

Chapter 1

INTRODUCTION

North Bengal, as the name implies is Located in the Northern part of the State of West Bengal in India. It is located at 89°7'30''E and 26°59'34'' N. The area comprises of Steep mountainous regions and vast plains. Hence it is rich in Flora and fauna. Likewise, extensive research has been undertaken to study the diversity with respect to flora and fauna of the region. However, the study on microbial diversity is limited in comparison .This provides a window of an opportunity to undertake research and study the microbial diversity of the region. Moreover, the cultivation of horticultural and agricultural crops is also indispensable source of livelihood for a large section of marginalized stakeholders belonging to the area. Thus to an extent it can be inferred that agriculture is a mainstay of rural economy in this region. In agriculture management two of the most important goals are to ensure the crop of enough nutrients and to prevent it from diseases.

Traditionally, these goals have been achieved by using pesticides and a high input of fertilizer. However, these management practices evidently contributed to a high loss of bio diversity all over the landscape. Therefore, other approaches should be investigated (Kaushik, 2007). Comparatively the North Bengal plains experience a tropical to subtropical type of climate with high relative humidity and temperature. The climatic factors favour growth and multiplication of microorganisms which may be either beneficial or pathogenic in nature. Farmers use chemicals as fertilizer, insecticide or pesticide to combat these and attain balance for productivity and profit. But as is known, this may not be as holistic an approach for sustainable farming and livelihood respectively. Hence an alternative mode without apprehension in the form of bio-control agents as growth enhancers, control, and antagonist is needed.

However as put forth by Chakraborty (2016) Most of the farmers in the country do not have sufficient and clear knowledge on the use of bio pesticide. Ministry of Agriculture as well as Ministry of Science and Technology, Government of India has taken initiative to establish Rural Bio resource centres in different states. Key drivers in the market are increasing consumer demand for organic farming practices that encourage organic farming practices and thus promoting bio-control products.

Moreover, parallel study of the soil ecosystem and its inhabitants is also necessary. Preliminary investigation to isolate microorganisms from the soil rhizosphere has been undertaken by some workers in the Darjeeling and Jalpaiguri district of west Bengal. However it is opined that mere isolation may not be the solution, to assist the soil system and the resulting crop cultivation. Efforts are being made throughout the world, to not just isolate but to identify certain microorganism from the selection that may be exploited in term of its attributes as antagonist and plant health growth promoter. Works in *Frankia*, PGPRs like *Bacillus*, *Pseudomonas* etc, Vesicular Arbuscular Mycorrhiza (Kamal *et al.*, 2014), isolates from fermented foods have been carried out in the recent past for the biota in and around areas in North Bengal. However there is minimal evidence of works on the same lines for Actinomycetes.

Any living being prevalent in the ecosystem is unique either in terms of physiology, morphology, habitat or mode of survival. Yet in terms of prospecting for beneficial microorganism, that protects crop system from pathogens, and at the same time boosts or maintains the plant vigour, there should be certain threshold criteria that has to be there so that the organism upon its application at field may provide the same results as was laboratory based, on which respective selection was made among many isolates.

Actinomycetes and its related species just upon superficial observance, may fit into the role mainly due to fact that they have been isolated from all around the world and under extremes of ecological condition, ranging from the depths of the marine trench, to deserts, hot water geysers, extreme high altitude, freezing temperatures, humid to extreme heat. Hence if a certain group of organism with its diversity does inhabit mostly every type of habitat, then it does need attention.

The relevance of actinomycetes as a biological medium for agricultural purposes can also be linked to the fact that they may be able to survive the drastic changes that has undertaken in the agricultural fields of the farmer owing to indiscriminate use of chemicals and also anthropogenic activities, and at the same time assist the cultivation of crops by providing protection and integrated nutrient to the soil rhizosphere. According to Crawford *et al.* (1993) they are quantitatively as well as qualitatively vital part of the rhizosphere. Recently Doolotkeldieva *et al.* (2015) have put forth that use of

a formulation *Streptomyces fumanus* as colonizer of rhizosphere of plants after competition with existing microflora.

The antibiotic aspects of *Streptomyces* species a type of actinomycetes cannot be ruled out either, however clinical study of the same has many results which have everyday human use and the number is increasing day by day. Behal (2000) reported secondary metabolites have antifungal, antitumor and immunosuppressive activities.. However, focus on their role for plant health and not just human health should also be considered, as good food from plants is the mainstay of healthy human health.

The role of actinomycetes as antagonist against many pathogens either fungal, bacterial, nematodes, pests etc. has been proved by many workers (Sowndhararajan and Kang,2012, Ningthoujam *et al.*,2009,Srividya *et al.*,2012, Heng *et al.*,2015, Hastuti *et al.*, 2012, Intra *et al.*, 2011, Ara *et al.*,2012b). Shrivastava *et al.*, (2017) have also clearly concluded that *Streptomyces aureofaciens* K20 under saline stress condition can be used for bio control of *M. Phaseolina*. However it is also to be believed that microorganism isolates from respective agroclimatic zone will perform better in terms of bio-control and growth enhancement rather than a foreign entity. Hence isolation assay and evaluation of target isolates from respective ecosystem may be the key to sustainable agriculture. . Janaki *et al.*, (2016) have added that search should be on for newer compounds from mangrove habitat as well. The same has been supported by Basha and Rao (2017) stating exploration of mangrove inhabiting actinomycetes for active secondary metabolite should be done. The host range of crops for which detailed and positive investigations in relation to actinomycetes, varies from fruits, grasses, vegetables, plantation crops.

Pulses are also an important crop as far as balanced diet is considered. There has been works where actinomycetes have assisted in bio control and growth enhancement of crop plants (Couillerot *et al.*, 2013). Cultivation of pulses even though is undertaken at other states of India as well, there is emerging scope for agribusiness of the same in the North East states of India including North Bengal, as evidenced by the fact that about 21 varieties of *Phaseolus* are cultivated in a single district of Tuensang in Nagaland state of India.

There is always evidence that many bio control agents like *Trichoderma viride*, *Trichoderma harzianum*, *Bacillus*, *Pseudomonas*, VAM formulation provide similar

results to an extent. However, the unique character of actinomycetes is its ability to survive in any type of soil system and even in chemical infested environment. As actinomycetes are known to be durable organism they are appropriate for soil application (Sharma 2014), as *Streptomyces* gn-2 strains improve the composition of microflora in the rhizosphere, mostly by attracting saprophytic microorganisms: ammonificators and oligotrophs (Doolotkeldieva *et.al.*2015). Jog *et al.*, (2014) have even proposed three *Streptomyces* strain namely mhrcr0816, mhcr0817 and mhce 0811 as potential bio inoculants, which were isolated from wheat roots and rhizosphere.

Though it may be early to put forth, but these can be taken as pointers for earmarking this group as potential agent for phyto- remediation of the soil system in area in-and around North Bengal, where extensive use of chemicals as insecticide spray, or fertilizers has taken place mostly owing to the fact that there are about 178 tea gardens in the Jalpaiguri and adjoining areas.

The tools and techniques for any experimental undertaking are as important as the aims and objectives outlined relevant to the hypothesis and review prepared for attaining certain results. Conventional to modern techniques were followed to assay the potential of the isolates under various experimental designs. Conventional anatomical studies to molecular characterization were carried forward with the single aim to provide a holistic evaluation of the objective at hand.

As put forth by Sunar (2014) there has been few evidence of beneficial microorganism being isolated from North Bengal and other North Eastern state of India. Mere isolation and identification can be one aspect of the study but identification and assay of the same as beneficial has to run parallel, so that the there is an existing repository of area specific bio-control and bio growth enhancers from the region and not just samples for identification purpose. As put forth an area specific repository of data on bio agents will ensure organic cultivation minimizing side effect on health issues is looked into, more so when most of North East till date is organic by default.

In view of the above situation a study was undertaken to found a biological method of improving the overall plant health and disease resistance capacity with the following

- Isolation of actinomycetes from soil.
- Morphological and biochemical characterization of isolates.
- Screening of isolates for phosphate solubilizing activity.
- *In vitro* antagonistic activity of selective actinomycetes isolates against fungal pathogens (*Fusarium solani*, *Sclerotium rolfsii*).
- Molecular detection of potential isolates of actinomycetes.
- Evaluation of potential actinomycetes as bio protector against fungal root pathogens of pulses (*Phaseolus vulgaris* and *Vigna radiata*).