Bakanae Disease: A New Threat to Rice Production under Temperate Ecology of Kashmir

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Abstract

In Jammu and Kashmir 26 percent (0.263 million ha) of total area under food grain crops is occupied by rice, out of which Kashmir valley comprises 63% (0.142 million ha). Rice is a major food crop of Kashmir occupying 30% of total area under cereals, and accounting for 35% of total cereal production. In Kashmir valley the impact of diseases on rice production has increased over time. In current rice-cropping environment a few major diseases particularly, rice blast, sheath blight and grain discoloration have caused significant yield losses in rice under temperate agro-climatic conditions of Kashmir. The minor diseases collectively could pose a potent threat to rice production. Estimated annual yield and quality loss in rice due to combination of different diseases is 8- 10 per cent. In the present climate change scenario rice crop is facing the tough competition of new diseases which were otherwise not touching the economical threshold. Furthermore as cultural practices and cropping intensity changed over time, some previously minor diseases became serious problem (Evenson et al., 1998). Bakanae/foot rot disease is emerging as one of the potential threats particularly against cultivated japonica rice under high altitude conditions of Kashmir. The rice genotypes of sub species japonica carrying semi-dwarf (sd-1) gene are highly susceptible to such disease. Bakanae is one of the most important diseases of rice widespread in many rice growing areas, both tropical and temperate. The yield loss estimated ranges from 10-50 percent (Khokhar and Jaffrey, 2002). The disease is seed as well as soil borne. The types of symptoms produced by an infected plant may depend upon the strain of the fungus and nutritional conditions. Severely infected seedlings die before transplanting, and those that survive may die after transplanting. The anamorph form of the pathogen produces gibberellin and fusaric acid. Biological studies of the two substances showed that fusaric acid causes stunting and gibberellin causes elongation of rice plants (Nyvall, 1999). For the last three years, Bakanae disease incidence was deeply felt at Mountain Crop Research Station, Larnoo located at 2280 m amsl. The gravity of the situation was felt both at farmer's fields and the Research Station.

Keywords: Bakanae, *Fusarium moniliforme,* rice, temperate ecology

The causal organism of bakanae disease of rice was isolated on Potato Dextrose Agar medium from diseased plants collected from rice grown fields of Kashmir valley during *Kharif,* 2011 and 2012. The cultures were purified by hyphal tip method (Dasgupta, 1988). Various cultural and morphological characteristics of isolated fungus were recorded by making visual observations and microscopic examinations and were compared with standard descriptions given by Nelson *et al*. (1983) and Ilija *et al*. (2009). The isolated pathogen was thus characterized and its pathogenicity was recognized by proving Koch's Postulates on important *japonica* rice varieties viz. K-332 and Kohsar, released and recommended for higher altitudes of Kashmir valley.

In the present study the frequent isolation of *Fusarium moniliforme* from diseased rice plants collected from the surveyed areas envisaged its possible role in development of bakanae/foot rot symptoms.

Experiments made to prove the Koch's postulates for the isolated fungus revealed that fungus was pathogenic to rice plants and produced characteristic bakanae/foot rot symptoms. The symptoms characterized were chlorotic, elongated and thin seedlings that were often several inches taller than healthy seedlings (Fig.-1). Infected seedling also showed chlorotic and stunted growth and exhibited rotting symptoms with powdery growth of conidiophores on the lower parts (Fig.-2). The infected plants produced adventitious roots at lower nodes and when the stem was split vertically white growth of fungal mycelium was observed at the point of nodes (Fig.-4). The abnormal growth of infected seedlings is probably due to the production of Gibberillic acid (GA_3), a growth promoting hormone by the pathogen. The pathogen also produces some secondary metabolites which affect the growth of rice plants such as carotenoids, fusarin, fumonisin, moniliformin and fusaric acid as shown by various researchers (Saremi *et al*., 2004., Zainudin *et al*., 2008). The pathogen has been reported earlier elsewhere as causal organism of bakanae disease of rice by Javaid *et al*., 2001; Zainudin *et al*., 2008; and Ilija *et al*., 2009.

The purified culture of *Fusarium moniliforme* on PDA initially produced cottony white colonies which became pinkish in older cultures and attained a growth of 30-40 mm in 5 days of incubation at 26±2^{o}C. Reverse the colonies were reddish-brown to pink coloured. Mycelium of *Fusarium moniliforme* is septate forming a dense coat of branching hyphae and had a width of 2-3µm. Microconidiophores are short, simple arise laterally from hyphae and produce microconidia singly in chains (Fig-4). The microconidia are produced abundantly and are single celled, ovoid or oblong, hyaline and measured 4-10 x 1-2 µm in size. Macroconidiophores bearing 2—3 apical phialides which produce macroconidia (Fig-5). Macroconidia are 3-7 septate, slightly curved, equally bent at pointed ends (Fig.-6) and measured 20-50 x 2.0 x 3.5 µm. The fungus develops brownish black chlamydospores during winter season on diseased crop debris mostly in chains, borne terminal as well as intercalary in hyphae and measured 6.5-12.5 µm in diameter (Fig.-7). Chlamydospores are not present in the mycelium or conidia of isolated fungus.

Bakanae disease of rice caused by *Fusarium moniliforme* is emerging one of the major biotic challenge to rice production of Kashmir valley. Fungicide treatment with Carbendazim + Mancozeb up on seed dressing is most efficient in controlling the bakanae disease (Ahangar *et al*., 2012). Thus in situations of sudden occurrence of disease use of the same fungicides are suggested as seed dressing for effective and viable solution for suppression of the disease.

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Fig.-1

Fig.-2

Fig.-3

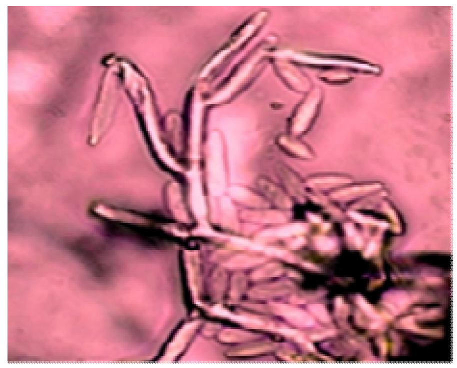

Fig.-4

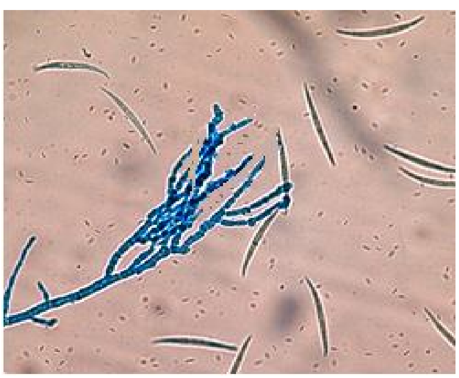

Fig.-5

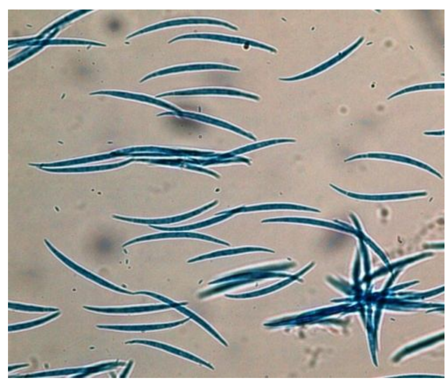

Fig.-6

Fig.-7