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Impact of bio inoculation, NPK and organic manure supplementation on growth and development *of Dalbergia latifolia* in nursery conditions

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Abstract

The present experiment was carried out to evaluate the efficiency of microbial cultures under different treatements on development of Dalbergia latifolia grown under nursery conditions. Seedlings of 30 days old plants were inoculated (thrice with interval of one month) with two fungal cultures (Aspergillus and Penicillium sp.) and two bacterial strains (BA and BT) with and without NPK and organic manure. Data recorded on no. of leaves, branches and shoot height exhibited the growth enhancing effect of fungal inoculation especially Penicillium sp. Plants inoculated with Aspergillus sp. produced more no. branches comparatively. Individual inoculation of Penicillium sp. and Bacterial strain BT has shown increase in shoot height. The Relative growth rate and leaf area ratio revealed the growth enhancing impact of bioinoculatnts supplemented with fertilizer and/or organic manure. Over all, microbial inoculations were found to be useful in enhancing growth of seedlings in nursery conditions. Rising of nursery of plants with such bioinoculants along with supplementation of fertilizer and organic manure will certainly be helpful in establishment of seedlings in field conditions.

Keywords: *Dalbergia latifolia*, *Penicillium*, *Aspergillus*, Bacteria, NPK.

Introduction

Dalbergia latifolia is one of the important tree species and high demanding due to its wood quality and pharmacological properties[1-3]. Several researchers worked on efficiency of microbial inoculants in enhancing plant growth in controlled environmental conditions[4]. Nayak *et al.* reported the effect of microbial inoculations on growth and development of *D. latifolia* and *D. sissoo*[5]. Phosphorus plays a crucial role in nutritional requirement of plant growth. Most of the equatorial region soils are fixing phosphorus; hence free form of P is not available. Role of mineral solubilising microbes are very vital in this regard. To this context, native micro floras play a vital role in formulation of bioinoculants for needed crops and/or transplantation plants species. In this view, an experiment was administered to know the effect of microbial (fungi and bacteria) inoculation with and without supplementation of NPK and organic manure on seedlings of *Dalbergia latifolia* grown in pot culture conditions during 2020-2021.

Materials and methods

The experiment was conducted in 30 days old seedlings of *Dalbergia latifolia* grown through seed sowing in polypots contained red laterite soil. Plants were inoculated trice with 100 ml/pot liquid cultures (7 days old, prepared in SD broth of 5.5 pH at 28±2°C) of *Aspergillus* sp. and *Penicillium* sp., and 50ml/pot bacterial cultures (4 days old, prepared in Nutrient broth of 7.2 pH at 37±2°C). Another experimental set was prepared by using these microbial inoculants along with NPK (20gm/pot) and Organic manure (100g/pot) individually. Final data of 180days old *Dalbergia latifolia* plants were recorded for morphological parameters. Data on NAR (Net Assimilation rate), LAR (Leaf area ratio), RGR (Relative growth rate), Root shoot ratio were also calculated as per the standard protocol[5-8].

Results and discussion

The pot experiment was carried out by inoculating organisms along with NPK and organic manure and different bacterial and fungal strains resulted in different growth patterns of plant as compared to uninoculated control (Figure-1). The application of phosphate solubilising fungi and bacteria were giving better result in root growth as compared to non-supplemented seedlings in nursery grown plants. Effect of *Penicillium* sp. and bacterial strain BA were having highest number of leaves and shoot height. Numbers of leaves measured up to 93.07±26.73 and 77.21±35.08 (Figure-2) and shoot length up to 41.66% and 28.98% (Figure-4) in *Penicillium* sp. and bacterial strain BA respectively as compared to uninoculated control. However, significant difference *Aspergillus* sp. was observed for the number of branches in supplemented plants over control (Figure-3).

Biomass of the 180 days old seedling was taken. RGR, NAR and LAR were calculated. In terms of biomass, combination of

Bacterial strain (BT) + organic manure and *Aspergillus* sp. + organic manure showed higher RGR and measured 30.24d^{-1} and 29.84d^{-1} respectively. However, *Penicillium* sp. + organic manure and *Aspergillus* sp.+ NPK showed higher leaf area ratio i.e 22.36cm^2g^{-1} and 21.83cm^2g^{-1} measured as compared to uninoculated control respectively (Figure-5). Net assimilation rate was quite higher in bacterial strain BT and *Aspergillus* sp. +organic manure recorded 5109.95gm^{-2} d^{-1} and 4370.04gm^{-2} d^{-1} respectively (Figure-6). Co inoculation of bacterial strain BA + Organic Manure and bacterial strain BA+NPK showed highest root-shoot ratio as compared to other treatments and non-supplemented control (Figure-7).

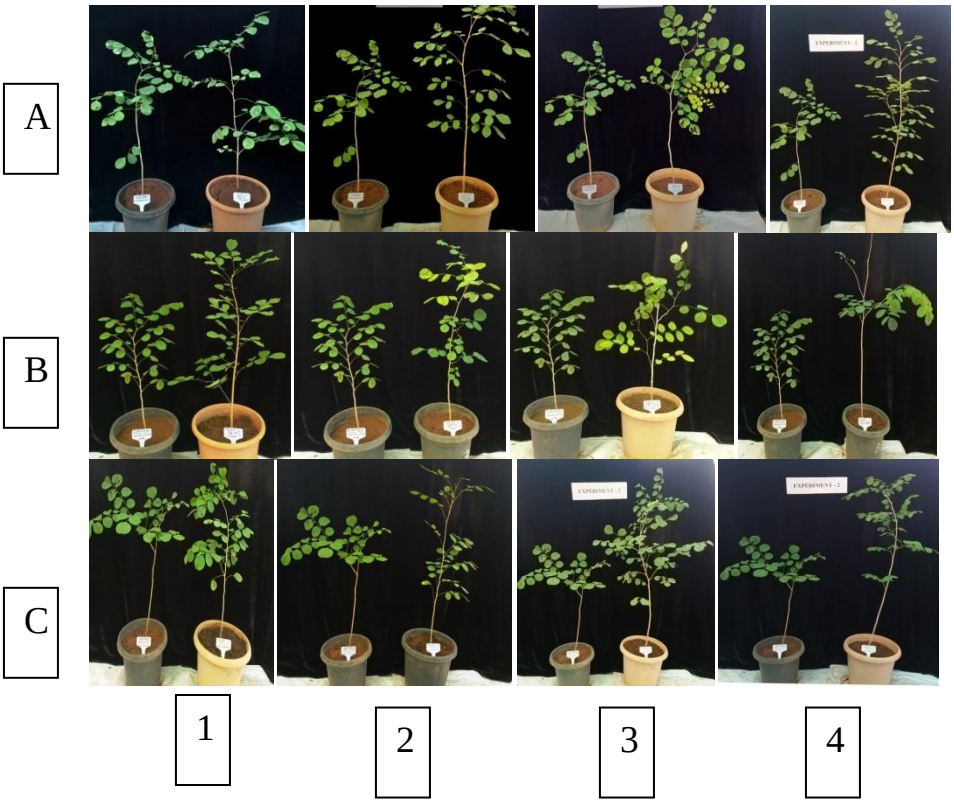


Figure-1: Experiential plants of *Dalbergia latifolia* (180 days old). (A) uninoculated and inoculated, (B) uninoculated + NPK / inoculated + NPK, (C) uninoculated + organic manure / inoculated + organic manure. (1) control / inoculated with Aspergillus sp. (2), control / inoculated with Penicillium sp. (3) control / inoculated with Bacterial strain BA sp. (4) control / inoculated with Bacterial strain BT sp.

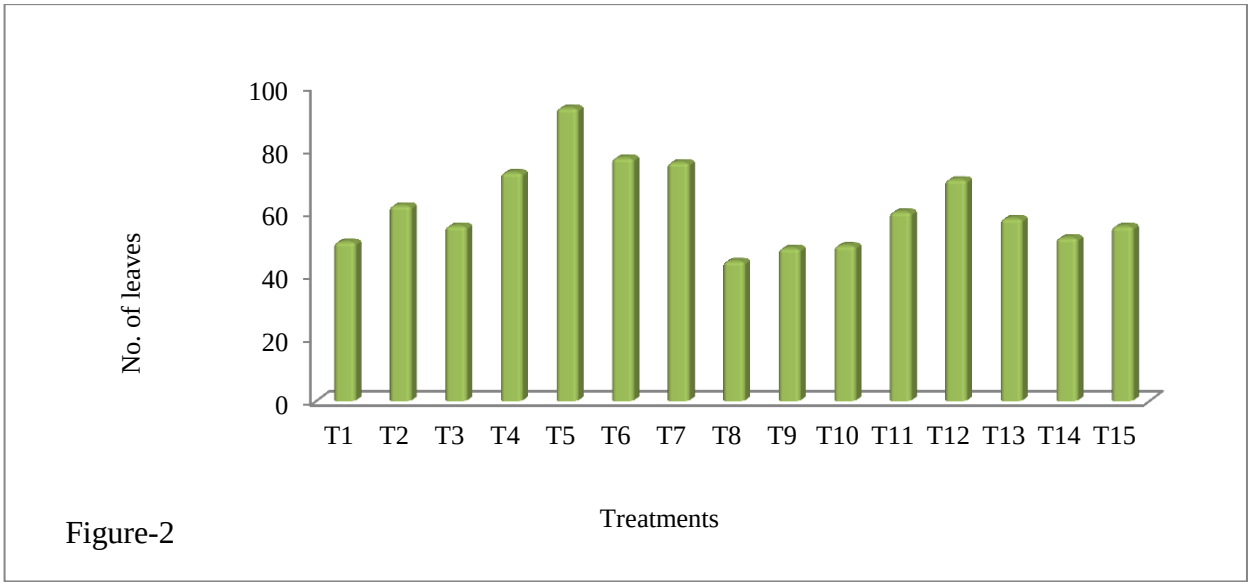
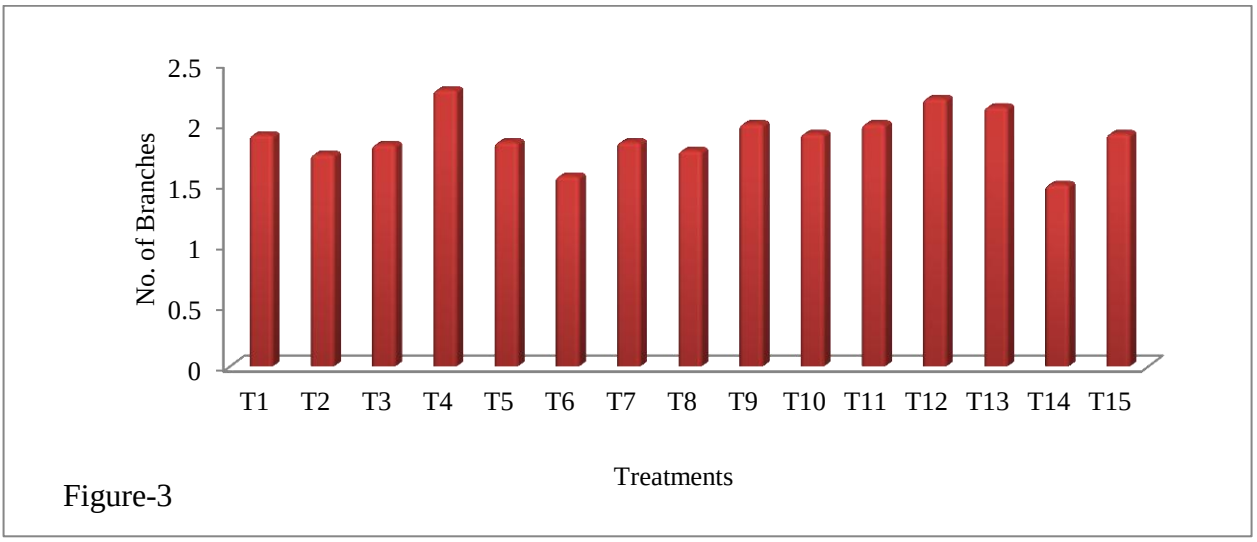


Figure-2



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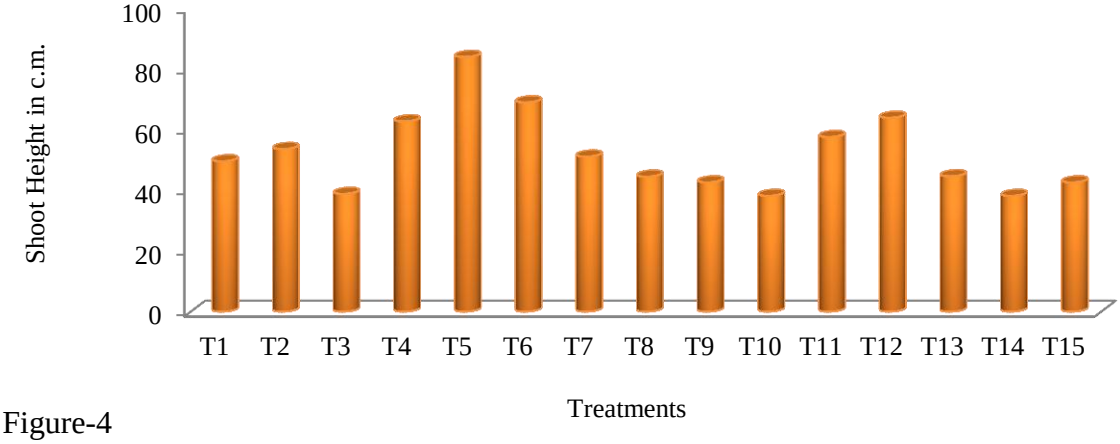

Figure-4

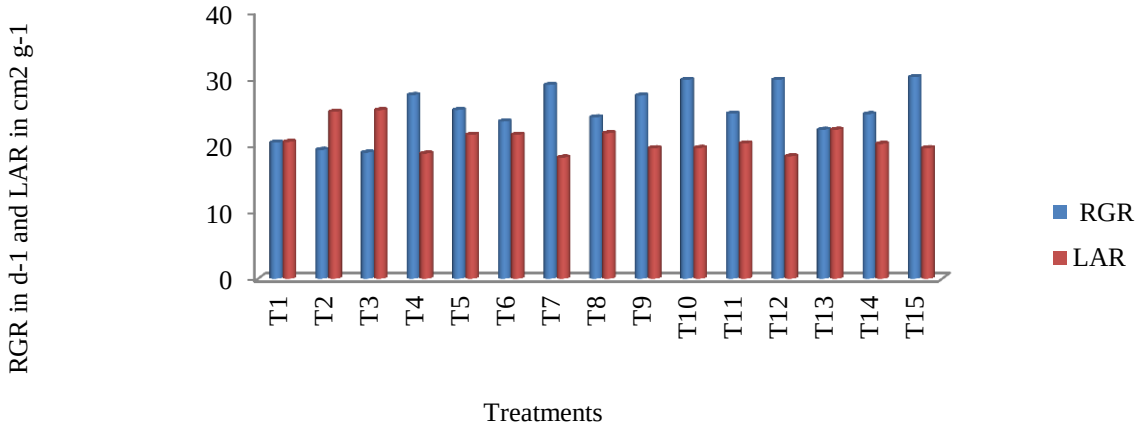

Figure-5

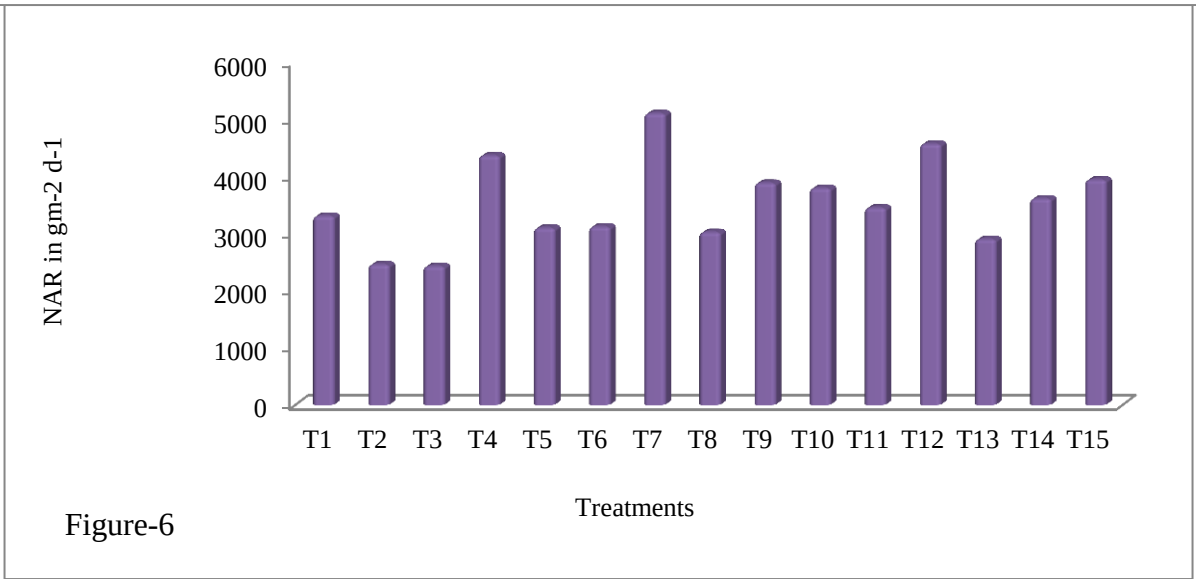

Figure-6

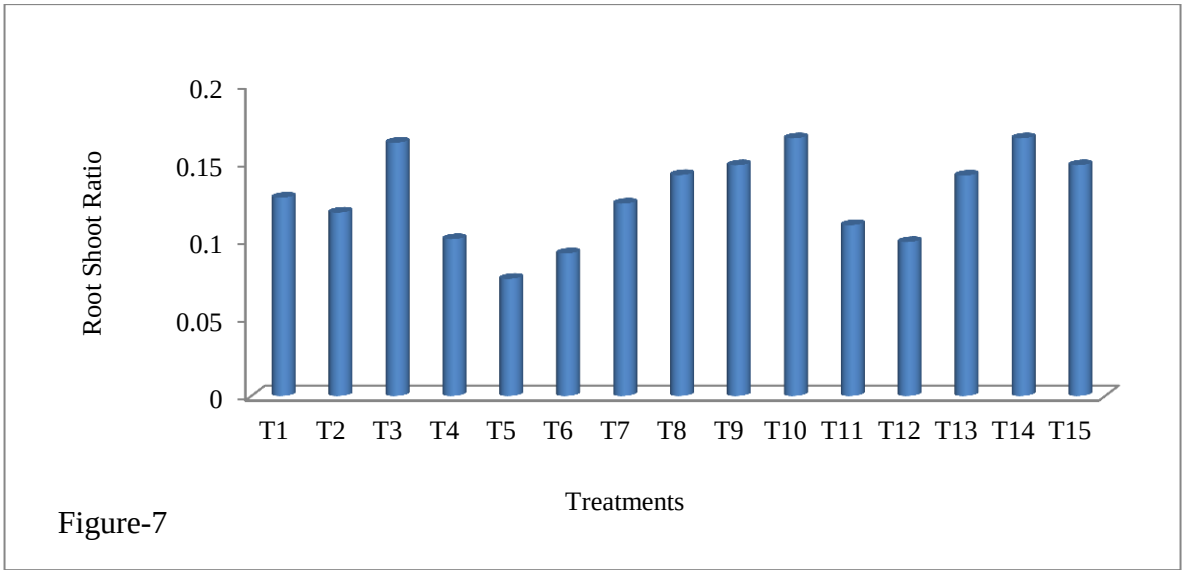

Figure-2-7: Effect of different treatments of bioinoculants, fertilizer and organic manure on growth of *Dalbergia latifolia* grown under nursery conditions. (1) Uninoculated control, (2) Uninoculated + NPK, (3) Uninoculated + Organic manure, (4) treated with Aspergillus sp., (5) Treated with Penicillium sp., (6) treated with bacterial strain BA, (7) Treated with bacterial strain BT, (8) treated with Aspergillus sp.+ NPK (9) Treated with Penicillium sp. + NPK, (10) treated with bacterial strain BA + NPK, (11) Treated with bacterial strain BT + NPK, (12) treated with Aspergillus sp.+ NPK (13) Treated with Penicillium sp. + NPK, (14) treated with bacterial strain BA + NPK, (15) Treated with bacterial strain BT + NPK.

Microbial inoculants are recommended in the form of liquid culture raise healthy seedlings of forest trees like *Eucalyptus tereticornis*, *Ailanthus excels* under nursery conditions[9,10]. In several tree species, inorganic fertilizers were helpful in increasing the height, biomass but they are costly and using in large amount can cause soil pollution.

To this context, the present experimental setup on *Dalbergia latifolia* under nursery conditions along with different treatments has also showed an effective microbial potential for increasing the growth of the plant.
Phosphate solubilising fungi *A. niger*, *A. flavus*, *A. fumigates*, *A. terreus* were reported for their efficiency in solubilising phosphate in host plants[11,12]. Another phosphate solubililizing bacteria *Bacilli* was also reported to have the potential to enhance the growth by providing nutrients to the root of the plant[13]. Several reports available on the efficiency of phosphate solubilizing fungal and bacterial inoculants like *Penicillium chrysogenum*, *Aspergillus sp.* on the growth analysis of *Dalbergia sissoo* in nursery conditions[14]. In 180 days old plant, *Penicillium* sp. was effective for the plant on number of leaves, shoot height followed by bacterial strain BA. *Aspergillus* sp., a fungal inoculant was found to be effective in increasing the number of branches. Without any fertilizer treatment except treatment of bioinoculants having the positive impact on the survival of plants has been reported[15,16] .

In this present study, inorganic fertilizer NPK and organic manure was used along with microbial inoculants. Several studies were reported on the growth of seedlings, soil properties by using chemical fertilizers and organic manure. Chemical fertilizers were measured which affects the pH of the soil. But organic manure did not affect the soil concentration and increases the availability of phosphorus to the soil[17]. Our study exhibited that in 180 days old plants, *Penicillium* sp. +organic manure and *Aspergillus* sp. + NPK was also having high leaf area ratio and *Aspergillus* sp. + organic manure and bacterial strain BT showed high net assimilation rate. These findings indicate that organic manure can be utilized for the growth of *Dalbergia latifolia* plant.

Conclusion

Results of this experiment showed that individual inoculation of *Penicillium* sp. and Bacterial strain BT has shown increase in shoot height and plants inoculated with *Aspergillus* sp. produced more no. branches comparatively. The RGR, LAR and NAR revealed the growth enhancing impact of bioinoculants supplemented with fertilizer and/or organic manure. However, the information obtained from the experimental work is beneficial to improve quality planting material.

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