Introduction

Tea occupies an important position among the plantation crops, in view of its popularity worldwide. Tea originated in China and is one of the world's oldest known prepared beverages. The earliest use of tea by the Chinese is said to have been in the 27^{th} century BC (Yamanishi, 1991). Globally, among some fifty countries growing tea, about a dozen could be regarded as the major producers. India is one of the largest producer while the other countries substantially contributing to global production includes China, Sri Lanka, Kenya, Russia, Japan, Argentina and Uganda.

The commercially cultivated tea plants are derived from *Camellia sinensis* (L.) O. Kuntze, the short leaved 'china' plants: *Camellia assamica* (Masters) Wight, the broad leaved 'Assam' plants: *C. assamica lasiocalyx* (Planchon ex Watt) Wight, the 'Combod' plants and the numerous hybrids among them. These plants prefer a warm humid climate, well-distributed rainfall and long sunshine hours. Presently tea is grown from Georgia, 43 ^{0}N latitude to Nelson (south Island) in New Zealand, 42 ^{0}S latitude and from sea level to 2300 m above mean sea level. Tea, cultivated near the equator produces almost the same yield every month, but further from equator, harvest in winter gradually declines and at latitude beyond about 16 ^{0}, there is complete winter dormancy, the length of dormant period increases progressively with increasing distance from equator (Barua, 1989).

With the introduction of different improved (in view of the production quantity, quality and environmental suitability) varieties and with the expansion of the plantation of the newer areas, the problems of diseases have also increased many folds. To keep pace with the huge demand for the planting material a large number of young plants are required every year. These plants are commonly propagated by clonal propagation, though seed propagation is also being attempted in certain varieties.

Historically, tea was cultivated in India by seed from the very beginning of the tea industry around 1830 and it remained in use for over 120 years. The use of clones started in fifties after the release of Tocklai clones in 1949, although the economic method of vegetative propagation was established around 1938.

Seed populations are highly heterogenous as a result of free outcrossing among themselves from which superior clones have been selected (Bezbaruah and Singh, 1988). Barua (1963) mentioned that the basic difference between clones and seed populations is one of adaptibility. A seed population in tea is composed of a large number of genetically distinct genotypes, is elastic and can be fitted into a wide range of environmental and cultural conditions, without much change in its overall performance. Contrary to seed populations, thousands of bushes of a clone separated widely in space and time behave in most ways as a single bush. Consequently, a clone lacks elasticity which makes a clone more selective of environment and cultural treatments (Bezbaruah and Singh, 1988). When a clone is forced to grow in some other environment, they becomes more susceptible to diseases. A considerable number of plants suffer within 6 months of their propagation in the clonal nurseries due to damages made by pests and diseases. In addition, many plants are affected in the field just after plantation. Since It is of utmost importance to keep young tea plants free from any pest and disease infestations (Barbora, 1988), intensive management of pest and diseases are essential during the years of early establishment.

It has been noticed that fungi often attack young tea plants. These fungal attacks either in the nurseries/seedbaries or in the new plantation areas may be primary or secondary in nature. It is important to know about a fungus present in a plant, their possible harmful effects, and their interaction with the host and control strategies of the pathogen for proper management of the disease. Interaction of plants and phytopathogenic fungi have become one of the most interesting and rapidly moving sciences. Several workers have worked or reported on different fungal diseases of tea plants (Sarmah, 1960; Chakraborty, 1987). However, it was considered worthwhile to find answers to the following questions: a) what are the different important fungi associated with the planting materials and young tea plants? b) what are the disease reactions? and c) how the diseases could be managed? In the last two decades much has been achieved in understanding the plant-pathogen interaction with reference to the action of genes involved. Infection may be prevented by means of well-determined and genetically managed defense mechanisms in the plant. The process includes constitutive defense barriers or their formation is induced by the attacking pathogen. It means that the defense reaction expression is proceeded by recognition of the pathogen by the plant.

Defense is possible through basic resistance i.e., presence of genetic determinant for host resistance. Cultivars of specific resistance represent a highly selective defense reaction of host plants against one particular pathogen or certain races of it. Some plant shows high resistance to some fungi while some cultivars are highly susceptible. As soon as the pathogen attacks the host, the result of signal transduction events that affect activation of genes synthesizing proteins or enzymes engaged in defense reaction play significant role. Hypersensitive defense reaction of the cells are affected by the pathogen and occurs very rapidly terminating with plant- cell death while inducible defense reaction develops more slowly in the surrounding and surviving plant cells is called a sensitive defense reaction (Klement, 1982).

Induced resistance has been demonstrated in many cultivated plants including vegetable crops, cereals, fruit yielding plants and others (Kuć, 1982; Kessmann *et al.*, 1994; Okey and Sreenivasan, 1996; Uknes *et al.*, 1992 and Lyon *et al.*, 1996). It appears that the first infecting pathogen or an injury immunizes the plants against further infections by homologous pathogens, even though the plant may not carry gene determining cultivar specific resistance. The readiness of the plant to repel subsequent pathogen attacks spread through the whole plant is called systemic acquired resistance (SAR).

The concept of common antigenic relationship between host and parasite has received much attention during the last two decades or so. A pathogen and its host share antigens, which play an important role in the determination of compatible interaction. The absence of the common antigens leads to incompatible interaction. Even within the compatible interactions the degree of compatibility might be determined by the sharing of the common antigens.

Biological control is the reduction of amount of inoculum or disease producing activity of a pathogen accomplished by or through one or more organisms other than man. The formulation technology of fungal antagonists is the effective implementation of biocontrol of various crop diseases (Prasad and Rangeswaran, 1999).

The social and environmental cost of synthetic pesticides and fungicides are very high. Hence there is an all-round compulsion among the multinational companies and other agencies to go in for biorational alternative arsenals which can be eco-friendly and benign to environment. Out of 2,50,000 higher plant species, which are believed to exist on earth only relatively few, have been thoroughly studied for their therapeutic potential. (Deans and Svoboda, 1990).

Currently plant products are targeted, as they comprise a rich storehouse of biochemicals that could be trapped for use as pesticides. There are 10,000 secondary metabolites such as tarpenoids, alkaloids, phenols, tannins etc. which are very effective in the control of phytopathogenic fungi. In India no such product is registered for the control of phytopathogenic fungi (Narasimhan and Masilamani, 2002). Hence, at the onset of the present work a thorough survey of the tea nurseries of North Bengal were done (Plate I). Following this, isolation of pathogens were also performed randomly. During the survey, six pathogens were isolated from the leaves of young tea plants. A young clone generally raised from a cutting of approximately 10 cm long twig having a large maintenance leaf and a leaf bud. However, both the new and the old leaf (maintenance) are susceptible to attack by fungal pathogens. In all the cases of isolation, it was found that the old maintenance leaf was attacked by *Pestalotiopsis theae*, *Colletotrichum camelliae*, *Corticium theae* and *Fusarium oxysporum*. As maintenance leaf is shed after 5-6 months, hence the damage done by the four above mentioned fungi are not so important in nurseries for developing healthy plants, unlike the *Botryodiplodia theobromae* and *Curvularia eragrostidis* which severely attack the new emerging shoots. Out of these two pathogens, *B. theobromae* can attack both tender stems as well as young leaf and leaf bud while *C. eragrostidis* attack mostly the fully expanded young leaves. *C. eragrostidis* is a new record in tea (Saha *et al.*, 2001) but *B. theobromae* was recorded by Sarmah (1960) and was described as a virulent pathogen of young tea plants.

Hence, in the present study, it was considered to study different aspects of host-parasite interaction with special reference to *C. sinensis* -*B. theobromae* and *C. sinensis* -*C. eragrostidis*. The basic objectives of this study are: -

- To isolate the different foliar fungal pathogens of nursery tea plants.
- Identification of the pathogens after completion of Koch's postulates.

- To find out the susceptible and the resistant varieties of tea plants against *B. theobromae* and *C. eragrostidis* following pathogenicity test.
- To study the morphological and physiological characteristics of *B. theobromae* and *C. eragrostidis.*
- To determine the serological relationship between *C. eragrstidis* and tea varieties as well as *B. theobromae* and tea varieties.
- To study whether the disease reactions could be altered in susceptible tea varieties by chemical treatment and by known SAR inducers.
- To control diseases by eco-friendly plant extracts, chemical fungicides and by biocontrol agents.

Plate I

Fig. 1 : Tea plantation at Taipoo Tea Estate, Kharibari, West Bengal.
Fig. 2 : *Curvularia eragrostidis* affected field at Matigara Tea Estate, Siliguri, West Bengal.
Fig. 3 : *Botryodiplodia theobromae* affected field at Kharibari, Siliguri, West Bengal.