Crop: Rice

Name of Disease: Rice Blast Disease caused by Rice blast fungus- ***Magnaporthe oryzae***

Host Range: Rice, wheat, barley, maize, millets, grasses and sedges.

Disease Distribution: Karnataka, Andhra Pradesh, Gujarat, Maharashtra, Kerala, Orissa, Manipur, Uttarakhand, Chhattisgarh, Jharkhand, Arunachal Pradesh, Tamil Nadu, Haryana, Himachal Pradesh Jammu and Kashmir, Meghalaya, Tripura and Northern districts of West Bengal.

Pathogen Etiology, Life cycle & Biology:

The fungus *Magnaporthe oryzae* is an ascomycete as it produces sexual spores (ascospores) in structures called asci. The perfect state of the fungus produces perithecia and the asci are found within these perithecia. The asci are unitunicate. The ascospores are hyaline, fusiform (spindle-shaped with tapering ends) and with three septa or 4 celled and slightly curved. The mycelium of *M. oryzae* is hyaline and septate, and the nuclei within the mycelium and spores of this fungus are haploid. Conidia are produced in clusters on long septate, olivaceous conidiophores. Conidia are pyriform to ellipsoid, and are hyaline to pale olive green, usually 3 celled.

Symptoms of disease: The fungus attacks the crop at all stages of crop growth from seedling to late tillering and ear heading stage. Symptoms appear on leaves, nodes, rachis, and glumes.

Leaf blast: The characteristic symptoms of the disease appear on the leaf and leaf sheath as brown spindle shaped lesions. The lesions resembles to eye or boat shaped with gray or dark brown margins. The lesions in older leaves remain circular but on young leaves they enlarge up to several centimeters long and about 1 cm broad. The spots coalesce as the disease progresses and large areas of the leaves dry up and wither. Spots also appear on sheath. Severely infected nursery and field appear as burnt. Leaf blast can kill rice plants at seedling stage and cause yield losses in cases of severe infection.

Collar blast: Collar refers to the junction of the leaf and leaf sheath. Collar infections can kill the entire leaf and may extend a few millimetres into and around the sheath. The fungus may produce spores on these lesions.

Node blast: Stem nodes may be attacked as the plant approaches maturity, causing the plant to break at the point of infection. Diseased nodes are brown or black. Black lesions appear on nodes girdling them. The affected nodes may break up and all the plant parts above the infected nodes may die (nodal blast). Nodal infection causes the culm to break at the infected area. Inter nodal infection also occurs at the base of the plant which causes white panicles similar to that induced by yellow stem borer or water deficit

Neck blast: Brown to black spots or rings are formed on the rachis of the maturing inflorescence. The neck becomes shriveled and covered with grey fluffy mycelium. If the infection has occurred much before the grain formation the latter are not filled and the panicles remain erect; but if the attack takes place after some grains have formed the panicle hangs down. This stage of the disease causes maximum damage. Panicle branches and glumes can also be attacked. Lesions on the neck are grayish brown and causes the girdling of the neck and the panicle to fall over. If infection of the neck occurs before milky stage, no grain is formed, but if infection occurs later, grains of poor quality are formed. Lesions on the branches of the panicles and on the spikelet pedicels are brown to dark brown. The size and shape of the spots vary on different rice varieties.

Mode of Survival & Spread:

The pathogen survives as mycelium and conidia on diseased straw, seeds, rice ratoons, volunteer rice plants and weed hosts. The initiation of the primary infection process begins with the attachment of the conidium of *M. oryzae* to the leaf cuticle. Later stages of the infection process include the formation of appressorium and it assists in pathogen penetration, generation of turgor, formation of penetration peg, and finally penetration into host tissue. After penetration, hyphae grow through the plant tissue, resulting in the disease lesions and rice blast symptoms. The sporulation continues for several days and provides the inoculum (secondary conidia) for secondary infection. Under congenial weather conditions, the fungus produces enormous number of conidia which brings the secondary spread and infection to other healthy plants nearby and spreads rapidly to adjacent fields by wind and dewdrops leading to field epidemic.

Favourable Conditions of Pathogen:

High relative humidity and low night temperature, low soil moisture, frequent and prolonged periods of rain shower, and cool temperature in the daytime. In upland rice, large day-night temperature differences that cause dew formation on leaves and overall cooler temperatures favour the development of the disease.

ETL Levels:

Foliar blast 3-5 lesions/leaf: **Early to late tillering**

Neck blast 2-5 neck infected plants/m2: **Panicle initiation to booting**

Management Practices:

Resistant varieties: Blast Rasi, Vikas, Krishna Hamsa, Tulasi, IR 64, Aditya, Swarnadhan, Himalaya 1, Himalaya 2, Himalaya 2216, Pant dhan 10, HKR 228 and PNR 519, Pusa Basmati 1847,Pusa Basmati 1885 and Pusa Basmati 1886 in 2021. **[Local agriculture office should be contacted for up-to-date lists of available resistant varieties].**

Cultural Practices

1. The primary control option for blast is to plant resistant varieties. Local agriculture office for up-to-date lists of available resistant varieties should be contacted.
2. Use of disease free seeds and seed treatment with approved biopesticides or chemical pesticides before sowing.
3. Remove and destroy the weed hosts in the field bunds and channels. Weeds like *panicum repens, Leersia, Echinochloa, Digitaria* etc. should be removed from nearby areas of rice fields as these serves as alternative host for the pathogen.
4. Burn previously blast affected straw and stubbles.
5. Adjust planting time. Sow seeds early, when possible, after the onset of the rainy season. Sowing and planting stages should be adjusted in such a way that the seedling and active tillering stages of the crop growth should not fall during 3rd week of September to 2nd week of November in Kharif season and 2nd week of February to 1st week of April in Rabi season as these periods are most vulnerable for blast development.
6. Avoid close spacing as it often increases the severity of the disease.
7. High doses of nitrogenous fertilizers (more than 60 kg per hectare) should not be used. Split nitrogen fertilizer application in two or more treatments. (Apply N in three split doses (50% basal, 25% in tillering phase and 25% N in panicle initiation stage). Potash and phosphorus should be used (30 kg/hect each) along with nitrogenous fertilizer to reduce the epidemic.
8. Silicon fertilizers (e.g., calcium silicate) can be applied efficiently to soils that are silicon deficient to reduce blast. Cheap sources of silicon, such as straws of rice genotypes with high silicon content, can be used as an alternative. Care should be taken to ensure that the straw is free from blast as the fungus can survive on rice straw and the use of infected straw as a silicon source can spread the disease further.
9. Irrigation Management: Moisture content of the soil also affects the susceptibility of rice plants to the blast pathogen. Moreover, plants grown under well irrigated fields are less prone to blast than plants which are grown under less irrigated or drought-stressed condition.

Biological control agents: (Approved biopesticides as per CIBR&C MUP)

1. Seed treatment with *Pseudomonas fluorescens* 0.5% WP @ 10 gm/kg seed, Broadcasting of 1 kg *Pseudomonas fluorescens* 0.5% WP by mixing with 2.5 kg organic manure in one ha area and foliar Spray of 0.5% WP @ 1 kg/ha. **or**
2. Seed treatment with *Pseudomonas fluorescens* 1.5% WP@ 5 gm/kg seed and Mix 2.5 kg of *Pseudomonas fluorescens* 1.5% WP with 50 kg FYM or and broadcast uniformly over hectare of land 30 days after planting. **or**
3. Seed treatment with *Pseudomonas fluorescens* 1.5% LF @ 4.5 ml per kg seed and foliar spray @6.0 litre per ha.

Chemical Control: (Approved Fungicides as per CIBR&C MUP)

Judicious use of any of the following chemical pesticide may be used after the proper diagnosis of the disease by an expert and after the disease crosses the ETL level.

Aureofungin 46.15% w/v SP @0.005% formulation in 500 L of water/ha**,** Carbendazim 50%WP @250-500gm formulation in 750 L of water/ha (wet slurry treatment), Carpropamid 27.8%SC@ 0.1% in 300-500 L of water /ha depending upon crop stage, Ediphenphos 50%EC @ 500-600 g in 750-1000 L /ha, Hexaconazole 5% EC @ 1000 ml in 500 L of water/ha, Isoprothiolane 40% EC @ 750 ml in 500-1000 L of water/ha, Kasugamycin 3% SL @ 1000-1500 ml in 750-1000 L of water/ha, Kitazin 17% GR @ 3 kg/ha, Kitazin 48% EC @ 200ml in 200 L of water/ha, Kresoxim-methyl 44.3% SC @ 500 ml in 500 L of water/ha, Mancozeb75 %WP @ 1.5-2kg formulation in 750L of water/ha, Metiram70%WG @ 1500-2000g formulation in 500 L of water/ha, Picoxystrobin 22.52% w/w SC @ 600 ml in 500L of water/ha, Prochloraz 39.6% w/w EC @ 1000ml in 500 L of water/ha, Pyraclostrobin 100g/l CS@ 1000 ml formulation in 500 L of water/ha, Tebuconazole 25.9%EC @ 750ml in 500 L of water/ha, Thiophanate methyl 41.7% SC @ 1000ml formulation in 500 L of water/ha, Tricyclazole75%WP @ 300- 400gm formulation in 500 L of water/ha, Azoxystrobin 18.2% + Difenoconazole 11.4% w/w SC @ 0.1% in 500 L of water/ha, Azoxystrobin 120 g/L + Tebuconazole 240 g/L SC @ 830 ml in 500 L of water/ha, Azoxystrobin 5.1%w/w +Tebuconazole 9.1% w/w+ Prochloraz 18.2 % w/w EC @ 1750ml in 500L of water, Azoxystrobin 16.7% + Tricyclazole 33.30% SC @ 500ml formulation in 500 L of water/ha, Carbendazim 1.92% + Mancozeb 10.08% GR (Broadcasting), Carbendazim12%+ Mancozeb63%WP @ 750g formulation in 750L of water/ha, Carbendazim 25%+ Mancozeb 50% WS @

30-35g formulation in 100 ml of water for seed treatment, Difenoconazole 10 % + Mancozeb 50% WDG @ 625g formulation in 500 L of water/ha, Flubendiamide 7.5% + Kresoxim-Methyl 37.5% SC @ 667 ml in 500L of water/ha, Hexaconazole 4% + Carbendazim 16% SC @ 750 ml in 400-500L of water/ha, Hexaconazole 5.00% + Validamycin 2.50% SC@ 1000 ml in 500L of water/ha, Hexaconazole 4% + Zineb 68% WP@ 1000-1250g in 500L of water/ha, Iprodione25%+ Carbendazim25%WP@ 500g in 500L of water/ha, Kasugamycin 5% + copper oxychloride 45% WP @ 750g in 400-1000L of water/ha, Kasugamycin 6 % + Thifluzamide 26% SC w/v @ 300-345ml in 500l water/ha, Kresoxim-methyl 40% + Hexaconazole 8% WG @ 500g in 500L water/ha, Picoxystrobin 6.78% + Tricyclazole 20.33 %w/w SC @1000ml in 500L water/ha, Prochloraz 23.5% + Tricyclazole 20.0% w/w SE@ @1000ml in 500L water/ha, Propiconazole 10.7% w/w + Tricyclazole 34.2% w/w SE@ 500-700ml in 500L water/ha, Sedaxane 12.61% w/w + Azoxystrobin 3.15% w/w + Thiamethoxam 22.06% w/w @3.00 (ml/kg seed) or 8-10 ml/kg seed (For Pre-soaked seeds) 15-20 ml/kg seed (For dry seeds), Tebuconazole 50% + Trifloxystrobin 25% WG @ 200g in 375-500L water/ha, Tebuconazole 15% + Zineb 57% WDG @ 1250gm in 500L water/ha, Tricyclazole 20.4% w/w + Azoxystrobin 6.8% w/w SC@ 1000ml in 500L water/ha, Tricyclazole 45% + Hexaconazole 10% WG @ 500g in 500L water/ha, Tricyclazole 18.0% w/w + Tebuconazole 14.4% w/w SC @ 1000 ml/ha.