Introduction

Soil is an excellent medium for the growth of microorganisms which includes bacteria, fungi, algae, actinomycetes, protozoa and various insects whose number and kinds in the soil depend mainly on the nature and depth of soil, seasonal condition, and state of cultivation, temperature, amount of organic matter, moisture content and aeration (Edwards, 1977). Soil microflora play an important role in the rhizosphere of the higher plants but are dependent to a great degree on the exudates of the roots in the rhizosphere (Tan, 1977). Microorganisms in soil are critical to the maintenance of soil function in both natural and managed agricultural soils because of their involvement in such key processes as soil structure formation; decomposition of organic matter; toxin removal and the cycling of carbon, nitrogen, phosphorus, and sulphur (Van, 1997). In addition, microorganisms play key roles in suppressing soil borne plant diseases, in promoting plant growth, and changes in vegetation (Doran *et al.*, 1996).

Fungi are an important component of the soil microbiota. Many important plant pathogens and plant growth promoting microorganisms (ecto and endo mycorrhizae) are fungi. The saprobic fungi represent the largest proportion of the fungal species in soil and they perform a crucial role in the decomposition of plant structural polymers such as cellulose, hemicellulose, chitin and lignin thus contributing to the maintenance of the global carbon cycle. Besides, these catabolic activities enable fungi to grow on inexpensive substrates. This property, coupled with their ability to produce commercially interesting organic molecules and enzymes explains the significant interest in the biotechnological utilization of filamentous fungi (Hawksworth *et al.*, 1995).

The term rhizosphere, originally coined by Hiltner in 1904, was defined as the volume of soil adjacent to and directly influenced by plant roots. Over the years, however, the term has been redefined several times, mostly to incorporate parts of the root tissue. Rhizosphere can be divided into ecto and endo rhizosphere. The term endorhizosphere is used to describe the multi-layered microenvironment, which includes a mucoid layer on the root surface, the epidermal layer of the root tissue including the root hairs and the cortical cells (Bolton *et al.*, 1993). Rhizosphere has been regarded as 'hot spot' for microbial colonization and activity (Plate–1). Actively growing roots release organic compounds, such as sloughed off cells, secretions, lysates and exudates, into the rhizosphere (Lynch and Whipps, 1990; Bowen and Rovira, 1991).

Plate 1: Agricultural crop fields of Terai-dooars region

The activity of microbes in the rhizosphere is expected to be higher and qualitatively different in the rhizosphere as compared to microbes in bulk soil. The amount and composition of organic materials released by the plants are important factors that determine the nature of this plant-microbe interaction (Griffiths *et al.*, 1999; Jaeger *et al.*, 1999). Since such root-released products can be highly specific for a given plant species or even a particular cultivar, plants are thought to selectively enrich their rhizospheres for microorganisms that are well adapted to the utilization of specific released organic compounds (Bowen and Rovira, 1991; Lynch and Whipps, 1990).

Increased plant productivity also results from the suppression of deleterious microorganisms by antagonistic bacteria, since soil-borne pathogens can greatly reduce plant growth. As variation in microbial community structure may have effects on ecosystem processes (e.g. nutrient recycling, decomposition of organics) or plant-microbe interaction (e.g. growth of pathogens, release of plant-growth promoting rhizobacteria or genetically engineered microorganisms), understanding how community processes affect ecosystem processes is of central interest in ecology (Miethling *et al.*, 2000). Knowledge of rhizosphere microbial community also opens possibilities to promote disease suppressive microflora in the rhizosphere. The increase in shoot growth and leaf area in *Trichoderma* treated seedlings suggests a common beneficial role of *Trichoderma harzianum* in improving plant growth (Yedidia *et al.*, 2001). The mechanisms involved in increasing growth responses induced by *Trichoderma sp* might be the production of growth-stimulating compounds (Gravel *et al.*, 2006; Harman *et al.*, 2004; Yedidia *et al.*, 2001; Altomare *et al.*, 1999; Chang *et al.*, 1986).

Scientific interest has long focused on the structure of microbial communities in the rhizosphere, assessed by cultivation-based studies. These studies have shown that the microbial diversity in the rhizosphere is often extensive and that there are distinct differences in bacterial community structures between bulk (non-rhizosphere) soil and rhizosphere soil. Several studies on different plant species in different locations, using a range of cultivation-based and molecular methods have been reported.

Plate 2: River basin of Balason of Terai-Dooars region

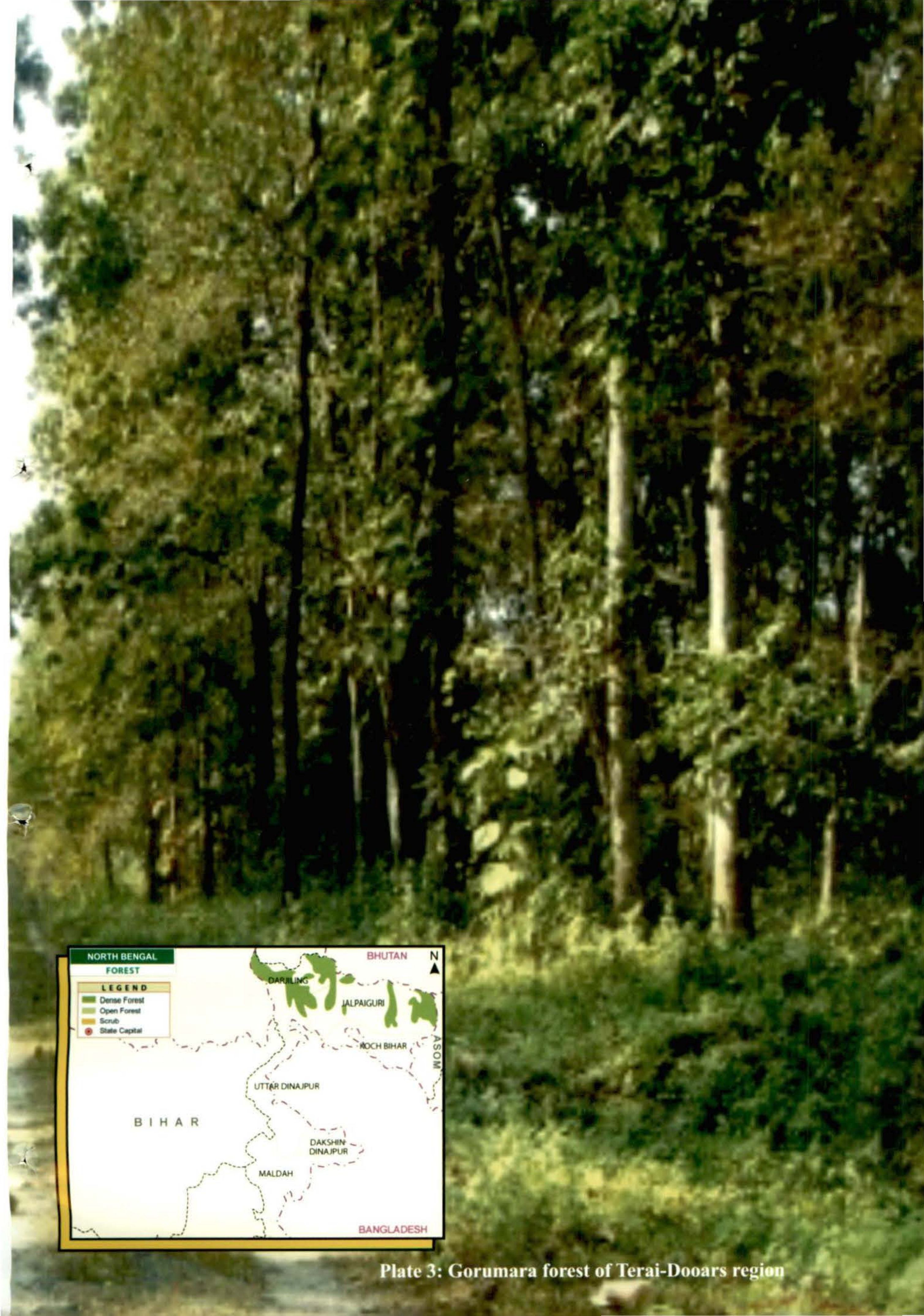

Plate 3: Gorumara forest of Terai-Dooars region

For the past decade, PCR based techniques have been used to detect and identify pathogenic fungi in plant tissue. It is much faster than using a microscope, but it can be quite time consuming if hundreds of samples have to be analysed (Luchi *et al.*, 2004). RAPD is analyzed in a series of steps that combine PCR, restriction enzymes and gel electrophoresis (Kitts, 2001).

The term biodiversity has been defined in various ways. In microbial terms, it describes the number of different types (species) and their relative abundance in a given community in a given habitat. In molecular-ecological terms, it can be defined as the number and distribution of different sequence types present in the DNA extracted from the community in the habitat. The river basins (Plate-2) and forest areas (Plate-3) of Terai-Dooars regions have been identified as unique ecological settings with high endemism, rare flora and fauna. However diversity in microflora has not been so far explored thoroughly in this region. Studies on microbial diversity and their importance as bioprotector and biofertilizer may signify the economically agricultural based regions. Many of these microbes produce economically important compounds, such as, antibiotics, steroids, and enzymes etc. that benefit mankind in numerous ways. Many microbes have a vital role in cleaning up the environment and bioremediation and thus have direct bearing on the ecosystem. Keeping this in view, the following major objectives were undertaken to generate the possible information for utilization of microorganisms isolated from the different ecological regions of Terai-Dooars regions in North Bengal.

A) Isolation and identification of microorganisms from soil samples of different river basins, forests and major crop fields.
B) Selection of microorganisms for cellulose degradation, chitin degradation, lignin degradation and phosphate solubilization activities.
C) Screening of plant growth promoters among the isolated microorganisms.
D) Screening of antagonistic microorganisms against important plant pathogens.
E) Molecular diversity analysis of the selected agriculturally important microorganisms