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Sheath blight of rice in West Bengal-an overview*

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PRESIDENTIAL ADDRESS

Distinguished guests, learned members of the Indian Mycological Society, friends, ladies and gentlemen.

I feel greatly honoured to serve the Society as the President at a time when the Society is going to complete its fifty years of existence, not a mean achievement for a scientific Society of India. I can remember, when the Society was founded in 1954, I was a post-graduate student of the Department of Botany of Calcutta University, from where the Society originated and I became an associate (student) member of the Society. I particularly remember the contribution of Dr. S. N. Banerjee, from whom we got the first lesson of Mycology and Plant pathology at the post-graduate level and who was a founder member of the Society. From those days we have come a long way, but still I am haunted by nostalgic memories of those past years. With deep grief I remember the distinguished member and a honourary fellow of the Society, Prof. S. B. Chattopadhayay, my research guide, who passed away only recently. I bow my head to express my respect and deep sense of gratitude to them.

My choice of the present topic, sheath blight of rice in West Bengal- an overview, is primarily due to the fact that rice is the major corp of West Bengal and prsently sheath blight is considered to be the most important disease of the crop.

Sheath blight of rice, by *Rhizoctonia solani* Kuhn [*Thanatephorus cucumeris (Frank) Donk*] has been reported from all the rice growing countries of the world, both temperate and tropical. Although the disease was first described on rice from Japan (Miyake, 1910), in India the disease first appeared in the early 60s of the 20th century with the introduction of high yielding dwaf cultivars. The first report of its occurrence was made by Paracer and Chahal (1963) from Gurdaspur from Punjab and later on from Uttar Pradesh (Kohli, 1966). Since then the disease has become one of the most common and destructive diseases in India, including West Bengal.

The magnitude of destructivencess that the disease could cause can be gauged from the report of Gangopadhyay and Chakraborty (1982), who observed in September 1980 at the Central Rice Research Institute farm (Cuttack, Orissa) that cv. Karuna could not be harvested due to death of all the leaves and incomplete emergence of the panicles. It is not unusual in tropical areas of observe most of the leaves killed and near total loss of crop, if a highly susceptible rice cv is grown in a large continuous area.

CHANGE OF RICE DISEASE SCINARIO

With the large-scale cultivation of high yielding cvs. rice disease situation has completely changed. The importance of diseases in yield and overall production of rice in United Bengal was realised for the first time in 1942-43 when brown spot incited by *Drechslera oryzae* was found to play a major part in the over all reduction of yield to the extent of 33 percent and is cosidered to be one of the major causes of Bengal famine of 1943 (Padmanabhan, 1973).

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However, with extensive cultivation of high yielding cvs., brown spot never appears in a destructive form now-a-days and is considered to be rather a minor disease. Instead some other diseases newly appeared on the crop and made their appearance felt. Rice tungro virus (RTV), bacterial blight (*Xanthomonas oryzae*), and sheath blight (*R. solani*) may be mentioned in this context.

An analysis of the present situation in rice diseases in West Bengal would show involvement of several factors which may be summarized as follows :

a) Due to multitude of factors including intensive and multiple cropping in rice in two or more seasons in a year, agro-ecosystem has been upset paving the way for insergence of diseases which were not present earlier and some diseases of minor importance gragually becoming major ones.

b) Due to multiple cropping with rice-rice rotation as a result of availability of irrigation water in many areas of West Bengal, virtually a continuous cropping of rice is taking place in many areas with the result-abundant inoculum is always present in nature. With the availability of suitable weather condition, multiplication of inoculum and their spread are taking place creating conditions for epiphytotics.

c) Cultivation of varieties with narrow genetic base, tending to have more homogenity, often lacking in multiple resistance are chosen on the basis of yield potential.

Some aspects of sheath blight only will be discussed here as it is by far the most serious and destructive disease under West Bengal conditions and a disease for which still no good management method is available. Much work on different aspects of sheath blight of rice has been reported from different parts of the world and also from different parts of India. The presentation and discussions here on the disease are restricted under West Bengal context.

Although rice sheath blight has been reported from West Bengal in 1977 by Mukherjee, it can be assumed that the disease made its foot hold much earlier, as hot and humid weather, which is most suitable for occurrence, distribution and severity of the disease are present for major part of the year in West Bengal.

SYMPTOMS

Rice plants may be infected with *R. solani* at any stage of growth, seedling to flowering, from different sources of inoculum. Depending upon the source of inoculum and host growth stage different types of symptoms may be produced, of which sheath blight is the most prominent and common (Acharya *et. al.*, 1997a) and from which the disease derived its common name. Lesions first appear on the leaf sheath near the water level or above soil level in upland conditions. Lesions are at first water-soaked, circular to oblong, ellipsoid or oval 3 to 4 cms in diameter. The centre is greenish grey to greyish white with narrow dark brown margin. Four to 5 such Lesions may coalesce and cover the whole leaf sheath causing death of the leaf. In severe cases all the leaves in a plant may be blighted in this way. Sclerotia appear loose among fine silvery threads of mycelium about 6 day after apearence of lesions. Other symptoms produced are : (a) Pre-and post emergence seedling blight : The seed may fail to germinate or the emerging radicle may die before plumule emerges above the soil surface. The seedlings which, may emerge show blight symptoms and the seedlings ultimately collapse. Such smyptoms may be easily confused with those of brown spot caused by *Drechslera oryzae*. (b) Banded leaf blight : A series of characteristic coppery bands appear accross the lesion. Such symptoms has been observed in some field in Coochbehar. (c) Flag leaf blight : Blight occurs an uppermost leaf sheath enclosing young panicles. (d) Spotted and chaffy grains : Infected grains in the panicles show dark brown, more or less circular to oval spots. A number of grains become chaffy.

Variability and existence of pathotypes of the pathogen

Isolates of *R. solani* obtained from sheath blight infected rice plants from different locations of West Bengal show only little variation in mycelial

characters but considerable variations could be detected in production, distribution and size of the sclerotia. A positive correlation can be seen between the size of sclerotia and pathogenicity (Basu and Sengupta 1992a). Isolates with larger size sclerotia are significantly more virulent than the smaller sized ones. The latter also forms significantly less polygalacturonase and cellulase enzymes, known for their involvement in pathogenesis, in clulture filtrates.

In an attempt to establish intraspecific relationship among *R. solani* isolates Ogoshi (1975) created anastomosis groups (AG) based on hyphal fusion reactions between different isolates and based on his studies placed rice isolate under AG 1. *R. solani* isolates isolated from sheath blight infected rice plants collected from different parts of West Bengal, when paired in different combinations show different fusion patterns — no anastomosis, attachment of pairing hyphae but no fusion, cell wall fusion followed by death of some adjacent cells and perfect fusions of the hyphae. (Basu *et al.*, 2003).

Different response of rice cvs. to rice isolates of *R. solani,* has been exhibited, which is indicative of the existence of pathotypes of the fungus, even within this limited geographical area (Sarkar *et al.*, 2000). Earlier Nandi and Chakrabarti (1984), working at C.R.R.I. also suggested the existence of pathotype groups in the rice isolates of the fungus.

However, due to worldwide distribution of the disease and the fact that a knowledge of the physiological races of the fungus is very important in breeding of disease resistance, selection of an International set of rice cvs. for race identification of *R. solani,* as has been done by Atkins *et al.*, (1967), for identification for races of the rice blast organism, *Pyricularia grisea,* appears very important.

Some factors affecting disease development

Sheath blight of rice is favoured by high temperature and humidity as is prevalent in West Bengal. These conditions favour both initiation of the disease and lesions enlargement on rice leaf sheaths (Sarkar *et al.*, 2003). Plant spacing and fertiliser doses also have considerable effect on severity of rice sheath blight. Very close placing, as well as very wide spacing increase sheath blight intensity. Consequently yield is also lower under such conditions. There is bushy growth both in plots having very closely spaced plants due to increased plant population, as well as those with very widely spaced plants due to significant increase in the number of tillers (Sarkar *et al.*, 1991). The effect of host density on disease development, as pointed out by Burdon and Chilvers (1982), may be direct due to the distance which spatially dispersed inoculum must traverse successfully in order to spread between plants or indirect by influencing the temperature and humidity in the micro-climate, which tend to increase in thickly populated plots.

Sarkar *et al.*, (1991) also observed the above 40 kg N/ha, applied in single dose, the disease incidence in significantly higher as compared to plots having no N fertilizer. With split application of N in 2 equal doses a reduction in disease incidence occurs. Maximum yield was recorded when N was applied at 40 kg / ha in 2 equal doses. Thus moderate dose of nitrogen and phosphorus and a high dose of potassium is expected to reduce sheath blight severity and increase the yield. The type of N fertilizer used has also some bearing on disease severity. Of the three nitrogen fertilizers, namely ammonium sulphate, urea and calcium ammonium nitrate, disease intencity tends to be lowest with calcium ammonium nitrate and highest with ammonium sulphate (Basu and Sen Gupta, 1996). Susceptibility of rice plants to sheath blight infection increases with increase in plant age and plants are most susceptible during the actively tillering stage (Sarkar *et al.*, 1993a).

Pathogen nutrition has also been observed to affect to pathogenicity of *R. solani,* the rice sheath blight organism. The virulence increases with the inoculum for plant inoculation is grown with increasing concentration of nitrogen (L-asparagine), while increase in carbon source (glucose) results in decrease in pathogenicity (Basu and Sen Gupta, 1993). Such effect of pathogen nutrition of pathogenicity could be correlated with the PG enzyme activity of the pathogen in different nutritional conditions.

Perennation and spread of the fungus

R. solani causing sheath blight of rice can perennate in several sources. (a) Seeds : Seeds collected from sheath blight infected plants are generally spotted and carry the fungus in them. The fungus has been found to be both externally and internally seed borne. Seed borne infection results in reduction of seed germination and causes seedling infection (Acharya *et al.* 2003). Basu and Sen Gupta (1992b), and Sarkar *et al.*, (1993a) reported that sheath blight infection vertically spreads upto the flag leaves encircling the panicles of a susceptible cv. and these infected flag leaves may result in transmission of the fungus on or in the seeds during panicle emergence. (b) Infected stubble : *R. solani* remains viable for a considerable period in infested rice straw. The perennating fungus in sheath blight infected crop residues scattered in the field or stored in hay stacks may form a perennial source of inoculum to the rice crop throughout the year (Basu and Sen Gupta, 2004). (c) Collateral hosts : A number of weed hosts belonging to several plant families collected from sheath blight infected rice fields were found to show sheath blight symptoms and carried the rice sheath blight organism (Acharya and Sen Gupta, 1998). These collateral hosts may carry the pathogen from one season to another and infect rice crop when cultivated. Some vegetable seedling such as tomato, brinjal, cabbage, cauliflower, onion, pea, bean, cucumber and bhendi, growing in rice sheath blight infected soil and showing different types of symptoms (water-soaked lesions at collar region, droopping and drying of leaves, damping off of seedlings etc) can carry the rice isolate of *R. solani* during the off season of rice and transmit the disease to rice when cultivated in the same field. (d) Soil : soil is the natural habitat of *R. solani*. Rice isolate of *R. solani* can perennate in soil for quite a long period, mainly as sclerotia. Perennation, however, is influenced by some soil factors, such as moisture, the depth of soil at which the inoculum is located etc. (Sen Gupta, 1997).

While discussing field spread of the disease, two aspects are to be considered, horizontal spread and vertical spread. The sclerotia that survive in the upper 5-6 cm of soil come to the surface during land preparation before sowing. After transplanting of the seedlings these sclerotia float in water after irrigation and when come in contact with the leaf sheaths at the water level infect them. Sclerotia produced on the infected sheaths also fall in water and are drifted towards healthy seedlings infecting them. Horizontal spread of the disease is greatly influenced by plant placing and direction and velocity of the wind. Not much different is observed in case of horizontal spread between infection of s susceptible or a resistant cv. From the initially infected lower sheaths the infection in a plant proceeds vertically towards the upper sheaths and in susceptible cvs. may reach upto the flag leaves. In resistant cvs, however, infection do not proceed beyond the third and fourth leaf sheath from the top (Sarkar *et al.*, 1993b). Thus lesion on the upper leaf sheaths can be regarded as an index of relative susceptibility of a cv.

Disease management

From the above observation and discussion it may be noted that rice sheath blight organism, *R. solani*, has many options left open for survival during the off season. Thus sustainable and very effective disease management poses a serious problem. The problem is compounded by the absence of satisfactory resistant cvs. against the disease. Several practices may, however, impart partial control of the disease. These include : (a) proper weeding should be done before cultivation as several weeds have been found to harbour the pathogen during the off season of rice, (b) as the disease is seed borne (externally and internally) seed treatment with some systemic fungicide may reduce seed borne inoculum and seedling infection. In laboratory assessment a few fungicides were found to be effective in reducing seed infection (Acharya *et at.*, 1997b). (c) Fairly good control of the disease in an infected field by spraying with some fungicides like Bavistin, Rhizolex and Dithane M-45 has been achieved (Sarkar *et al.*, 1991). (d) Judicious application of fertilizers is recommended. Deleterious effect of higher doses of fertilizer has already been discussed (e) Organic amendment of soil in the form of oil cakes increases *R. solani* population in soil in the early stage of soil amendment, but with increased

incubation period *R. solani* population decreases significantly and consequently the population of some other soil saprophytes including *Trichoderma* sp. increases. These saprophytes have antagonistic reaction on *R. solani* (Sarkar *et al.* 2002).

However, an integrated approach must be taken to combat the disease effectively.

Several aspects of sheath blight of rice have been detailed and discussed. Studies on several fields are still needed to understand the disease more properly so that some effective management practices could be evolved. These include :

(a) Thorough survey of sheath blight of rice in different parts of West Bengal (different agro-climatic zones) to understand whether there is any endemic or hot spot areas of the disease. Influence of soil types on disease development has already been reported (Sarkar and Sen Gupta, 2002).

(b) Assessment of crop loss due to the disease needs to be studied.

(c) Some highly susceptible cvs. "swarna masuri" etc are quite popular among some farmers due to yield potential of these cvs. Continuous cultivation of these cvs. increases the inoculum level in the area and disease pressure may reach such a high level that moderately resistant cvs grown in adjacent fields may show high incidence of the disease. Hence the farmers are to be advised to desist from cultivation of these cultivars.

At the end I must apologize for not being able to attend some of the meetings of the Indian Mycological Society for various reasons. I also like to take this opportunity to express my deep sense of appreciation to all the learned members of the Society in general and the executive council members in particular for their support and co-operation extended to me.

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