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REVIEW ARTICLE

Two Major Fungal Diseases of Rice (*Oryza sativa* L.) and Management Methods: Review

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ABSTRACT

Rice blast and sheath blight disease caused by a fungus *Pyricularia oryzae* (Cavara) and *Rhizoctonia solani,* respectively, is a worldwide problem in rice and is dangerous because of its yield loss potential up to 100%. The objective of this review is to provide useful facts about rice blast and sheath blight disease and to be familiar with the different methods for controlling the diseases. Rice blast and sheath blight disease has been recognized in more than 85 rice producing countries worldwide. At present, more than 100 R genes for blast resistance have been identified in rice. Unlikely, there is no commercial variety which is resistant to sheath blight disease, but the land races can be used to achieve the novel genes for disease resistance**.** Rice sheath blight caused by *R. solani* is a destructive disease that leads to yield loss of 20–50%. Sheath blight disease management is difficult because of high genetic diversity of the causal organism and wide host range. Symptoms of this disease are generally observed from the milking stage to tillering stage of the rice crop. *P. oryzae* is favored by moist warm conditions and increased by fog, shade, or frequent light rains. Similarly, rice cultivar that accumulated more silicon on the shoots showed less incidence of rice blast. Among the fungal disease control method may include biological, chemical, and nutrient management; cultural practices and use of resistant varieties are the best disease management options.

Key words: Disease control, *Magnaporthe oryzae*, *Rhizoctonia solani*, rice

INTRODUCTION

Rice taxonomy

Rice belongs to the family "*Gramineae*" and the genus "*Oryza*". There are about 25 species of *Oryza* of these only two species are cultivated, namely, *Oryza sativa* Linus and *Oryza glaberrima* stead. The former is originated from North Eastern India to Southern China but has spread to all parts of the world. The latter is still confined to its original home land, West Africa. Rice is grown in more than a hundred countries, with a total harvested area of approximately 158 million hectares, producing more than 700 million tons of annually. Rice (*O. sativa* Linus) is one of the main staple foods for 70% of the population of the world. Africa produced an average of 26.4 million tons of rough rice (17.4 million tones, milled) in 2012 (FAO, 2013). The following review of rice diseases comprises first a description of two major fungal pathogens: Rice blast *Magnaporthe grisea* (Hebert) Barr) and rice sheath blight *Rhizoctonia solani*, including the disease control management.[1-11]

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Rice production

Rice is one of the main sources of food in the world where the increased demand for rice is expected to enhance production in many parts of Asia, Africa, and Latin America. Most of the world's rice is cultivated and consumed in Asia which constitutes more than half of the global population (Chakravarthi and Naravaneni, 2006). In developing countries, rice accounts for 715 Kcal per capita/day and provides 27% of global human per capita energy, 20% of per capita protein, and 3% dietary fat (FAO, 2002). World rice production increased at a rate of 2.3–2.5% per year during 1970s and 1980s, but this rate of growth was only 1.5% per year during the 1990s. The yield growth rate for rice has further declined during the first decade of 21st century. However, the populations in the major rice-consuming countries continue to grow at a rate of more than 1.5% per year. The average rice productivity in the world's is 4.4 t/ha (FAO, 2012).[12-20]

The host, O. sativa L.

Rice (*O. sativa* L.) belongs to the family *Poaceae* and the staple food for about 2.5 billion world's population which may rise to 4.6 billion (Maclean, 2002, Liu, 2013). Rice is one of the significant cereal commodities and fulfills the nutritional requirements of half of the world's population (Lopez and Joseph, 2008). In the world, the largest volume of rice production is concentrated in countries China, India, Indonesia, Vietnam, Thailand, Bangladesh, Burma, Philippines, Brazil, and Japan. The percentage share of the above top ten rice producing countries accounts for about 32.9, 24.4, 11.0, 7.0, 6.0, 5.4, 5.3 2.9, and 1.8% of the world production, respectively. Ethiopia is 73rd in the world ranking with almost 0.0% (FAO, 2013). There are more than 40,000 verities of cultivated rice said to exist. However, the exact figure is uncertain (www.riceassociation.org.uk).[21-30]

The pathogen

The potentially devastating economic impact resulting from blast infection has prompted worldwide efforts to produce blast resistant rice varieties (Bormans *et al*., 2003). Rice blast, caused by the filamentous ascomycete fungi *M. grisea* (Hebert) Barr, is one of the most devastating diseases of rice and often reduces rice yields greatly in rice growing countries under disease conducive conditions (Ou, 1985). Rice is affected by a series of epidemic as well as devastating diseases like rice sheath blight that caused by a destructive *R. solani* and leads to massive yield loss and degradation of rice. According to Lee and Rush (1983), yield loss occurs between 20% and 50%, when all the sheaths are infected.

LITERATURE REVIEW

Major fungal disease of rice

Fungal diseases of blast and sheath blight are listed as major diseases of rice ecologies of the world. In Asia, where more than half of the world's rice is produced and consumed, these diseases are major production constraints.

Rice blast disease

The rice blast disease is one of the most important diseases of *O. sativa* in the world and caused by a fungus *Pyricularia oryzae* (Cavara) (synonym: *Pyricularia grisea*) (Cook) Sacc. anamorph of *M. grisea* (Hebert) Barr. Webster and Gunnell, 1992; Zhou *et al*., 2007). It is filamentous ascomycetes that can reproduce both sexually and asexually. Rice blast is a worldwide problem in rice and is dangerous because of its yield loss potential ranging up to 100% under favorable conditions (Luo *et al*., 1998; Netam *et al*., 2011). The disease is generally considered the most important worldwide disease in all the rice growing regions of the world and has been reported in more than 85 countries (Rao, 1994). It is also the most important fungal disease in both upland and lowland rice (Bonman *et al*., 1991; Lee, 1994).[31-40]

The fungus infects the plant by the spore germinating and forming an appressorium thick fungal cell on the plant surface and then exerting a haustoria (feeding structure) into the plant cells. When the spores land on leaves and other aerials tissues of susceptible plant, they germinate and develop the appressorium which penetrate the plant cell by producing a penetration peg. Pressure in the appressorium increases and the structure explodes forcing the penetration through the cell wall and into the cell (Dean *et al*., 2005).

The fungus grows hyphae inter or intracellular within the leaf and form lesions. The initial infections occur on leaves usually around tillering and appear as diamond, football, or spindle shape lesion with pointed ends. Once it is established in the host plant the fungal hyphae sporulates and produce asexual spores (Kim, 1994). The pathogen completes its lifecycle within 1 week. Each of the phases (sporulation, releases, germination, and the penetration) play an important role during the blast epidemic and requires different environments.

Biology of blast pathogen and diseases development

The rice blast disease is caused by a fungus *P. oryzae* (Cavara) (synonym: *P. grisea*) (Webster and Gunnell, 1992; Zhou *et al*., 2007). It is filamentous ascomycetes that can reproduce both sexually and asexually. Sexual reproduction occurs when two strains of opposite mating types meet to form a fruiting structure known as perithecium in which ascospores are formed (Dean *et al*., 2005).

The asexual lifecycle begins when the hyphae of the fungus produces fruiting structures and sporulates to give conidia, which measure 20–22 × 10–12 μm, 2-septate, translucent, and slightly darkened. The fungus infects the plant by the spore germinating and forming an appressorium (a thick fungal cell) on the plant surface and then exerting a haustoria (feeding structure) into the plant cells. When the spores land on leaves and other aerials tissues of susceptible plant, they germinate and develop the appressorium which penetrate the plant cell by producing a penetration peg. Pressure in the appressorium increases and the structure explodes forcing the penetration through the cell wall and into the cell (Dean *et al*., 2005).[41-50]

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Sporulation phase is the first step that facilitate in building up the leaf blast epidemic as it provides the inoculums population (Webster and Gunnell 1992; Kim, 1994). The leaf blast phase occurs mostly between the seedling and late tillering stages. Lesions start as small water soaked areas on young leaves and enlarge quickly, under moist warm conditions, into diamond shape with a blue gray cast which are the fungal spores. However, under natural conditions, sporulation is greatly affected by the age of the crop and the size of the lesion together with the variety of rice (Kim, 1994). In case of sever or multiple infections, lesions may coalesce covering most of the leaf blast (Groth and Hollier, nd).[51-55]

Favorable conditions and disease transmission

P. oryzae is favored by moist warm conditions long dew periods (9 plus h) increased by fog, shade, or frequent light rains. Moreover, a minimum of 8 h moisture is needed for infection to occur. Blast development is favored by thick stands and high nitrogen rates which increase canopy thickness resulting in higher moisture levels but is most severe under upland or drained conditions. The fungus produces many spores, on stalk like structures called sporangia, in the presence of a favorable environment and a susceptible host and causes numerous new infections in the field and neighboring fields. The spores are carried by wind and water over long distances. Other conditions that favor blast are sandy soils and fields lined with trees (Groth and Hollier, nd).

In addition, draining of water allows the formation of nitrates resulting to drought stress. According to Kato *et al.* (2004), rice is more susceptible to drought than other cereals due to its inability to regulate its transpiration water loss a weakness that may be accelerated by rice blast attack. In contrast, water seeding, i.e., planting on very wet soil is recommended as this will reduce the transmission of disease from the seed to the seedling. As reported by Manandhar *et al.* (1998), water management through flooding is also recommended to reduce rice blast unlike when there is water stress.

The pathogen can continue to live in plants from one crop season to another in the tropics, or survive in the temperate zone on crop residues of diseased plants, or on ratoon (Zeigler *et al.*, 1994). Seed as secondary hosts also have been reported as possible sources of primary inoculums (Lee and Dean, 1993). The pathogen overwinters as spores in infected plant debris. The fungus produces new spores in the spring that reinfects rice. Spores are carried by wind and splashing rain. Movement can be over long distances (Groth and Hollier, nd). There are several control strategies that may be undertaken in management of rice blast, these may include chemical control, nutrition management, cultural practices, and use of resistant varieties.[56-65]

Sheath blight of rice

Rice is affected by a series of epidemic as well as devastating diseases. Rice sheath blight disease caused by *R. solani* is a destructive disease that leads to massive yield loss and degradation of rice. This disease was first reported by Miyake from Japan in 1910 referred as oriental leaf and sheath blight. Although from India, it was first reported by Pancer and Chahal in 1963. Apropos of Lee and Rush (1983), yield loss occurs between 20% and 50% when all the sheaths are infected. Sheath blight occurs in areas having high temperature and high humidity content and by application of excess nitrogenous fertilizer.

However, there is no commercial variety which is resistant to this disease, but the land races can be used to achieve the novel genes for disease resistance as well as abiotic stress tolerance and source of yield enhancing traits (Shakiba and Eizenga, 2014). Sheath blight disease management is difficult because of high genetic diversity of the causal organism and wide host range, apart from the conventional breeding approaches and application of hazardous pesticides. In spite of successful adaptation of scientific developments and establishment of rice crop, pests, and pathogens are inevitable and protective methods should be available to minimize the crop loss.

The pathogen and its biology

The pathogen**:** *R. solani* AG1-1A Kuhn (Telemorph Donk: Thantephoruscucumerisand (A. B. Frank) it has several hosts: Rice, soybean, bean, sorghum, corn, sugarcane, turf grass, and weed hosts such as barnyard grass, crabgrass, and broadleaf signal grass. *R. solani* infects rice leaf sheathes at the base of culms, producing oblong, gray brown, and water soaked lesions. R rice sheath disease is the most economically significant rice disease worldwide. The 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 soil born disease caused by the fungus *R. solani* AG-1A.The fungus belongs to the phylum Basidiomycota, family Ceratobaidiaceae.[66-70]

Pathogen biology

R. solani is accepted to be the causal organism and *T. cumuris* to represent the perfect stage (Chin, 1976; Kozaka, 1975). The pathogen is soil borne saprotrophic and facultative parasite (Ogoshi, 1996). It has a wide host range and worldwide distribution. The movement of the pathogen is limited as there is lack of spores and survives in unfavorable conditions by formation of dormant hyphae and sclerotia Datta *et al.,* 1997). *R. solani* is a basidiomycete fungus and it does not produce any asexual spores. Vegetative mycelium is produced which is colorless but becomes brown as it grows and mature. *R. solani* possess pale to dark brown rapidly growing mycelium. There is a formation of septum in the branch near the point of origin. Sclerotia formed varying in size but uniform in texture. The outer cells of the sclerotia were darker and thick walled. *T. cumuris* represents the sexual stage of *R. solani*

Disease symptoms

A plant disease symptom is the phenotypic or physiological manifestation of a successful invasion in the host by the pathogen. The visible or otherwise detectable abnormality arising from a disease or a disorder is called symptom. (Riley *et al*., 2002) Symptoms of sheath blight disease are generally observed from the milking stage to tillering stage of the rice crop. The symptoms are also seen in tillering to heading stage. Initially, lesions occur on the sheaths with the diameter of 0.5–3 cm occurring below the leaf collar. Later, the lesions extent to 1 cm in width and 2–3 cm in length (Fleet and Rush, 1983). Oval or elliptical or irregular greenish gray colored spots are formed. When the spots enlarge, the center of the spots becomes grayish white with blackish brown irregular border. Blightening occurs as formation of several lesions and they unite with each other. As the disease severity increases, the infection extends to the inner sheaths which cause death of the whole rice plant.

MANAGEMENT OF RICE DISEASE

There are several control strategies that may be undertaken in management of rice these may include to rotate crops, to plant resistant varieties, nutrition management, cultural practices, and biological control, and to use chemical when necessary. An integrated approaches the uses all of these method is the most effective and profitable. Obtaining long-lasting durable resistance to blast from a single gene is not likely, as the fungus has the ability to quickly mutate and attack formerly resistant cultivars (Araujo *et al*., 2000). One way to improve the durability of blast resistance is to "pyramid" resistance genes by crossing rice varieties with complementary genes to provide multigenic resistance against a wide spectrum of blast races (Hittalmani *et al*., 2000; Bormans *et al*., 2003).[71-74]

Introgression of resistance genes from four *Indica* cultivars (LAC23, 5173, Pai-Kan-Tao and Tetep) into the susceptible high yielding cultivar CO39 that led to near isogenic lines (NILs) harboring one or two resistance gene(s) each. These NILs allowed for the discovery of new resistance genes, namely, *Pi1, Pi2* (=*Piz5*), *Pi3,* and *Pi4b* (Yu *et al*., 1991; Mackill and Bonman, 1992; Inukai *et al*., 1994).[75-80]

Some upland cultivars such as the traditional African cultivars Moroberekan and OS6 have been cultivated for many years in large areas in West Africa without high losses from blast (Notteghem, 1985; Bonman and Mackill, 1988). Five resistance genes have been identified in African cultivar, Moroberekan (Wang *et al*., 1994; Inukai *et al*., 1996; Naqvi and Chattoo, 1996; Chen *et al*., 1999). These cultivars have been widely used as resistance donors in breeding programs (Wang *et al*., 1994). Scientists are hesitant because they are looking for the potentially devastating economic impact resulting.

Nutrition management

The understanding of the impacts of nutrition management on interactions between rice and diseases is a base to stimulate high yield production system (Luong *et al*., 2003). In this view, Magdoff *et al*. (2000) indicated that nutrition management is one of the most important practices for high production system that may affect response of rice to diseases, as well as developmental pattern of the disease populations due to the change of environments. Indeed, most disease management methods used by farmers can be considered as soil fertility management strategies (Magdoff *et al*., 2000). Increasingly, recent research is showing that the ability of a crop plant to resist or tolerate insect pests and diseases is tied to optimal physical, chemical, and mainly biological properties of soils (Luong *et al*., 2003).

According to Luong *et al*. (2003) soils with high organic matter and high biological activity generally exhibit good soil fertility as well as complex food webs and beneficial organisms that prevent infection. With this in mind it indicated that some fertilizer application may have a negative or positive response of plants toward the disease. For instance, excess nitrogen encourages disease hence overlap must be avoided since this enhances the increase of inoculums levels (Webster and Gunell, 1992). Therefore, despite the positive role played by nutrition in control of diseases, some farming practices may cause nutrition imbalances resulting to disease development (Magdoff *et al*., 2000). Meyer (2000) also indicated that soil fertility practices have impact on the physiological susceptibility of crop plants to insect pests and diseases either affecting the resistance of individual plant positively or negatively. On the other hand, though excess nitrogen encourages disease, split application of nitrogen in upland rice was found to decrease the rice blast as compared to a single application in furrow at planting (Kurschner *et al.,* 1992).

Silicon

Silicon (Si) is known as a beneficial element for plants. The direct and indirect benefits of the element for crops especially grasses are related to resistance to diseases, insect pests, and drought. Plant species are considered Si accumulators when the concentration of Si (in dry weight basis) is >1 g/kg (Epstein, 1999). Dry land grasses such as wheat, oat, rye, barley, sorghum, corn, and sugarcane contain about 10 g/kg in their biomass, while aquatic grasses have Si contents of up to 50 g/kg (Korndorfer *et al*., 2001). In rice, Si accumulation is about 108% greater than that of nitrogen while the concentrations between 3% and 5% may be the minimum tissue levels needed for disease control (Datnoff *et al*., 1997). It is estimated that a rice crop producing a total grain yield of 5000 kg/ha will remove Si at 230–470 kg/ha from the soil (Savant *et al*., 1997).

In the absence of adequate silica, brown spot disease (*Bipolaris oryzae*) was often found to be very severe giving rice an overall brownish appearance. Neck rot (*P. oryzae*) too increased in the rice field that contained inadequate silicon (Datnoff *et al*., 1990; Datnoff *et al*., 2001). Low Si uptake was also seen to increase the susceptibility of rice to blast and other diseases (Kobayashi *et al*., 2001; Rodrigues *et al*., 2001; Massey and Hartley, 2006).

For plants disease resistance, epidermal cell walls of silicon accumulators are impregnated with a firm layer of silica and become effective barriers against water loss and fungal growth thereby preventing formation of haustoria and hyphal penetration (Marschner, 1995). The function of silicon deposition in the defense mechanism may be similar to that of enhanced synthesis of polyphenols and lignin at the site of infection (Vance *et al*., 1980). The phenolics play a role as either phytoalexins or as precursors of lignin and suberin biosynthesis. Silicon can also be associated with lignin-carbohydrate complexes in the cell wall of rice epidermal cells (Inanaga, 1995). In addition, the leaves and culms of rice plants, grown in the presence of silicon showed an erect growth that greatly improved the distribution of light within the canopy. This avoided the shading that would otherwise encourage a suitable environment for survival of the pathogens (Ma and Takahashi, 1991).

Seebold *et al*. (2001) noted a reduction in number of the sporulating lesions on partially resistant and susceptible rice cultivars fertilized with calcium silicate indicating fewer successful infections per unit of inoculum. Similarly, Prabhu *et al*. (2001) found that rice cultivar that accumulated more silicon on the shoots showed less incidence of rice blast. Experimental result conducted by Seebold *et al.* (2001) using blast resistant, partially resistant, and susceptible cultivars of rice planted in soil amended with Si at 0, 500, or 1000 kg/ha, showed that the interaction between rate of Si and rice cultivar was significant ($P \leq 0.05$). The application of Si at 500 and 1000 kg/ha significantly reduced severity of leaf blast from 1.8% to 0.5% on Linea 2SR and from 5.9% to 1.6% on Oryzica 1 as compared to these cultivars without Silicon [Table 1].[85]

Cultural measures

Cultural method means management of disease without application of any chemicals. Cultural methods do not have adverse environmental effects too (Katan, 2010). Breeding disease-resistant rice cultivars is believed to be one of the most promising approaches to control the disease. However, no rice cultivar has been found completely resistant to the soil borne fungus so far (Bonmann *et al*., 1992; Zou *et al*., 2000). Biocontrol of rice sheath blight has been reported and well documented. Biological control of sheath blight can be achieved using antagonistic *Pseudomonas* spp. (Nagarajkumar *et al*., 2004; Nandakumar *et al*., 2001), *Bacillus* spp. (Chen *et al.,* 2004), *Trichoderma* spp. (Shanmugam *et al*., 2001; Tang *et al*., 2002), and antifungal metabolites produced by *Streptomyces* spp. (Liao *et al.,* 2009; Prabavathy, 2006) (Yang *et al.,* 2017). Several rhizobacteria are known to detoxify the toxins produced by fungal pathogens and they have been developed as biocontrol agents to control fungal diseases of crop (Nagarajkumar *et al*., 2004).[81-84]

Biological control using PGPR

Antagonism between organisms is common in the ecosystem and is most prevalent among soil

Table 1: Severity of leaf blast and neck blast on blast-resistant, partially resistant, and susceptible cultivars of rice treated with Si at 500 or 1000 kg/ha

Silicon rate kg/ha		Leaf blast severity % in each rice variety		Neck blast severity % on each rice variety		
Oryzica Lilanos 5	Linea 2SR	Oryzica 1	Oryzica	Lilanos 5	Linea 2SR	Oryzica 1
0	0.06^{a}	1.8^{a}	5.9^{a}	2.8^{a}	33.0^{a}	55.1^{a}
500	0.04^{a}	0.8^{a,b}	3.0^{b}	4.4^{a}	28.0^{a}	48.7^{a}
1000	0.01^{a}	0.5^{b}	1.6^{b}	2.4^{a}	20.5^{a}	39.4

Column followed by the same letter does not differ significantly according to Fisher's protected least significant difference test (FLSD) ($P \leq 0.05$). Source: Seebold *et al*. (2000)

microorganisms. Natural interference between beneficial soil microorganisms and plant pathogens results in zone of buffer, thereby inhibiting or reducing disease development (Kohl *et al*., 2011). Various microbial defense mechanisms may work independently or together, depending on the rhizosphere or phyllosphere characteristics. Managing soil abundant beneficial microbes for the improvement of plant root and shoot growth and plant health is an exciting field. Microbial interactions in the rhizosphere influence plant health and soil fertility (Jeffries *et al*., 2003). Advancements in biological control have led to the identification and development of antagonistic bacteria with plant and root growth stimulating ability (Yellareddygari *et al*., 2014).

Several strains of *Pseudomonas fluorescens* have been successfully used for biological control of rice sheath blight (Mew and Rosales, 1986; Gnanamanickam *et al*., 1992; Rabindran and Vidhyasekaran, 1996; Krishnamurthy and Gnanamanickam, 1997; Vidhyasekaran and Muthamilan, 1999). Since the fungus *R. solani* survives in soil as sclerotia and produces oxalic acid (OA) it would be ideal to identify an antagonistic strain of *P. fluorescens* with a potential to detoxify the OA.

CHEMICAL CONTROL

Basically, chemical control of any fungal plant disease consists of application of systemic or contact fungicide. The application of systemic fungicide is prevalent since 1960s and it is found that they provide better disease management than the non-systemic ones (Gullino *et al*., 2000). A vast range of fungicides differing in modes and formulations are available in the market for the management of sheath blight disease. The fungicides which come under the strobilurins group are widely used to combat sheath blight disease. Among the strobilurins group fungicides, the azoxystrobin fungicide is widely used as it is very much effective in managing this lofty disease (Groth and Bond, 2006). This fungicide was the first registered fungicide being derived from â-methoxy acrylate. It is sold as various names by various companies (Syngenta, Bayer, and Raleigh etc.) in the market (Gricahr and Besler, 2004). Another effective chemical against sheath blight is validamycin which is used throughout Asia (Miyagi, 1990). Meanwhile, two antifungal compounds are found from *Streptomyces* sp. PM5 which are antifungal and can be used against sheath blight disease (Prabhavathy *et al*., 2006). The foremost benefits of using fungicides are lower incidence of disease and reduction of inoculums and improved grains and quality (Groth, 2006). However, chemical control has its drawbacks too. The pathogen has the chances to develop resistance to a chemical by regular continuous application of fungicide (Zhang and Liu, 2009). Although chemical methods are main measures taken against any disease, there stands the chance of developing resistance in the pathogen which makes the pathogen more virulent (Brent and Hollomon, 1998).

CONCLUSION

The rice blast disease, caused by a fungus *P. oryzae* (Cavara), is a worldwide problem in rice and is dangerous because of its yield loss potential ranging up to 100%. The disease is the most important worldwide disease in all the rice growing regions of upland and low land rice. Blast epidemics are mainly dependent on climatic conditions, crop management practices, such as nitrogen inputs or water supply, and cultivar susceptibility. Moreover, the rice blast disease development is favored by thick stands, very low silicon, and high nitrogen rates which increase canopy thickness resulting in higher moisture levels but are most severe under upland or drained conditions. On the other hand, the diseases could be managed through proper application of silicon fertilizer, avoiding of excess nitrogen fertilizer, planting on very wet soil, and flooding. Therefore, rice growers can manage the disease using these methods.

Rice sheath blight is a destructive disease that leads to massive yield loss and degradation of rice sheath blight being a crop ruinous disease, the management should be more effective and less time consuming. It prefers areas having a high temperature, high humidity content and by application of excess nitrogenous fertilizer to occur. Even though several control management strategies of rice sheath blight available such as chemical control, biological control, nutritional management, and cultural practices breeding for disease resistant rice cultivars is the most promising approaches to control the disease.

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