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BIOLOGICAL STUDIES ON THE EFFECT OF AGROCHEMICALS ON NODULATION OF SOME CULTIVATED LEGUMES

M. LAXMI PRASUNA

Govt. W.W. Patankar P.G. Girls College, Durg, C.G. India

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ABSTRACT

Symbiotic nitrogen fixation is of great importance not only in production of leguminious crops but also in the global nitrogen cycle. Nodulation is a highly host specific interaction in which with few exceptions, specific rhizobia strain infect a limited range of plant host. The connection between pesticides and nitrogen fixation shows that pristine and natural interactions between bacteria and plants are being jeopardized by what we put into the soil (Ann. Hirsch). The pesticides significantly affected nitrogen activity of the *Rizobium* strains used and influenced the growth and appearance of leguminous plants which proved that the bacteria and the plants were sensitive to Agro-chemicals (Niewiadonska and Ktoma, ...).

INTRODUCTION

The impact of increasing population is enormous upon agriculture and food production so that the increased demands are met with. This has created new trends in the whole agricultural system where now the emphasis is on higher production shift in agricultural practices has been towards the use of improved varieties of crop plants, chemicals fertilizer and successful crop protection by Agrochmicals. The main use of pesticides in India is for cotton, then on paddy and wheat, pesticides belonging to different chemical when applied on legumes reduced nodulation.

Biological Nitrogen Fixation

Amongst the soil bacteria a unique group called rhizobia have beneficial effect on the growth of legumes. Rizobia either live in soil saprophytically or in symbiotic association with host legumes. The complex process by which the rhizobia produce nitrogen for the legume is called biological nitrogen fixation (BNF). Biological nitrogen fixation is a process of which atmospheric nitrogen gas is converted to ammonia and it is subsequently available for plants. In agriculture land approximately 80% of biologically fixed nitrogen comes from symbiosis involving leguminous plants and bacteria of the family Rhizobiaceae.

Significance of Indiginous Rhizobia

The native rhizobial populations are diverse containing effective and ineffective strains. The infection and nodulation of legumes takes place without human

***Corresponding authors email:**

Table 1. Taxonomy, Morphology and Growth behaviour of the indigenous strains of Rhizobium obtained from cultivated crop plants

S. No.	Host- Legume Plants	Bacterial Species	Isolate Code	Nodule morphology			Rhizobial growth in log phase	
				Shape	Average No./Plant	Average size/ plant (mm)	Biomass (NTU)	Duration (Hours)
1.	*Glycino max*	*Bradyrhizobium japonicum*	GM	Globular	22	8.70X6.95	2.4-6.5	8-48
2.	*Melilotus alba*	*Sino rhizobium meliloti*	MA	oblong to corolloid	10	3.90X3.4	9.2-35.7	8-96
3.	*Trigonella foenum graecum*	*Sino rhizobium meliloti*	TFG	oblong to corolloid	12	4.3X3.39	5.1-38.3	12-96
4.	*Cicer arietinum*	*Meso rhizobium ciceri*	CA	Round to cylindrical	27	5.9X3.30	14X183.2	8-120
5.	*Pisum Sativum*	*Rhizobium Leguminosarum biovar viciae*	PS	Round to cylindrically branched	16	3.40X3.75	4.4-19.2	12-182
6.	*Lens esculenta*	*Rhizobium Leguminosarum biovar viciae*	LE	Cylindrically branched	2	3.67X3.15	8.3-53.8	8-72
7.	*Phaseolus oureus*	*Rhizobium Leguminosarum biovar phaseoli*	PA	Round	33	3.3X2.98	2.0-74.0	12-120
8.	*Phaseolus mungo*	*Rhizobium Leguminosarum biovar phaseoli*	PM	Round	60	1.95X1.04	2.7-45.3	12-96
9.	*Trifolium alexandrium*	*Rhizobium Leguminosarum biovar trifolli*	TA	Round	56	2.37X1.93	4.0-33.6	12-120
10.	*Arachis hypogea*	*Brady rhizobium* sp.	AH	Round to oblong	60	2.82X2.00	3.3-185	12-84

The nomenclature of *Rhizobium* species is according to Stephen K. Barnhart - 2006

intervention. The greater number of rhizobia in the soil nodulate a legume crop induce biological nitrogen fixation. The proper combination of *rhizobium* and legume will result in the best nodulation and more nitrogen fixation. The bacteria reside in the nodules where they fix N_2 and provide the plant with nitrogen essential for their growth.

MATERIALS AND METHODS

As many as 10 cultivated legumes were observed for nodulation after surveying from various fields treated with agrochemicals (organophosphates and organochlorines) were collected in the month of July-Septemeber and January -February.

The legume roots were uprooted carefully washed under running water so that the soil is removed completely and the nodules are clearly exposed. The location of nodules on the root system is species dependent. The record of number size and shape of nodules were taken for each plant species as an average of 10 plants in each case Table 1.

A general procedure by vineent (1970-82) was followed for isolation and identification of the Rhizobia from nodules. Investigation to dertermine the growth behaviour were carried out in broth culture developed on Nutrient broth medium. Periodic growth measurments after initial 4 hour difference and later on 12 hour difference was recorded. The growth was based on turbidimetric measurements as NTU units and plate count simultaneously Table 1.

RESULTS AND DISCUSSION

Chhattisgarh region has been traditionally rice growing part of the country and the soils are much deficient in nitrogen content which requires nitrogenous fertilizers for agriculture. Since the symbiotic mode of Nitrogen fixation is by far best of all this study has been undertaken in the fields where pesticides such as chloroporiphos, Endosulphon, monochrotophos, Aamber etc are used.

The legume species examined were poorly nodulated with four main types of nodule morphology (a) globular (b) globular compartmentalised (c) cylindrical (d) cylindrical branched attaining corrolloid type of ramification.

The nodules of legume crops studied varied significantly in number size and shape in some legumes (cyamopsis) the number is few, compound and large but in phaseolus mungo and Arachis the nodule number is better with smaller in size.

Regarding growth parameters the rhizobia are both slow and fast growing bacteria. There is definitely a rather narrow lag phase which is followed by much prolonge logphase extending upto 144 hours of growth period in slow growing rhizobial species. The data showed that a considerable variation occurred in these isolates in respect to their growth phase and generation times.

The uses of Agrochemicals on legumes are increased 7 folds in the past decades. They are used to control the pests and weeds. The application of pesticides on pests starts from presowing stage of legumes. The treatment includes soil application, seed treatment and foliar spray. The indiscriminate use of pesticides persists in soil contaminate the soil whose impact may adversely affect soil biodiversity. The agrochemicals such as DDT, methylparathion and pentachlorophenol results in nitrogen fixation in legumes and thus reduce crop yields.

Kumar (1981); Niewiadomska *et al*....., showed a significant reducing effect on nodulation, changes in morphology of root nodules in legumes due to phyto-toxic effect of agrochemicals.

Orgnochlorines and other pesticides supresses nitrogen fixing bacteria from replenishing natural nitrogen fertilizer in soil lowering crop yields (Carolpotera, Hamedia *et al.* .....)

CONCLUSIONS

The use and effect of Agrochemicals definitely pollute the soil, hinders the microbial population and nodulation in legumes. Alternative methods for instances resistant plant varieties and use of bio-fertilizers will be successful resolving pest problem. Symbiotic nitrogen fixation by root nodule formation must be enhance as this process save the world economy $ 10 billion against synthetic nitrogen fertilizer every year.

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