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Sheath blight: A big challenge of rice growers in India and its management approches through IPM

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Abstract
Rice (*Oryza sativa* L.) is a staple food for human being all over the world and India is the second largest producer and consumer of rice at global level. Production of rice in India is limited by several biotic and abiotic factors. Among the fungal diseases, Sheath blight caused by *Rhizoctonia solani* Kuhn (Teleomorph: *Thanatephorus cucumeris* Frank) is one of the most important diseases of rice. The disease causes yield losses up to 69%. Normally the disease appears at maximum tillering stage. The disease is soil-borne in nature. The sclerotia produced by the fungus are the main source of survival of the pathogen. Once infection occurs, secondary spread take place through direct contact. Rice cultivars that are short, high tillering, more erect and responsive to high fertilizer doses are more susceptible to the sheath blight. The management of sheath blight has not been successful because adequate level of résistance has not found. In these article symptoms, disease cycle, factors affecting disease development and management of sheath blight are briefly described through integrated pest management (IPM) approaches.

Keywords: Rice, IPM, sheath blight & *Rhizoctonia solani*

Introduction
Rice (*Oryza sativa* L.) belongs to the family Poaceae, and is one of the most important cereal crops for human consumption all over the world. Globally, after China, India ranks second in rice production. It is a major food crop in India, China and most of the other Asian countries, where 92% of the world's rice is cultivated (Rai, 2006) [7]. India has maximum area under rice cultivation at world level but productivity is low which is attributed to several factors like socio-economic problems, drought, lack of inputs, unfavorable weather conditions, lack of suitable varieties, poor seed quality, use of untreated seeds, less availability of agro-chemicals, non-adoption of modern production technologies and the most important is the losses caused by weeds, insect-pests and diseases. The rice crop suffers from many diseases caused by fungi, bacteria, nematodes, viruses and nutritional disorders. Among these, rice sheath blight disease caused by *Rhizoctonia solani* Kuhn [Thanetephorus cucumeris (Frank) Donk] was first reported in Japan by Miyake (1910) [5]. In India sheath blight, first reported from Gurdaspur by Paraser and Chahal (1963) [6], Despite advances in the development of rice varieties with improved resistance and new fungicides, diseases remain a major cause of yield loss and lower profits in rice production. Diseases are estimated to cause annual yield and quality losses of 8 to 10 percent (Rajan, 1987) [8]. Production costs are also increased by the use of chemical and cultural methods of disease control. Diseases and their impact on rice production have increased in importance over time. Use of high yielding varieties and greater nitrogen (N) fertilizer requirements have increased rice yields and production efficiency. The current rice-cropping environment includes thick stands, high N rates, inability to water effectively, depletion of essential soil nutrients and higher yielding, but often disease-susceptible, varieties. The various rice management styles used on different farms, plus patterns of rice variety usage among different farms and geographic regions, often determine the type and seriousness of particular diseases. The effect of farming practices and rice varieties on diseases over time illustrates two sides of the well-known "Disease Triangle." The disease triangle is used by plant disease specialists to teach others the basic principles of plant disease development. A combination of all three sides of the triangle results in the highest level of

diseased plants. If one of the sides is not present, then disease will be less severe or nonexistent.

Important disease and insect pest of rice

The major problems in rice production around the world are biotic and abiotic stresses against rice crops. Sheath blight, Blast disease, bacterial blight, brown spot, rice stem borer, rice leaf hopper and others are common biotic stress to rice crop (Jamal *et al.*, 2012) [4] were identified as important diseases of rice. Introduction of high yielding varieties, expansion in irrigation facilities and indiscriminate use of increased rates of agrochemicals such as fertilizers and pesticides in recent years with a view to increase productivity has resulted in heavy crop losses due to insect pests in certain crops. This situation has risen mainly due to elimination of natural enemies, resurgence of pests, and development of insecticide resistance and out-break of secondary pests. Rice is grown under different agro-climatic conditions and the crop is damaged by more than 100 species of insect pests and infested by varied diseases. These insect pests' cause enormous grain yields losses, which may vary from 20-50% if not managed in time.

Rice sheath blight disease

Rice sheath blight is one of the most economically significant rice diseases worldwide. This disease causes significant grain yield and quality losses. Yield losses of up to 50% have been reported under most conducive environments. Sheath blight is a soilborne disease caused by *Rhizoctoina solani* Kühn [*Thanetephorus cucumeris* (Frank) Donk]. *R. solani* is a complex of genetically distinct groups of fungi with more than 100 species; having very diverse life histories (Binder *et al.*, 2005) [2] with a wide host range and infects large number of crop plants, horticulture and weed species. Among *R. solani* anastomosis groups (AGs), the subgroup AG1-IA is one of the predominant causal agent of sheath blight from rice growing regions worldwide (Gonzalez-Vera *et al.*, 2010) [3].

Disease symptoms

Early symptoms usually develop on the leaf sheaths at or just above the water line as circular, oval or ellipsoid, water-soaked spots which are greenish-gray in color. As the disease progresses, they enlarge and tend to coalesce forming larger lesions with pale greenish-grey to grayish white center with narrow blackish to dark brown margins (Acharya *et al*., 2004) [1]. Finally, 4-5 such lesions coalesce and girdle the whole leaf sheath, culm, boot and flag leaf whereby the tiller is encircled to death. Under favourable conditions, the disease may progress in three ways : (i) inward spread - From outer to inner sheaths with bleached center and irregular purple brown border (ii) vertical spread - upward rapidly invading the lamina loosening the sheath from the culm, even causing blight of boot, flag leaf, panicle and lodging and grains become chaffy or partially filled particularly in the lower parts of the panicle (iii) horizontal spread - laterally the disease spreads from tiller to tiller and hill to hill apparently by physical contract in a densely crowded planting. When conditions are less favourable, the lesions remain restricted to lower leaf sheaths following some advancement of disease, as subsequent opening of the plant canopy due to leaf death permits increased penetrations of sun light and reduced relative humidity, lesions become dry, oblong, well defined, white, tan or grey with brown to reddish brown borders. They coalesce, overlap, and form a typical cobra skin pattern. The disease normally attacks the leaf sheath and leaf blade but symptoms were found on emerging panicle which were chaffy, grayish brown and matted together by fungal mycelium. Numerous white and brown sclerotia are formed on diseased panicles. The formation of sclerotia depends upon environmental conditions. Under humid conditions the mycelium of the fungus grows over the surface of the leaf sheaths and can spread to a considerable distance (several cm) in 24 hrs.

Perpetuation of sheath blight pathogen

The fungus mainly survives as sclerotia and/or mycelia in diseased plants debris left in the field. The viability of sclerotia in soil is influenced by environmental conditions. In undisturbed land, sclerotia are present only upto 2 cm depth. Population of sclerotia in ploughed land is higher at 6-12 cm depth than in the upper layers. The sclerotia buried deep in soil have better buoyancy and viability. In tap water at 35°C the sclerotia lose viability within a month but at 20°C, they remain viable for 2 years. However, in some recent studies prolonged survival of sclerotia in soil has been doubted.

Disease Cycle

It has been reported that the infected rice seeds may produce 4.0-6.6% seedlings infection in India. But on transplanting the infected seedlings were unable to develop disease. The sheath blight disease cycle takes place pre-dominantly through sclerotia in the humid tropics. Sclerotia, the major dormant form of the fungus are shed before/or during the harvest operations and remain on soil and survive for a long time when the buoyant sclerotia tend to accumulate in undisturbed standing water at the plant water interface, the aerobic fungus creeps up several centimeters in 24 hrs and the primary infections are caused in wetland rice. Rainwater runoff and flood irrigation permit good dispersal of floating sclerotia and consequently provide the primary foci of infection through the stretches of rice fields. The pathogen induced lesions on leaf blades and leaf sheath of infected plants. It produces sclerotia on both abaxial and adaxial leaf sheath surfaces but not in the tissue. The pathogen form infection cushions and lobate appressoria on the leaf sheath and directly penetrate the cuticle or through stomata.

Factors affecting disease development

The major factors include the rice cultivars, nitrogen fertilizer application and meteorological factors. It was suggested that different rice cultivars showed different levels of resistance to rice sheath blight. The degree of disease was closely correlated to the average daily temperature and frequency of rain. Sheath blight is usually severe on cultivars that are short, high tillering, more erect and response to high fertilizer doses in comparison to tall cultivars with less tillers. The susceptibility of moderately susceptible and moderately resistant cultivars to sheath blight increases with increasing plant age. Plant being most susceptible during the actively tillering stage, with further maturity at booting and heading plants become less susceptible. Optimum disease development occurred at 28°C or 30 to 32°C over the range of 23°C to 35°C and 81-92% or 96-97% relative humidity. The lesion development was rapid in light; disease severity was maximum at 50% light intensity, medium at normal sunshine and least in complete shading irrespective of susceptibility/resistance of cultivars. Low moisture level of soil (30-60%) encourages the seedling infection, while water logging reduces it. The influence of host factors on sheath blight of rice also plays an important role. The influence of the age of seedlings at the time of transplanting, growth stages of the plant and position of the leaves were investigated for sheath blight development. Seedlings of 20 and 30 days old were the most susceptible. Disease severity is higher at the maximum tillering stage.

Disease management through "IPM" approches

As rice scientists and farmers have gained experience in the cultivation of the modern varieties and the agronomic practices that have accompanied the "Green Revolution" there has been a shift from a primarily unilateral approach of disease control, with a strong reliance on pesticides, to a multilateral approach involving a mix of control tactics. The Some approaches related to Integrated pest management for over come of such devastating disease are under given

Host resistance

Cultivation of resistant varieties of rice would be the cheap, most effective and economical method to control sheath blight. But the management of sheath blight by the use of resistant cultivars has not been successful because adequate level of resistance has not been found. However, a few moderately resistant cultivars such as CR 1041, Nalini, Ratangiri, PTB 33, Bharti, IR 40, KK 2, CR 1014, Nabin, DS 4, Pankaj, Ratna, Terep and Hoshiyutaka were found to be less susceptible to sheath blight.

Healthy seed

To obtain healthy seeds, the seeds must be collected from the field located under unfavorable conditions for the pathogen, and fungicide must be applied if necessary. Gravity separation methods for seeds are useful. Salt solution, 200 g l–1, or ammonium sulfate solution, 230 g l–1, is used to separate sufficiently matured seeds, followed by chemical treatment for seed disinfection against a range of pathogens.

Fertilizer management

Nitrogen and phosphorus content in the plants affects disease proneness. Excess nitrogen fertilizer encourages disease development, while silica application reduces disease development. Therefore the amount and type of fertilizer must be carefully decided upon according to the cultivar used, soil condition, climatic conditions and disease risk.

Cultural control

1. Field sanitation by destroying grasses and other collateral hosts and burning infected straw and stubbles reduce infection.
2. Transplanting rice seedling at the spacing of 25 x 25 cm against 15 x 15 cm
3. Split application of N in NPK combination reduces the disease incidence
4. Incorporation of oil cakes, organic amendments, neem cake etc. and some green manuring crops particularly *Sesbania aculeata* (Dhaincha), sunhemp and green gram reduce the survival of the sclerotia of the pathogen and 5. Drainage of water after puddling reduces the chances of contact of floating sclerotia to come in the contact of plants.

Chemical control

Foliar sprays of propiconazole (Tilt 25 EC) 200 ml per acre or Hexaconazole 400 ml per acre and some combinational fungicide Tebuconazole 50+ Trifloxystrobin 25 WG @ 80-100 gm per acre or Azoxystrobin 16.7% + Tricyclazole 33.3% SC @ 200-240 ml per ac depending upon the past experience at an interval of 15 days as the initial symptoms of the disease appear are effective to control the disease.

Biological control

Sheath blight can be controlled by using biocontrol agents. Many biocontrol formulations are available in the market. Foliar sprays of spore/cell suspension or seed treatment of antagonists reduces the disease. Among different antagonists *Trichoderma* spp. and *Pseudomonas fluorescens* have been found effective in controlling the disease. The disease can be controlled by the seed treatment and foliar sprays with *Pseudomonas fluorescens* or *Trichoderma* spp.

Summary and Conclusion

The major problems in rice production around the world are biotic and abiotic stresses against rice crops. Rice sheath blight is considered as the most important disease of rice. Sheath blight can be controlled by an integrated management system using a variety of methods – resistant cultivars, cultural practices and chemical application – based on the information from disease forecasting systems.

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