases of Pearmillet (Bajra) and Its Management

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### Smut of Bajra:

It was first reported from India (Ajrekar & Likhite, 1933). It causes loss from 1-30%. The pathogen causes Local Infection.

**Symptoms:-** The affected ovaries converted into sori (singular-sorus). The ssori (smutted grains) are oval or top-spaped bulb shaped. The sori turn green or brown and finally black. Individual grains are infected & present in patches on the ear or cob. The sori (smutted grains) contain sports spore balls covered by a membrane of host origin.



**Pathogen:-** *Tolyposporium penicillariae* [now=*Moesziomyces bullatus*]

Classification according to Hawksworth *et al.* (1955):

Kingdom - Fungi

Phylum - Basidiomycota

Class- Ustomycetes

Order- Ustilaginales (The smut fungi)

Family- Ustilaginaceae

Genus - *Tolyposporium* [*Moesziomyces*]

Species- *penicillariae* [bullatus]

The smut spores (also known as Teliospores) are held together in compact balls. Each ball may contain 200-1400 teliospores packed together. The spore mass is granular & black. Individual spores are round to irregular, light-brown in colour and with slightly roughened wall.

#### Disease Cycle:

- **Survival / perennation-** The pathogen is "soil borne" in nature. It survives through spore balls (teliospores) in soil. Spores balls germinate at the time of ear formation in the next crop season.
- **Primary infection-** The primary infection takes place at flowering stage by air-borne sporidia. Spores balls (teliospores) germinate at the time of ear formation. The sporidia are wind-blown & brought the florets. They infect ovaries & produce dikaryotic mycelium (two nuclei in a cell). The infection is local & the ovary gets stuffed by the hyphae. The ovaries are transformed into sori & covered by ovary wall. After pollination there is very less chance of infection due to production of organic acid which is toxic to fungi.
- **Secondary infection-** Sec. infections are caused by sporidia (produced by early infected ovaries), on late sown crops or on ears emerging out late. Last generation of teliospores perennates in the soil as primary inoculum for next season.
- **Pre-disposing factors:** - The disease is favoured by high RH & high temp. (30°C)

**Management:-** "Use healthy seeds, In healthy soil".

(a) **Cultural Practices:** As the pathogen is soil- borne, so:

- (i) Remove the smutted ears & burn immediately.
- (ii) Follow field sanitation.
- (iii) Follow deep summer ploughing.
- (iv) Follow crop rotation
- (v) Follow intercropping of Mungbean with Bajra, it reduces incidence.

(b) **Chemical Control:** As the infection occurs at flowering stage, so:

- (i) Spray carboxin or captafol or carbendazim (0.1%) at boot stage.

(c) **Resistantvar -**

(i) Genotypes like ICI 7517-S-I & SSC PS- 252-S-4 shown high level of resistance to the smut.

### "Downy Mildew" or "Green Ear" of Bajra-

- First reported from India by Butler in 1907.
- It is now a major disease of Bajra in Asia & Africa.
- It is locally known as "Jogia Rog"
- It caused losses up to 30% in HYV (high yielding varieties) in India.
- Oospores (sexual spore) are primary inoculum & survive in soil & seed.
- Pathogen is "obligate parasite" (Biotroph).
- Disease is severe in "ill-drained & low lying areas".

**Symptoms:** The pathogen causes systemic infection. There are two stages of symptoms-

- (i) **Downy mildew stage:** Symptoms appear as chlorosis of the first to third leaves of the seedlings. White downy growth appears on the lower surface of the chlorotic areas.
- (ii) **Green ear stage:** The transformation of floral organs into twisted leafy structures (i.e. Phyllody). This gives an appearance of "green leafy mass" hence the name "Green ear". The bristles of the spikelets become hypertrophied. Sometimes, only a portion of the ear shows the green ear symptoms & rest of the ear is normal.



**Causal Organism:** *Sclerospora graminicola*

Classification according to Hawksworth et. al. (1995):

Kingdom - Straminopila (Chromista)

Phylum	-	Oomycota
Class	-	Oomycetes
Order	-	Sclerosporales (earlier = Peronosporales)
Family	-	Sclerosporaceae
Genus	-	<i>Sclerospora</i>
Species	-	<i>graminicola</i>

The pathogen is "obligate" (Biotroph). The mycelium is cocenocytic (multi-nucleate), inter cellular (in between cells) with bulbous haustoria inside plant cells. Sporangiphore is hyaline, long, stout with 2-6 upright thick short branches, di-or trichotomously at the tip. Sporangia are hyaline, thin-walled, and broadly elliptical with a papilla at the end. Oospores (sexual spores) are yellowish brown, thick-walled, covered by an irregular brown oogonial wall. Oospores look like "Gold coin" (Golden color).

#### Disease Cycle:

- (i) **Perennation / Survival :-** The pathogen survives through "Oospores" in diseased parts fall down on the ground and through mycelium in the infected seeds (internally seed-borne). Collateral hosts (e.g. Panicum spp.) also play a role in perennation of the pathogen.
- (ii) **Primary Infection:** The oospores present in soil germinate & cause primary infection of the underground parts of the seedlings (around 9 days after the crop is sown). The infection spreads upwards systemically along with plant growth. The susceptibility of roots & underground portion of the stem decreases with advancing age of the host plant.
- (iii) **Secondary Infection:** Sec. infections are caused by zoospores produced by germination of sporangia. Dispersal of sporangia are takes place by means of wind, water & insects to the health, plants.
- (iv) **Pre-disposing factors:**
  - (i) Abundant air supply & high humidity (90%)
  - (ii) Low soil moisture (i.e. dry soil).
  - (iii) Temperature range of 20-25°C are the most favorable conditions.
  - (iv) The pathogen readily infects "Teosinte" (*Euchaen mexicana*) & (*Setaria italica*).

**Management-** "Use healthy seeds, in healthy soil".

(a). **Cultural Practices-** As the pathogen seed & soil-borne-

- Use disease free & certified reeds.
- Destroy collateral hosts.
- Remove & destruct of infected plant parts (Roguing).
- Avoid mono-culturing (Don't grow bajra regularly in a field).
- Follow deep summer ploughing.
- Early sowing should be followed.
- Intercropping with must bean reduce disease incidence.
- Avoid water-logging in the field.

**(b). Chemical Control-** As the pathogen seed & soil-borne, so-

- Treat the seeds with Apron SD-35 (metalaxy) at the rate of 6 g/kg seed or mancozeb (2 g/kg) or thiram (3g/kg).
- Give hot water treatment at 55°C for 12 min. followed by drying in shade.
- Steeping (soaking) the seeds in 0.1% HgCl<sub>2</sub> (now Clorax 2.6%) for two min. followed by many washings with tap water.
- Treat the seeds with PGPR (Plant Growth Promoting Rhizobacteria, like *Pseudomonas fluorescens*, *Bacillus subtilis*).
- Spray the crop within one month of sowing with mancozeb (0.25%) or ridomil MZ-72 (0.25%).

**(c). Resistant Var-**

(i). Grow hybrid - "ICMH-88088" (produced by ICRISAT), NHB-10, NH8-14, WCC-75, Pusa-23, Mallikarjun, ICMH-451 etc.

### 1. Ergot of Bajra:

- Ergot means sclerotium (plural-sclerotia).
- Ergot: A disease of some cereal crops in which infected grain is converted into hard structure i.e. sclerotia (Ergot means Grains converted into sclerotia).
- Ergotin: An alkaloid obtained from the sclerotia of *Claviceps* fungus is called ergotin/ergotoxin.
- It has medicinal values (in controlling excessive bleeding during child birth).
- It is toxic also, to animals & humans (if consumed in excessive quantity).
- Mature sclerotia contain 0.42% total alkaloid as ergotoxin.

- Sclerotia (ergot) contains hallucinogenic chemical - LSD (d-lysergic acid diethyl amide) (drug).
- Ergotism:- A disease of animals & humans caused as a result of eating the sclerotia of fungus *Claviceps*, Symptoms include gangrenous (rotting) legs, hoofs & tails and abortion of pregnant females.
- This disease caused losses up to 58% in yield.
- Ergot disease affects only the "flowering parts" of the Poaceae species (& appears at the time of flowering).
- Brine solution (salt solution) about 20% used to separate sclerotia from seeds before sowing.

**Symptoms:** Symptoms appear at the time of flowering. Symptoms appear in two stages:

- (i) Honey-dew stage- Pinkish or light brown, honey colored sticky fluid exudes from infected spikelets. Honey-dew contains conidia of fungus.
- (ii) Sclerotial stage- Small dark brown sclerotial bodies are formed on the ears. These sclerotia replace ovary or grain. These sclerotia (ergots) contain alkaloids responsible for ergot poisoning in animals.



**Disease Cycle:**

The pathogen is soil-borne and sclerotia admixture with seeds & infection is air-borne.

- **Survival:** Fungus survives through the sclerotial bodies and conidia on it. These sclerotial bodies fall down on the ground or carried with the seed only to return to the soil at the next sowing time.
- **Primary infection-** Primary infection caused by ascospores & conidia (present on sclerotial surface) through stigma.
- **Secondary infection-** Secondary infection caused by conidia produced & contained in honey- dew like exudates. Secondary spread occurs through conidia by insect or rain to the healthy plants in the same season.
- **Pre-disposing factors-** High humidity (85-95%) during flowering, cloudy weather, low sunshine & daily light showers favour the disease. Rains washed down the pollen & this increased ergot in infection.

#### Management-

(a). **Cultural Practices-** Since the pathogen is soil- borne, so follow:

- Long crop rotation
- Use of sclerotia free seed
- Deep summer ploughing
- Dipping the seeds in 20% brine/salt solution. This floats the sclerotia, which can be removed.
- Intercropping or mixed cropping with mungbean.
- Adopt early sowing (before 15 July)
- Destroy grass hosts before (sclerotia) formation.

**Brine solution:** For this flotation method can be used. Soak the seeds in a 20 per cent salt solution and stir. The ergot bodies will rise to the top and can be skimmed off. Then thoroughly rinse and dry the remaining seeds and can be used for sowing.

#### (b). **Chemical Control:**

Since the ergot infection is local through air- borne propagules, the control by chemicals is not good feasible. However, somewhat can be reduced. Spray starts just before ear head emergence & repeated 2-3 times at 5-7 days interval. So, spray fungicides like -



ziram (0.2%), or copper oxychloride or zineb (0.2%) or sulphur (0.25%) or Benlate (0.1%) or Bavistin (0.1%) or propiconazole or tebuconazole.

**(c). Resistant Var:-** Resistant against smut disease is also quite effective against ergot disease Genotypes like ICI 7517-S-1 & SSC PS- 252-S-4 shown high level of resistance.

**(d). Biological control:-**

Application of mycoparasite- BCAs (Bio-Control Agents).Fusarium sambucinum, F. semitectum var. majus reduced sclerotial formation & disintegrated them. (Mycoparasite means a fungal parasite on other parasite, like *Trichoderma* sp.)

