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Foliar diseases of maize and their management

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India is the fifth largest producer of maize in the world contributing 3 per cent of the global production. In India, maize is grown in all the seasons *i.e.*, *Kharif*, *Rabi* and Summer. Of these three seasons, nearly 90 per cent of the production is from *Kharif* season, 7-8 per cent during *Rabi* season and remaining 1-2 per cent during Summer season. Currently it is cultivated over 8.0 million ha with a production of 16.78 million tones having an average productivity of more than 2 tonnes/ha, and contributing 7 per cent in food basket of the country. Being a potential field crop in India, maize occupies an important place as a source of human food (26%), animal feed (11%), poultry feed (48%), industrial products (12%) and 3 per cent seed. Among the major producing states, Andhra Pradesh tops the list with the contribution of 17 per cent to the total Indian maize production. Other producers are Rajasthan (14%), Madhya Pradesh (12%), Bihar (10%), Uttar Pradesh (9%), Karnataka (8%) and Gujarat (6%) (Maize Outlook Report, 2006-2007)

Maize is prone to a number of foliar, ear rot and stalk rot diseases incited by fungi, bacteria and virus. Under favourable environmental conditions a number of them are capable of causing severe losses and impair the quality of the produce or even complete failure of the crop.

Although 18 foliar diseases occur (common rust, 16 other fungal diseases and 1 bacterial disease), 3 are considered to be of major importance in term of geographical distribution and potential to cause significant reductions. Based on experimental work and other observations, yield loss estimates have been prepared for India as a whole (Table 1). The total estimate of loss in the economic product per annum has been determined to be the order of 13.2 per cent which is considerable more than the global disease loss estimates of 9.4 per cent of total production.

Table 1 : Estimation of losses due to major diseases of maize in India

Disease group	Loss (%)
Seed and seedling blights	0.1
Downy mildews	2.1
Foliar diseases (Turcicum leaf blight, Maydis leaf blight, Phaeosporia leaf spot, rust, brown stripe downy mildew)	5.0
Stalk rots, root rots, ear rots	5.0
Sheath blights, smut, viruses and other	1.0
Total	13.2

Maydis leaf blight :

Causal organism :

Helminthosporium maydis Nisikado and Miyake

Symptoms :

In maydis leaf blight, individual spots are grayish, tan in colour, up to one and a half inches in length, oval-shaped with straight zonations. Young lesions are small and diamond shaped. As they mature, they elongate. Growth is limited by adjacent veins, so final lesion shape is rectangular and 2 to 3 cm long. Lesions may coalesce, producing a complete burning of large areas of the leaves. The symptoms described to the "O" strain of the fungus. In the early 1970s the "T" strain caused severe damage to maize cultivars in which the Texas source of male sterility had been incorporated. Lesions produced by the T strain are oval and larger than those produced by the O strain. A major difference is that the T strain affects husks and leaf sheaths, while the O strain normally does not.

Disease cycle :

The fungus over-winters as mycelium and spores in maize debris in the field and on kernels in cribs, bins and elevators. Conidia are carried by wind or splashing water to growing plants where primary infection occurs. Sporulation on the lesions produces additional primary or secondary inoculum. The disease cycle can be completed in about 60 to 72 hours (race T) under ideal conditions. Infected kernel may be potential means of overwintering and spread of *H. maydis*. Infected grains are not toxic to livestock.

Disease pathogen congenial environment :

Maydis leaf blight (on southern maize leaf blight) is prevalent in hot, humid, maize-growing areas where the temperature ranges from 20-30°C during cropping period.

Management :

- Ploughing down of crops debris may reduce early infection.
- Rotation with non-host species will help reduction of inoculum.
- Use tolerant varieties viz., Suwan, Ganga Safed -2, Deccan, Ganga-4, Ganga-5, Kisan, Jawahar, PRO345, JH10655, MCH117 and JHM1701.
- Seed treatment with Captan or Thiram @ 2.5g/ kg seed before sowing.
- Spray Spray of Dithane M-45 or Zineb @ 2 g/litre water as soon as first symptoms of disease become apparent on leaves or when the crop is at knee high stage. Two to four applications may be depending on disease intensity.

Turcicum leaf blight**Causal organismism :**

Exserohilum turcicum (Pass.) Leonard and Sugg.

Symptoms :

An early symptom can be easily recognized, slightly oval, water-soaked, small spots produced on the leaves. These grow into elongate, long, elliptical, spindle shaped grayish green or tan lesions ranging from 2.5 to 15 cm. in length. They may appear first on lower leaves and increase in number as the plant develops and can lead to complete burning of the foliage. They will later have dark, reddish-brown borders and occur on leaves, stalks, leaf sheaths, husks, and shanks. Cob Rot ear occurs as well as ear drop. Severe infection causes a premature death and gray appearance that resembles frost or drought injury. The fungus overwinters in corn debris and on seed. Wind and splashing water spread the spores rapidly in the field under ideal conditions, cycling in about 72 hours.

Disease cycle :

Crop debris is the usual source of primary inoculum. As

the ears are not affected the possibility of the disease being carried on the seed is remot. Once the infection takes place, it spreads through wind currents. The damage is severe in area with heavy dew and rainfall. Spores germinate and penetrate the leaves within a few hours in the presence of free water and when the temperature range is 25-30°C. Losses are high if the disease occurs in the early stages of the crop in a severe form, blighted leaves are killed prematurely and lose their nutritive value even for fodder.

Disease pathogen congenial environment :

The disease is prevalent in areas where cooler condition prevails and maize is planted in high lands, winter planting in the plains as the cool/moderate humid conditions (18-27°C) favors disease developments. When infection occurs prior to and at silking stage and conditions are optimum, it may cause significant economic damage.

Management :

- Sanitation, clean plough down of infected crop debris.
- Following proper cropping sequence.
- Apply recommended dose of different nutrients.
- Grow tolerant varieties like like, Vivek 21, Vivek 23, Vivek 25, Pratap, Kanchan Rajendra Hybrid Makka-1, R.H.M, M-2, Deoki, Lakshmi, PRO345, JH10655 and MCH117.
- Seed treatment with Captan or Thiram @ 2.5 gm/kg seed before sowing.
- Spray the crop with Mancozeb (Indofil M-45) @ 0.2% or 2 kg fungicide /1000 liters water/ hectare if disease is noticed on the crop and repeat spraying at 15 days depending upon severity of disease.

Banded leaf and sheath blight :**Causal organismism :**

Rhizoctonia solani f.sp. *sasakii* Exner

Symptoms :

The symptoms of the disease appears at the pre-flowering stage in 40-50 day old plants but infection can also occur on younger plants. The disease is manifested on leaves, sheaths, stalks and ears; (infection on tassels on tassels has not been observed.) Symptoms develop on leaf and sheath are characteristic concentric spots that cover large areas of infected leaves and husks, which show conspicuous light brown cottony mould with small, round, black sclerotia. In later case, severe blight occurs which is accompanied by death of the apical growing point.

Disease cycle :

The primary source of inoculum are sclerotia in the soil and grass hosts that grow in the vicinity of maize crop. Secondary spread of disease is by contact of infected leaves

with parts of adjoining healthy plants. The optimum temperature for *in vitro* growth of the pathogen is 30°C and the highest level of disease is induced when RH is in the range of 90-100 per cent. At RH 70 per cent or lower, the disease development is negligible or absent. These conditions of moisture and temperature exist in North Indian plains, the month of July and August, a time when the crop is in vulnerable growth stage.

Disease pathogen congenial environment :

The disease is prevalent in hot humid foothill region in Himalayas and in plains.

Management :

- Deep summer ploughing.
- Sowing should be done on ridges to avoid high moisture
- Grow tolerant varieties like Pratap Kanchan 2, Pratap Makka 3, Pratap Makka 5, Shaktiman 1, Shaktiman 3, Deoki, Suwan, , Ganga-11, Ganga Safed-2, Sweta and D941.
- Stripping of 2 lower leaves alongwith leafsheath.
- Provide proper drainage in the field.
- Use recommended dose of different nutrients.
- Treat seed with Captan @ 2.5gm/kg seed before sowing.
- Seed treatment of peat based formulation @ 16g/ kg of *Pseudomonas fluorescence* or as soil application @ 7g/ liter of water.
- Spray the lower part of the standing crop by Sheethmar (Validamycine) @ 2.7ml/liter of water.
- Spray the crop with Rizolax 50WP @ 10g/10liter of water.

Common rust :

Causal organism :

Puccinia sorghi Schw.

Symptoms :

Common rust is most conspicuous when plants approach tasseling. It may be recognized by small, elongate, powdery pustules over both surfaces of the leaves. Pustules are dark brown in early stages of infection; later, the epidermis is ruptured and the lesions turn black as the plant matures. These spores eventually turn black. Rust is favored by cool temperatures and high humidity. Older tissue are generally resistant to the disease.

Disease cycle :

The life cycle of *P. sorghi* involves two hosts (maize and *Oxalis* species) and five spore stages (teliospores, basidiospores, spermatia, aeciospores and urediniospores). In tropical or subtropical regions, urediospores can overwinter and serve as the primary source of inoculum in subsequent seasons. Urediospores are disseminated by wind over vast distances (hundreds of kilometers) and frequently spread from

tropical/subtropical regions to temperate regions in spring and summer when maize is cultivated. The sexual stage of the life cycle occurs predominantly in tropical and subtropical regions. Generally, urediospores germinate within 6 hours. Infection structures penetrate the host via stomata on leaf surfaces, stems, and ear sheaths. Chlorotic spots as a result of infection can arise in as little as 24 hours in favorable climatic conditions. In favorable weather conditions the disease cycle can be completed in 5 days.

Disease pathogen congenial environment :

The disease is common in subtropical, temperate and highland environment moderate temperature (16-25°C) and high relative humidity.

Management :

- Do not plant seed corn in a field where corn was the previous crop, unless absolutely necessary.
- Following proper cropping sequence.
- Cultivate early maturing varieties.
- Grow hybrids like Deccan, Ganga-5, Hybrid Makka-103 and DHM-1 which are tolerant to this disease to minimise the disease intensity.
- Spray the crop with Zineb or Indiofil M 45 @ 2-3 g/liter of water.

Brown stripe downy mildew of maize :

Causal organism :

Sclerophthora rayssae var. *zeae* Payak and Renfro

Symptoms :

Affected leaves become narrow with chlorotic spots (3.7mm wide) with well defined margins extended in parallel fashion between the veins. The stripes later turn redish to purple. If the development of the chlorotic stripes occurs prior to flowering, seed development fails and plants die prematurely. Collapse of the tissues has never been observed. Malformation or deformation is also not on record.

Disease cycle :

S. rayssiae overseasons as in infected debris in the soil. On germination, the oospore produces a sporangiophore bearing a sporangium that liberates the zoospores that constitute the primary inoculum. In the presence of enough moisture or high temperatures, the sporangium may produce a germ tube that can also overseason in the grasshopper as mycelium from which srongia are produced. This is an other source of inoculum. Secondary spread is by sporangia produced after primary infection is established.

Disease pathogen congenial environment :

The disease is most prevalent in warm, humid regions

and common in the Himalayan areas of northern India. The disease is limited to location below 1500 masl.

Management :

- Planting before rainy season begins, can minimize the occurrence of disease
- Use tolerant varieties such as Prabhat, Kohinoor PAC 9401 etc.
- Follow recommended cultural practices and the field

well drained.

- Rogue and destroy infected plants.
- Seed treatment with systemic fungicide such as metalaxyl @ 2.5 g/kg.
- Brown stripe downy mildew can be controlled by three to four foliar sprays of Ridomil 25 WP @ 2.5 g/l . Give first spray as soon as disease appears in the field. The sprays should be given between 10 to 15 days intervals depending upon the severity of disease.
