INTRODUCTION

Rice (*Oryza sativa*) is the most important cereal food crop of India. It occupies about 23.3% of gross cropped area of the Country. It plays a vital role in the national food grain supply. Rice contributes 43% of total food grain production and 46% of the total cereal production of the Country. It is the staple food of more than 60% of the world's population especially for most of the people of South-East Asia. Among the rice growing Countries in the world, India has the largest area under rice crop and ranks second in production next to China with a production of about 135 million tonnes (89 million tonnes of clean rice) (Barah, 2005).

There is considerable increase in productivity of rice in India during the recent past. The productivity of rice, which was 668 kg/ha in 1950-51, has reached to 2,066 kg/ha during 2001-02. The increase in productivity of rice is about 209% and this increase is due to introduction of high yielding rice varieties responsive to high dose of fertilizers coupled with improved package of practices evolved by agricultural scientists for various regions. In fact, there is considerable increase in productivity of rice in the country but there are still certain areas, where rice productivity is low. Rice productivity in such areas fluctuates significantly from region to region due to various factors such as soil type, soil fertility, rainfall pattern, flood, water logging, climatic conditions etc. (Anonymous, 2002).

In India, majorly rice is subjected to one or more diseases caused by bacteria, fungi and viruses (Sridhar *et al.* 1975; Kalita *et al.* 1996; Gnanamanickam *et al.* 1999; Chakrabarti, 2001). Sheath blight incited by basidiomycetous fungus *Rhizoctonia solani* Kuhn anamorph once considered a minor disease, is now a major threat to rice crop inflicting substantial yield losses in most of the Asian Countries. Various estimates of crop losses due to sheath blight have been made and estimates from Southern India suggested that yield losses were 5.2 to 50% in 1978 and were higher than 70% in severe conditions during 1992 (Baby, 1998). In other countries, average yield losses have been reported to be in the range of 20 to 40%. (Cu *et al.* 1996). Hence an urgent need has been created for the control of the disease. A thorough knowledge of the biology, ecology and epidemiology of the pathogen is absolutely necessary to devise suitable control measures.

Rice sheath blight, one of the most serious fungal diseases of rice, is caused by multinucleate *R. solani* Kuhn [teleomorph *Thanatephorus cucumeris* Donk], a ubiquitous pathogen. Fourteen anastomosis groups (AGs) have been described in *R. solani* (Carling *et al.* 1996). Several AGs are further subdivided into intraspecific groups (ISGs). Isolates of AG1 have been divided into three ISGs, including IA, IB, and IC based on host origin, symptoms, and cultural characteristics (Ogoshi, 1987; Sneh *et al.* 1991; Liu and Sinclair 1993). Isolates of AG1-IA have been associated with the development of rice sheath blight (Gangopadhay and Chakrabarti, 1982; Banniza *et al.* 1999).

Diversity within rice sheath blight isolates has been studied by morphological characterization (Sherwood, 1969; Vijayan and Nair, 1985) and pathogenicity testing (Jones and Belmar, 1989; Banniza *et al.*1996) and by studying intra and extracellular enzymes and proteins (Matsuyama *et al.* 1978; Zuber and Manibhushanarao 1982; Liu and Sinclair, 1993). Cellular fatty acids (Johnk and Jones, 1992; Johnk and Jones, 1994) and various molecular techniques (Kuninaga and Yokosawa, 1982; Jabaji-Hare *et al.* 1990; Vilgalys and Gonzalez, 1990; Liu and Sinclair, 1993).

Although earlier studies suggested that AG-1IA represented a homogeneous group of isolates (Kuninaga and Yokosawa, 1982), recent investigations support the hypothesis that the sheath blight pathogen is far more diverse than previously assumed (Vilgalys and Gonzalez, 1990; Liu and Sinclair, 1993). Knowledge of field populations of this pathogen is still scarce, particularly in tropical agro ecosystems and only few detailed studies of field populations have been published (Ogoshi and Ui, 1983). However, understanding of disease epidemiology and host-pathogen interactions is greatly dependent on knowledge of the diversity of the pathogen at the field level. Thus there is a need to characterize isolates of *R. solani* in paddy rice plots by morphological characterization, pathogenicity testing in conjunction with molecular markers. Inadequate information about the genetic structure of the polyphagous *Rhizoctonia solani* has made sheath blight resistance breeding a difficult task.

The genetic variability of the pathogen increases the difficulty encountered in developing the resistant host genotypes as well as in effectively deploying available tolerant cultivars. Genetic variability is often characterized by morphological characters of cultures, variation in virulence, proteins, isozymes, Restriction fragment length polymorphism and RAPD amplification of polymorphic DNA. Genetic differences underlying *R. solani* populations provide a useful means for examining the nature and spread of population within the rice system (Neeraja *et al.* 2002).

The sheath blight pathogen has a wide host range (Roy, 1973; Kozoka, 1975). Unfortunately, at present, there is no known rice variety, which is either immune or possesses high degree of resistance to this disease. Because of lack of varietal resistance against the disease, there is a need to understand more about the pathogen of various endemic locations and their virulence pattern. Conventional cross breeding programmes are handicapped due to the lack of definite resistant donor lines with adequate levels of resistance to sheath blight (Bonman *et al.* 1992).

Studies have indicated the polygenic nature of sheath blight resistance (Xie *et al.* 1990; Xie *et al.* 1992). It is also known that dominant gene(s) confer only partial resistance to sheath blight. Hence integrating the use of cultural, biological and chemical measures with moderately resistant rice cultivars will prevent the ravages of sheath blight to rice production (Hashioka, 1970; Kozaka, 1970; Rao *et al.* 1979; Anderson, 1982; Gangopadhya and Chakrabarti, 1982; Lee and Rush, 1983; Ou, 1985; Kannaiyan, 1987; Rao, 1990, 1995).

The most effective strategy of the management for *R. solani* is based primarily on the application of fungicides that are likely hostile to our environment. Management of the disease through cultural methods has been generally challenging due to the lack of the host specificity of the pathogen and the susceptibility of rotation crops. In this view biological control stands promising and is an attractive alternative approach to control the disease. As *R. solani* affects only the foliar parts of the rice plants, the selected biocontrol agent must be able to survive in the foliage and/or induce systemic resistance if it survives only in the rhizosphere. The ideal biocontrol agent for the management of foliar infection by a soil-borne pathogen may be the one that can survive in both rhizosphere and phyllosphere. Among various bacterial bioagents fluorescence *Pseudomonas* are known to survive both in rhizosphere (Parks *et al.*1991) and phyllosphere (Wilson *et al.* 1992).

Among many potentially antagonistic soil fungi *Trichoderma* spp. of late have been used as biocontrol agents as they have been termed as presumptive mycoparasites. *Trichoderma* species are present in nearly all agricultural soils and in other environments such as decaying wood. The antifungal abilities of these beneficial microbes have been known since the 1930s, and there have been extensive efforts to use them for plant disease control since then. *Trichoderma viride* and other species of *Trichoderma* have also served as effective biocontrol agents to control sheath blight infection in rice (Baby, 1992). Mycoparasitism of rice sheath blight fungus, *R. solani* by *Trichoderma* spp. is well known. *Trichoderma* spp. are also well known to survive in foliage (Dodd *et al.* 2004). The ability of *Pseudomonas* and *Trichoderma* to survive and spread in the phylloplane of crop plants over an entire growing season makes them ideal biological control agents to control foliar diseases. Considering the economic importance of the sheath blight of rice and also the reduction of the efficiency of control by fungicides, there is a need to isolate *Pseudomonas* and *Trichoderma* spp. from the rice fields affected with sheath blight and to study the biocontrol potential for this disease under greenhouse conditions and field conditions to develop regional specific best formulation and delivery system for applying the biocontrol agents to achieve consistent and reliable control of sheath blight causing *R. solani* inoculum.

With the above background, the present work was undertaken with following objectives:

Objectives

1. To isolate sheath blight pathogen *Rhizoctonia solani* from different rice growing areas of the country.

2. To assess the cultural, morphological, pathological and molecular variability among the isolates of *R. solani*.
3. To isolate *Pseudomonas* and *Trichoderma* spp. from the rice fields affected with sheath blight and to assess their biocontrol potential under *in vitro* and *in vivo* conditions against sheath blight pathogen.
4. To develop the formulations of potential bioagents and to evaluate the efficacy of biocontrol potential under field conditions.