

Original Research Article

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Effect of Inoculation of Microbial Consortia on Growth Parameters of Green Gram (*Vigna radiata* L.)

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ABSTRACT

A field experiment was conducted to study the effect of inoculation of microbial consortia on growth parameters of green gram. The beneficial microbial strains were collected from the department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad. These strains were tested for their compatibility and prepared three different microbial consortia such as rhizosphere consortia-1, rhizosphere consortia-2 and phyllosphere consortia. Each consortium was treated to green gram by seed treatment, soil application and foliar spray along with graded levels of chemical fertilizers and plant growth parameters were recorded at different intervals of time. The treatment inoculated with microbial consortia showed significantly higher soil enzyme activities as compared to the uninoculated treatment. The treatment with 50 percent recommended dose of chemical fertilizers along with microbial consortia can reduce the cost of inputs and significantly enhanced the plant height, number of leaves, branches, number of nodules, nodules weight and chlorophyll content of green gram.

Keywords

Gluconoacetobacter,
Rhizosphere and
colonize, Microbes

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Introduction

The resurgence of the interest in use of biofertilizers has developed due to increase in cost of production and hazardous nature of chemical fertilizers for environmental sustainability, lower cost of production and good crop yield (Egamberdiyera, 2007). The first step happens to be the successful

application of the selected beneficial microorganisms to seed in a commercial way in order to improve the soil health and crop growth.

The inoculated microorganisms must be remain viable in rhizosphere and colonize the roots to improve plant growth and suppress the diseases. The microbes when applied to

seeds established in rhizosphere, as they get transferred on to the developing roots as they emerge from the seed (Harman, 1991).

In soil, microorganisms live together in groups and provide beneficial effects to plants. Further, when microorganisms added to rhizosphere soil, they interact with host plant and alter the soil conditions. The positive interaction of small microbial community takes an important role in enhancing the soil nutrient status and thus helps in growth, nutrient uptake, soil enzymatic activities and yield of different crops.

The microbial consortium concept has been developed using compatible microorganisms which gives synergistic effect without affecting the growth of other beneficial microorganisms. In the microbial consortia, the compatible microbes will have positive effect on other microbe and no harm effect occurs when co-cultured (Jain *et al.*, 2012) and the microbial consortium enhance plant growth, nutrient uptake and biomass of crop (Akhtar and Siddiqui, 2008).

The United Nations has declared 2016 as International Year of Pulses (IYP) in year 2013 and also in our country, pulses play a major role in vegetarian diet for their source of dietary protein. Apart from this dietary value, they also maintain soil fertility and productivity through BNF (biological nitrogen fixation) and takes major role in sustainable agriculture. Green gram (*Vigna radiata* L.) is an important pulse crop among all pulse crops which is native to India and Central Asia and grown since ancient period. It is now grown in almost all parts of the country and which is popularly known as “Moong dal”.

Materials and Methods

An experiment was conducted by collecting the microbial cultures of N₂- fixing, P

solubilizing, potassium solubilizing, Zn solubilizing and silicon solubilizing bacteria, PGPR and lactic acid bacteria from the Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad. After testing the compatibility, different consortia were prepared and evaluated for enzymatic activities in green gram rhizosphere soil under field condition of MULLaRP Scheme (Plot number: F-143), MARS, University of Agricultural Sciences, Dharwad.

Preparation of the microbial consortium

Based on the functional traits of the microbial strains used, all three microbial consortia were prepared which included two rhizosphere consortia and one phyllosphere consortium. The organisms included in different consortia are given below.

By using all these compatible individual cultures, consortia were prepared by mixing them in equal proportion (liquid formulation; Jayashree and Jagadeesh, 2017).

Rhizosphere consortium 1

Gluconoacetobacter sp., PSB (*Pseudomonas striata*), KSB (KSB-27), ZnSB, JK-16, PPFM-33, LAB-75.

Rhizosphere consortium 2

Azospirillum sp. (ACD-15), PSB (*Pseudomonas striata*), KSB (KSB-27), ZnSB, SiSB, JK-16, PPFM-33, LAB-75.

Phyllosphere consortium

Actinomycetes strains (AUDT-502, AUDT-248, A34, PSA-5, PSA-7, UPM-3), pink pigmented facultative methylotrophs (PPFM-33, PPFM-58), lactic acid bacteria (*Leuconostoc mesenteroides* LAB 82, LAB LS-36).

Method of application of consortia

Rhizosphere consortium

Seed treatment @ 4 ml of rhizosphere consortium kg⁻¹ seed.

Soil application @ 2.5 l acre⁻¹ after mixing with 250 kg vermicompost and applied to root zone.

Phyllosphere consortium

Spraying of phyllosphere consortium was done @ 4% at 30 DAS and 45 DAS.

Treatment details

T₁ = POP (package of practices)

T₂ = POP + inoculation with rhizosphere consortium 1 alone

T₃ = POP + inoculation with rhizosphere consortium 2 alone

T₄ = POP + inoculation with phyllosphere consortium alone.

T₅ = POP + inoculation with rhizosphere consortium 1 + phyllosphere consortium

T₆ = POP + inoculation with rhizosphere consortium 2 + phyllosphere consortium

T₇ = 50 % NPS

T₈ = 50 % NPS + inoculation with rhizosphere consortium 1 + phyllosphere consortium

T₉ = 50 % NPS + inoculation with rhizosphere consortium 2 + phyllosphere consortium

Green gram seeds of variety DGGV-2 were treated with *Rhizobium* strain (GGR-10) biofertilizer and sown with optimized spacing.

The application of recommended dose of chemical fertilizers and protection measures were taken up as per package of practices. Growth parameters like plant height, number of leaves, branches, nodules, chlorophyll content, nodules weight and dry matter production were measured.

Results and Discussion

In general, obtained results showed that the growth parameters of green gram were significantly enhanced because of application of microbial consortia when compared to treatment with no application of microbial consortia.

The stimulatory effect of microbes in consortia on growth of green gram could be attributed to the N₂ fixation ability, growth promoting hormones, P-solubilizing and K-solubilizing capacity of the strains used in the consortia. These results are in accordance other scientists who also obtained plant growth promotion which was mainly attributed to the N₂ fixation, P solubilization and phytohormone production by the strains they used (Karlidag *et al.*, 2007).

In the present experiment, plant height, number of branches and leaves were significantly higher due to the inoculation of three different microbial consortia, which could be account for the contribution of major nutrients, organic matter and carbohydrates in addition to plant growth promoting substances (Thilagavathi, 2007).

The increase in these parameters by cell elongation and multiplication due to enhanced nutrient uptake by plants might have been due to the inculcation of the beneficial microbial consortia. The plant height of green gram was significantly enhanced due to microbial consortia inoculation at graded levels of NPS (Kamlesh and Dubey, 2012) (Table 1).

Table.1 Influence of inoculating microbial consortia on growth parameters of green gram at 60 DAS

| Treatment | Details | Plant height (cm plant ⁻¹) | Number of branches (plant ⁻¹) | Number of leaves (plant ⁻¹) | Number of nodules | Relative chlorophyll content (SPAD value) |
|-----------------|---------------------|---|--|--|----------------------|--|
| T ₁ | POP | 58.28 | 6.55 | 29.33 | 41.58 | 51.29 |
| T ₂ | POP + RC1 | 59.27 | 9.00 | 31.17 | 54.16 | 65.52 |
| T ₃ | POP + RC2 | 57.83 | 8.58 | 25.50 | 52.45 | 61.12 |
| T ₄ | POP + PC | 62.25 | 9.41 | 31.50 | 54.19 | 63.83 |
| T ₅ | POP + RC1 + PC | 67.16 | 11.75 | 37.33 | 70.47 | 70.83 |
| T ₆ | POP + RC2 + PC | 66.83 | 9.67 | 35.58 | 64.86 | 64.01 |
| T ₇ | 50 % NPS | 58.04 | 5.89 | 27.80 | 39.35 | 49.91 |
| T ₈ | 50 % NPS + RC1 + PC | 63.75 | 9.16 | 32.67 | 58.49 | 67.81 |
| T ₉ | 50 % NPS + RC2 + PC | 60.83 | 9.25 | 31.17 | 51.60 | 66.15 |
| S. Em. ± | | 1.64 | 0.58 | 1.92 | 3.92 | 1.58 |
| P = 0.05 | | 4.78 | 1.71 | 5.61 | 11.44 | 4.62 |

Note: POP-Recommended package of practices
RC-Rhizosphere consortia

DAS- Days after sowing
PC- Phyllosphere consortia

NPS- Nitrogen, phosphorous and sulphur

Inoculation of the microbial consortia with half dose of recommended NPS showed higher plant height when compared to treatment with full supply of recommended dose of chemical fertilizer dose only. This result indicates microbial consortia treatment can reduce 50 per cent NPS fertilizers.

The plant height was increased due to application of *Rhizobium*, *Gluconacetobacter*, *Azospirillum* and PSB were found by many scientists. The co-inoculation of more than two organisms viz., N₂ fixers, P solubilizers, Zn solubilizers have been reported by many workers where growth enhancement was due to additive effects of these beneficial microbes (Reddy and Saravanam, 2013 and Dutta and Podile, 2010).

The number of branches and leaves were also increased because of microbial consortia. The treatment treated with microbial consortia along with half the dose of recommended fertilizer resulted higher branches and leaves indicating that consortia could reduce chemical fertilizer dose about half of recommended NPS dose.

The chlorophyll content, nodule number and nodule weight of green gram also enhanced due to application of microbial consortia (Kumar *et al.*, 2016).

The microbial consortium inoculation to plants along with 50 per cent NPS fertilizer application resulted in significantly higher chlorophyll content, nodule number and weight of nodules when compared to plants applied with full dose of NPS.

Considering the non-quantifiable benefits on the environment, treatment T₈ with 50 per cent NPS and application of microbial consortia was better than the treatment with 100 per cent NPS. The cost of chemical fertilizers also reduced by 50 per cent apart from significant

increase in the growth parameters of green gram.

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