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8. Disesease of Cereal Crops and Their Management

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Abstract:

Famers all over the world growing cereals, loss their economic gains due to diseases caused by pathogens. The quality of the yields of cereals depends on crop management system and correct diagnosis of the disease at the right time. This chapter reviews all the major diseases causing economic loss in India and around the world. The symptoms of the disease are explained in a precise and simple manner for proper and immediate diagnosis. Fungal diseases in cereals cause up to 20-60 per cent crop loss. Factors which determine the occurrence of diseases are weather parameters, cultural practices such as growing season, monoculture practices, crop rotation, soil tillage etc. these diseases are known to decrease plant growth, reduce grain yield and quality. The diseases disease causing most damage among cereal crops include the likes of rusts, bunts, mildews etc. these may vary in intensity season after season depending on the availability of favorable conditions conducive for the growth of the pathogen.

Keywords:

Cereals, rusts, symptoms, epidemiology, control, fungicides

8.1 Wheat:

Wheat is one of the most important cereal crops, contributing about 30 per cent to our total food production. Wheat yields fluctuate over the years due to various biotic and abiotic stresses. Diseases caused by fungi are most important followed by bacterial and viral diseases.

A. Rusts:

Symptoms:

- **Yellow/Stripe rust (*Puccinia striiformis*):** The uredo pustules are small, oval, containing yellow to orange-yellow uredospore's, arranged end to end in narrow stripes on the leaves. Pustules are found on the leaf sheaths along with necks and glumes. The teliosori covered by epidermis are dull black in color and also arranged in long stripes chiefly on under surface of leaves, also on other green parts of the plants.

- **Brown/Leaf rust (*Puccinia triticina)*:** The pustules are round to slightly elliptical, scattered or in clusters, contain masses of orange to orange brown uredospore's, primarily formed on the leaves and occasionally on the leaf sheaths, stalk and ears. As the plants mature, the uredosori are gradually replaced by teliosori. These are silvery black in color and covered by epidermis.
- **Black/Stem rust (*Puccinia graminis tritici*):** The uredo pustules are large, scattered, may coalesce, elongated, dark reddish brown and formed on stem, both sides of the leaves, leaf sheaths and spikes. Remnants of the epidermis which rupture during spore release are visible on the margins of the pustules giving it a ragged and torn appearance. Gradually the uredosori are replaced by black teliosori with ruptured epidermis.

Management:

a. Grow recommended varieties like HPW 155 (Onkar), HPW 236, HPW 249 (Asmi), HPW 89 (Surabhi), VL 829, VL892, VL 907, HS 490 and HS 507
b. Spray the crop with Tilt (propiconazole) 25 EC or Folicur (tebuconazole) or Bayleton (triadimefon) (0.1%), and Dithane Z-78 (zineb) 75WP (0.2%) at 15 days' interval from first appearance of disease symptoms.

B. Loose smut (*Ustilago segetum tritici*):

Symptoms:

The entire inflorescence/ ear except the rachis, is converted into black powdery mass of smut spores. These olive brown to black teliospores are often blown away by the wind, leaving behind bare rachis and remnants of other floral structures.

Management:

a. Grow resistant varieties like HPW 155, HPW 251, VL 829 etc.
b. Use disease free seed or treat the seed with Vitavax 75WP or Bavistin 50WP @ 2.5g/Kg seed or Raxil 2DS @ 1.0 g/kg seed before sowing. Seed can also be treated by dipping in 0.01% (100ppm) solution of Tilt 25EC for six hours and drying under shade before sowing.
c. Rogue out smutted plants as soon as they appear by covering ears with polythene bags and destroy them. This helps in producing disease free seed.

C. Hill bunt /Stinking smut (*Tilletia caries and T. foetida*):

Symptoms:

At the heading stage, infected spikes tend to be bluish green (or darker) in color and the glumes tend to spread apart slightly. The bunt balls often become visible after the soft dough stage. All the grains in the ear head art affected and the entire grain is converted into a bunt ball. The contents of infected grains are replaced by greasy dense mass of black spore enclosed by the seed coat and upon crushing produce smell like rotter fish. A slight reduction in plant height is typical of common bunt by caries.

Management:

a. Use disease free seed or treat the seed with Vitavax (carboxin 75WP or Bavistin (carbendazim) 50WP @ 2.5 g/kg seed befor sowing.
b. Avoid deep and late sowing.

D. Karnal bunt / Partial bunt (*Neovossia indica*):

Symptoms:

The disease is generally detected at the harvest time of the crop. In an ear only few grains and in a stool, few ear heads are infected by the pathogen. The grains are generally partially infected and rarely the entire grain is converted into a sorus. A mass of thick walled dark brown to black teliospores replaces a portion of the endosperm (normally embryo is not destroyed) and the pericarp may be intact or ruptured. Diseased kernels give off a fishy odor when crushed.

Management:

a. Sow the crop well in time, late planting results in more disease.
b. Use disease free seed or treat the seed with Bavistin or Vitavax @ 2.5 g/kg seed before sowing.
c. Spray the crop meant for seed production with Tilt 25 EC (0.1%) at flag leaf stage and 50% ear emergence (10-12 days after first spray).
d. Avoid excessive nitrogenous fertilizers and irrigation particularly at flowering stage.

E. Foliar Blights and Blotches:

Symptoms:

- **Spot blotch (*Bipolaris sorokiniana*):** Lesions are elongated to oval in shape and are generally dark brown in color. As lesions mature, centers often turn light brown to tan colored surrounded by an irregular dark brown ring.
- **Tan spot (*Pyrenophora tritici-repentis*):** Lesions first appear as tan to brown flecks which expand into large, irregular, oval or lens shaped blotches with a yellow or chlorotic margin. As these spots coalesce, large blotches are formed. The development of a dark brown to black spot in the centre of the lesion is the characteristic-symptom of the disease.
- **Alternaria leaf blight (*Alternaria triticina*):** Initially, small, chlorotic, oval or elliptical lesions appear, later they enlarge and become irregular in shape. The chlorotic borders of lesions may become diffused and turn light to dark brown in color.
- **Septoria blotch (*Septoria tritici and S. nodorum*):** Initial infection sites tend to be irregular in shape, oval to elongated chlorotic spots or lesions. The centers of the lesions turn pale, straw colored and slightly necrotic with numerous small black dots (pycnidia). The lesions of S. tritici blotch tend to be linear and restricted laterally while those of S. nodorum blotch are lens shaped.

Management:

a. Treat the seed before sowing with Thiram or Vitavax @ 2.5 g/kg seed.
b. Spray the crop meant for seed production with Dithane Z-7% (0.2%) or Tilt 25 EC (0.1%) at 15 days' interval from first appearance of disease symptoms.
c. After the harvest of crop, burn the plant residues.
d. Follow 2-3 years crop rotation, including non-host crops.

F. Powdery mildew (*Blumeria graminis tritici*):

Symptoms: Initially, white to pale gray, fuzzy or powdery colonies of mycelia and conidia appear on the upper surfaces of leaves and leaf sheaths, culms and sometimes on the ear heads. Host tissue beneath the fungal growth tum chlorotic or necrotic. Older fungal colonies turn yellowish gray and studded with black dot like fruiting structures (perithecia/cleistothecia).

Management:

a. Spray the crop at fortnightly interval with Karathane or Bavistin (0.1%).
b. Spray of crop with Tilt 25 EC or Contaf 5 EC (0.1%) alternate with the first appearance of disease at 15 days.
c. Grow recommended and moderately resistant varieties like HPW 236, HPW 89, VL 829, VL 907, HS 490 etc.

G. Flag smut (*Urocystis tritici*):

Symptoms: Black teliosori are produced in narrow stripes running parallel to th veins just beneath the epidermis of leaves, leaf sheaths and occasional the culms. Diseased plants often are stunted, tiller profusely and t spikes may not emerge. A severe infection usually induces the leaves roll. The epidermis of older diseased plants tends to shred releasing the teliospores.

Management:

a. Practice shallow sowing and avoid late planting.
b. Apply irrigation immediately after sowing in fields where disease is serious.
c. Dress the seed with Vitavax or Bavistin @ 2.5 g/kg seed before sowing.
d. Rogue out the affected stools and destroy them by burning.

H. Head scab/ Blight (*Fusarium* spp.):

Symptoms:

Initial infections appear as small, water soaked, brownish spots at the base or middle of the glume or on rachis. The symptoms then spread in all directions from the point of infection. A salmon-pink to red fungal growth may be seen along the edges of the glumes or at the base of the spikelet. Infected kernels shrink, sometimes permeated with mycelia and the

surface of the florets totally covered by white matted mycelium. Premature death and bleaching of one or more spikelet's or rarely the entire ear is a common symptom. During prolonged warm, moist weather, spikelet's on early infected heads appear speckled as a result of black perihelia giving the scabbed appearance.

Management:

a. Use disease free seed and treat seed with Bavistin @ 2.5 g/kg seed before sowing.
b. Spray the crop with Tilt 25 EC (0.1%) immediately after head emergence.
c. Destroy crop residues by burning or ploughing it deep.

I. Yellow ear rot (*Corynebacterium tritici*) and Ear cockle (*Anguina tritici)*:

Symptoms: The infected plants fail to form ears. If ears are formed they become abortive with twisted or distorted stalks and bearing yellow slime. Infected plants that escape the gummy phase develop black galls known as cockles containing thousands of nematode larvae in the ear heads in place of the normal grains.

Management:

a. Rogue out affected plants and destroy them by burning.
b. Separate out the nematode galls from seed by floatation method in 5 per cent common salt solution.

8.2 Barley:

A. Rusts:

Symptoms: Yellow rust (*Puccinia striiformis*): Small yellow pustules arranged stripes are formed on the leaves. In severe attack leaf sheaths, awa glumes are also affected.

Leaf rust (*P. hordei*): Small brown irregularly scattered pustu sometimes gathered in small clusters are formed on leaves and are rare the sheaths and stalks

Management:

a. Sow resistant varieties.
b. Spray the crop with Tilt or Folicur or Baylet (0.1%) for effective management.

B. Powdery mildew (*Erysiphe graminis hordei*):

Symptoms: The symptoms of this disease are also much like to those on wheat. T fungus develops numerous superficial white colonies on all the abo ground parts of the plant. The white color of colonies changes to gray reddish brown. Later dark cleistothecia develop on mildew growth.

Management:

a. Grow recommended varieties.
b. Spray the crop at fortnightly intervals with Karathane or Bavistin or Tilt 25 EC or Contaf 5 EC or Bayleton (0.1%).

C. Stripe disease (*Drechslera graminea*):

Symptoms: Yellow stripes develop on leaf blades and leaf sheaths which soon brown resulting in drying up of the leaves. The plants become stunted s the leaves are shredded.

Management:

a. Treat the seed with 3g Vitavax + 3g Thiram (1:1) per kg before sowing.
b. Spray Tilt or Folicur (0.1%) as soon as the disease appears.
c. Practice field sanitation and 3-4 years' rotation with host crops.

D. Loose smut (*Ustilago nuda*):

Symptoms: The affected plants produce black smutted ears containing loosely held spore mass which is blown away by wind leaving behind the naked rachis.

Management:

a. Rogue out smutted ears as and when they appear and destroy them.
b. Use disease free seed or treat seed with Vitavax or Bavistin @ 2.5 g/kg seed or Raxil @ 1.0 g/kg seed.

E. Covered smut (*Ustilago hordei*):

Symptoms: The grains are replaced by black spore masses, which do not fall apart as in loose smut but are held together by the ovary wall and the glumes.

Management: Use disease free seed or treat the seed with Vitavax @ 2.5 g/ kg seed or Raxil @ 1.0 g/kg seed.

8.3 Rice:

A. Blast (*Magnaporthe grisea*):

Blast disease of rice is more prevalent in mid hill region of the state where high humidity and low night temperatures prevail. This disease affects almost all plant parts including leaves, stem, sheath, panicles nodes and grains.

Symptoms: On leaves, disease appears as small, brown lesions, which later on become spindle shaped with greyish centers and brown margins. Under favorable environmental

conditions, these lesions expand rapidly and coalesce resulting in the complete necrosis of infected leaves giving them a burnt appearance. Similar kind of lesions also appear on the stem, nodes, sheaths, panicles, spikes and spikelet's. Infected plants produce lesser number of panicles with lighter grains. Sometimes heavy infection during early phase of growth causes death of the plants. Infection at the neck at node below the panicle results in neck blast. Neck infection is very destructive, causing production of unfilled grains and chaffy panicles or causing the entire panicle to fall over, resulting in considerable reduction in the crop yield.

Management:

a. Go for early planting of the crop in blast infested areas.
b. Use recommended doses of nitrogenous fertilizers.
c. Treat the seed before sowing with carbendazim (Bavistin 50 WP) or tricyclazole (Beam 75 WP) @ 2g/kg seed.
d. Grow blast resistant varieties like, HPR 2143, HPR 1068 Kasturi (Basmati) under irrigated ecosystem and HPR 1156 and VL Dhan 221 under upland conditions or a hybrid Arize 6129 which has been recommended for areas up to a height of 1000 mamsl.
e. Spray the crop with carbendazim (Bavistin 50 WP) @ 30 30 L water/ Kanal or tricyclazole (Beam 75 WP) @ 18 g/3 L water/Kanal with the appearance of the symptoms at 10 to 15 days' interval and at 5 to 10 per cent panicle emergence stage.

B. Bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*):

Symptoms:

This is a typical vascular disease in which causal bacterium spread through the xylem vessels. Its symptoms appear in two distinct phases:

a. **Kresek phase**: This is the most destructive phase of this disease in the tropics resulting from early systemic infection in the nursery or from seed infection. Leaves roll completely, droop, turn yellow to grey and ultimately the tillers wither away.
b. **Leaf blight phase**: Leaf blight symptoms appear at booting or panicle emergence stage which are characterized initially by pale green to yellow colored stripes which later on turn straw colored with wavy margins on both the edges of leaves. As the disease progresses the entire leaf turn white or greyish and dries up. In humid weather, yellowish opaque and turbid drops of bacterial ooze may be observed on the surface of young lesions.

Management:

a. Use healthy seed. Dip the seed in 5 % common salt solution container (500 g salt dissolved in 10 L water) and remove light floating seeds. Take out the heavy seeds from the contaf M and dry under shade before sowing.
b. Grow HPR 1068, HPR 1156, Arize 6129 in BLB infested are and avoid cultivation of HPR 2143 as it is highly susceptible BLB.

C. False smut (*Ustilaginoidea virens*):

This disease is favored by high fertility conditions. However, its incidence has been observed to be more on high yielding rice varieties.

Symptoms: The disease manifests its effect only after flowering when the causal fungus transforms individual grains of the panicle into velvety green spore balls. Initially these balls are small which later enlarge to enclose all the floral parts. These spore balls are covered by a membrane that bursts due to increase in their size and the colour of balls changes to orange, yellowish green, green olive green and finally to greenish black.

Management:

a. Collect and destroy the infected panicles.
b. Use recommended doses of nitrogenous fertilizers.
c. Spray the crop with copper oxychloride (Blitox 50%) @ 90 g/ 30L water/ Kanal or propiconazole (Tilt 25 EC) @ 30 ml/ 30L water/ Kanal when panicles start emerging from the sheaths (booting stage) and repeat after 10 days of first spray if needed.

D. Brown spot (*Drechslera oryzae*):

This disease occurs more or less every year in mild or severe forms in almost all the rice growing areas of the state and is correlated with poor soil conditions.

Symptoms: On leaves symptoms appear as small, purple brown, oval spots which enlarge and become dark brown at the edges while remain pale yellow, dirty white, brown or grey at the center. These spots are surrounded by a yellowish halo and later coalesce to become irregular in shape. Badly affected leaves turn brown and dry out. On glumes dark brown spots are formed from where infection spreads in the grains. The infection of nodes causes the panicle to break and fall down which results in the formation of shriveled grains that are unsuitable for seed purpose.

Management:

a. Float seed in 5% Sodium chloride solution and exclude the floating seeds; treat the seed with Thiram @ 3 g/kg before sowing.
b. Use recommended dose of nitrogenous fertilizers
c. Spray the crop with mancozeb (Dithane M -45) or zine (Dithane Z-78) @ 75 g/ 30L water/ Kanal at 10 days' interval or spray propiconazole (Tilt 25 EC) @ 30 ml/ 30L water/Kanal after 45 and 65 days of transplanting.
d. Collect and destroy the infected plant material.

F. Sheath blight (*Rhizoctonia solani*):

This disease is very common in lower hills of the state and affects plan both in the nursery and after transplanting.

Symptoms: Symptoms initially appear on stem and sheath near the water level in t field. On sheaths oval, greenish grey lesions are formed, which increase in length and become irregular in shape. The lesions are greyish white with brown or purple margins which on coalition appear like a ribbon. Outermost sheath breaks and falls off and later on, whole plant withe out. In favorable weather, mycelium and sclerotic of the fungus visible on the stem and sheath.

Management:

a. Grow resistant cultivars in sheath blight infested areas.
b. Use recommended dose of nitrogenous fertilizers.
c. Spray the crop with carbendazim (Bavistin 50 WP) @30g/30 water/ Kanal as soon as the symptoms appear at booting heading stage by directing the spray towards the base of plant.

G. Sheath rot (*Sarocladium oryzae*):

Symptoms: The disease causes rot on the uppermost leaf sheath that encloses panicle. On the sheath, oblong to irregular, greyish or greyish bro lesions with brown margins appear which enlarge and coalesce so cover most of the leaf sheath. In severely infected plants, young pan remains within the sheath or emerge partially.

Management:

a. Use healthy seed.
b. Collect and destroy the infected plant materials.

H. Glume discolouration (*Sarocladium, Helminthosporium, Gerlachia, Curvularia* etc.):

Symptoms: Disease appears in the crop when the panicles are still inside the sheath and is characterized by small, round, brownish black spots on the glumes. Severe infection leads to darkening and rotting of glumes which produce light grains.

Management:

a. Use recommended dose of nitrogenous fertilizers.
b. Spray the crop with carbendazim (Bavistin 50 WP) @ 30 g, mancozeb (Dithane M-45) @ 75 g or copper oxychloride (Blitox 50 WP) @ 90 g/ 30 L water/ Kanal at 10 days interval starting from the panicle emergence.

I. Stem rot (*Sclerotium oryzae*):

Stem rot is an important disease in water logged and low lying areas of the state. Disease starts appearing at the time of flowering but becomes severe nearing maturity.

Symptoms: Disease starts as small black, irregular lesions on the outer leaf sheath near the water line. These lesions enlarge as the disease progresses. The stem softens and the plants lodge. Affected plants produce only shrivelled grains. On splitting open the stem, dark greyish mycelium may be seen within the hollow stem along with dark brown mustard like sclerotia of the fungus.

Management:

a. Collect and burn the rice stubble after harvesting of infected crop to reduce the source of primary inoculum.
b. Avoid continuous flooding of the field. Drain out water frequently.
c. Do not let the irrigation water flow from infested to the non-infested fields.
d. Grow Basmati cultivars in the infested fields.

8.4 Maize:

A. Banded leaf and sheath blight (*Rhizoctonia solani*):

Symptoms: The disease symptoms develop on leaves and sheaths as characteristic banded lesions that cover large areas of infected leaves and husks. The main damage occurs in humid conditions on cobs as brownish rotting showing conspicuous, light brown, cottony mycelium with small, round black sclerotic.

Management:

a. Deep plough the fields in summer.
b. Grow recommended varieties.
c. Use proper spacing.
d. Remove lower leaves.
e. Spray the crop with Bavistin @1g/L. vi. After harvest burn the infected residue.

B. Stalk rot (*Erwinia chrysanthemi* pv. *zeae*):

Symptoms: The rot occurs at the lower nodes and spreads up and down the stalk. The leaves start yellowing and drying. The infected tissues of the stalk ar soft, but later on turn into a dry mass of shredded and easily disjointed fibers. At this stage the plant topples down.

Management:

a. Grow recommended cultivars like Renuka (DKH-9705), early composite, Parvati.
b. Apply judicious doses of nitrogen and potassic fertilizers.
c. Avoid heavy nitrogen fertilizer.
d. Ensure proper drainage.
e. Apply the first dose of bleaching powder @ 16.5 kg/h at the time of sowing, second dose at earthing up and third dose at tasseling stage in heavily infected field.

C. Leaf blight (*Drechslera maydis* and *D. turcica*):

Symptoms: Infection appears on leaves, stalks, leaf sheaths, and ear husks. Lesion are large, spindle shaped or elliptical, with yellow green or chlorot halos surrounding the lesions. Often lesions may have dark red-brows borders. Lesions may merge resulting in blighting and killing the leaves.

Management:

a. Grow resistant and recommended varieties.
b. Avoid delayed sowing
c. Apply foliar fungicides like Indofil Z-78 or Indofil M-45 @ 1.5kg/750 1 of water /h, as the disease appears and weather conditions are conducive to disease development.
d. Plough under infected residue to reduce inoculum.

D. Brown spot (*Physoderma maydis*):

Symptoms: Small yellow to brown chlorotic lesions appear on leaf blades, leaf sheaths and stalks. Later the lesions on leaf midrib become dark brown to black spots. Severe infection leads to breaking of the stalk.

Management:

a. Grow resistant and recommended varieties.
b. Adopt crop rotation and field sanitation.
c. Spray the crop with Indofil M-45 @2.5g/L

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