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Rhizobium Inoculation and Productivity of Pulses

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Pulses are one of the essential sources of protein and helps in maintaining food security. It also helps in biological nitrogen fixation. But due to decrease in soil fertility and soil nutrient availability the production of pulses is decreasing. Now a day the inoculation of rhizobium helps in enhancement of nodulation, nitrogen fixation, plant growth and yield of pulse crops. It is also an environment friendly and cost-effective approach. It increases soil fertility and reduces dependency on chemical fertilizers. This article focuses on importance of rhizobium inoculation along with their mechanism, benefits and impact on pulse productivity and sustainable agriculture.

Keywords: Rhizobium inoculation, Nodulation, Pulse productivity, biological nitrogen fixation, Soil fertility

Introduction

Pulses are mainly cultivated in India and world due to its nutritional and economic value. Major pulses are green gram, black gram, chick pea, pigeon pea, lentil, french bean etc. They provide protein, vitamins, minerals and dietry fiber. They use as food, improve fertility of soil by fixation of nitrogen through symbiotic association with Rhizobium bacteria present in root nodules. Nitrogen is one of the important nutrients for crop growth as it helps in increasing vegetation. Farmers generally apply nitrogen through chemicals, but excessive use of this leads to environment pollution and increase in cost. So, inoculation of rhizobium helps in supplying nitrogen to plant by forming nodules on roots of leguminous plants. This increase plant growth, yield of crop and soil health by a sustainable way. Now a days this has gained importance as it is ecofriendly, economical and beneficial for long term soil productivity. Several studies show the positive effect of inoculation of rhizobium on pulse yield, nodulation, uptake of nutrient, and stress tolerance.

Role of rhizobium in pulse crops

Rhizobium forms a symbiotic association with roots of pulse crops where they help in biological nitrogen fixation. They help in converting atmospheric nitrogen into ammonia which leads to reduction in use of chemical fertilizers. Here first bacteria infect the root hairs of pulse crops and then enter to root tissues and stimulate the formation of root nodules. Inside the nodules with the help of enzyme nitrogenase, rhizobium multiplies and converts atmospheric nitrogen (N_2) into ammonia. This fixed nitrogen helps in growth and development of pulse crops. In this process an important component is present called leghaemoglobin, which is a pink coloured pigment present inside the root nodules. They operate the supply of oxygen in nodule as nitrogenase is highly sensitive to oxygen. Healthy pink nodule represents active nitrogen fixation and effective rhizobium activity. Rhizobium enhances soil fertility, increase crop yield and improve protein content in pulses.

Advantage of rhizobium inoculation

1. Increase in nitrogen fixation: Inoculation of rhizobium enhances biological nitrogen fixation in pulses and reduce requirement of chemical nitrogen fertilizers. Research show that inoculated plant shows greater nitrogen accumulation in plant tissues and soil.

2. Increase in nodulation: Rhizobium increases the number and size of nodules in pulse crops which leads to increase in nodulation and improve nitrogen supply throughout crop growth stages.

3. Increase in plant growth: It increases germination of seed, root development, increase nitrogen availability which promotes chlorophyll formation and photosynthesis leads to increase in growth of the plant. Inoculated plant produces taller plants, more branches and more dry matter accumulation in pulse crop like black gram.

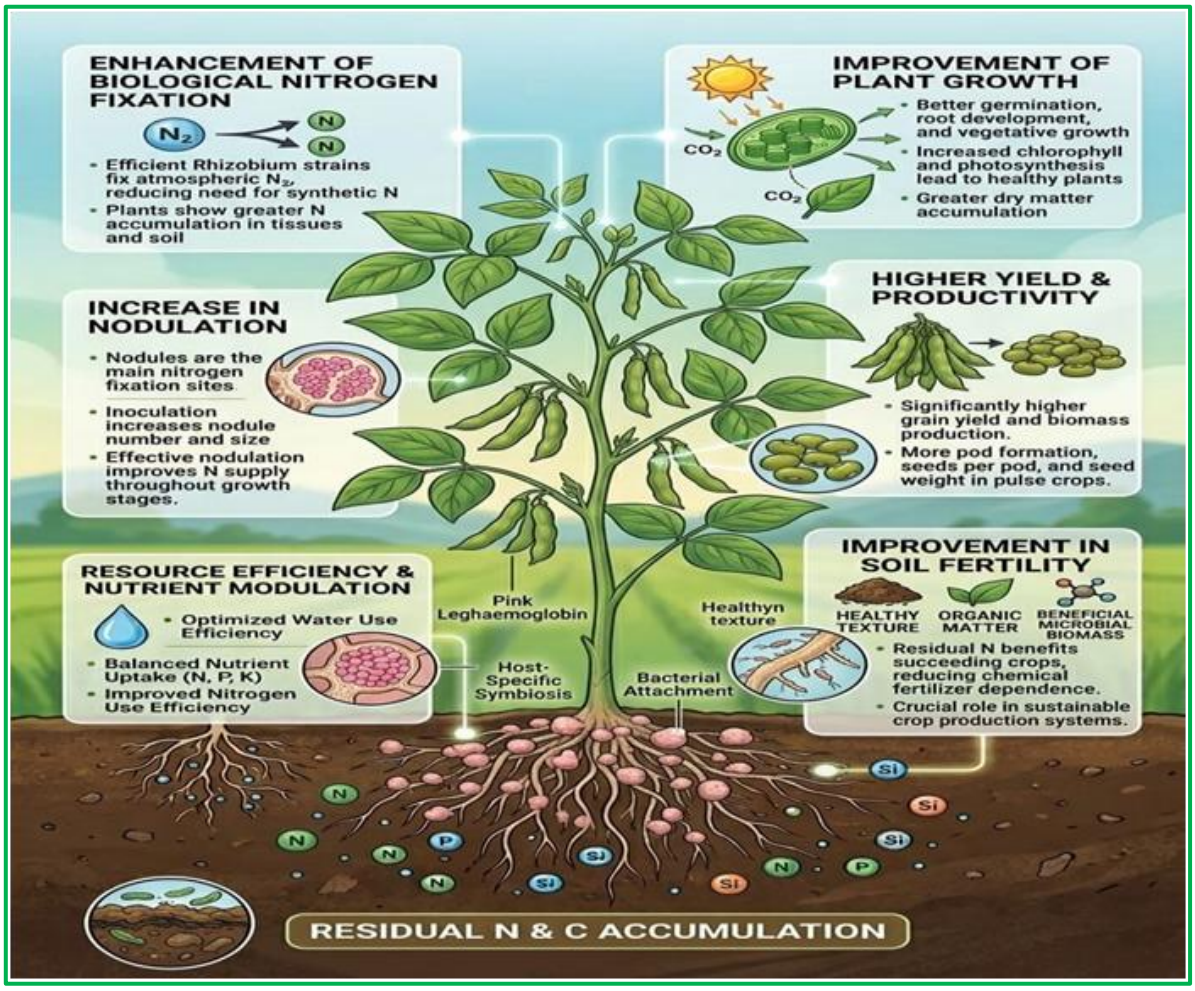
4. Improvement in soil health and fertility: Inoculation of rhizobium enhances accumulation of nitrogen and organic matter which improves soil fertility. The residual nitrogen also benefits succeeding crops and reduce requirement of chemical fertilizers.

5. Increase in yield and productivity: There is increase in grain yield and biomass production after inoculation of rhizobium. There increase in seed number, number of pod formation and seed weight which leads to higher yield in pulse crop like black gram, green gram and French bean.

6. Reduction in use of chemical fertilizers: Biological nitrogen fixation reduces use of chemical fertilizers specially nitrogen and reduces the cost of production and minimizes environment pollution.

7. Environment friendly approach: Rhizobium inoculation is easily degradable in soil and they do not pollute soil or water resources.

8. Better cropping systems: The residual nitrogen left after pulse cultivation helps in subsequent cereal crop in rotation system and improve overall farm productivity.



Impact of rhizobium inoculation on plant and soil

Method of inoculation of rhizobium

1. Seed inoculation: In this method seed is coated with rhizobium culture before sowing. A 10% jaggery solution is prepared by dissolving jaggery in water and then rhizobium culture is mixed with cooled solution to form a slurry. The prepared slurry is poured over the seeds and mixed thoroughly so that all seeds are uniformly coated. Then the seed are dried under shade for 20 to 30 minutes and treated seeds are immediately sown in the field. It is most economical and effective method.

2. Soil application: Here rhizobium culture is mixed with fine soil or compost and then spread uniformly in the field before sowing. It is done where a large quantity of inoculant is required.

3. Seedling root dip method: Here roots of seedlings are dipped in rhizobium suspension for a few minutes before transplanting. It is used in transplanted leguminous crops.

4. Furrow application: Here rhizobium inoculant is applied directly into seed furrows at the time of sowing. Seeds are placed over the treated furrow and covered with soil. It ensures closed contact between rhizobium bacteria and roots of plants.

Challenges in inoculation of rhizobium

1. Environmental factors such as drought and unfavourable soil condition like soil acidity, salinity reduce the activity of bacteria.
2. Ineffective or poor-quality strains of rhizobium leads to poor nodulation and decrease nitrogen fixation.
3. The productivity of rhizobium is adversely affected by salinity stress.
4. Improper storage and handlings of inoculants decrease viability and effectiveness before application.
5. Under saline and rainfed condition crop productivity is limited due to lack of efficient stress tolerant strains of rhizobium.
6. Lack of awareness among farmers and improper application methods reduce adoption of rhizobium.

Future prospects

Recent advances in science and biotechnology helps in improving rhizobium inoculation technology. Development of efficient and stress tolerant rhizobium inoculants can increase pulse production under salinity and adverse condition. Integrated application of balanced nitrogen and rhizobium inoculation can enhance nodulation, soil fertility and crop yield. Development of rhizobium strains adapted to local climate increase production of pulses. Improved storage methods and biofertilizer production technology improve inoculant quality and shelf life. At the end increasing awareness among farmers can leads to wider adoption of sustainable pulse production practices.

Conclusion

Inoculation of rhizobium is an effective and sustainable method for improving pulse productivity and restoring soil health. It enhances nitrogen fixation, nodulation, uptake of nutrient and plant growth. It increases yield of pulses and reduces dependency on chemical fertilizers. It is an ecofriendly and economical way to improve soil health and maintain sustainable agriculture. Selection of efficient strains of rhizobium, efficient inoculation methods and integration with balanced nutrient management can enhance pulse productivity and soil health. Therefore, wider adoption of rhizobium inoculation technology helps in sustainable pulse production and agriculture development.

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