International Journal of Engineering and Management Research Vol. 1, Issue-1, November-2011
ISSN No.: 2250-0758
Pages: 36-38
www.ijemr.net

RHIZOBIUM: A Natural Biofertilizer

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ABSTRACT

Nitrogen is an essential nutrient for plant growth and development. Legumes play an important role in sustainable management of dry arid regions. Most legumes can provide enough nitrogen for their physiological needs. Intensive farming practices that accomplish high yields need chemical fertilizers, which are not only costly, effective and also create environmental problems. Each major legume crop is nodulated by different species of *Rhizobium*.It is a fast growing bacteria which is a rich source of nitrogen to the crop. Increasing and extending the role of biofertilizers such as *Rhizobium* would decrease the need for chemical fertilizers and reduce adverse environmental effects.

Keywords---- *Rhizobium*, legumes, nodules, biofertilizer, nitrogen

I. INTRODUCTION

Nitrogen is one of the essential elements required for the synthesis of amino acids which, in turn, are used by the plant to form protein. Plants primarily take nitrogen in the ionic form as either ammonium (NH_4^+) or nitrate (NO_3^-). Leguminous plants are also able to utilize nitrogen derived from the symbiotic relationship they form with root nodule bacteria.[1].

Legumes play an important role in sustainable management of dry arid regions. *Rhizobia* are the gram negative bacteria which have been widely used in agricultural systems for enhancing the ability of legumes to fix atmospheric nitrogen [2]. These inhabit the root nodules of most legumes which can provide enough nitrogen for their physiological needs [1]. Each major legume crop is nodulated by different species of *Rhizobium.*

Intensive farming practices that accomplish high yields need chemical fertilizers, which are not only costly but also create environmental problems [3]. The extensive use of chemical fertilizers in agriculture is currently under debate due to environmental concern and fear for consumers' health. Consequently, there has recently been a growing level of interest in environment friendly sustainable agricultural practices and organic farming systems which include the use of biofertilizers as a substitute of chemical fertilizers[4]. Thus, in the development and implementation of sustainable agriculture techniques, biofertilization is of major importance in decreasing environmental pollution and the conservation of nature [5].

Thework focuses on published studies that haveexamined the relationship between *Rhizobium* in root nodule of leguminous plants and theirapplication as fertilizer.

II. BIOFERTILIZER

Biofertilizers are actually the compounds that enrichthe nutrient quality of the soil by using microorganisms that establish symbiotic relationships with the plants.Biofertilizers may also be defined as microbialinoculants which are artificially multiplied cultures ofcertain soil microorganisms that can improve soilfertility and crop productivity. These are low costrenewable sources of plant nutrients which supplementchemical fertilizers. Biofertilizers generate plantnutrients like nitrogen and phosphorous through theiractivities in the soil or rhizosphere and make themavailable to the plants on the soil. These contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the *rhizosphere* or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Biofertilizers add nutrients through the natural processes of Nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth promoting substances. Biofertilizers can be expected to reduce the use of chemical fertilizers and pesticides. Thechemical fertilizers arethe main causes of losing soil fertility and are actually causing huge amount of soil and land degradation. In India, systematic research on biofertilizers started with the first study of N.V. Joshi in 1920. This was followed by extensive research by Gunguless, Sarkaria and Macho on the physiology of the nodule bacteria and its inoculation for increasing crop yield [6].These can be interpreted as a living fertilizer. Actually the name of fertilizer is less suitable, because the biological fertilizers do not contain nutrients in the form that are added through chemical means. Groups of microbes that are often used are the microbes that fix Nitrogen from the air, which dissolves microbial nutrient (especially P and K), the microbes that stimulate plant growth. Other microbes often used in biofertilizer are the microbial growth stimulant[7]. A microbe from the group of bacteria is often referred to as Plant Growth Promoting *Rhizobacteria* (PGPR), but now fungi are also used to stimulate plant growth. Bacteria known to stimulate plant growth include

Pseudomonas spp., *Azospirillum spp.*,*Bacillusspp.* while one from fungus is *Trichoderma spp*. *Rhizobium*is one of the most beneficial species[8].

Biofertilizers are sold in liquid or solid forms. There are lots of biological fertilizers in the market. Biofertilizers, microbial inoculants that can promoteplant growth and productivity, are internationally acceptedas an alternative source of N-fertilizer. They are environmentally friendly and can be used to ensure asustainable cereal production. In the biofertilizer technology,new systems are being developed to increase thebiological N_2 fixation (BNF) with cereals and other non-legumesby establishing N_2-fixing bacteria within the roots[9]. Nitrogen fixation and plant growthpromotion by rhizobacteria are important criteria for aneffective biofertilizer.

III. RHIZOBIUM

Rhizobium is a gram negative bacterium which inhabits the root nodules of most leguminous crops.

Rhizobia are soil bacteria that fix N_2 (diazotroph) afterbecoming established inside root nodules of legumes(Fabaceae). There are several different genera ofrhizobia, all of them belong to the Rhizobiales, aprobably-monophyletic group of proteobacteria and theyare soil bacteria characterized by their unique ability toinfect root hairs of legumes and induce effective N_2-fixingnodules to form on the roots. They are rod shaped livingplants which exist only in the vegetative stage. Unlikemany other soil microorganisms, rhizobia produce nospores and they are aerobic and motile. Rhizobia(species of *Rhizobium, Mesorhizobium, Bradyrhizobium,Azorhizobium, Allorhizobium* and *Sinorhizobium*) formintimate symbiotic relationships with legumes byresponding chemotactically to flavonoid molecules released as signals by the legume host. These plants compounds induce the expression of nodulation (nod)genes in rhizobia, which in turn produce lipo-chitooligiosaccharide(LCO) signals that trigger mitotic celldivision in roots, leading to nodule formation [10, 11].The legume-*Rhizobium* symbiosis is a typical exampleof mutualism.The *Rhizobia,* which are widely used in agricultural systems, are represented by 7 genera containing about 40 species. Although rhizobia naturally infect legumes ashost plants, some *Rhizobium* strains can form symbioticrelationships with non-legumes species such as*Parasponia* [12].

IV. BIOFERTILIZER ACTIVITY

It has been found from various experimental results thatinoculation of *Rhizobium* in different cereal grainsincreased yield to some extent. An increase in N uptake byrice plants inoculated with rhizobia was also reported [13, 14]. This plantresponse is significant because of its potentialimportance to sustainable agriculture, especiallyin cropping systems involving rotations of rice andlegumes.It was observed that rhizobial inoculation enhancedstomatal conductance, thereby increasing the photosynthesic rates by 12% in rice varietieswhere 16% grain yield was recorded. A positivecorrelation between increased grain yield andphotosynthetic rate at zero N-level was also found[15]. Similarly, an increase was found in photosynthetic rate and yield inBananas inoculated with PGPR. [16] They also foundhigh and quality banana produced by inoculation.Inoculation with*Rhizobium leguminosarum* bv. *trifolii* E11,*Rhizobium* sp. IRBG74 and *Bradyrhizobium* sp.IRBG271 increased rice grain and straw yields by 8 to 22 and 4 to 19%, respectively, at different N rates.Nitrogen, P and K uptake were increased by 10 to 28%due to rhizobial inoculation which also increased Feuptake in rice by 15 to 64%.This increase might be attributed to changes inmany metabolic and physiological processes [17].

V. CONCLUSION

Information from the various literatures depicts that association between *Rhizobium* and legumes or some non-leguminous plants is a naturalphenomenon. Progressive knowledge of this area maybring benefits for using this technology. Therefore, more research is needed on the interaction between crops and rhizobia or rhizobia-like bacteria.

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