

ROLE OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR), SULPHUR AND MICRONUTRIENTS ON THE COST PRODUCTION OF LENTIL (*LENS CULINARIS*).

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Abstract: Bacteria that colonize roots effectively are termed “Rhizobacteria”. PGPR are free-living bacteria and some of them invade the tissues of living plants and cause unapparent and symptomatic infections when applied to seeds or crops, enhance the growth of the plant or reduce the damage from soil-borne plant pathogens. An experiment was conducted at the farm of J. V. College, Baraut, during Rabi seasons of 2008-09 on nodulation of Lentil (*Lens culinaris*). Inoculated with PGPR, S and micronutrients viz. Mn, Zn and Mo. Application of PGPR along with S @ 60 kg/ha, Zn @ 4 kg/ha, Mn @ 0.5 kg/ha and Mo @ 0.1 kg/ha significantly increases protein content, The use of PGPR along with S and Mn (7,498 Rs. in 2008 & 7,768 Rs. in 2009) was the most economical treatment with higher net return followed by PGPR + S + Mo + Mn (7,323 Rs. in 2008 & 7,533 Rs. in 2009) > PGPR + S (7,113 Rs. in 2008 & 7,233 Rs. in 2009). It is concluded that use of PGPR, S and micronutrients would be an effective approach in term of cost production of lentil under natural conditions.

Keywords: PGPR (Plant growth-promoting rhizobacteria), S (Sulphur), Micronutrient (Mn, Zn & Mo), *Lens culinaris*, L-4076 and PL-406

INTRODUCTION

World's major source of food for human nutrition comes from the most important grain crops such as wheat, rice and maize. As the food demand is increasing day by day because of increasing world population, so the growers need to use additional nutrient inputs to increase their yields. Mineral fertilizers and farmyard manure are the traditional source of nutrients. Farmers are averse to use these resources due to their unaffordable prices and their related environment hazards. There are number of approaches among which the best approach is to improve the uptake of nutrients and their use efficiency which can be engineered via using beneficial microbes as they are cost effective and environment friendly and can reduce the dependence on the synthetic resources and can enhance the crop yield (Ijaz *et al.*, 2011). Microorganisms that colonize the rhizosphere can be classified according to their effects on plants and the way they interact with roots, some being pathogens whereas other trigger beneficial effects. Rhizobacteria inhabit plant roots and exert a positive effect ranging from direct influence mechanisms to an indirect effect. So, the bacteria inhabiting the rhizosphere and beneficial to plants are termed PGPR. In the last few years, the number of PGPR that have been identified has seen a great increase, mainly because the role of the rhizosphere as an ecosystem has gained importance in the functioning of the biosphere. Various species of bacteria like *Pseudomonas*, *Azospirillum*, *Azotobacter*, *Klebsiella*, *Enterobacter*, *Alcaligenes*, *Arthrobacter*, *Burkholderia*, *Bacillus* and *Serratia* have been reported to enhance the plant growth (Joseph *et al.*, 2007).

Gram negative bacterium *pseudomonas sp.* is found to positively influence vitality and plant growth, often resulting in higher yield (Sarvan and Samiyappan, 2007 and Fliehdach, *et al.* 2009). India is the largest producer (25%) and importer (11%) of the leguminous crop (Shakya *et al.*, 2008). In India, during 2007-08, the total production of pulses was 15.19 million tonnes from an area of 24.38 million hectares with the average productivity of the country about 622 kg/ha against the average global productivity of 857 kg/ha (Banergee and Palke, 2010). The present production of 15.19 million tons is still short of the present consumption (17.65 million tones), thus forcing the country to import pulses to the tune of 2.0-2.5 million tones in 2008-09. The future requirement of pulses is expected to rise further mainly due to ever increasing population and preference for pulses as the cheapest source of dietary protein. (Ali and Shivkumar, 2008). Our country is home to a large number of pulse crops and presently grown more than a dozen of them on a large scale under varied agro-climatic conditions round the year. Amongst the leguminous crops, lentil (*Lens culinaris*) occupies an important position due to its nutritive values (26g protein) in large vegetarian population of the country (Yadav, *et al.* 2007). India rank first with annual output of about 1.51 million hect. which is almost double the level of production during the 1980. Productivity of lentil is about 684 kg/ha compared to an average winter pulse yield of 723 Kg/ha. In India, the production is 0.95m. tones (Dixit *et al.* 2009). In spite of these characteristic there are many agro-ecological, biological, socio-economic and management related constraints that are responsible for lower production of lentil. Proper management practice coupled with the use of biofertilizers and micronutrients may not only improve productivity but also helps in bringing

up large area under lentil cultivation in different cropping system (Sekhon, *et al.* 2007). The objectives of this study were to investigate the effect of PGPR (Plant Growth Promoting Rhizobacteria), Sulphur and micronutrient on cost production of Lentil (*Lens culinaris*) cv. L-4076 and PL-406.

MATERIAL AND METHOD

Lens culinaris seeds of known varieties L-4076 and PL-406 collected from Indian Agriculture Research Institute (IARI) Pusa, New Delhi. The uniform basal dose of nitrogen in the form of urea (20 kg/ha) were applied before sowing. S, Zn, Mo, and Mn were used at the time of sowing of seed. Sulphur was used in the form of gypsum (60 kg/ha), Zn in the form of zinc sulphate (4 kg/ha), Mo as sodium molybdate (0.1 kg/ha) and Mn as manganese sulphate (0.5 kg/ha) along with basal dose of N with different combination.

Bio-fertilizers

In this study biofertilizer PGPR was used. Biofertilizer was also taken from Indian Agriculture Research Institute (IARI) Pusa; 200 g of jaggary was dissolved in 500 ml of warm water. The syrup was allowed to cool down to room temperature and 100g pack of PGPR was added to make a thick paste except control. The seeds were well smeared with this inoculum and were spread on blotting paper in shade to get rid of extra moisture before sowing. In each plot, seeds were sown in rows. Row to row distance was kept 30 cm and plant to plant distance was kept 15 cm. There were ten rows in each plot and ten plants in each row.

RESULT AND DISCUSSION

From the economic data it is clear that during both year of experiment the crop was found to be effective in term of net-income (Figure 1a & b). From the table (1) it is clear that net income of the farmers increased during the year 2008-09 in comparison to year 2007-08. The treatment comprising PGPR + S + Mn gave highest net income (7768 Rs. in 2008-09 & 7498 Rs. in 2007-08) than any other treatment. The treatment containing PGPR + S + Mo + Mn also gave better income (7533 Rs. in 2008-09 & 7323 Rs. in 2007-08) over any other treatment except PGPR + S + Mn. The treatments having PGPR + S also give fruitful result in term of net income (7233 Rs. in 2008-09 & 7113 Rs. in 2007-08), it is effective over any other treatment except PGPR + S + Mn and PGPR + S + Mo + Mn. Economic viability of any treatment that enhanced the grain yield is a very important factor and the cost of production may affect the net gain to the farmers. In our experiment it was observed that the PGPR along with sulphur and micronutrients under study have enhance the grain yield to its maximum which was significantly higher than any other treatment and control, but was not viable in term of net income (Table 20). For the poor farmer the treatment along with PGPR was most economical. The addition of the any of the micronutrient had escalated the cost of production especially the application of Zn had escalated the cost of production as the result of higher market price and hence low economical yield. The use of PGPR along with S and Mn was the most economical treatment with higher net return followed by PGPR + S + Mo + Mn > PGPR + S, where as the treatment PGPR + Zn + Mn, PGPR + Zn + Mo and PGPR + Zn + Mn + Mo were not at all found economical because the net income was less than the control.

Table: Economic data of lentil to show Role of plant growth promoting rhizobacteria (PGPR), Sulphur and micronutrients.

Treatments	Economic Data					
	2007-08			2008-09		
	Gross income	Cost of cultivation	Net income	Gross income	Cost of cultivation	Net income
Control	21,435	17,377	4,058	22,335	17,377	4,958
PGPR	22,290	17,427	4,863	22,785	17,427	5,358
PGPR + Mn + Mo	22,680	18,582	4,098	23,535	18,582	4,953
PGPR + Zn + Mn	23,460	19,972	3,488	23,850	19,972	3,878
PGPR + Zn + Mo	24,015	20,517	3,498	24,285	20,517	3,768
PGPR+ Mn + Zn + Mo	24,390	20,822	3,568	24,615	20,822	3,793
PGPR + S	24,690	17,577	7,113	24,810	17,577	7,233
PGPR + S + Mo	25,020	18,427	6,593	25,230	18,427	6,803
PGPR + S + Mn	25,380	17,882	7,498	25,650	17,882	7,768
PGPR + S + Zn	25,770	19,817	5,953	25,965	19,817	6,148
PGPR +S + Mo + Mn	26,055	18,732	7,323	26,265	18,732	7,533

PGPR + S + Zn + Mn	26,265	20,122	6,143	26,400	20,122	6,278
PGPR + S + Mo + Zn	26,550	20,467	6,083	26,835	20,467	6,368
PGPR + S + Mo + Mn + Zn	27060	20,772	6,288	27,270	20,772	6,498

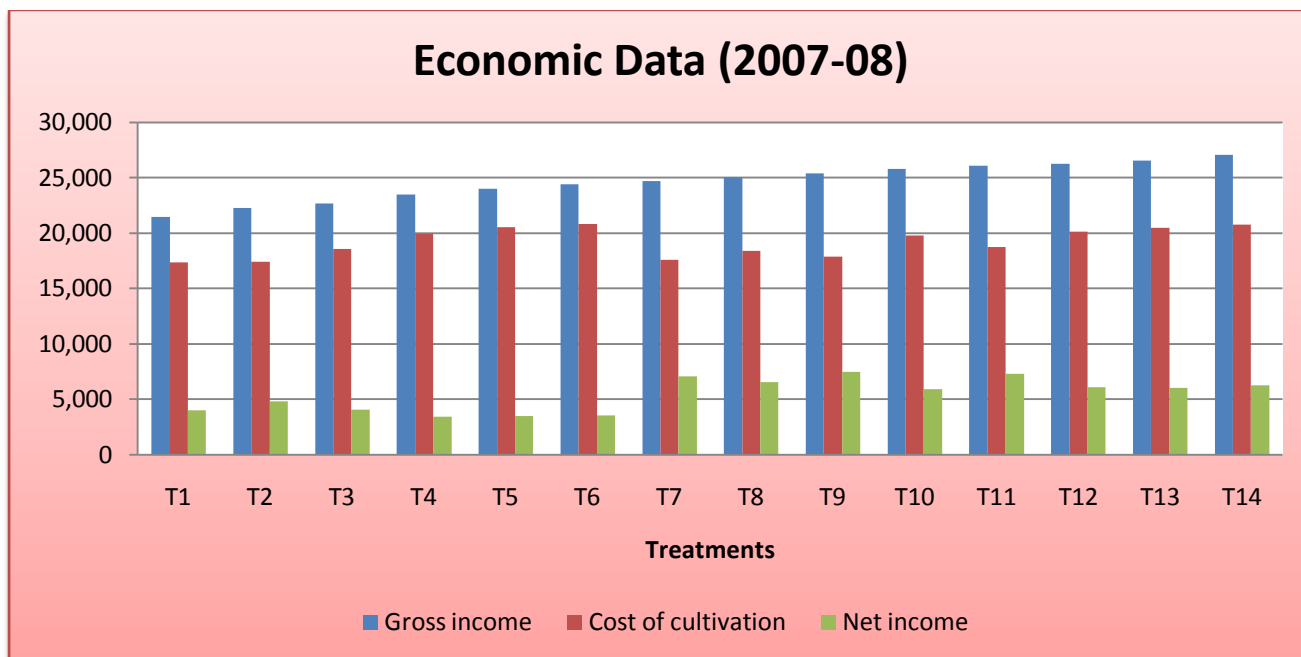


Figure 1a- Economic value of lentil during 2007-08

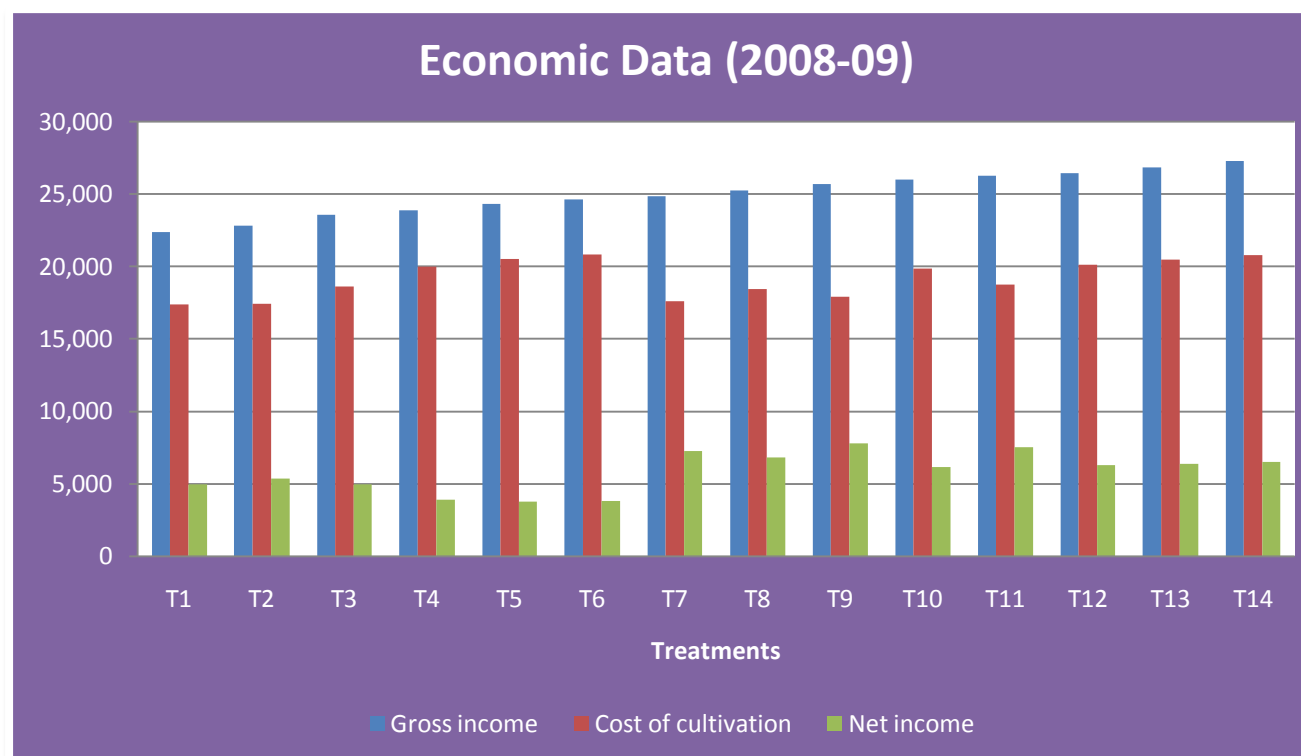


Figure 1b- Economic value of lentil during 2008-09

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