

Diagnosis of Common Diseases of Rice

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Introduction

A disease is an abnormal condition that injures the plant or causes it to function improperly. Diseases are readily recognized by their symptoms - associated visible changes in the plant. The organisms that cause diseases are known as pathogens. Many species of bacteria, fungus, nematode, virus and mycoplasma-like organisms cause diseases in rice. Disorders or abnormalities may also cause by abiotic factors such as low or high temperature beyond the limits for normal growth of rice, deficiency or excess of nutrients in the soil and water, pH and other soil conditions which affect the availability and uptake of nutrients, toxic substances such as H₂S produced in soil, water stress and reduced light. In broad sense such disorders and abnormalities refer as physiological diseases. However, here we will cover only the common diseases of rice those cause by pathogen. Before attempting diagnosis of rice diseases it is important to understand some frequently used terms.

2.1. Diagnosis

Diagnosis is the investigation or analysis of the cause or nature of a condition, situation, or problem. Diagnosis of plant disease is the identification of specific plant disease through the symptoms, signs, or other factors.

2.2. Symptoms

Symptoms are external manifestations of diseases or visible abnormalities arising from disease. Symptoms may vary according to time, environment, host variety, and race of the pathogen.

2.3. Dwarfing or stunting

Size of the entire plant or of some of its organs becomes smaller than the normal size (Photo 1).



Photo 1: Dwarfed or stunted rice plant.

2.4. Yellowing or Chlorosis

Yellowing of normally green tissue due to chlorophyll destruction or failure of chlorophyll formation.



Photo 2: Chlorosis in rice leaf.

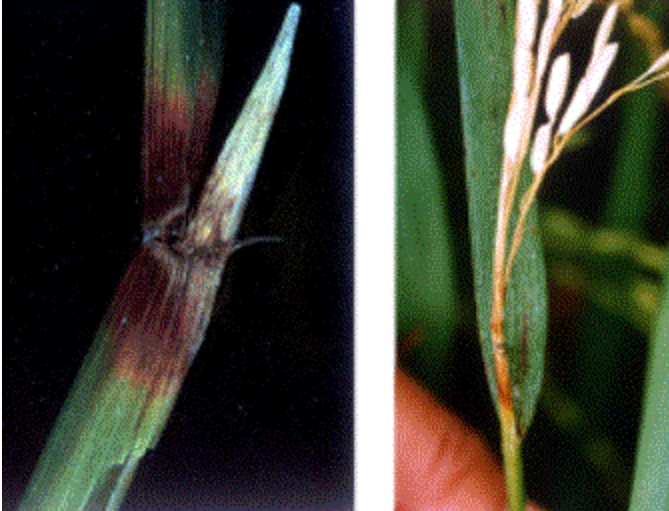


Photo 3: Rotting.

Rotting is disintegration and decomposition of host tissue (Photo 3). The rot may be dry or soft. Dry rot is firm or dry decay, while soft rot is soft, watery decomposition.

2.6. Spot

A spot is a localized necrotic or dead area (Photo 4). It may be circular, angular, or irregular in shape. Several spots may run together or coalesce forming larger necrotic areas. Based on color and location, spots may be characterized viz. brown spot, black spot, leaf spot, fruit spot etc.

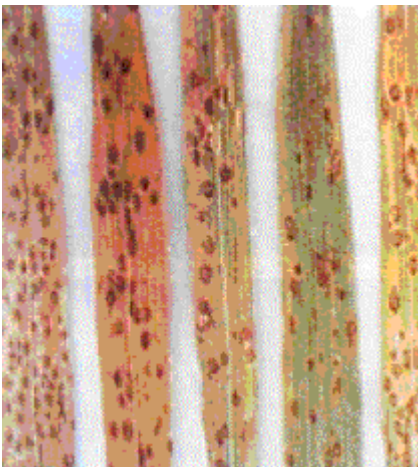


Photo 4: Spots on rice leaf.

2.7. Lesion

A localized area of discolored, diseased tissue.

2.8. Signs

Sign is the structure of the pathogen that is found associated with an infected plant. Most of the signs are best seen and distinguished under the microscope. Examples of signs are spores, hypha, mycelium, sclerotia, bacterial ooze, etc.

2.9. Spores

Spores are reproductive structure of the fungus (Photo 5). A spore is analogous to the seed of plants. They can be sexual or asexual.

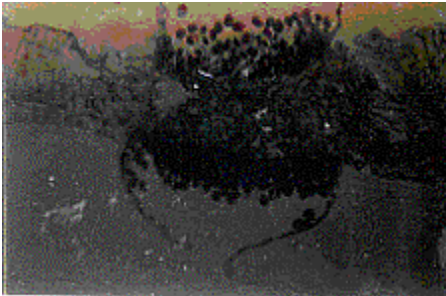


Photo 5: Spores.

2.10. Conidia

Conidia are asexual spores of fungus (Photo 6).

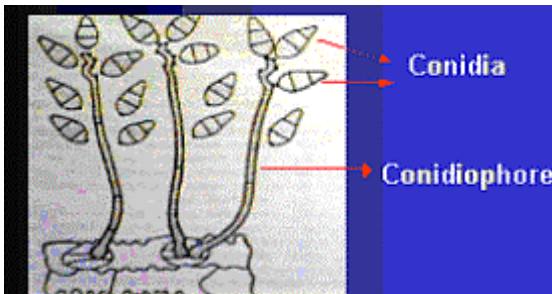


Photo 6: Conidia of fungus.

2.11. Hypha

Hypha is the single thread or filament of the fungus (Photo 7).

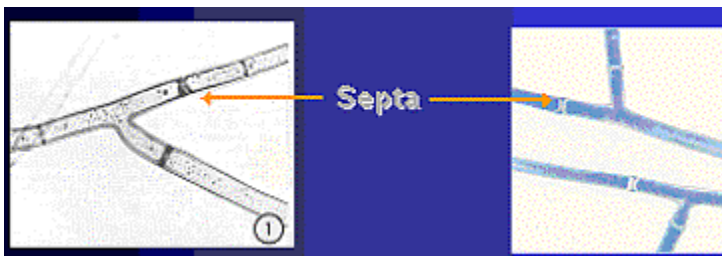


Photo 7: Hypha of fungus.

2.12. Mycelium

Mycelium is the body of the fungus consisting of individual filaments or hyphae (Photo 8).

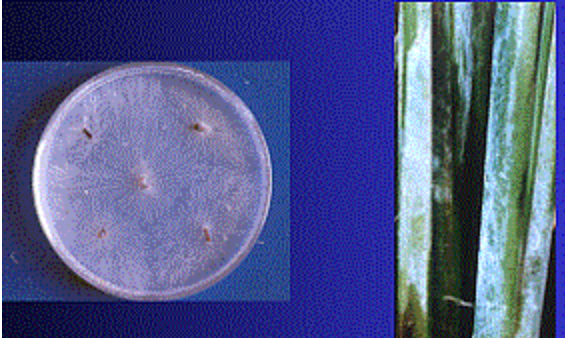


Photo 8: Fungal mycelium.

2.13. Sclerotia

Sclerotia are compact or hard masses of mycelium (Photo 9).

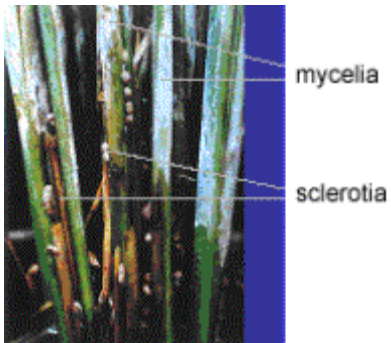


Photo 9: Fungal sclerotia.

2.14. Bacterial ooze

Bacterial ooze exudates bacterial cells on the surface of plant parts infected with bacteria (Photo 10).

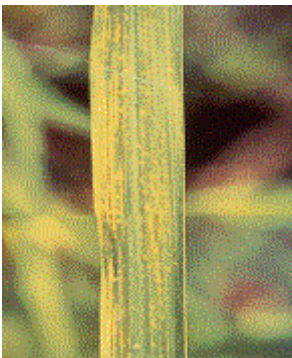


Photo 10: Bacterial ooze.

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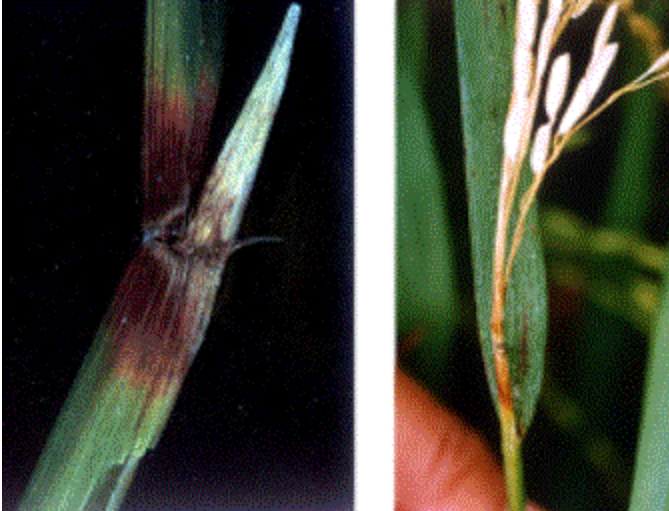


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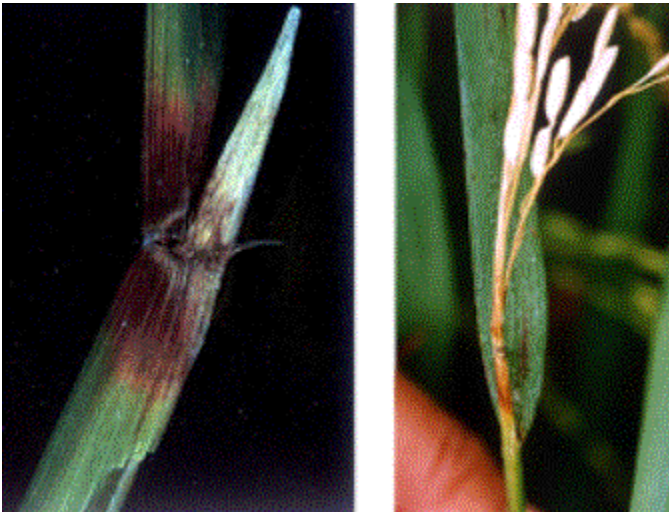


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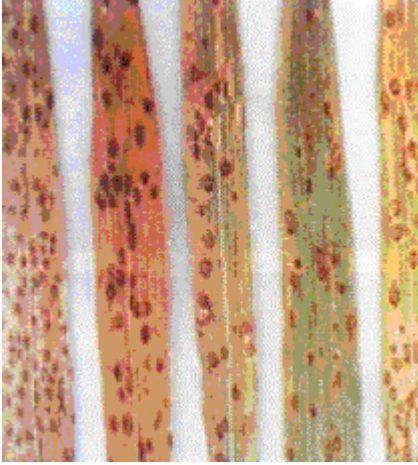


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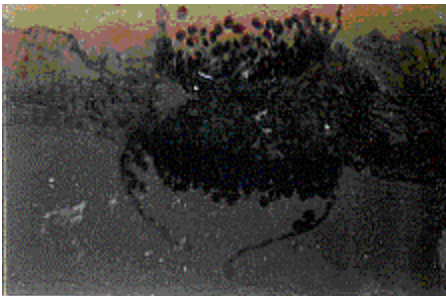


Photo 5: Spores.

2.10. Conidia

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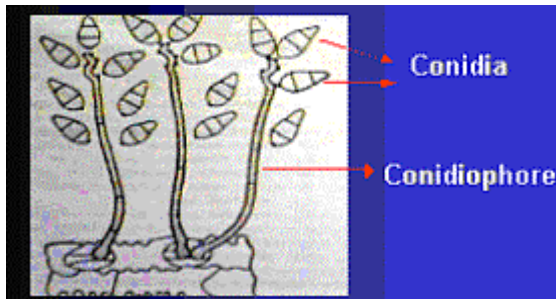


Photo 6: Conidia of fungus.

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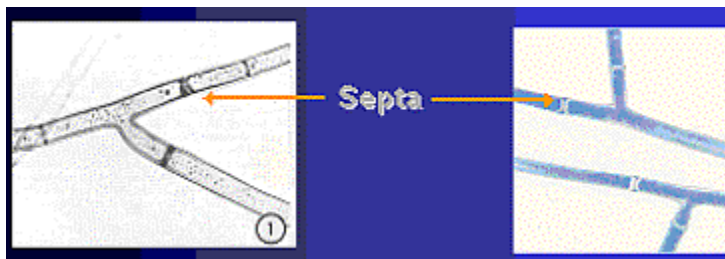


Photo 7: Hypha of fungus.

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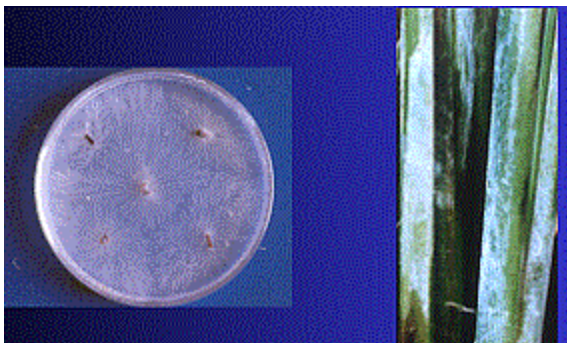


Photo 8: Fungal mycelium.

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Sclerotia are compact or hard masses of mycelium (Photo 9).

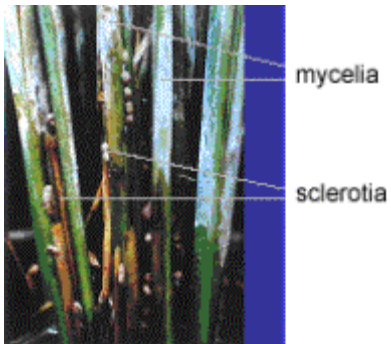


Photo 9: Fungal sclerotia.

2.14. Bacterial ooze

Bacterial ooze exudates bacterial cells on the surface of plant parts infected with bacteria (Photo 10).

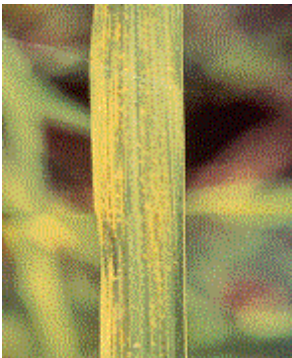


Photo 10: Bacterial ooze.

3. Diagnosis of Rice Diseases

3.1. Fungal Diseases

3.1.1. Rice Blast [*Pyricularia grisea* (Cooke) Sacc.]

3.1.1.1. Symptoms

The fungus attacks all aboveground parts of the rice plant. Depending on the site of symptom rice blast is referred as leaf blast, collar blast, node blast and neck blast. In leaf blast, the lesions on leaf blade are elliptical or spindle shaped with brown borders and gray centers (Photo 11). Under favorable conditions, lesions enlarge and coalesce eventually killing the leaves. Collar blast occurs when the pathogen infects the collar that can kill the entire leaf blade. The pathogen also infects the node of the stem that turns blackish and breaks easily; this condition is called node blast. Neck of the panicle can also be infected. Infected neck is girdled by a grayish brown lesion that makes panicle fall over when infection is severe. The pathogen also causes brown lesions on the branches of panicles and on the spikelets.

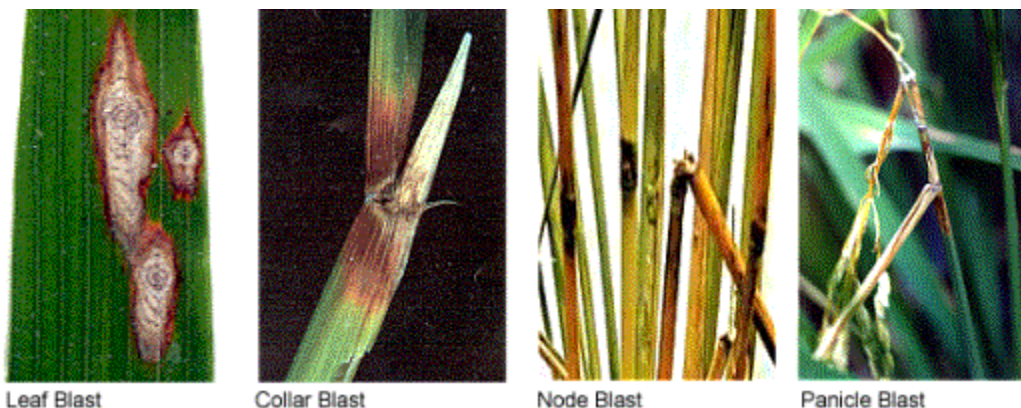


Photo 11: Different kinds of rice blasts.

3.1.1.2. Causal Organism

Mature conidia are usually three-celled or 2 septate (Photo 12) (rarely 1 or 3), pyriform (pear-shaped), hyaline or colorless to pale olive, 19-27 x 8-10 μ m in size and exhibit a basal appendage at the point of attachment to the conidiophore. Conidia usually germinate from the apical or basal cells. The conidiophores are pale brown, smooth and straight, or bending. The perfect stage is rarely found in the field.

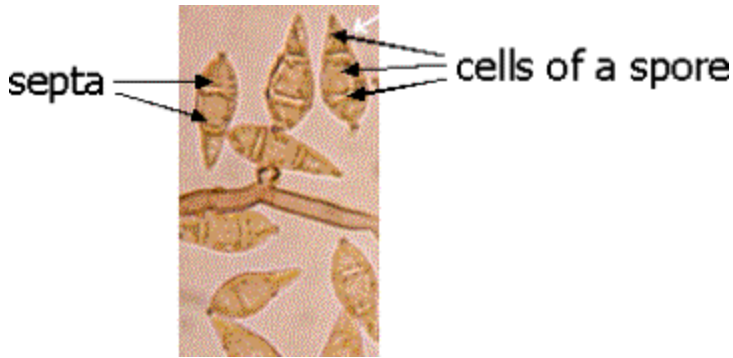


Photo 12: Rice blast conidia.

3.1.2. Sheath Blight [*Rhizoctonia solani* Kuhn]

3.1.2.1. Symptoms

The lesions are usually observed on the leaf sheaths although leaf blades may also be affected. The initial lesions are small, ellipsoid or ovoid, and greenish-gray (Photo 13) and usually develop near the water line in lowland fields. Under favorable conditions, they enlarge and may coalesce forming bigger lesions with irregular outline and grayish-white center with dark brown borders. The presence of several large spots on a leaf sheath usually causes the death of the whole leaf.

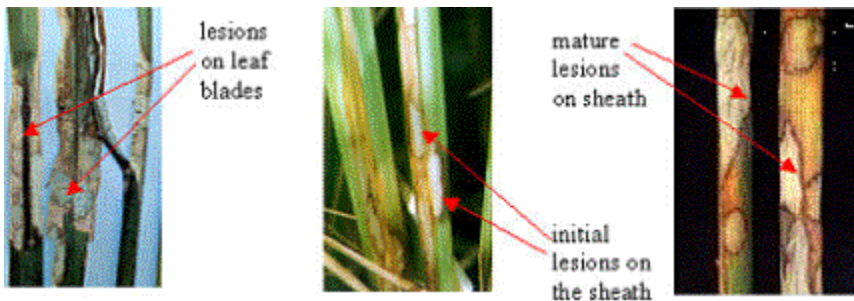


Photo 13: Sheath blight disease of rice plant.

3.1.2.2. Causal Organism

Instead of spores, the rice sheath blight fungus produces sclerotia measuring usually 1 to 3 mm in diameter and relatively spherical (Photo 14). Sclerotia are formed on or near the spots and can be easily detached from the plant. Under natural conditions, sclerotia usually occur singly but may sometimes coalesce to form larger masses. They are whitish when young and turn brown or dark brown when old.



Photo 14: Sclerotia of rice sheath blight disease.

3.1.3. Brown Spot [*Bipolaris oryzae* (Breda de Haan) Shoemaker]

3.1.3.1. Symptoms

Brown spot may be manifested as seedling blight or as a foliar and glume disease of mature plants. On seedlings, the fungus produces small, circular, brown lesions, which may girdle the coleoptile and cause distortion of the primary and secondary leaves. In some cases, the fungus may also infect and cause a black discoloration of the roots. Infected seedlings are stunted or killed. On the leaves of older plants, the fungus produces circular to oval lesions that have a light brown to gray center surrounded by a reddish brown margin (Photo 15). On moderately susceptible cultivars, the fungus produces tiny, dark specks. When infection is severe, the lesions may coalesce, killing large areas of affected leaves. The fungus may also infect the glumes, causing dark brown to black oval spots, and may also infect the grain, causing a black discoloration.



Photo 15: Brown spot symptoms on rice leaf and grains.

3.1.3.2. Causal Organism

The brown spot fungus produces multiseptate (three or more septae) conidiophore, singly or in bundles (generally 17), up to 600 μ m long, and 4-8 μ m wide. Conidia are generally curved, boat, or club-shaped, with 6 to 14 transverse septa or cross walls (Photo 16), 63-153 x 14-22 μ m, and often with a minute, slightly protruding hilum (dot at the point of attachment to a conidiophore).

Diagnosis of Common Diseases of Rice

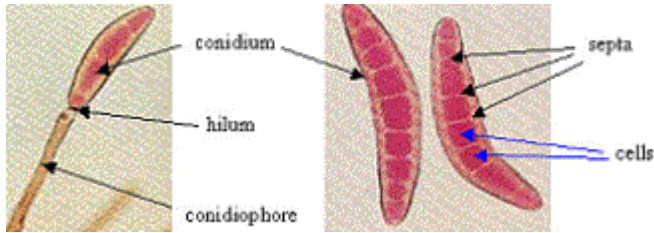


Photo 16: Conidia of rice brown spot disease pathogen.

3.1.4. Leaf Scald [*Microdochium oryzae* (Hashioka & Yokogi) Samuels & I.C. Hallett]

3.1.4.1. Symptoms

Leaf scald disease exhibits a variety of symptoms. The characteristic symptoms are zonate lesions of alternating light tan and dark brown starting from the leaf edges or tips (Photo 17). The lesions usually occur on mature leaves, and are more or less oblong with light brown halos. Individual lesions are 1-5 cm long, 0.5-1 cm broad and may enlarge to as long as 25 cm. The continuous enlargement and coalescing of lesions may result in the blight of a large part of the leaf blade. The zonation on the lesions fades as they become old and affected areas dry out, giving the leaf a scalded appearance.

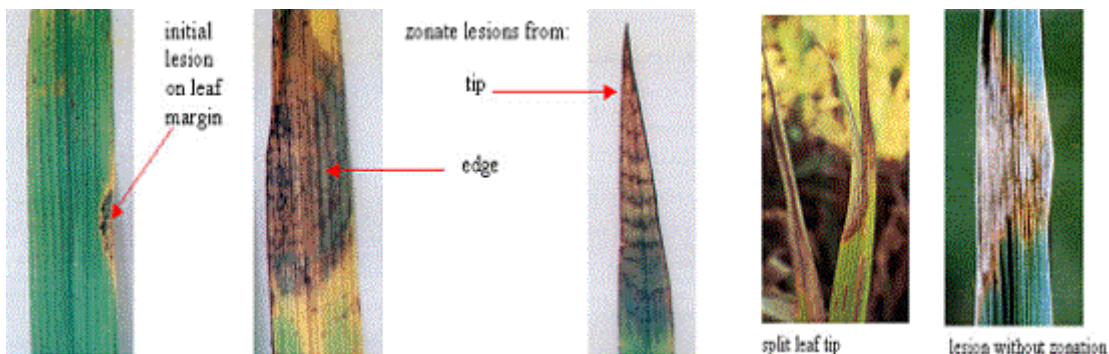


Photo 17: Lessons of rice leaf scald.

3.1.4.2. Causal Organism

The conidia are borne on superficial stromata (compact masses of specialized vegetative hyphae) arising on lesions. They are bow to new-moon shaped (Photo 18), single-celled when young and 2-celled when mature, occasionally 2-3 septate, pink in mass and hyaline under the microscope. The teleomorph produces brown, globose perithecia that are embedded in the leaf tissue, except for the opening called ostiole. Asci are cylindrical/club-shaped and unitunicate (an ascus in which both the inner and outer walls are more or less rigid and do not separate during spore ejection); ascospore are fusoid, straight or somewhat curved, 3-5 septate.

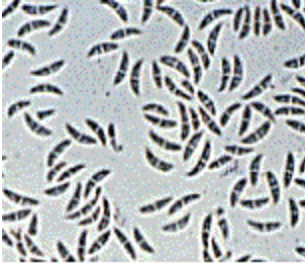


Photo 18: Conidia of rice leaf scald pathogen.

3.1.5. Narrow Brown Spot [*Cercospora janseana* (Racib.) O. Const.]

3.1.5.1. Symptoms

The characteristic symptoms of the disease are usually observed during the late growth stages and are characterized by the presence of short, linear, brown lesions mainly on the leaves, although it may also occur on leaf sheaths, pedicels, and glumes (Photo 19). The lesions are 2 to 10 mm long and 1 mm wide. The lesions tend to be narrower, shorter and darker brown on tolerant varieties and wider and lighter brown with gray necrotic centers on more susceptible ones. Leaf necrosis may also occur on susceptible cultivars. A net blotch-like pattern often forms on leaf sheaths, where the cell walls turn dark brown and the intercellular areas are tan to yellow. The disease usually appears at mature crop stages.

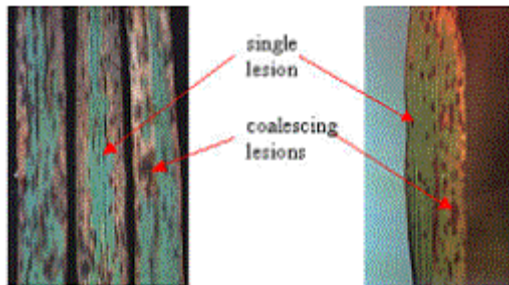


Photo 19: Narrow brown spots on rice leaves .

3.1.5.2. Causal Organism

The conidiophores are emerging from stromata, solitary or in group of two or three, dark, paler at apex, three or more septate, 88-140 x 4.5µm with conidia that are cylindrical to clavate (Photo 19), 3-10 septate, 20-60 x 5µm.

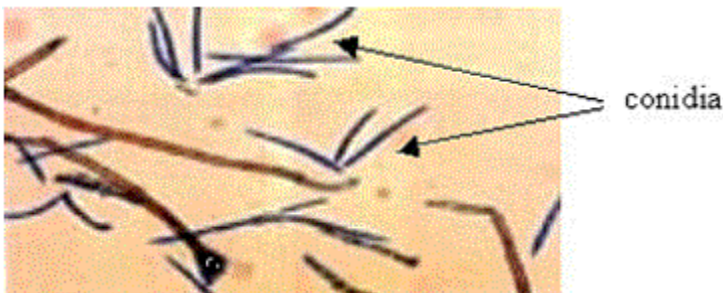


Photo 20: Conidia of narrow brown spot disease pathogen.

3.1.6. Stem Rot [*Sclerotium oryzae* Cattaneo]

3.1.6.1. Symptoms

The first symptoms are generally observed in the field after the mid tillering stage. Initially, the disease appears as small, blackish, irregular lesion on the outer leaf sheath near the water line. The lesion enlarges as the disease progresses with the fungus penetrating into the inner leaf sheaths. Eventually, the fungus penetrates and rots the culm while the leaf sheath is partially or entirely rotted (Photo 21). Infection of the culm may result in lodging, unfilled panicles, chalky grains, and in severe cases, death of the tiller. Brownish-black lesions appear and finally one or two internodes of the stem rot and collapse. Upon opening infected stem, dark grayish mycelium may be found within the hollow stem and numerous tiny, black sclerotia are embedded all over the diseased leaf sheath tissues. Sclerotia and mycelium of the fungus are generally present inside infected culms (Photo 22). The presence of sclerotia is usually a positive and easy way of diagnosing the disease.



Photo 21: Lesion of stem rot disease on rice leaf sheath.

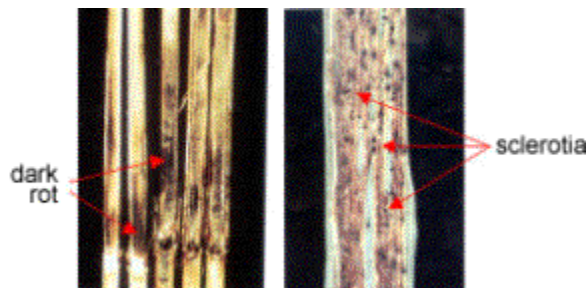


Photo 22: Rice stem rot symptom and sclerotia of pathogen.

3.1.6.2. Causal Organism

Perithecia of the fungus are found embedded in the leaf sheaths, and are dark, globose, and 250-650 μm in diameter, with a short beak that generally does not protrude from the tissue. Asci are cylindrical, short-stalked, and 104-165 x 8.7-17.7 μm ; they deliquesce (dissolve or liquefy) at maturity and contain eight ascospores. Ascospores are fusiform, somewhat curved, 3-septate, and 35-65 x 8.7 μm . Sclerotia are black, globose or near globose, smooth, and usually 180-280 μm in diameter. Conidiophores are dark, upright, and septate. Conidia are fusiform, three-septate, curved, 29-49 x 10-14 μm , and produced on pointed sterigmata.

3.1.7. Sheath Rot [*Sarocladium oryzae* (Sawada) W. Gams & D. Hawksworth]

3.1.7.1. Symptoms

Rotting occurs on the leaf sheath enclosing the young panicles (Photo 23). The lesions start as oblong or somewhat irregular spots, 0.5-1.5 cm long, with gray to light brown centers surrounded by distinct dark reddish brown margins. As the disease progresses, lesions enlarge and coalesce and may cover most of the leaf sheath. Lesions may also consist of diffuse reddish brown discoloration in the sheath. An abundant whitish powdery growth may be found inside affected sheaths; the leaf sheath may look normal from the outside. With early or severe infection, the panicle may fail to emerge completely or not at all; the young panicles remain within the sheath or only partially emerge. Panicles that have not emerged tend to rot, and florets turn red-brown to dark brown. Most grains are sterile, shriveled, partially or unfilled and discolored.

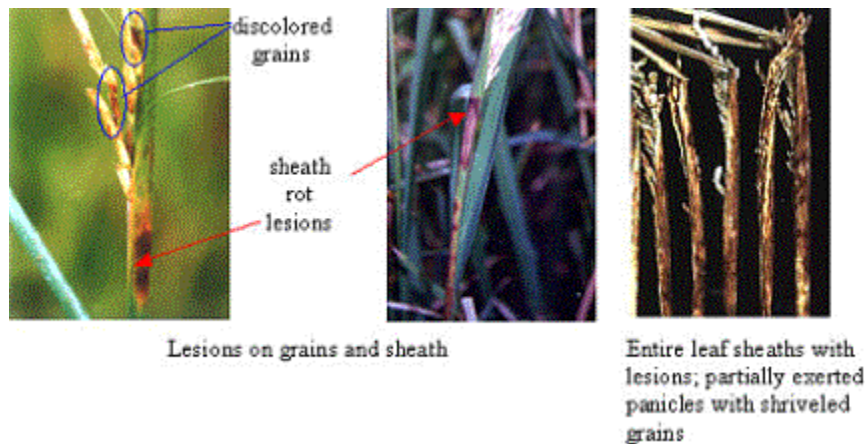


Photo 23: Symptoms of rice sheath rot disease.

3.1.7.2. Causal Organism

The fungus produces white mycelium, sparsely branched, septate, and measures 1.5-2 μ m in diameter. Conidiophores arising from the mycelium are slightly thicker than the vegetative hyphae, branched once or twice, each time with 3-4 branches in a whorl. Conidia are borne simply on the tip, produced consecutively, hyaline, smooth, single-celled, cylindrical, and are 4-9 x 1-2.5 μ m.

3.1.8. Bakanae [*Fusarium fujikuroi* Nirenberg]

3.1.8.1. Symptoms

The classic and most conspicuous symptom of the disease is the hypertrophic effect or abnormal elongation of plant (Photo 24). These symptoms can even be observed from a distance. The affected plants may be several inches taller than normal plants, thin, yellowish green and may produce adventitious roots at the lower nodes of the culm. Diseased plants bear few tillers and leaves dry up quickly. The affected tillers usually die before reaching maturity; when infected plants survive, they bear empty panicles.



Photo 24: Bakanae infected rice plant.

3.1.8.2. Causal Organism

The fungus has micro and macroconidiophores bearing micro and macroconidia; respectively (Photo 25). Microconidiophores are single, lateral and formed from hyphae, while macroconidiophores consist of a basal cell bearing 2-3 apical phialides which produce macroconidia. Macroconidia are multi-celled (3 to 7 septate), slightly curved or bent at pointed ends, typically canoe-shaped and measure 25-60 x 2.5-4 μm . Microconidia are one-celled, ovoid or oblong, borne singly in chains or false head on laterally borne conidiophores and measure 5-12 x 1.5-2.5 μm . Some conidia are intermediate, with two or three cells, oblong or slightly curved.

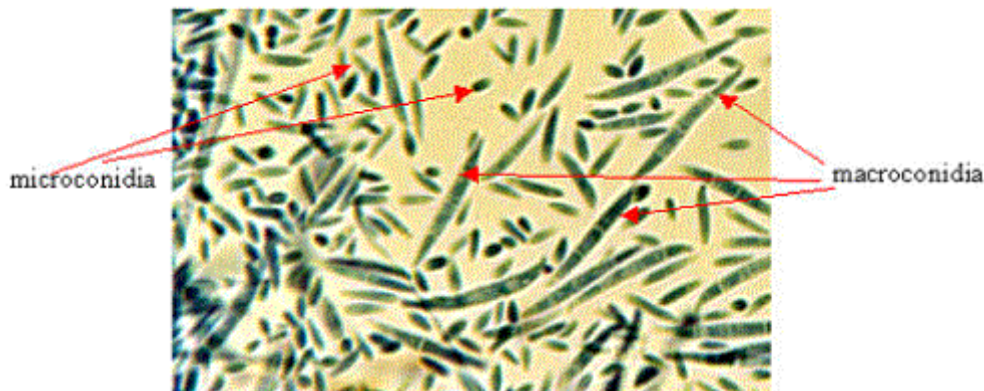


Photo 25: Microconidia and macroconidia of rice bakanae disease pathogen.

3.1.9. False Smut [*Ustilagoidea virens* (Cooke) Takahashi]

3.1.9.1. Symptoms

The disease occurs in the field at hard dough to mature stage of the crop. The fungus transforms individual grains of the panicle into greenish spore balls that have velvety appearance. The spore balls are small at first and visible in between glumes, grow gradually to reach 1 cm or more in diameter and encloses the floral parts. They are covered with a membrane that bursts as a result of further growth. The color of the ball becomes orange and later yellowish green, or greenish black (Photo 26). At this stage, the surface of the ball cracks. The outermost layer of the ball is green and consists of mature spores together with the remaining fragments of mycelium. The outer sporiferous region is three-layered. The outermost layer is greenish black with powdery spores; the middle layer, orange; the innermost, yellowish.

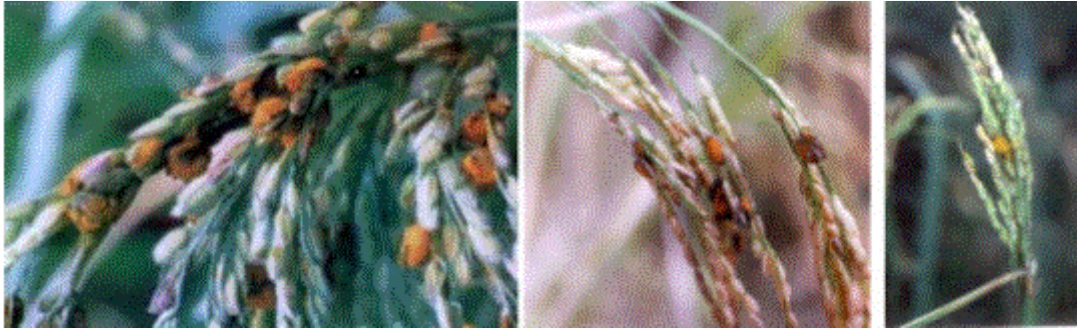


Photo 26: False smut on rice grains.

3.1.9.2. Causal Organism

Chlamydospore (a thick- or double-walled asexual spore formed directly from a vegetative hyphal cell that functions as a resistant or overwintering stage) formed on the spore balls are born laterally on minute sterigmata (a small, arclike, usually pointed hyphal branch or structure supporting a spore) on radial hyphae, and are spherical to elliptical, warty, olivaceous, 3-5 x 4-6 μm ; younger spores are smaller, paler, almost smooth. Chlamydospores germinate in culture by germ tubes, which become septate and form conidiophores bearing conidia at the tapering apex. These conidia are ovoid and very minute (Photo 27).

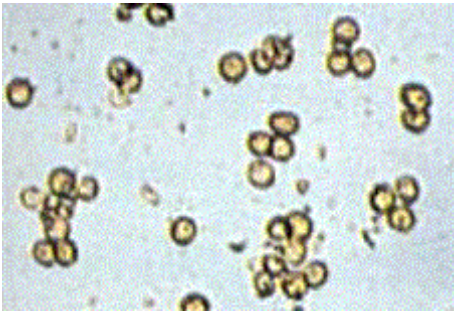


Photo 27: Conidia of rice false smut pathogen.

3.2. Bacterial Diseases

3.2.1. Bacterial Blight [*Xanthomonas oryzae* pv. *oryzae* (Ishiyama) Swing et al.]

Water-soaked lesion usually starting at leaf margins, a few cm from the tip, and spreading towards the leaf base; affected areas increase in length and width, and become yellowish to light brown due to drying; with yellowish border between dead and green areas of the leaf (Photo 28). It is usually observed at maximum tillering stage and onwards. In severely diseased fields grains may also be infected. In the tropics infection may also cause withering of leaves or entire young plants (refers as kresek) and production of pale yellow leaves at a later stage of the growth.



Photo 28: Bacterial blight infected rice leaf and fields.

3.2.2. Bacterial Leaf Streak [*Xanthomonas oryzae* pv. *oryzicola* (Fang et al.) Swing et al.]

Bacterial Leaf Streak first appears as short, water-soaked streaks between the veins, which become longer and translucent and turn to light brown or yellowish brown. Thus, large areas of the leaf may become dry due to numerous streaks. At the late stage the disease is indistinguishable from the bacterial leaf blight.



Photo 29: Rice fields with bacterial leaf streak infested plants

3.3. Virus Diseases

3.3.1. Tungro [Rice tungro bacillifor virus and spherical virus]

Plants affected by tungro exhibit stunting and reduced tillering. Their leaves become yellow or orange-yellow, may also have rust-colored spots. The leaf discoloration starts from the tip and may or may not extend to the lower part of the leaf blade; often only the upper portion is discolored. Young leaves may have a mottled appearance and old leaves show rusty-colored specks of various sizes (Photo 30). Infected plants have delayed flowering. The panicles are small and not completely exerted, and bear mostly sterile or partially-filled grains often covered with dark brown specks. Tungro are transmitted by the green leafhoppers.



Photo 30: Tungro disease infected rice leaf and field.

3.3.2. Grassy Stunt [Rice grassy stunt virus]

Plants affected by this disease, show severe stunting; excessive tillering, with short leaves that are narrow and, pale green to pale yellow in color (Photo 31). They may have newly-expanded leaves that maybe mottled or striped and may also have numerous small, irregular, dark brown or rust-colored spots. Brown plant hopper transmit this disease.



Photo 31: Grassy stunt infected rice hills.

3.3.3. Ragged Stunt [Rice ragged stunt virus]

Affected plants show stunting that may have reduced tillering. The leaves are short, dark green, and serrated along one or both edges giving a ragged appearance (Photo 32). The leaf blades are often twisted from a spiral. The vein swellings appear on leaf sheaths, leaf blade and culms and nodal branches are developed at later growth stages. Brown plant hopper transmits the disease.

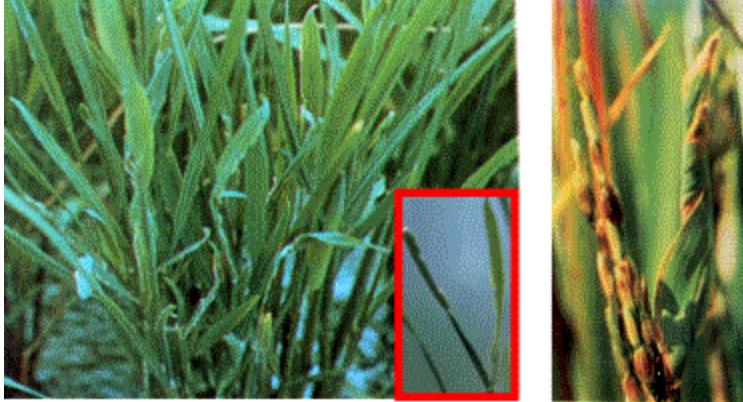


Photo 32: Ragged stunt infected rice plants

3.4. Nematode Diseases

3.4.1. Ufra or Stem Nematode [*Ditylenchus angustus* Butler]

Affected seedlings or plants show whitish discoloration (chlorosis) at the early stage of infection (Photo 33). Plants then are stunted and have deformed and twisted leaves. These plants have panicles, which are exserted, or panicles that inside the leaf sheath of the flag leaf. However, panicles that are exserted, become twisted and deformed, with unfilled grains.



Photo 33: Ufra disease damage symptoms at different growth stages.

3.4.2. White Tip [*Aphelenchoides besseyi* Christie]

Affected plants show characteristic symptoms on leaf tips; which become chlorotic or whitened for a distance of up to 5 cm (Photo 34). Eventually the infected leaf becomes dry and shreds while flag leaf becomes twisted and panicles may not emerge or if emerged may have high sterility, distorted glumes, and small and distorted kernels.



Photo 34: White tip diseased rice plants

3.4.3. Root Knot [*Meloidogyne graminicola* Golden & Birchfield]

Affected plants are stunted and become yellow in color. They have reduced tillering and their most diagnostic symptom is the presence of root galls. The disease is more serious in upland than in lowland rice.

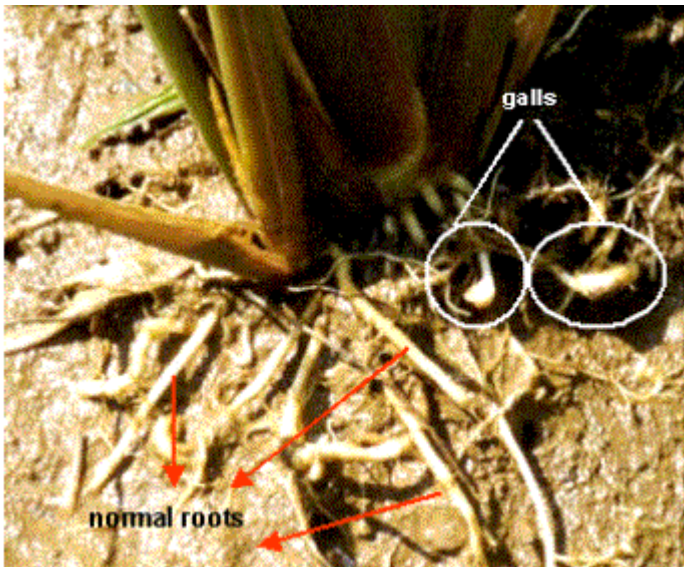


Photo 35: Rice plant with knot or gall on roots.

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