

**Effect of dual inoculation of *Rhizobium leguminosarum* biovar
phaseoli and *Piriformospora indica* Verma et al. on *Phaseolus
vulgaris* grown in the soil treated with vermicompost**

A

Dissertation

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Master of Science in Microbiology (Environment and Public Health)**

By

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RECOMMENDATION

This is to certify that Ms. Jeny Shrestha has completed this dissertation work entitled “**Effect of dual inoculation of *Rhizobium leguminosarum* biovar *phaseoli* and *Piriformospora indica* on *Phaseolus vulgaris* Verma et al. grown in the soil treated with vermicompost**” as a partial fulfillment of M. Sc. Degree in Microbiology under our supervision. To our knowledge this thesis work has not been submitted for any other degree.

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ABSTRACT

A pot culture experiment was conducted to study the effect of dual inoculation of *Rhizobium leguminosarum* biovar *phaseoli* and *Piriformospora indica* on the growth of *Phaseolus vulgaris* L. grown in soil treated with vermicompost. French bean (*Phaseolus vulgaris* L.) were grown with and without vermicompost, inoculated, or uninoculated with *R. l* biovar *phaseoli* and *P. indica* singly or in combination using sterile soil. Treatment effects on plant growth, percent root colonization, and nutrient uptake of plants were evaluated.

In the flowering stage, dual inoculated plants with or without vermicompost showed the best nodulation compared to other treatments. Rhizobial inoculation positively influenced nodulation of plants. Dual inoculation with *Rhizobium* and *P. indica* significantly increased shoot length, root length, shoot fresh weight, and root fresh weight as compared to rest of the treatment. Dual inoculated plants with *Rhizobium* and *P. indica* increased the shoot length by 26.58%, root length by 46.26%, shoot fresh weight by 62.58%, shoot dry weight by 44.21%, root fresh weight by 112.50%, and root dry weight by 86.67% respectively over the control plant. However, the results were not statistically significant for shoot and root dry weight, although all the treatments showed greater shoot and root dry weight than the control plants.

In harvesting stage, shoot length, root length, shoot weight, root weight, pod number, pod fresh weight and dry weight were more pronounced in dual inoculated plants with vermicompost compared to other treatments. Dual inoculated plants with *Rhizobium* and *P. indica* along with vermicompost increased the shoot length by 21.97%, root length by 61.74%, shoot fresh weight by 54.32%, shoot dry weight by 83.92%, root fresh weight by 152.94%, root dry weight by 147.61%, pod number by 107.33%, pod fresh weight by 84.08% and pod dry weight by 160% respectively over the control plants. Shoot and root NPK uptake were significantly higher in dual inoculated plants with vermicompost compared to rest of the treatment. The percentage increased in shoot and root nitrogen, shoot and root phosphorous and shoot and root potassium in dual inoculated plants along with vermicompost were 78.85%, 156.75%, 72.72%, 105.26%, 51.71%, and 66.15% respectively over the control plants. Percent root colonization by *P. indica* was significantly higher in dual inoculated plants with or without vermicompost. Control and the plants without *P. indica* inoculation were devoid of any root colonization. Percent root colonization by *P. indica* was found to be increased in fruiting stage than in flowering stage.

In general, dual inoculation showed better results than single inoculation and better positive effects of dual inoculation were observed in plants grown in vermicompost treated soil than vermicompost non-treated soil suggesting higher dependency of vermicompost on these symbionts for better growth and development.

Key words: dual inoculation, percent root colonization, *P.indica*, *Rhizobium*

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LIST OF ABBREVIATIONS

| | |
|--------|--|
| ANOVA | ANalysis Of Variance |
| AMF | Arbuscular Mycorrhizal Fungi |
| ATP | Adenosine Tri Phosphate |
| BNF | Biological Nitrogen Fixation |
| cm | Centimetre |
| C: N | Carbon:Nitrogen |
| DNA | Deoxy Nucleic Acid |
| ECM | Ectomycorrhizae |
| ER | Endoplasmic Reticulum |
| G+C | Guanine + Cytosine |
| gm | Gram |
| Ha | Hectare |
| IAA | Indole Acetic Acid |
| kg | Kilogram |
| MMN | Modified Melin Norkran |
| MS | Murashige- Skoog |
| N | Nitrogen |
| NPK | Nitrogen Phosphorous Potassium |
| P | Phosphorous |
| ppm | Parts per million |
| PDA | Potato Dextrose Agar |
| rRNA | ribosomal Ribonucleic acid |
| rDNA | ribosomal Deoxyribo Nucleic Acid |
| RONAST | Royal Nepal Academy of Science and Techology |
| SPSS | Statistical Package for the Social Sciences |
| um | Micro meter |
| UV | Ultra Violet |
| WPM | Woody Plant Medium |
| YM | Yeast Mannitol |

| | |
|----------|---------------------------------------|
| YEMA | Yeast Mannitol Agar |
| YEMA-BTB | Yeast Mannitol Agar- Bromothymal blue |
| YEMA-CR | Yeast Mannitol Agar- Congo Red |

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