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# Bio Inoculation of Pulse Crops for Improving Productivity

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In India, pulses have been cultivated for ages and served as an essential part of diet owing to its nutritional quality especially in terms of protein content. Due to its ready availability and lower cost, pulses are employed for several applications in traditional as well as modern diet.Pulses provide fibre as well as a significant source of vitamins and minerals, like iron, zinc, folate, and magnesium, and consuming half a cup of beans or peas per day can enhance diet quality.Pulse production faces a number of constraints and challenges, including food security, natural resource management and a lack of technology assessment to maximise cropyield potential, improve farm profitability, reduce negative environmental impact, improve soil health and increase food self-sufficiency. Farmers are mostly focused on cereal production which leads to negligence for pulses. They are generally grown in the marginal areas without much care and on the residual moisture and nutrient. So, it is crucial to look for sustainable approaches to increase productivity of pulses. One such practice is the use of bioinoculants which can improve plant growth, soil health, and crop yields. They can be used to reduce the dependency on chemical fertilizers for the nutrient requirements of the crop. Bioinoculants are agricultural amendments that use beneficial rhizospheric or endophytic microbes to promote plant health.

**Key words**: Constraints, Bio fertilizers, Rhizobium, micronutrient

## Introduction

Pulses are an important source of nutrition for billions of people around the world. The terms pulses and legumes are interchangeable because all pulses are considered legumes but not all legumes are considered pulses. Pulses are the edible seed from a legume plant that is mainly used as dal purpose while legumes are plants from the family Fabaceae that includes its pods, stems, and leaves. Legumes as a source of human food are probably as old as civilization and agriculture. Over the years, legumes consumption has evolved in conjunction with cereals. With some 18,000 species, they are the third largest family of higher plants on the earth. The grain and forage legumes are grown in about 12-15 %of earths' arable land surface. The grain legumes alone contribute to about 33% of the dietary protein nitrogen needs of human being. Currently 65 % of protein is obtained directly from plants and the rest 30 per cent through animal production. Compared to meat, plant protein is much more economical to produce, store and transport (Singh and Mohanty, 2015). Pulses are high in fibre, gluten free, low fat and contain mainly the unsaturated fatty acids. They are filled with minerals likemagnesium, potassium, calcium, iron, and essential trace elements like copper, manganese, selenium, zinc and molybdenum. The National Institute of Nutrition (2011) recommends a daily intake of 80 g of pulse per day while the Indian Council of Medical Research (ICMR) recommends atleast 40 g of pulses per day.

Image Source

## Constraints in Pulse Production

Mainly there are 3 types of constraints Argo-ecological, Socio economical and Biological.

**1. Agroecological**: Nearly 90 per cent area under pulses is rainfed. Mostly uplands and medium lands are used for pulse cultivation and they are generally marginal and sub-marginal in nature. Uneven distribution of rainfall associated with high temperature leads to moisture stress, limits the crop growth and encourages flower drop which ultimately lowers the yield. Generally, the rice fallows areas are majorly used for pulse production thatsuffers deterioration of soil structure following puddling, poor organic matter content, with low residual fertility and poor water holding capacity leading to poor crop growth and yield.

**2. Social**: Lack of awareness about the use of package of practices (POPs) for increasing pulse productivity. Non-availability of desired agro-inputs in time such as quality seeds, lime, biofertilizers, pesticides etc. Seed replacement rate is < 3 % against the desired yearly rate of 10-15 %. Usually, farmers are more concentrated upon cereals based cropping system so they don't take much care of pulses and are grown under residual moisture and nutrient conditions.

**3. Biological**: Lack of high yielding varieties for different agroecological zones. The local varieties are of long duration, indeterminate growth habit with shattering non-synchronous maturity, low harvest index. Pulses being high protein sources, are susceptible to store grain pests incurring about 60% storage losses. The varieties being used are found to be unresponsive towards high inputs application of fertilisers and irrigation. Poor rhizobial population in soil leading to poor nodulation in available cultivars.Lack of availability of quality Rhizobium and phosphorus solubilizing micro-organisms (PSM) preparations for inoculation.Acid soils limit rhizobial growth and activity which adversely affects the crop root growth.In acid soils the availability of P, Ca, Mg, Mo and Si become limited, on the contrary, the concentration of H, Al, Fe and Mn predominates and restrict the available nutrients and ultimately crop growth and yield (Pattanayak and Sarkar, 2016).

## Strategies to Increase Pulse Productivity

Supplementation of nutrient through microbial technologies has a great potential for augmenting nutrient resources and bridging the gap between nutrients removed in the produce and that added through chemical fertilizers in Indian agriculture. Additionally, they help to overcome the hazards of conventional inorganic synthetic fertilizers and thereby reduce environmental pollution.

"Biofertilizers" are living or latent cells of efficient strains of beneficial microorganisms capable of fixing atmospheric N (*Rhizobium*, *Azolla*, BGA, *Azotobacter* and *Azospirillum*), solubilizing insoluble P. (*Pseudomonas*, *Bacillus*) mobilizing nutrients (*Mycorrhizae*) and decomposing organicmaterials (*Trichoderma*). They promote plant growth by secreting growth hormones (IAA, gibberlic acid, cytokinin etc.) to regulate seed germination, root growth (length, density and volume), influencing root cation exchange capacity, CEC improve nutrient use efficiencies flowering, pollen viability. Micro-organisms produce ammonia, HCN, siderophore, organic acids which chelate the toxic elements like Al, Fe and Mn in acid soils and improve availability of P. Ca and Mg.

The *Rhizobium* strains can be used as seed inoculant @ 1.0-1.5 kg per 25 kg of seed (inoculants have population level of $10^8$ CFU/g inoculum). It can be used after seed treatment with chemicals (Bavistin), followed by sodium molybdate @ 10 g per 25 kg seed dried under shade and sown during afternoon hours. The PSM can be used @ 4 kg/ha mixed with FYM and applied on the day of sowing of seeds.

Image Source

Generally acid soils are deficient in Mo, the most important micronutrient required for N fixation as it is a component of nitrogenase enzyme. Its supplementation with cobalt (component of vitamin

$B_{12}$ required for leghaemoglobin is very much essential for maintaining reducing environment at the site of N fixation inside nodules) which ultimately boosts productivity of pulses.

Application of 10 g sodium molybdate and 1 g cobalt chloride, to 25 kg seeds of green gram along with *Rhizobium* inoculation of seeds can improve nodulation and N content in nodules significantly and increases the seed yield.

The acid soils in problematic areas (coastal acid saline soils, hilly, laterite soils) can also be ameliorated with acid soil ameliorants like paper mill sludge applied @ 0.2 LR mixed with FYM or vermicompost, placed below the seed zone on the day of sowing of pulse seeds.

## Conclusion

The pulse crops are generally cultivated in coarse textured acidic soils with low organic C and low available N, P, K, and S. So, to increase production soil test-based fertilizers (100% NPK, FYM @ 2t/ha, seed inoculation with *Rhizobium* and liming the acid soil (@0.2LR) is essential. The positive impacts of Integrated Nutrient Management (INM) practices can be reflected on nodular N content, extra N gain, recovery of nutrients by the crop and overall economics of the practice. Integrated package of practices not only boosts the yield but also helps to maintain sustainability.

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