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Influence of *Rhizobium* and Phosphate Solubilizing Bacteria on N and P accumulation by *Lathyrus (Lathyrus sativus* L.) Under Climatic Conditions of Chhattisgarh Plains

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Abstract

The present investigation was carried out in the, Collage of Agriculture and Research station, Indira Gandhi Krishi Vishwavidylaya, Janjgir-Champa, during the year 2017-18 Rabi Season to study the Influence of *Rhizobium* and phosphate solubilizing bacteria on performance of field grown *Lathyrus (Lathyrus sativus L.)* under climatic conditions of Chhattisgarh plains. In the present investigation total 8 treatments T_1 Control (No inoculum no fertilizer), T_2-Recommended Dose of Fertilizer (N:P:K::20:40:20), T_3-Rhi.HG-25+PSB-H-27, T_4 Rhi.HG-25+Korba PSB-118, T_5-Rhi.L-3 *Lathyrus*+ PSB-H-27, T_6 Rhi.L-3 *Lathyrus*+Korba PSB-118, T_7- Rhi.L-11 *Lathyrus*+PSB-H-27, T_8 Rhi.L-11*Lathyrus*+Korba PSB-118 and replication three. The highest total N uptake was observed in Treatment T_8 (73.12 kg/ha) followed by Treatment T_3 (Rhi.HG-25+PSB-H-27) 70.17 (kg/ha) and least total N uptake was observed in T1 control (32.22 kg/ha). The highest total P uptake was observed in Treatment T4 (Rhi.HG-25+Korba PSB-118) 4.39 kg/ha followed by Treatment T8 (3.74 kg/ha) and least total P uptake was observed in T1 control (1.59 kg/ha).

Keywords: RDF, Microbe, PSB, Rhizobium, Lathyrus

Introduction

Newly formed Chhattisgarh state is bigger than many state of the country. Its economy is mainly based on agriculture. Soil of this state are very rich in the natural resources, in spite of the fact, people of Chhattisgarh region has been under constant

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thread of poverty, unemployment and hunger that often forced rural poor people in particular to leave their home to find job elsewhere especially after every kharif rice.

In the Rabi summer season, very less area is cultivated, that too with crops like *Lathyrus*, linseed, gram, lentil, mung etc. with productivity of less than half a tonne per hectare, making such farming virtually uneconomic. The situation is becoming worse day-by-day with mounting population pressure and shrinking rate of job opportunities and income for illiterate poor resource farmers. Numerous research proposals submitted for consideration to various funding agencies by the Indira Gandhi Agricultural University, Raipur have commonly voiced the need of increase agriculture production of not only cereals but pulses and oilseeds in the state on a sustainable low cost input basis. Inherent low level of soil-fertility status (Sinha and Gupta. 1985). Out of 135.00 lakh ha (1.35 lakh sq. km) area of Chhattisgarh, about 46.02 lakh hectares is under kharif mostly with rice crop while about 18.00 lakh ha only under rabi crops. About 28.02 lakh ha area remains fallow during rabi.

The important *Lathyrus* growing Districts of this region are Raipur, Durg, Mungeli, Bilaspur and Rajnandgaon. *Lathyrus* (*Lathyrus* sativus L.) is an important pulse take bonus crop in rice belts of Central and Eastern part of India.

Nitrogen (N) fixation is the process whereby legume crops and specific *Rhizobium* bacteria (rhizobia) work together to make nitrogen from the soil air surrounding the roots available for use by the plant. Soon after the crop germinates, rhizobia enter the root hairs. Once inside, the bacteria penetrate further into the root through an infection thread. The rhizobia rapidly multiply within the root and the plant responds by forming specialized structures called nodules, in which the rhizobia are contained. The process of root infection and nodule formation is referred to as nodulation. It may take three to four weeks after seed germination before nodulation is evident on the plant roots.

Phosphorus (P) is one of the major essential macronutrients for plants and is applied to soil in the form of phosphatic fertilizers. However, a large portion of soluble inorganic phosphate applied to the soil as chemical fertilizer is fixed rapidly and becomes unavailable to plants. Microorganisms are involved in a range of processes that affect the transformation of soil P and are thus an integral part of the soil P cycle.

The aim of the proposed study was to increase *Lathyrus* productivity in Chhattisgarh. Hence, keeping in view, the present investigation was planned with following objectives in order to select effective of above combinations of acidity tolerant *Rhizobium* and PSB isolates for better biological nitrogen fixation and P solubilizing, respectively under low input and Eco-friendly technology for sustainable *Lathyrus* production. The productivity per unit of area of this crop is also very low again it's yield potential.

Raipur showed that 67.54 per cent area of Raipur, Durg, Rajnandgaon, Bilaspur and Raigarh districts of Chhattisgarh state do not have native *Rhizobium* of one or more than one legume crop [1].

Nitrogen is an essential element to all life, although it's abundant and composes nearly 80 percent of the atmosphere. Nitrogen is one of the major constraints in soil that limit the growth and productivity of plant in many ecosystems. This is a result of the inability of plant to directly utilize atmospheric nitrogen to meet their biological requirement for this element. Biological nitrogen fixing (BNF) root nodule bacterium i.e. *Rhizobium* is highly beneficial for enhancing productivity of various legumes including pulses and oilseeds. The symbiotic relationships between specific soil micro-organisms and plants are the most significant contributor of BNF in most terrestrial ecosystems [2].

Phosphate Solubilizing Microorganisms (PSM) play a significant role in making phosphorus available to plants by bringing about favorable changes in soil reaction in the soil micro-environment leading to solubilization of inorganic phosphate sources. Some microorganisms associated with different plant rhizosphere are able to solubilize inorganic insoluble P salts. *Pseudomonas* and *Bacillus* are two important genera of soil bacteria with promising activity of phosphate solubilization [3.]

Hence, it is beneficial to identify the effective combination of *Rhizobium* and PSB stain for different crops grown in Chhattisgarh, so that suitable one's for mass multiplication can be released to farmers for increasing crop productivity per unit area of this state. The work pertaining to different aspect of *Lathyrus-Rhizobium* symbiosis and PSB inoculation.

The Biological Nitrogen Fixation (BNF) is a complex biochemical reaction where by the inert atmospheric N_2 is enzymatically reduced into utilizable form for plants by nitrogenase enzyme complex that is the assimilation of atmospheric nitrogen in forms of organic compounds by microorganisms, is one of the most important contributions to the agricultural sustainability. BNF is a sustainable source of nitrogen in cropping systems, as fixed-nitrogen can be used directly by the plant and it is less susceptible to volatilization, denitrification and leaching, avoiding pollution problems in soil and water [4,5].

James et al. observed that the legume in the genera *Lathyrus*, Pisumand Viciacan have all their N-requirement supplied by forming N-fixing symbioses with a common soil bacterium called *rhizobium* leguminosarum bv.vicieae (Rlv) [6]. In present study, seedling of native rare and/or scarce species of *Lathyrus* and Vicia ("vetches") were grown in soil from their native environment (costal, woodlands or highland) in other of the induced nodulation by "trapping "the indigenous Rlv *Rhizobium*.

Pablo J. Villadas et al. mentioned that mainly legumes, which have a high protein content and low dependence on N fertilizers due to their ability to establish nitrogen-fixing symbiosis with rhizobia [7]. In this study, the rhizobia isolated from the nodules of six legumes from the genera Vicia, *Lathyrus* and Trifolium were analyzed in a firewall zone established in LanjarÃ³n (Granada) close to the Sierra Nevada National Park (Spain). Some of these strains clustered with strains isolated in other countries and continents, but others formed atpD, recA, glnII and nodC clusters and lineages only found to date in this study.

Shubhojit Das study that the *Rhizobium* bacteria are important in symbiotic noduleation process and have the capacity to fix the atmospheric N_2 for present as well as future. Few isolates were selected on the basis of their infectiveness with the respective host plant in N_2 free Jensen's agar medium in big size test tube. Finally 30 numbers of *Rhizobi*um isolates (from Khesari plant) were selected.

Algawadi and Gaur observed an increase in nodulation and nitrogenase activity due to single inoculation of *Rhizobium*, while the phosphate solubilizers increase the available phosphorus content of soil [8].

Materials and Methods

Available nitrogen

Available nitrogen was determined by alkaline permanganate (Kmno4) method as described by Subbiah and Asija (1956). Twenty gram sample was taken in one litre boiling flask and 200 ml distilled water, 100 ml of 0.32 percent $Kmno_4$ and 100 ml of 2.5 per cent NaOH were then added in sequence. The flask was connected to the condenser immediately after adding NaOH and the content was boiled on heater to collect about 150 ml distillate in 10 ml boric acid solution containing mixed indicator [9]. Ammonium-N in distillate was determined by titrating against 0.005N H_2SO_4 [9].

Available phosphorus

Available phosphorus was extracted using N_aHCO_3 (pH 8.5) by the method described by Olsen et al. and the amount of available phosphorus was determined by ascorbic acid method described by Watnabe and Olsen (1965) using spectrophotometer.

Available potassium

Available potassium was extracted by neutral normal ammonium acetate (pH-7) and determined with the help of Flame photometer as described by Jackson [10].

Results

Available soil physical chemical characteristics of soil of carbon of *lathyrus* crops Data presented in the table there was no variation in observation the pH, EC, Organic Carbon % value after harvest of *Lathyrus* field (**TABLE 1**).

TABLE 1. **Effect of *Rhizobium* and PSB inoculants in Physico-Chemical Characteristics of Soil after harvest of *Lathyrus* crops.**

Treatment	PH	EC ds/m2	OC %	Available N (kg/ha)	Available P (kg/ha)	Available K kg/ha)
Control	6.79	0.24	0.49	197.33	5.97	228.93
Recommended Dose of Fertilizer (RDF)	6.52	0.23	0.52	217.08	7.23	237.88
Rhi.HG-25*+PSB-H-27 *	6.82	0.22	0.58	204.54	8.96	262.02
Rhi.HG-25*+Korba SB-118**	6.66	0.24	0.54	205.53	8.96	237.98

Rhi.L-3 *Lathyrus***+PSB-H-27 *	6.62	0.24	0.62	221.26	8.96	256.63
Rhi.L-3 *Lathyrus***+Korba SB-118**	6.43	0.19	0.53	216.74	8.35	236.66
Rhi.L-11 *Lathyrus***+PSB-H-27*	6.73	0.2	0.51	212.56	9.33	239.67
Rhi.L11 *Lathyrus***+KorbaPSB-118 **	6.55	0.16	0.54	225	8.98	243.5
CD	NS	NS	NS	22.61	0.54	25.97
CV	-	-	-	12.58	7.33	12
Initial value	6.9	0.24	0.56	200.7	6.33	267.23

*Standard strain **Local strain

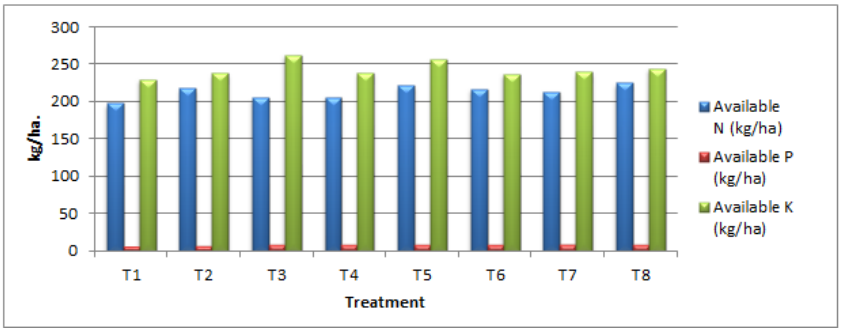

FIG. 1. **Effect of *Rhizobium* and PSB inoculants in Physico-chemical Characteristics of Soil after harvest of *Lathyrus* crops.**

In case of soil nitrogen only T_8 (Rhi.L-3 *Lathyrus*+Korba PSB-118) shown significant variation 225.00 N kg/ha followed by T5 (Rhi.L-3 *Lathyrus*+PSB-H-27) 221.26 N kg/ha compare to the T1 (control) 197.33 N kg/ ha. Initial soil sample value was obtained 200.70 kg /ha. After harvest the experiment of crop the N was buildup due to fixation of atmospheric N by *Rhizobium*. Maximum N buildup 20 kg N/ha in treatment T8 (Rhi.L-11*Lathyrus*+Korba PSB-118) and least N buildup 4.5 N kg/ ha in T2 (RDF) (**FIG. 1**).

Similar treatment observed in the available soil P. the maximum available soil P was obtained in treatment T_7 (Rhi.L-11*Lathyrus*+PSB-H-27) 9.33 P kg/ha and lowest was found in T1 (control) 5.97 P kg/ ha residual available soil P in all the treatment shown slightly high as compare to T1 (control) and T2 (RDF). In this content the maximum solubilizing capacity of PSB was observed in the PSB-H-27 as compare to the Korba PSB-118. This finding was supported by the [8,11] Solubilizing of insoluble phosphate compound and aid the plant growth and soil by secreting of organic acids [12].

REFERENCES

1. Katre RK, Adil ML, Gupta SB. Department of Biotechnology, New Delhi sponsored project report (II to V) submitted by Department of Soil Science, IGKV, Raipur, (M.P.). 1977.

2. Russelle MP. Biological Dinitrogen Fixation in Agriculture: Nitrogen in Agricultural Systems. 2008;49:281-359.

3. Yadav BK, Tarafdar JC. Penicillium purpurogenum, Unique P Mobilizers in arid agroecosystems. Arid Land Res. Manage. 2011;25:87-99.

4. Jenson ES, Hauggaard-Nielsen H. "How can increase use of biological N_2 fixation in agriculture benefit the environment?" Plant Soil. 2003;252:177-86.

5. Garg N. "Symbiotic nitrogen fixation in legume nodules: process and signalling: A Review." Sustainable Agriculture. Eds Lichthfouse, Eric et al. Springer Netherland; 2009. 519-31.

6. James EK, Iannetta PPM, Kenicer G. et al. Nodulation of *Lathyrus* and Vicia spp.in non-agricultural Soils in East Scotland. Aspect Appl Biol. 2011;109:119-24.

7. Pablo J, Villada AV, LasaPilarMartÃnez-Hidalgo,et al. Analysis of rhizobial endosymbionts of *Vicia*, *Lathyrus* and *Trifolium* species used to maintain mountain firewalls in Sierra Nevada National Park (South Spain). Syst Appl Microbiol. 2017;40:92-101.

8. Alagawadi AR, Gaur AC. Associative effect of *Rhizobium* and phosphate solubilising bacteria on the yield and nutrient uptake of chickpea. Plant Soil 1988;105:241-6.

9. Bremner JM. Nitrogen availability indexes. In C.A. Black (ed.). Methods of soil analysis part-2. Agronomy. Am Soc Agro Madison Mis. 1965;9:1324-45.

10. Jackson ML. Soil chemical analysis.Prentice-hall of India Private Limited New Delhi. 1967.

11. Hoque MS, Sattar MA. Status of microbiological research on pulses. Advances in Pulses Research in Bangladesh. 1999:103.

12. Rodríguez H, Fraga R. Phosphate solubilizing bacteria and their role in plant growth promotion. Biotech Adv 2011;17:319-39.