Diseases of Rice

Fungal diseases	
Brown spot	*Bipolaris oryzae*
Narrow brown leaf spot	*Cercospora oryzae*
Blast	*Pyricularia oryzae*
Leaf scald	*Microdochium oryzae*
Sheath blight	*Rhizoctonia solani*
Sheath rot	*Sarocladium oryzae*
Stackburn (*Alternaria* leaf spot)	*Alternaria padwickii*
Foot rot and bakanae	*Fusarium moniliforme*
False smut	*Ustilaginoidea virens*
Stem rot	*Sclerotium oryzae*
Bunt or Kernel Smut or Black smut	*Tilletia barclayana*
Bacterial diseases	
Bacterial blight	*Xanthomonas oryzae* pv. *oryzae*
Bacterial leaf streak	*Xanthomonas oryzae* pv. *oryzicola*
Nemic diseases	
Ufra	*Ditylenchus angustus*
White tip	*Aphelenchoides besseyi*
Viral diseases	
Tungro	*Rice tungro bacilliform virus (RTBV) and Rice tungro spherical virus (RTSV)*
Grassy stunt	*Rice grassy stunt virus*
Dwarf	*Rice dwarf virus*
Ragged Stunt	*Rice ragged stunt virus*
Yellow mottling	*Rice yellow mottle virus*
Yellow dwarf (Mycoplasmal Disease of Rice)	

Diseases of Rice

Sheath blight

Causal organism: *Rhizoctonia solani* (Sexual stage: *Thanatephorus cucumeris*)

Symptoms:

The fungus affects the crop from tillering to heading stage. Initial symptoms are noticed on leaf sheaths near water level. On the leaf sheath oval or elliptical or irregular greenish grey spots are formed. As the spots enlarge, the center becomes greyish white with an irregular blackish brown or purple brown border.

Lesions on the upper parts of plants extend rapidly coalescing with each other to cover entire tillers from the water line to the flag leaf. The presence of several large lesions on a leaf sheath usually causes death of the whole leaf, and in severe cases all the leaves of a plant may be blighted. The infection extends to the inner sheaths resulting in death of the entire plant. Older plants are highly susceptible. Plants heavily infected in the early heading and grain filling growth stages produce poorly filled grain, especially in the lower part of the panicle.

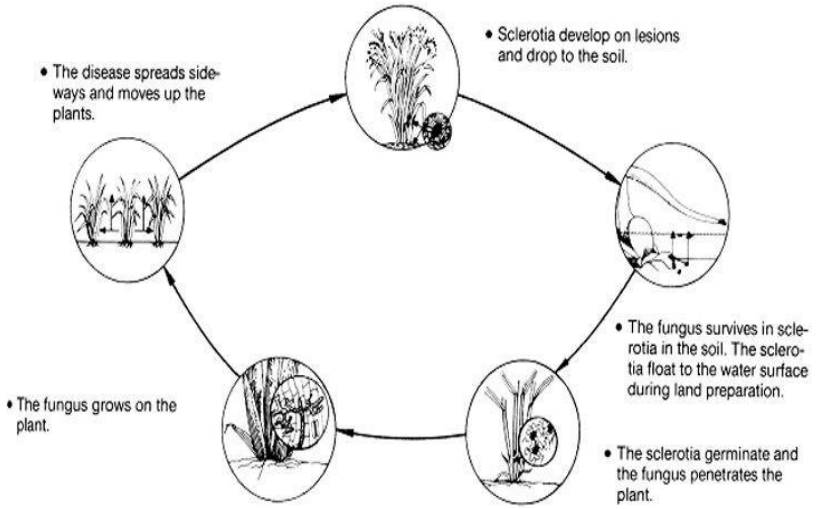
Average yield loss is around 30%

Predisposing factors

- High temperature (30-35°C) and relative humidity (>80%)
- Presence of inoculum in the field
- Close spacing and high dose of nitrogenous fertilizer

Disease cycle

R. solani has a wide host range and it can survive as sclerotia or mycelium in dry soil for about 20 months but for 5-8 months in moist soil. Sclerotia spread through irrigation water.



Control measures

- Planting in wide spacing (20 cm x 20 cm), using tall varieties
- Burning residues in infected fields at least once in a year
- Alternate wetting and drying of the field
- Using balanced dose of fertilizer
- Top dressing of 40 kg muriate of potash in two equal splits at disease initiation.
- In T. Aman, planting after mid-August in endemic areas.
- Spray Amistar Top, Power Blast 325 SC @ 1 ml/Litre of water or Bavistin DF, Aimcozim 50 WP @ 500 g/ha or Genuine 50 WP, Vulcan 50 WP @ 1 kg/ha at PI to booting stage

Blast

Causal organism: *Pyricularia oryzae (Syn: P. grisea)* (Sexual stage: *Magnaporthe oryzae*)

Symptoms:

Depending on the plant parts infected the disease is named as leaf blast, node blast and neck blast or panicle blast.

Leaf blast

Shape and size of the spots vary with susceptibility of the variety, age of the spots and the prevailing environmental conditions.

• Typical leaf spots are elliptical and somewhat pointed at both ends (eye-shaped).
• Margins usually reddish brown with grey or whitish center.
• On susceptible varieties spots begin as water-soaked whitish, grayish or bluish dots.
• Numerous spots coalesce and cause death of the leaf.

Node blast

• When node is infected, the sheath pulvinus rots and turns black, dry and often breaks apart remaining connected by the nodal septum only. All parts above the infected node become die.

Panicle blast/ Neck blast

• In case of panicle blast the fungus usually attack at the base of the panicle, producing brown lesions and the panicle often fall over due to rotting of the neck.
• The fungus also caused infection to the seed and panicle branches.



Yield loss: Up to 80%

Predisposing factors

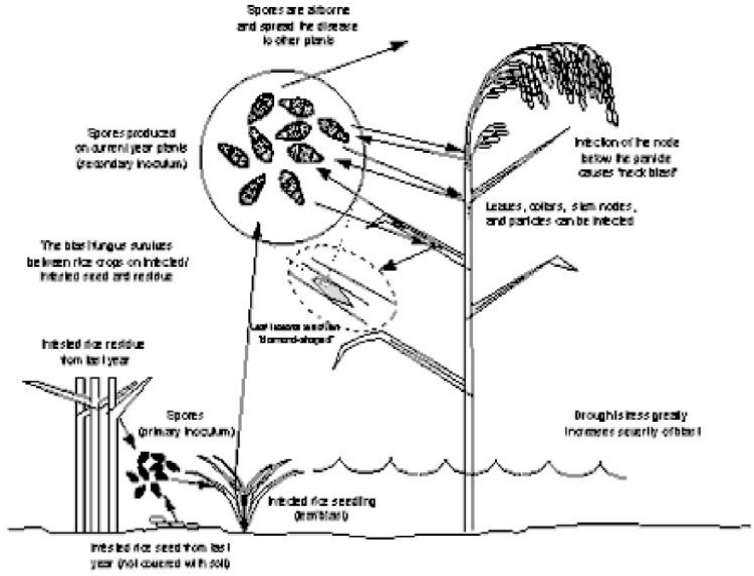
- High dose of nitrogenous fertilizer
- Dry and sandy type soil with low water holding capacity
- Low night temperature (20°C) and dew formation on leaves
- High humidity (>85%) and frequent rainfall

Disease Cycle

The disease spreads primarily through airborne conidia since spores of the fungus present throughout the year. Mycelium and conidia in the infected straw and seeds are major sources of inoculum. Irrigation water may carry the conidia to different fields. The fungus also survives on collateral hosts.

Spores land on leaves, germinate, penetrate the leaf, and cause a lesion 4 days later; more spores are produced in as little as 6 days. Infections from spores arriving from a distance are termed primary infections.

Primary infections generally result in a few widely scattered spots on leaves. Spores arising from the primary infections are capable of causing many more infections. This cycling is called secondary spread. Secondary spread is responsible for the severe epidemics of blast in fields and localized areas.



Control measures

• Use resistant/moderately resistant varieties; BR2, BR3, BR14, BR15, BR16, BR25, BR26, BRRI dhan28, BRRI dhan32, BRRI dhan33.
• Balanced fertilizers.
• Collect seeds from disease free field
• Regular irrigation
• Spray Amistar Top, Edifen 50 EC @ 800 ml/ha or Nativo 75 WP, Trooper 75 WP, Zeal 75 WP, Difa 75 WP @ 350 g/ha.

Brown spot

Causal organism: *Bipolaris oryzae* (Sexual stage: *Cochliobolus miyabeanus*)

Symptoms:

The fungus attacks the crop from seedling to milky stage in main field. Symptoms appear as minute spots on the coleoptile, leaf blade, leaf sheath, and glume, being most prominent on the leaf blade and glumes.

The spots become cylindrical or oval, dark brown with yellow halo later becoming circular. Several spots coalesce and the leaf dries up. The seedlings die and affected nurseries can be often recognized from a distance by scorched appearance. Dark brown or black spots also appear on glumes leading to grain discoloration. It causes failure of seed germination, seedling mortality and reduces the grain quality and weight.

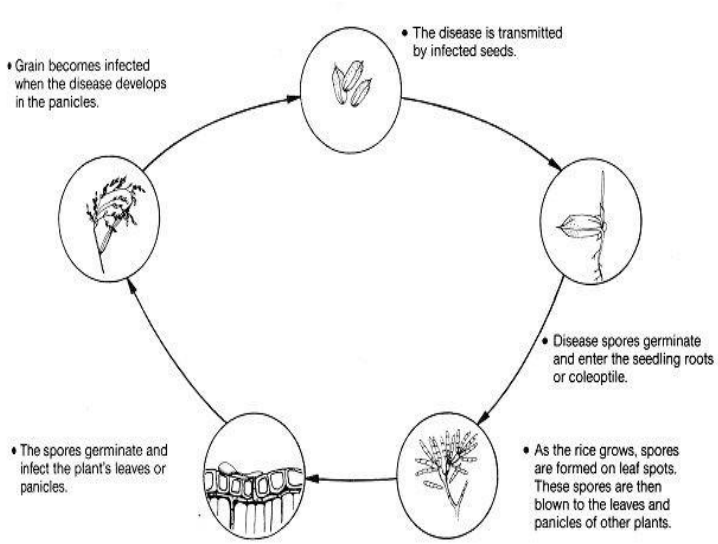
Predisposing factors

• Infected seeds
• Inoculum present in infected stubbles.
• Alternate hosts
• Light soil with low organic matter and poor soil nutrition

Disease Cycle

Infected seeds and stubbles are the most common source of primary infection. The conidia present on infected grain and mycelium in the infected tissue are viable for 2 to 3 years. Airborne conidia infect the plants both in nursery and in main field.

The fungus also survives on collateral hosts. The brown spot fungus is normally present in areas with a long history of rice culture. Airborne spores that are capable of causing infection are produced in infested debris and older lesions.



Control measures

- High amount of organic matter
- Healthy seeds
- Balanced fertilizer and irrigation
- Use fungicides (e.g., Iprodione, Propiconazole, Azoxystrobin, Trifloxystrobin, and Carbendazim) as seed treatments.

Narrow brown leaf spot

Causal organism: *Cercospora oryzae*

Symptoms:

Short, linear brown lesions are produced on the leaves but may also occur on the leaf sheaths, pedicels and glumes. The lesions are approximately 2-10 mm long and 1 mm wide. Large number of spots/lesions usually appears during the later stage of the plants.

Management

- Spray Carbendazim 500 g or Mancozeb 2 kg/ha.

Sheath rot

Causal organism: *Sarocladium oryzae*

Symptoms:

Initial symptoms are noticed only on the upper most leaf sheath enclosing young panicles. The flag leaf sheath show oblong or irregular greyish brown spots. They enlarge and develop grey center and brown margins covering major portions of the leaf sheath.

The young panicles remain within the sheath or emerge partially. The panicles rot and abundant whitish powdery fungal growth is seen inside the leaf sheath.

Predisposing factors

• Infected seeds
• Air-bone conidia from nearby infected field
• High nitrogenous fertilizer
• Hot and humid climate

Disease Cycle

The disease spreads mainly through air-borne conidia and also seed-borne. Primary source of inoculum is by means of infected plant debris. Secondary spread is by means of air borne conidia produced on the leaf sheath.

Control measures

• Use healthy seeds
• Apply balanced fertilizers
• Burn plant debris after harvest
• Spray Homai @ 2kg/ha or Tilt @ 1 L/ha at booting stage

Leaf scald

Causal organism: *Microdochium oryzae*

Symptoms

• Usually occurs in the mature leaves.
• The disease starts mostly near the tips, sometimes at the margin of the leaf blade.
• Lesion extends downwards.
• Successive bands of dark brown and lighter inner areas exhibit a characteristic zonation
• Badly affected leaves finally dry and turn into bleached straw colour.

Yield Loss. Up to 30%.

Predisposing factors

• High nitrogenous fertilizer
• Close spacing
• High humidity
• Moderate temperature

Disease Cycle

The disease spreads mainly through air-borne conidia and also seed-borne. Primary source of inoculum is by means of infected plant debris. Secondary spread is by means of air borne conidia produced on the leaf sheath.

Control measures

- Use healthy seeds and apply balanced fertilizers
- Burn plant debris after harvest
- Planting seedlings in wider space
- Spraying Kumulus DF, Thiovit 80 WG @ 2.5 kg/ha.

Stem rot

Causal organism: *Sclerotium oryzae*

Symptoms

• Disease starts near the water line as small, rectangular black lesion on leaf sheath.
• The lesion invades inward into the stem
• Numerous appressoria may be seen on the stem.
• Brownish black lesion appears on the stem.
• Finally one or two inter nodes of the stem rot and collapse.
• At maturity numerous black, round sclerotia may be seen inside the culm.

Yield Loss. 10-25%

Predisposing factors

• Sclerotia present in the soil and stubble
• Stagnant water in the field
• High nitrogenous fertilizer

Disease Cycle

The sclerotia survive in stubbles and straw those are carried through irrigation water. The fungus over winters and survives for long periods as sclerotia in the upper layers (2-3 inches) of the soil profile. The half-life of sclerotia in the field is about 2 years. Viable sclerotia have been found in fields for up to 6 years after a rice crop. The sclerotia are buoyant and float to the surface of floodwater where they contact, germinate, and infect rice tillers near the water line.

Control measures

• Alternate wetting and drying of the land
• Apply less nitrogen
• Burn plant debris after harvest
• Avoid thick planting
• Use fungicides (e.g., Provax 200WP, Bavistin DF) as seed treatments.

Bakanae

Causal organism: *Fusarium moniliforme* (Sexual stage: *Gibberella fujikuroi)*

Symptoms:

- The fungus secrets hormone at the base of the stem and stimulates adventitious root formation and internode elongation
- The diseased plants are much taller, slender compared to healthy plants and detected easily by their tall pale green leaves.
- Infected seedlings may, however, also be stunted and chlorotic, exhibiting root and crown rot. Infected seedlings usually are killed
- Older leaves can also be infected and may exhibit abnormal elongation and produce adventitious root from the first, second and third nodes above the ground level
- The severe affected plant become slender and weak and ultimately die

Predisposing factors

• Infected seeds
• Inoculum present in soil and infected stubble
• Alternate hosts
• High temperature (around 35°C)
• Damp soil condition
• High nitrogenous fertilizer

Control measures

• Use healthy seeds
• Use less nitrogen
• Good sanitation and alternate wetting and drying of field
• Seed treatment with Benlate or Homai @ 3 g/kg seed

Stack burn

Causal organism: *Alternaria padwickii*

Symptoms:

Large, oval or circular spots with narrow dark brown margins on the leaf. Initially, center of the spots remain pale brown and gradually becoming almost white and sometimes bearing minute black dots of sclerotia. Usually only a few spots on a few leaves are observed in the field. Grains infected by the fungus show pale brown to whitish spots with a dark brown boarder of relatively large size. Overwintering. As spores or mycelium in the seed and infected host tissues.

Management

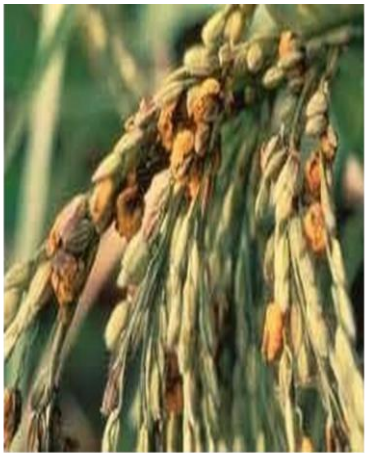
- Treat the seeds with Thiram or Mancozeb at 2 g/kg.
- Hot water treatment at 54 °C for 15 minutes is also effective.
- Burn the stubbles and straw in the field.

False smut

Causal organism: *Ustilaginoidea virens*

Symptoms:

Infected grains are transformed into greenish spore balls of a velvety appearance. Initially the spore balls remains in between the glumes gradually enclosing the floral parts. They are slightly flattened, smooth and yellow and are covered by membrane. The membrane burst as a result of further growth and the colour becomes orange and later yellowish green or greenish black. Two types of infection are observed. One type at flowering stage when the ovary is destroyed but the style, stigma and anther remains intact and covered by the spore mass. Second type occurs when the grain is matured. Spore accumulation on the grain absorb moisture, swell and force the lemma and palea apart.



Disease Cycle

Grasses and wild rice species are alternate hosts. The main source of inoculum is airborne spores. Ascospores produced from sclerotia act as primary source of infection while chalmydospores are secondary source of infection. Chlamydospores are air - borne, abundant at heading stage.

Favorable conditions

- Rainfall and cloudy weather during flowering and maturity

Control measures

- Keep the field clean.
- Remove infected seeds, panicles, and plant debris after harvest.
- Reduce humidity levels through alternate wetting and drying (AWD) rather than permanently flooding the fields.
- Where possible, perform conservation tillage and continuous rice cropping.
- Use moderate rates of nitrogen.
- Use certified seeds. Resistant varieties have been reported.
- Treat seeds at 52°C for 10 min.

Bunt or Kernel Smut or Black smut
Causal organism: *Tilletia barclayana*

Symptoms:

Minute black pustules or streaks are formed on the grains which burst open at the time of ripening. The grains may be partially or entirely replaced by the fungal spores. The sorus pushes the glumes apart exposing the black mass of spores. Only a few flowers are infected in an inflorescence. The fungus survives as chlamydospores for one or more years under normal condition and 3 years in stored grains.

Bacterial leaf blight

Causal organism: *Xanthomonas oryzae* pv. *oryzae*

Symptoms

The disease is usually noticed at the time of heading but it can occur earlier also. Seedlings in the nursery show circular, yellow spots in the margin that enlarge, coalesce leading to drying of foliage. **"Kresek"** (wilt) symptom is seen in seedlings, 1-2 weeks after transplanting. The bacteria enter through the cut wounds in the leaf tips, become systemic and cause death of entire seedling.

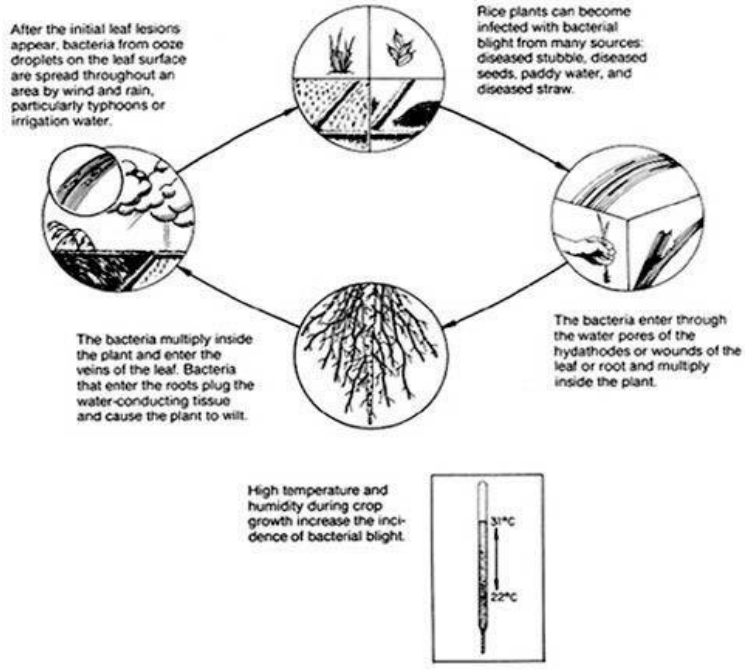
In grown up plants water soaked, translucent lesions appear near the leaf margin. The lesions enlarge both in length and width with a wavy margin and turn straw yellow within a few days, covering the entire leaf. As the disease advances, the lesions cover the entire lamina which turns white or straw coloured. Milky or opaque dew drops containing bacterial masses are formed on young lesions in the early morning. They dry up on the surface leaving a white encrustation. The affected grains have discoloured spots. If the cut end of leaf is dipped in water, it becomes turbid because of bacterial ooze.

Favorable Conditions

- Clipping of tip of the seedling at the time of transplanting
- Heavy rain, heavy dew, flooding, deep irrigation water
- Severe wind and temperature of 25-30 C
- Application of excessive nitrogen, especially late top dressing

Disease Cycle

The infected seeds as a source of inoculum may not be important since the bacteria decrease rapidly and die in the course of seed soaking. The pathogen survives in soil and in the infected stubbles and on collateral hosts. The pathogen spreads through irrigation water and also through rain storms.



Management

- Burn the stubbles.
- Use optimum dose of fertilizers.
- Avoid clipping of tip of seedling at the time of transplanting.
- Avoid flooded conditions. Remove weed hosts.
- Grow resistant cultivars.
- Spray Streptomycin sulphate and tetracycline combination 300g + Copper oxychloride 1.25 Kg/ha.

Bacterial leaf streak

Causal organism: *Xanthomonas oryzae* pv. *oryzicola*

Symptoms

- Symptoms initially appear as small, water-soaked, linear lesions between leaf veins. These streaks are initially dark green and later become light brown to yellowish gray.
- The lesions are translucent when held against the light.
- Entire leaves may become brown and die when the disease is very severe.
- Under humid conditions, yellow droplets of bacterial ooze, which contain masses of bacterial cells, may be observed on the surface of leaves.

Disease Cycle

The infected seeds as a source of inoculum. The pathogen survives in soil and in the infected stubbles and on collateral hosts. The pathogen spreads through irrigation water and also through rain storms.

Management

- Burn the stubbles.
- Use optimum dose of fertilizers.
- Avoid clipping of tip of seedling at the time of transplanting.
- Avoid flooded conditions.
- Remove weed hosts. Grow resistant cultivars IR 20 and TKM 6.
- Spray Streptomycin sulphate and tetracycline combination 300g + Copper oxychloride 1.25 Kg/ha.

Tungro

Causal organism: *Rice tungro spherical virus* (RTSV) and ii) *Rice tungro bacilliform virus* (RTBV).

Symptoms:

The degree of symptom expression of tungro (meaning degenerated growth) infected plants varies largely depending on the varietal susceptibility and the age of rice plant at infection, the status and abundance of vector, type of virus (strain) and the environment. However, the general symptoms are—

• Yellowing of leaves (inter-veinal chlorosis),
• Twisting of young leaves,
• Stunting (slight to severs) of plants,
• Reduction in tiller number,
• Wider leaf angle and
• Delayed flowering or panicle emergence.

Stunting of plant is due to shortening of both leaf and sheath; yellowing may range from light yellow to orange/orange-red. Bronzing or rusty spots/lesion may also appear on leaf. Discoloration of leaves from yellow to orange or orange-red (may occur). Irregular spots like bronzing may appear on the leaves of infected seedlings/plants. The symptoms first appear on young leaves, 1-2 weeks after transmission of the virus as yellow and then turn yellow to orange-yellow in another two weeks. In some varieties, the leaf angle becomes wider and the texture of the leaf becomes stiff.

Causes of the disease

Tungro is caused by rice tungro virus (RTV), which is a complex of two types of virus particles-i) *Rice tungro spherical virus* (RTSV) and ii) *Rice tungro bacilliform virus* (RTBV). Plants infected with both virus particles develop severe symptoms, while those infected with RTBV alone produce moderate symptom. RTSV alone produce no distinct symptom. The viruses are non-persistent in the vector.

Transmission and spread of tungro

Tungro viruses are transmitted by five species of GLH. Of them *Nephotettix virescens* in the most efficient transmitter. The insect can acquire the virus from the source plants in 5 minutes and then immediately can transmit it into healthy plants in 5 minutes. Tungro symptom appears 1-2 weeks after virus transmission. Usually, symptoms appear faster on susceptible and younger plants than in older ones.

Factors responsible for successful transmission and spread

Tungro virus infection and its spread successfully occurs if the following factors are present in the field:

- High population of green leafhopper
- Susceptible rice cultivars
- Source (infected) plants around the field
- Early growth stages of rice plant
- Favourable environment: i) temperature, ii) rainfall and iii) wind velocity

Diagnosis of tungro

Proper diagnosis of tungro virus disease in the field is of great importance for managing the disease efficiently. Rice plants may show yellowing or orange-yellow coloration as a result of suffering from:

- Toxicity due to herbicide, insecticide, excess fertilizer etc.
- Deficiency in N.K.S. Mn and Fe
- Cold injury
- Soil salinity
- Mealy bug infestation
- Other diseases like brown spot, bacterial leaf streak
- Unknown diseases and many other factors.

In case of above problems (toxicity), almost 100% plants of the affected field may show yellowing from the very beginning. But in case of tungro, the infection pattern initially show sporadic or in patchy and gradually may cover entire plot or part of the plot.

Control measures

Elimination of the sources of infection

- eradication of weeds, ratoons and volunteer plants
- rouging infected plants within the crop
- destruction of infected plants after harvest

Planting healthy seedlings

Avoidance of the vector insects

- planting or sowing in vector free area or vector free time
- changing variety.

Control of the vector in seedbed and at tillering stage

Use of resistant varieties.

Grassy stunt

Causal organism: *Rice grassy stunt virus*

Symptoms

Plants are markedly stunted with excessive tillering and an erect growth habit. Leaves become narrow, pale green with small rusty spots. May produce a few small panicles which bear dark brown unfilled grains.

Disease Cycle

Disease spreads by the brown plant hopper, *Nilaparvata lugens*, in a persistent manner having a latent period of 5 to 28 days in the vector. Ratoon crop and presence of vector perpetuate the disease from one crop to other.

Ufra

Causal organism: *Ditylenchus angustus*

Symptoms:

Symptoms on leaf or sheath-

- Splash pattern chlorosis
- Corrugation of leaf or sheath margin
- Crinkling and twisting of leaf tip

Symptoms on panicle and grain

- Pedicle discoloration, Shrinking and twisting
- Grain brownish, malformed and unfilled

Categorization of ufra symptoms on panicle Ufra I 'Thor ufra' (no emergence of panicle) Ufra II Partial emergence of panicle Ufra III 'Pucca ufra' (complete emergence with unfilled grains)

Other symptoms - Plants become bushy due to secondary tillering.
Yield loss. Ten to 100% yield losses may be incurred depending on the category of symptom production on panicle. Thor ufra' can cause 100% yield loss. In general, an average of 4-8% yield loss is attributed due to ufra by reducing plant population and panicle number, and poor grain filling.


Survival:
It survives in the off season forming coil on infested dried stubble, panicles or grains left on the field at harvest and or in living state on ratoon, volunteer rice and weed hosts. Ufra nematode can withstand desiccation for a period from 4-15 months.

Favorable environment:
More than 70% relative humidity, 28-31°C temperature, free moisture on host tissue, and Zn deficient soil favor ufra disease of rice.

Control measures
Cultural practices: Drying soil, ploughing land for 5-6 times at 1-12 days intervals, and during stubble reduce nematode population in the field. Raising seedling in disease free land, Crop rotation with jute/pulse or oil seeds was found effective to reduce ufra. Zn application also reduces ufra infestation.

Chemicals control: Curbofuran group of nematicides. Agridhan 3G, Furadan 5G, Sunfuran 3G 20 kg/ha were found effective to control ufra nematodes. Application of chemicals in two splits, one at transplanting and the other at 6-8 week after transplanting increases the effectiveness of the treatment. Nematicides may be applied in seedbed 7 days before seedling uprooting for control.

Resistance variety. All BRRI released varieties are susceptible to ufra. Traditional rice cultivar Rayada, Karkati, Bazail, Gowai etc were found resistant to ufra.

Yellow dwarf
Yellow dwarf is caused by mycoplasma which is also transmitted by GLH. Infected hills do not recover but they die before maturity of the crop. The mycoplasma maybe defined as polymorphic microorganism. They are non-motile, do not have cell wall and are bounded by a unit membrane, resistant to penicillin.

Symptoms:

- 100% leaves show cholorosis i. e pale green/ pale yellow leaves
- Severe stunting and profuse tillering
- Slight or no panicle emergence
- Death of the plant before or at maturity.

Control measures:

Control measures are the same as mentioned in cause of tungro disease