EFFECT OF BIOFERTILIZERS ON *JATROPHA CURCAS* UNDER ABIOTIC STRESS

by

ASHWANI KUMAR

Centre for Rural Development and Technology

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Dedicated

to

My family

[The power of God is with you at all times; through the activities of mind, senses, breathing, and emotions; and is constantly doing all the work using you as a mere instrument]

(BhagavadGita)

CHAPTER 1

INTRODUCTION

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 3

MATERIALS AND METHODS

CHAPTER 4

RESULTS AND DISCUSSION

CHAPTER 5

SUMMARY

AND CONCLUSIONS

REFERENCES

CERTIFICATE

This is to certify that the thesis entitled "**Effect of Biofertilizers on *Jatropha curcas* under Abiotic Stress**" submitted by Ashwani Kumar has been prepared under our guidance with the rules and regulations of Indian Institute of Technology Delhi, India. The research report and results presented in thesis have not been submitted for any degree or diploma in any other institute or university.

(Prof. Satyawati Sharma)
Center for Rural Development and Technology
Indian Institute of Technology Delhi
Hauz khas, New Delhi, 110016,
India

(Prof. Saroj Mishra)
Department of Biochemical Engineering and Biotechnology
Indian Institute of Technology Delhi
Hauz khas, New Delhi, 110016,
India

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(Ashwani Kumar)

ABSTRACT

Jatropha curcas L. has been identified as a drought resistant, multipurpose non-edible oil seed plant recommended for biofuel production and reclamation of salts affected marginal lands. Understanding the effect of salts and management practices on *Jatropha* adjustment and biomass yield on these soils, is necessary for meeting energy demands. Various approaches involving inoculation of bioinoculants, and management practices have been studied to enhance biomass yield quality parameters of *Jatropha* by alleviating the adverse effect of environmental stress. This thesis consists of four studies aimed at examining (1) the efficacy of bioinoculants individually as well in combinations, and along with different agronomical practices, on biomass, seed yield and oil content of *Jatropha* (2) the role of bioinoculants to increase the biomass yield of *Jatropha* on salt stressed soil (3) protein profiling of stressed *Jatropha* leaf and (4) interaction of *Jatropha* with surrounding vegetation. In the first study, the effect of bioinoculants, different shading (%) and irrigation was studied on seed grown *Jatropha* with regards to various biomass parameters. Comparative performance of vermicompost and FYM (farmyard manure) was tested on different vegetative and generative parameters of *Jatropha* raised through cuttings. The application of bioinoculants showed a promoting effect on the growth of *Jatropha.* Among all the treatments (*Azotobacter*, Microfoss and AMF), co-inoculation of *Azotobacter* and AM fungi showed best plant growth. Plants under optimum light condition (25% shading), irrigation (thrice in a week) and without any biotic interference showed maximum growth responses and fruiting. Vermicompost enhanced biomass yield of cuttings raised *Jatropha* over FYM and control.

In the second study, effect of different level of salinity (NaCl and Na_2SO_4) and alkalinity (Na_2CO_3 and $NaHCO_3$) on various morphological and biochemical parameters in nursery as well as in field conditions (IIT Delhi and Bawal, Haryana, India) was studied. *Jatropha* seedlings showed higher stress under alkaline than under saline conditions.

However, after establishment, *Jatropha* performed better in terms of biomass yield on alkaline than saline soil. Inoculation of bioinoculants alleviated adverse effect of salt by nutrient acquisition, solute accumulation, reducing leaf membrane damage and also by increased production of antioxidants. High salt level decreased the glomalin related soil protein (GRSP) concentration, but the highest values of GRSP were recorded in the inoculated soils. The oil content (%) in *Jatropha* grown under 0.3 % salinity and alkalinity at Micromodel, IIT Delhi was found almost at par (30.35 and 30.75%) while it was significantly less in Bawal (28.34%), Haryana. But co-inoculation of *Azotobacter* + AMF resulted in maximum increase in higher oil content under alkalinity stress (33.55%) followed by salinity stress conditions (32.87%) at Micromodel, IIT Delhi and alkalinity stress (32.11%) at Bawal, Haryana. Thus amongst the bioinoculant treatments, combination of *Azotobacter* + AMF resulted in best growth and biochemical parameters. The synergistic effect of *Azotobacter* (nitrogen fixation, production of plant growth promoting hormones and vitamins) and AMF (increase nutrient and water uptake, plant protection from stresses and other problems) most likely are responsible for this effect. In the third study, the changes in protein profile of *Jatropha* seedlings grown under different salt stress regimes were studied using 1D SDS-PAGE and MALDI-TOF for peptide mass finger printing. Proteomic analysis showed up- and down-regulation of some proteins. Taken together these results suggested that exposure to high concentrations of salt causes up and down regulation of the defense related proteins in *Jatropha* leaves, and perhaps this could have been the reason of tolerance of plants against salt stress in the present study. In the fourth study, the impact of *Jatropha* on soil was evaluated and it was found to be positive with respect to soil flora and fauna and no adverse effects on surrounding vegetation and other economically important crops was seen. The results concluded that application of bioinoculants and appropriate management practices can enhance the yield of *Jatropha* on salt affected lands.

CONTENTS