Introduction

Solanum melongena L. also known as eggplant, brinjal or aubergine is an important solanaceous crop. The cultivated eggplant is presumed to originate from India and China is the secondary center of origin. It is believed to have been domesticated in north eastern India where individual growing in the wild were found (Kluza *et al.*, 2000). Although brinjal is cultivated in all the continents, it is grown extensively in tropical Asia and Mediterranean countries (Sunseri *et al.*, 2003). Brinjal is a major commercial vegetable crop and is grown all over India except at high altitude (Wesley, 1956) [Fig. 1].

China is the largest producer of brinjal while India occupies the second position in production although the productivity of brinjal is quite low in comparison to advanced countries. In India, brinjal occupies sixth position in production and fourth position in cultivation area and comprises 8% of the total vegetable production (http://www.ikisan.com/links/tn_brinjalHistory.shtml). West Bengal is the largest producer of brinjal followed by Maharashtra and Bihar. The other major brinjal growing states are Karnataka, Maharashtra, Gujarat, Andhra Pradesh, Assam and Madhya Pradesh (http://agricoop.nic.in/hort/hortrevo5.htm).

The shape of brinjal fruit varies greatly and indicates characteristic features of a variety. Fruits can be spherical, pear-shaped, egg-shaped, oval, cylindrical, long to oblong and their weight can reach up to 2000 g in large fruit varieties (Borowiak and Tkacz, 1992). The colour of the mature fruit is typically purple to purple black, but can also be red, yellowish white, white or green. Brinjal is of high nutritive value and has been a staple vegetable in our diet since ancient times. Brinjal fruits are considered to be specially useful for those people who have to maintain low calorie diets. It is very useful as a dietary element of old and sick people due to the unparallel taste as well as the presence of a number of phytochemical compounds in its flesh, which protects against cancer and atheromatosis. Fresh edible portion of brinjal contains about 90-93% moisture and 7-11% dry mass. Dry masses include about 3-4% carbohydrate, 1.4% protein, 0.3% fat and 1.5% dietary fibre (Adamicki, 1995 and Esteban *et al.,* 1992). Brinjal fruits are also rich in minerals such as calcium, magnesium, sodium, phosphorus, potassium, copper, sulphur, chlorine etc. (http://www.ikisan.com/links/tn_brinjalHistory.shtml). Fruits also contain small amount of vitamins such as ascorbic acid, thiamin, riboflavin, β-carotene etc. (Adamicki, 1995). Seeds are supposed to contain medicinal properties (Hemi, 1955). Taste of unripe

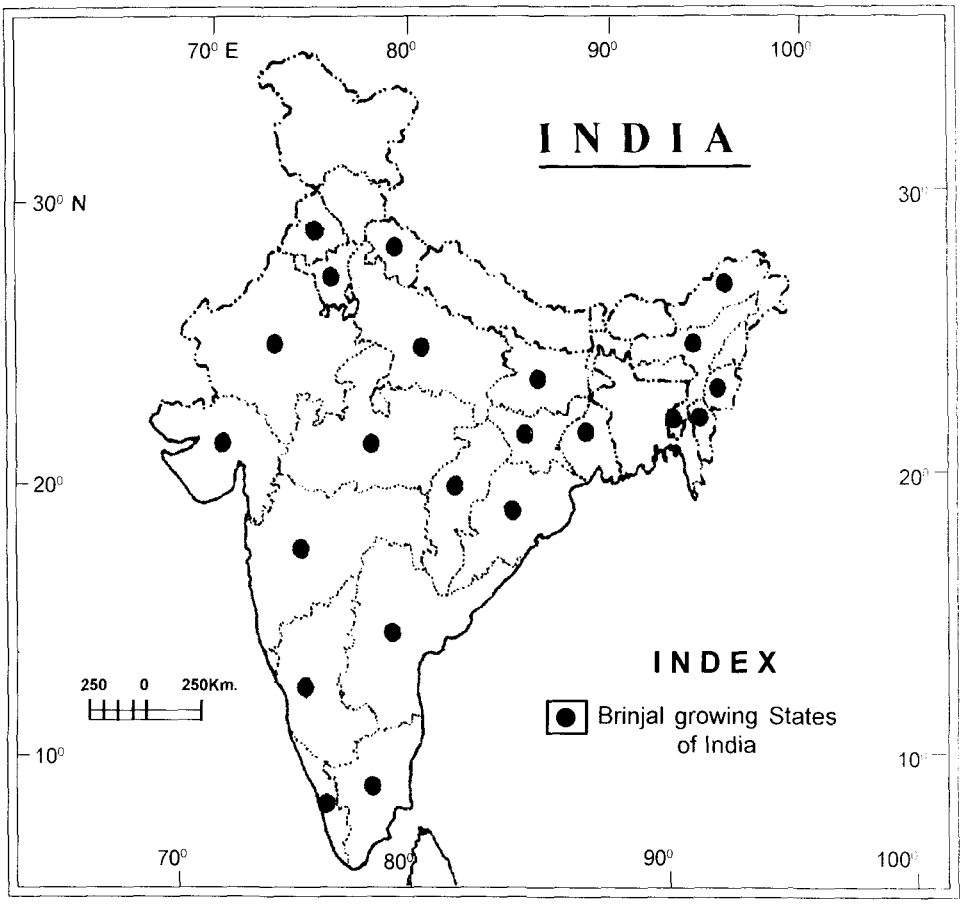

Fig. 1. Brinjal growing states of India

brinjal fruit is bitter due to the presence of giycoalkaloids frequently present in solanaceous plants. The amount of an alkaloid called solanine-M or melongene is present as much as 20 mg/100 g dry wt. As it contains large amount of mineral salts, brinjal fruits are very much effective in strengthening the heart activity and lowering the level of cholesterol in blood (Adamicki, 1995).

Market demand of brinjal is increasing rapidly leading to an increase in the cultivation of the crop into new areas. Brinjal is subjected to attack by many fungi, bacteria, viruses, nematodes and insect pests. Fungal diseases are considered as a major factor limiting the successful cultivation of the crop.

During the course of the study in Barobisha field station in the state of West Bengal, India (Fig. 2) between latitude 26 to 27 ^{0}N and longitude 89 to 90 ^{0}E, a virulent strain of fungal pathogen was isolated from the infected leaves and fruits and subsequently Koch's postulates were verified. The fungus was identified as *Colletotrichum gloeosporioides* (Penzig) Saccardo. *C. gloeosporioides* is the causal organism of anthracnose in brinjal (Fernandes *et al.,* 2002; Madeira and Reifschneider, 1987). The symptom of the disease is characterized by sunken black lesions on the leaves and fruits and subsequently blackening of the inner tissues of affected areas.

C. gloeosporioides (Penz.) Sacc. is a ubiquitous, proliferating and economically important pathogen causing substantial yield losses due to fruit decay and damage to the vegetative parts in a variety of plant species (Freeman and Shabi, 1996). It is an important pathogen for several reasons, one of them being its ability to infect a variety of crops (Jeffries *et al.,* 1990; Manandhar *et al.,* 1995; Zulfiqar *et al.,* 1996; Pandey *et al.,* 1997). Many hosts susceptible to *C. gloeosporioides* are cultivated worldwide and losses could be enormous where multiple hosts are grown in close proximity (Freeman *et al.,* 1998).

For proper management of the disease, it is important to know about a fungus present in a plant, its possible harmful effects, its interaction with the host and control strategies of the pathogen. In the last two decades much has been achieved in understanding the plant pathogen interaction with reference to the action of genes involved. Cultivars of specific resistance represent a highly selective defense reaction of host plants against one particular pathogen or certain races of it. Some cultivars 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

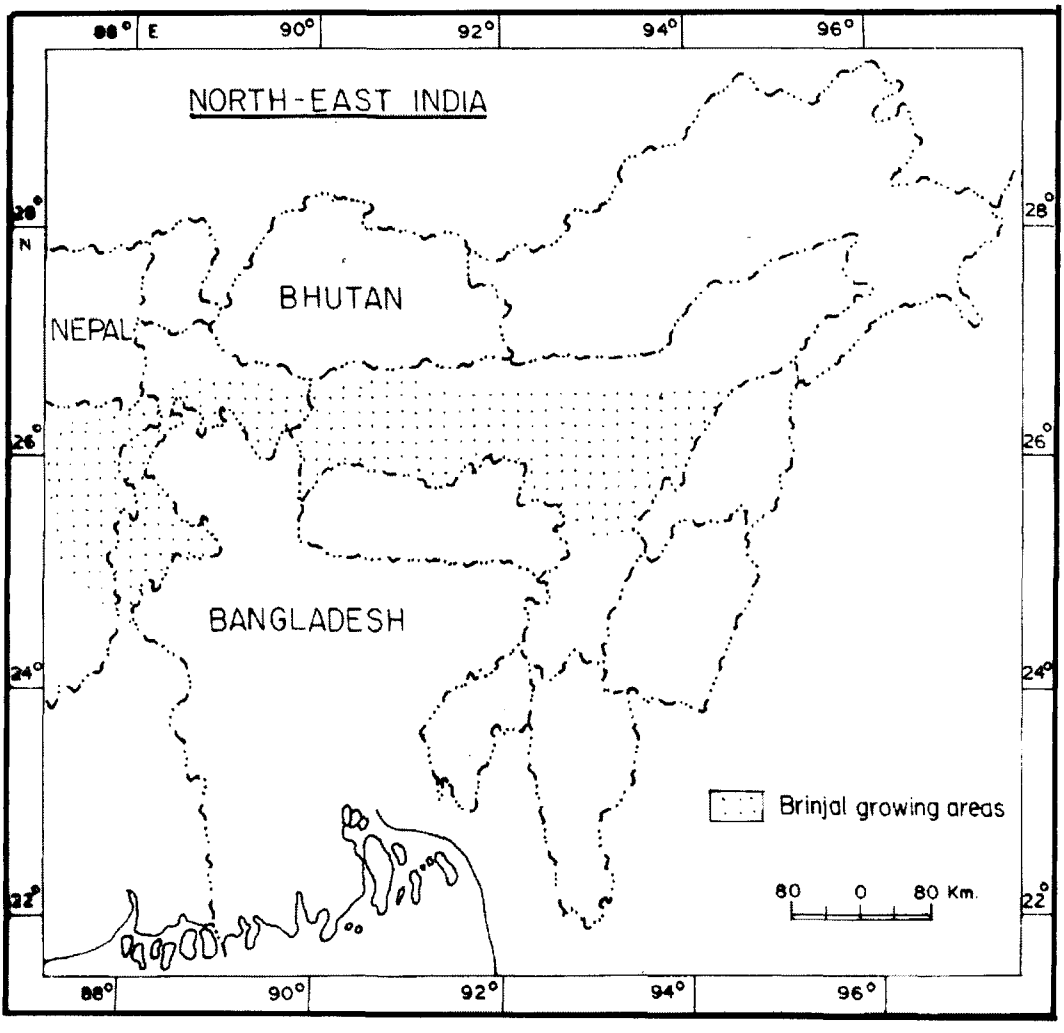

Fig. 2 : Major brinjal growing areas of North-East India

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 develop more slowly in the surrounding and surviving plant cells is called sensitive defense reaction (Klement, 1982).

Induction of resistance has been demonstrated in several crops including solanaceous plants (Tuzun *et al.*, 1989; Cohen *et al.*, 1993; Delaney *et al.*, 2004) against a broad spectrum of leaf and root pathogens. One of the procedure used for induction is through exogenous treatment with naturally occuring metabolites and chemical substance. Several chemicals like salicylic acid, jasmonic acid, benzothiadiazole derivatives etc. have been used in different crops for induction of resistance (Kuc, 1982; Uknes *et al.*, 1992; Kessman *et al.*, 1994; Okey and Sreenivasan, 1996).The readiness of the plant to repel pathogen attacks spread throughout the whole plant is called systemic acquired resistance (SAR). Salicylic acid plays a central role in signal transduction after pathogen infection and has long been known as exogenous inducer of PR protein accumulation and resistance (White *et al.*, 1994; Meena *et al.*, 2001; Veronese *et al.*, 2003).

It has been demonstrated by several workers that the similarity and disparity of the antigenic determinants of a host and a parasite determines the resistance or susceptibility of the host plant (Devay and Adler, 1976; Chakraborty, 1988; Purkayastha, 1989; Chakraborty and Saha, 1994; Dasgupta *et al.*, 2005). Cross-reactive antigens, have also been suggested, to be involved in determining host parasite compatibility (Alba *et al.*, 1983; Alba and DeVay, 1985; Chakraborty and Saha, 1994; Ghosh and Purkayastha, 2003; Dasgupta *et al.*, 2005).

Use of chemical fungicides for controlling diseases in agricultural crops has a long history. The present awareness on the harm caused by fungicides has limited its use but it continues to play critical roles where integrated disease control strategies are adopted. However extended use of fungicides resulted in selection for resistant pathogen genotypes, which remained predominant for several years after withdrawal of the fungicide from the market (Moorman and Lease, 1992; Ziogas and Girgis, 1993). Because of the present day public perception on pesticide contamination of food, there is need for development of alternative economical and ecofriendly approaches for disease management (Patni *et al.*, 2005).

The reduction of amount of inoculum or disease producing activity of a pathogen accomplished through one or more organisms other than man is called biological control. The formulation technology of fungal antagonists is critical for the effective implementation of bio-control of various crop diseases. Soil has enormous untapped potential antagonistic microbes, which are helpful in reducing pathogen inoculum through different mode of action such as competition for nutrients and space, antibiosis, mycoparasitism, production of siderophores and lytic enzymes (Sharma and Sain, 2005).

Till now several plants have been reported to posses substances that are toxic to microbial pathogens. Non-host plants with medicinal properties are known to have antifungal activities (Bowers and Locke, 1997; Raghab, 2003). Out of 2,50,000 higher plant species that 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 biochemical's that could be tapped for use as pesticides. The total number of plant chemicals exceeds 400,000; of these 10,000 are secondary metabolites whose major role in the plants is defensive. Numerous defensive chemicals, such as terpenoids, alkaloids, phenols, tannins are very effective in the control of phytopathogenic fungi. Even though many antifungal and antibacterial compounds are reported in literature, plant products have not been used to any significant extent in the development on antimicrobial fungicides (Narasimhan and Masilamani, 2002).

Hence in the present study it was considered to study different aspects of host parasite interaction with special reference to *Solanum melongena* vs. *Colletotrichum gloeosporioides* and control of the disease. Therefore the basic objectives of this study are:

1. Isolation of the fungi from infected region of plant parts.

(a) Collection of infected parts from different brinjal plants.

(b) Isolation of the fungi in pure culture.

(c) Identification of the culture.

(d) Maintenance of the culture.

2. To determine the pathogenicity of *Colletotrichum gloeosporioides* in brinjal (*Solanum melongena* L.) varieties.

3. Studies on physiological characteristics of the pathogenic fungi.
4. To study whether the disease reaction could be altered in susceptible varieties by application of chemicals.
5. To determine the serological relationship between *C. gloeosporioides* and different brinjal varieties.
6. To find suitable antagonistic micro-organisms which may be used as biocontrol agents for controlling the pathogen.
7. To screen, identify and formulate botanicals extracted from different plants collected from north eastern Himalayan region as potential bio-fungicides.

Plate I

Fig. A : Brinjal field at Barobisha (north east India).

Fig. B : *Colletotrichum gloeosporioides* affected brinjal plant.