

**EFFECT OF BIOINOCULANTS ON
CAJANUS CAJAN AND ITS
RHIZOSPHERIC MICROBIAL COMMUNITY**

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**DEPARTMENT OF BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY
INDIAN INSTITUTE OF TECHNOLOGY DELHI
NEW DELHI – 110016, INDIA**

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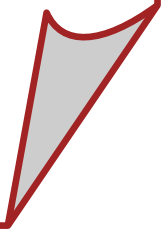
Submitted
in fulfillment of the requirements of the degree of
DOCTOR OF PHILOSOPHY
to the



**INDIAN INSTITUTE OF TECHNOLOGY DELHI
NEW DELHI – 110016, INDIA**

NOVEMBER 2014

Dedicated to my Grandfather
(Late Sh. O. P. Gupta)



CERTIFICATE

This is to certify that the thesis entitled “**Effect of bioinoculants on *Cajanus cajan* and its rhizospheric microbial community**” being submitted by **Ms. Rashi Gupta** is worthy of consideration for the award of the degree of Doctor of Philosophy. The thesis has been prepared under our supervision and guidance in conformity with the rules and regulations of Indian Institute of Technology Delhi and is a record of the original bonafide research work. The results presented in this thesis have not been submitted in part or full to any other universities or institutes for the award of any other degree or diploma.

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ABSTRACT

A rapid transition to sustainable mode of agriculture needs to be employed on a huge scale with great urgency in order to stop the deleterious effects of excessive industrialization and urbanization on our ecosystem including soil, water, biodiversity, and other natural resources. Among the various methods used for sustainable agriculture, bioinoculants, which are living microbial isolates, are currently gaining much popularity as an alternative to synthetic fertilizers due to their minimal impact on the environment. However, their application to ecosystem in numbers larger than their natural population must also induce at least transitory perturbations in the equilibrium of indigenous microbial communities and hence other soil processes in which these microbes were involved. Such indirect effects of bioinoculants are known as their non-target effects, which can be both positive and negative.

The present study attempted to fulfill two major research gaps in this area: efficacy and risk assessment of bioinoculants. Efficacy assessment included the designing of a microbial consortium best suited for growth and grain yield of *Cajanus cajan*. Risk assessment involved the study of non-target effects of this microbial consortium on indigenous microbial community structure and function. The outcome of interplay of different combinations of three selected bioinoculants (*Bacillus megaterium*, *Pseudomonas fluorescens* and *Trichoderma harzianum*) on the resident and active microbial community structure in *C. cajan* rhizosphere was assessed using both cultivation-dependent and –independent techniques, along with plant growth parameters. Also, the impact of bioinoculants was studied on the resident as well as active microbial guild involved at various steps of the nitrogen cycle by targeting genes and transcripts of N cycle. The results thus obtained were also compared with those of the chemical fertilizers.

The present study concluded that the best growth of *C. cajan* was obtained with mixed consortium of the three bioinoculants, even better than the recommended dose of chemical fertilizers. Also, the enhancement in abundance and activity of beneficial rhizospheric microorganisms as evidenced by increased abundance of genes and transcripts involved in nitrogen fixation (*nifH*) with bioinoculants application proved them to be “safe” for field applications.

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