PREFACE

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The world's growing population depends ultimately on plants for food. For adequate supply of food as well as feed the necessity is not only to maintain but to increase current levels of crop production. In global terms, the production of crops is limited by the availability of fixed nitrogen and other nutrients. It seems likely that increased application of nitrogenous fertilizer will play a key role in narrowing the very wide gap which exists between average crop yields and those recorded under optimum conditions of agronomic managenent. Indian farmers realize on an average only about 15% of the potential yield of crops primarily due to limited application of nitrogen fertilizer. In agriculture today, the natural process of replenishing nitrogen used up by crops are too slow to sustain the productivity needed and the shortfall is made up by chemical fertilizers prepared industrially. Indian fields have been subjected to intense cultivation for more than 7000 years and been depleted of their essential native nutrients. To restore the nutrient status of Indian soils application of nitrogenous fertilizer is becoming an agricultural priority. currently nearly 55×10^6 tonnes of nitrogen fertilizer is consumed every year throughout the world. Most of this fertilizer is used in the developed countries whereas, only about 30%

of the world population is shared by them. The average amount of nitrogen fertilizer currently applied to fields in developing countries is well below the requirement. To meet the demand for food in developing countries increased application of nitrogen fertilizer is necessary but restricted due to economic reasons. India's production of nitrogenous chemical fertilizer is well below its provisional consumption. The process of N_2 fixation, whereby rather inert nitrogen molecule is converted into ammonia, is an endergonic one and requires a large amount of energy. The supply of energy from petroleum or other fuels is becoming costly with the passage of time. Importation of fossil fuel has severely been handicapped due to significant shortfall in foreign exchange reserve in India. Besides, use of synthetic fertilizer also adds upto pollution of environment. As such, exploitation of biological N_2 fixation process by microorganisms is gaining increasing appreciation throughout the world and more so in the developing countries like India.

Only certain prokaryotes are endowed with the genetic capability of fixing nitrogen. These organisms fix N_2 either in free-living state or in symbiotic association with the higher plants. The plant themselves are incapable of fixing atmospheric nitrogen. About 80% of biological N_2 fixation is indebted to symbiotic forms and Rhizobium - legume symbiosis is known to be most effective among them. Taxonomically the symbiotic

bacteria infecting roots of leguminous plants are classified under two generic heads, Rhizobium and Bradyrhizobium. The bacteria fix N_2 from the atmosphere in the protective niche of nodules of leguminous plants.

About 30% of total photosynthates as metabolic fuel are transported to nodules from the photosynthetic organs. The photosynthates or their immediate metabolic products are used for generation of reducing power to be used during energy demanding N_2 fixation. It is believed that sucrose alongwith other carbons are transported to the nodules. The mechanism of metabolism of these compounds and the exact identity of compounds metabolized during N_2 fixation for a supply of reducing power are not clear. The metabolic pathways involved during generation of reductants and the mechanism of regulation of the metabolic pathways are intriguing to us. Solutions to the problems, it is expected, will help in improvement of nitrogen fixing capability of root-nodule bacteria and thereby increase plant productivity.

It is our endeavour to study carbohydrate metabolism of root-nodule bacteria that infect the legume Cicer arietinum. The studies on regulation of the metabolic process under different nutritional regime are also within our purview. The present investigation carried out by us primarily addressed what known carbohydrate metabolic pathways are involved in the free-living bacteria to metabolize available carbons or what regulation of

metabolic pathways operate during femine condition and at different nutritional regime causing induction/or repression of the metabolic enzymes. In one experiment results were compared with the system prevailing in bacteroids immediately after isolation from host. The results are presented and probable inferences are made from these in the discussion section of this dissertation. The choice of the bacteria nodulating Cicer arietinum was primarily governed by the fact that chickpea is the third most widely grown legume in the world and is grown extensively in many regions of India. From a previous study in this laboratory rhizobia infecting Cicer were thought to warrent the formation of a new separate species.

It was hoped that studies on the carbon metabolism and its regulation in free living root nodule bacteria of Cicer arietinum would provide a base line from which events in the dissimilation of carbon in Cicer bacteroids could be recognized.

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