1. Introduction

Tea, the most important and popular non-alcoholic beverage, is obtained from the leaves and leaf buds of the plant *Camellia sinensis* (L.)O. Kuntze and belonging to the family Theaceae. Chinese first used tea as medicinal drink as well as beverage Eden (1958) reported that. They also reported that Chinese had been using tea for the past 3000 years. Scaly (1958) included 82 species under the genus but Mondal *et al.* (2002) mentioned about 325 species. However (i) *Camellia sinensis* (L.) O.Kuntz. (ii) *Camellia assamica* sub spp. *Lasiocalyx* and to an extent *Camellia irrawadiensis* have mainly made the genetic pool of present day tea. So the term "tea" indicates the progenies of these taxa and the hybrids there of or between them (Islam *et al.*, 2005). Although tea originated in South and Southeast Asia, today it is cultivated across the world in tropical and sub tropical regions (Wight, 1959). Tea plants are grown either from seeds or by vegetative means *i.e.* from vegetative clones. Clonal plants are genetically alike, and, therefore, have less adaptive characteristics for different agro-climatic environment and soil conditions. The Clonal plants show susceptibility like their parents to diseases/pests and become vulnerable due to their genetic homogeneity. On the other hand as the progenies of seed plants are genetically different, they do not suffer from the same problems as that of the parental plants (Barbora *et al.*, 1996). Seed planting is comparatively less labour intensive than raising clonal cuttings (Rawat, 1980).

Tea seeds are indispensible in tea cultivation as well as for other industrial purposes. Seeds of the genus *Camellia* produce edible oil in West Bengal, Himachal Pradesh, Assam and in the Northern region of Indo-China (Owuor *et al.*, 1985; Sengupta *et al.*, 1976; Facciola, 1990; Duke, 1983). Five saponins including "Theasaponin" have been detected in tea seeds (Yoshioka *et al.*, 1970; Singh *et al.*, 1992). Tea seed cakes are used as fertilizer, crude drug, for curing skin diseases in Thailand and also as fodder (Roberts and

Desilva, 1972; Sekine *et al.*, 1991). Seeds like any other parts of plants are also vulnerable to several pathogen attacks. It is necessary to control the seed borne pathogens to get healthy tea seeds which in turn produce healthy tea seedlings. Substantial works has been done for control of the pathogens of tea plants but relatively less work has been done on the seed borne diseases and their control. Many fungal pathogens, like *Fusarium solani*, *Nigrospora* sp., *Aspergillus niger*, *Pestalozzia theae*, *Penicillium* sp. and *Verticillium* sp. have been reported to cause serious diseases of tea seeds and/or tea seedlings (Barthakur *et al.*, 1998; Sarmah and Bezbaruah, 1988). Phukan (1967) and Barua (1983) reported that *Rhizoctonia bataticola* and *Rhizoctonia* sp. cause secondary root and leaf diseases of tea respectively. In the present study, while screening the seed borne pathogens *Rhizoctonia solani* Kuhn [Teleomorph: *Thanatephorus cucumeris* (Frank) Donk] was found to be one of the major pathogen of tea seedlings (Mandal *et al.*, 2006). *Rhizoctonia solani* also cause diseases in shed trees (*Albizzia chinensis*) in tea gardens (Barua and Dutta, 1986).

Rhizoctonia solani is cosmopolitan with a very wide host range including crop plants and weeds (Adams, 1988; Ou, 1985). *Rhizoctonia solani* has an ability to survive in soil and it affects the cropping system as a whole rather than an individual crop. Therefore it is necessary to collect all the information on the behavior of this pathogen to plan management strategies in a cropping or planting system (Biswas and Samajpati, 2007).

Rhizoctonia solani is a species complex and have been divided into 14 anastomosis groups (Ags). Many Ags have been sub-divided into intra specific groups depending on cultural, virulence, molecular, biochemical, immunological and other characteristics (Ogoshi, 1975, 1987; Carling *et al.*, 1994; Carling, 1996; Carling *et al.*, 1999 a, b; Singh *et al.* 2002; Biswas and Samajpati, 2007). According to Carling (1995) it has become a routine work to characterize the strains of this fungus through anastomosis grouping

systems. Some scientists have also characterized the several isolates of this fungus and confirmed its taxonomic position through PCR-RAPDs, mitochondrial DNA RFLPs and ITS sequencing (Welsh *et al.*, 1990; Williams *et al.*, 1990; Duncan *et al.*, 1993; Banniza *et al.*, 1996; Yang *et al.*, 1996; Bounou *et al.*, 1999; Toda *et al.*, 1998; Leclerc *et al.*, 1999; Pascual *et al.*, 2000; White *et al.*, 1991; Carling *et al.*, 2002; Singh *et al.*, 2002; Cardinale *et al.*, 2006).

Resistance screening of plant varieties against any fungal pathogen is a prerequisite for management of any disease of plants. Resistant and susceptible plant cultivars can be detected by the levels of common antigens present in both host and pathogen (Charudattan and Devay, 1972; Alba *et al.*, 1983; Purkayastha and Banerjee, 1990; Chakraborty and Saha, 1994; Ghosh and Purkayastha, 2003; Dasgupta *et al.*, 2005; Saha *et al.*, 2010). Common antigenicity can be detected by performing immunodiffusion, immuno electrophoresis and indirect ELISA between susceptible varieties and pathogen (Alba and Devay, 1985; Mohan, 1988; Chakraborty, *et al.*, 1995; Croft, 2002; Dasgupta *et al.*, 2005; Saha *et al.*, 2010).

In the recent years, interest is growing successively in the field of biological control of pests and diseases replacing the chemical control techniques. The actual reasons behind this fact are chemicals cause health hazards and sometimes perform non selective action against harmful and beneficial microorganisms in the rhizosphere. More over pathogens and pests develop resistance against these chemicals. Most importantly, bio-diversity should be maintained through minimizing the use of toxic plant protectants (Dennis and Webster, 1971; Papavizas and Lumsden, 1980; Papavizas, 1985; Mukhopadhya and Chandra, 1986; Barthakur, 1999; Barthakur *et al.*, 2002). Among the bio-agents *Trichoderma viride, Gliocladium* sp., *Bacillius subtilis* and *Pseudomonus* sp. have been reported as effective biocontrol agents against some root and stem diseases of tea and other plants (Dennis and Webster,1971a,b,c; Papavizas,1985; Barthakur and Dutta 1992;

Barthakur,1994,1999 ; Barthakur *et al.*, 1993,2002; Chandramouli, 1993). On the other hand it has been experimentally proved that various diseases of plants caused by *Rhizoctonia solani* isolates are effectively checked by the bio-agents *Trichoderma harzianum, T. virens, T. longibrachiatum, T. aureoviride, Bacillus subtilis* and *Pseudomonas fluorescens* through the production of volatile and non-volatile antibiotics and by plant extracts like *Xanthium strumarium, Blumea* sp., *Parthenium hysterophorus, Mentha piperita, Cymbopogon citrates* and *Cyperus scariosus* etc. (Banker and Mathur, 2001; Upmanyu *et al.*, 2002; Saikia and Gandhi, 2002; Meena *et al.*, 2003; Sharma and Gupta, 2003; Gautam *et al.*, 2003; Dhaliwal *et al.*, 2003).

On the basis of the above reports it has been observed that there is a necessity to control the seed borne pathogens of tea seeds of North East India (Plate I). Among the seed borne pathogens *Rhizoctonia solani* was found to cause severe damage to the seedlings, resulting to mortality of seedlings even up to 30 percent in susceptible varieties. The present study proposes the following objectives to be done to control seedling diseases of tea.

OBJECTIVES

1. Screening of tea seeds of different varieties for isolation of seed-borne pathogens.
2. Identification of major pathogen (*Rhizoctonia solani*) following Koch's postulates.
3. Pathogenicity of the fungus against seedlings of different tea varieties.
4. Studies on physiological characteristics of the pathogenic fungus.
5. Studies on the resistance of tea against *Rhizoctonia solani* following serological techniques.
6. Control of the pathogen (*Rhizoctonia solani*) by antagonistic microorganisms and botanicals.

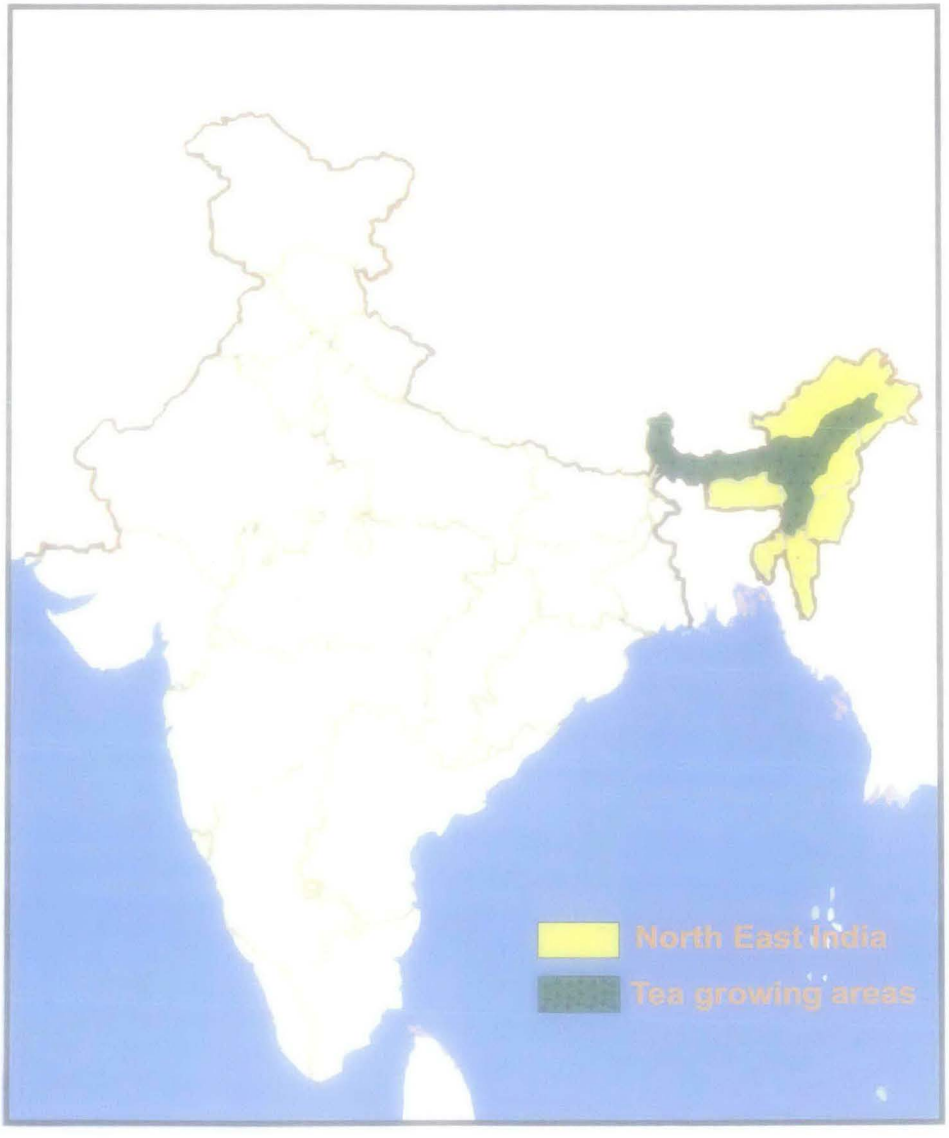

Plate I: Tea growing areas of North-East India and adjoining areas