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# RHIZOBIUM INOCULATION AND NUTRIENT LEVELS ON NODULATION AND SEEDLING GROWTH IN NITROGEN FIXING TREE SPECIES

Improved mineral nutrition during the early stages enhances growth of plants. Association of suitable strains of *Rhizobium* with tree legume trees enhances the establishment, seedling vigour and soil fertility. However, our knowledge on suitable nitrogen fixing tree species and influence of nutrients on legume - *Rhizobium* interaction is inadequate to suggest practical recommendations. The present investigation was undertaken as a preliminary step to study the influence of *Rhizobium* and seedling growth on a few commonly grown leguminous tree species.

The investigation was carried out at the College of Agriculture, Vellayani for one year. Three tree species viz., *Acacia arabica, Acacia catechu* and *Paraserianthes falcataria* were used for the study. Exotic *Rhizobium* isolates of *Acacia* sp. and *Albizia* sp. were used for inoculation. The exotic isolates used for *Acacia* sp. was TAL 1868 and for *Albizia sp.* was TAL-48 obtained from NIFTAL Project, Hawaii (USA).

The experiment was laid out in completely randomised design with two levels of rhizobium (no inoculation and inoculation with rhizobium), three levels of nitrogen (0, 20 and 40 kg $ha^{-1}$) and three levels of phosphorus (0, 25 and 50 kg $ha^{-1}$) and their combinations. Polybags of size 30 x 20 cm (500 gauge) were filled with nonsterilized potting mixture each weighing 3 kg. Seeds of all the three sp. were inoculated with rhizobium isolates. The entire quantity of nitrogen and phosphorus was applied as basal dose at the time of sowing the seeds. Seeds were sown in polybags and irrigated immediately after sowing. The plants were harvested 180 days after sowing. Observations on height of plants, shoot dry weight, nodule number per plant and nodule dry weight were recorded. The data relating to each character were analysed using the analysis of variance technique. Wherever the effects were found to be significant, critical differences were calculated for effecting comparison among each.

The data on various characters under study are presented in Table 1. *Rhizobium* inoculation significantly influenced plant height in *A. catechu* and *P. falcataria.* There was significant increase in plant height due to nitrogen application except in *P. falcataria.* Different levels of phosphorus significantly influenced this character only in the case of *A. catechu. Rhizobium* inoculation had not influenced the shoot dry weight of all the species. Application of nitrogen up to 20 kg $ha^{-1}$ resulted in highest shoot dry weight in *A. catechu* and *P. falcataria.* Nitrogen application did not significantly increase the root dry weight in *A. arabica.* Nitrogen application up to 40 kg $ha^{-1}$ decreased the root dry weight in *A. catechu* and *P. falcataria.* With increasing levels of P application up to 25 kg $ha^{-1}$ there was an increase in root dry weight in *A. arabica* and *A. catechu.* However, P application had not influenced this character in *P. falcataria.* According to Barnett (1986) nursery growth of legume tree sp. can be significantly increased by rhizobium inoculation. In the present study, selection of suitable rhizobium strains, its **inoculation** combined with nutrient application would have helped to activate the bacterial strains for nodulation.

Nitrogen application increased the growth characters favourably in *A. catechu* and *A. arabica.* Small amounts of nitrogen added during the nitrogen hunger period would have probably helped the leguminous plants for steady growth and better development in the initial stages (Gunawardena and Senanayake, 1989). The response to N application up to 20 kg $ha^{-1}$ by an increase in the growth parameters of the two species in the present study could be attributed to the above facts. Response to P application in improving growth characters was not observed in *A. arabica* and *P. falcataria.* It may be due to the difference in their inherent capacity to absorb P from the medium. *Rhizobium* inoculation had significantly increased nodule number per plant. There was an adverse effect of nitrogen

Table 1. Effect of *Rhizobium* inoculation, nitrogen and phosphorus levels on growth characters of three tree sp.

| Treatment | *Acacia arabica* | | | | |
|---|---|---|---|---|---|
| | Plant height, cm | Dry weight, g | | Nodule | |
| | | Shoot | Root | No./plant | dry wt. g |
| r O | 129.63 | 37.25 | 5.15 | 6.75 | 0.29 |
| r 1 | 132.28 | 37.68 | 6.75 | 15.91 | 0.36 |
| CD | NS | NS | 0.71 | 2.45 | 0.05 |
| n 0 | 121.88 | 41.15 | 5.60 | 16.25 | 0.39 |
| n 1 | 154.88 | 38.95 | 6.08 | 10.91 | 0.40 |
| n 2 | 126.13 | 32.29 | 6.14 | 6.87 | 0.16 |
| CD | 11.49 | 2.64 | NS | 3.00 | 0.06 |
| p O | 138.75 | 37.92 | 4.75 | 8.92 | 0.40 |
| p 1 | 125.50 | 36.28 | 7.18 | 12.83 | 0.25 |
| P 2 | 132.67 | 38.19 | 5.89 | 12.29 | 0.31 |
| CD | NS | NS | 0.88 | 3.00 | 0.06 |

Table 1 (contd.)

| Treatment | *Acacia catechu* | | | | |
|---|---|---|---|---|---|
| | Plant height, cm | Dry weight, g | | Nodule | |
| | | Shoot | Root | No./plant | dry wt. g |
| r O | 119.95 | 28.06 | 19.06 | 2.64 | 0.01 |
| r 1 | 125.44 | 28.82 | 19.78 | 8.78 | 0.26 |
| CD | 3.25 | NS | NS | 0.91 | 0.08 |
| n O | 109.75 | 27.49 | 18.04 | 11.42 | 0.12 |
| n 1 | 131.94 | 31.63 | 20.89 | 9.46 | 0.28 |
| n 2 | 126.42 | 26.19 | 19.33 | 3.25 | 0.01 |
| CD | 3.99 | 1.42 | 1.37 | 1.12 | 0.01 |
| p 0 | 117.68 | 26.35 | 18.15 | 2.79 | 0.01 |
| p 1 | 126.75 | 29.08 | 21.31 | 9.08 | 0.26 |
| P 2 | 123.67 | 29.88 | 18.81 | 7.25 | 0.13 |
| CD | 3.97 | 1.42 | 1.37 | 1.12 | 0.01 |

application on nodulation in all the three sp. Highest number of nodules were produced at zero level of nitrogen.

Table 1 (contd.)

| Treatment | *Paraserianthes falcataria* | | | | |
|---|---|---|---|---|---|
| | Plant height, cm | Dry weight, g | | Nodule | |
| | | Shoot | Root | No./plant | dry wt. g |
| r O | 69.72 | 19.56 | 11.05 | 186.69 | 7.92 |
| r 1 | 82.32 | 22.74 | 12.91 | 244.64 | 10.69 |
| CD | 10.61 | NS | 1.57 | 25.92 | 1.20 |
| a O | 75.25 | 22.58 | 12.01 | 253.33 | 8.09 |
| a 1 | 79.96 | 24.75 | 13.75 | 241.13 | 9.92 |
| a 2 | 72.87 | 16.10 | 10.16 | 152.54 | 9.61 |
| CD | NS | 4.25 | 1.92 | 31.75 | 1.47 |
| p 0 | 72.88 | 21.69 | 12.29 | 233.96 | 8.08 |
| p 1 | 72.55 | 21.10 | 12.17 | 221.79 | 10.65 |
| P 2 | 83.44 | 20.65 | 12.47 | 191.25 | 8.89 |
| CD | NS | NS | NS | 31.75 | 1.47 |

**CD** (0.05) ; NS - Not significant

The effect of P on nodule number was positive and the number of nodules increased as the level of P increased. Similar trend was noticed in the case of dry weight of nodules per plant. Mineral nutrient deficiencies could specifically limit nodulation at root infection stage of the nodule bacteria in legumes. The depressive influence of nitrogen on nodulation has been shown by Rao *et al.* (1974). Increase in the nodulation and nodule, dry weight with lower levels of N application and decrease with higher levels were reported by Kotoch *et al.* (1983).

According to Russell (1977) the process of infection and nodule formation can be disturbed if the nitrate or ammonia concentration around the plant root is high. Positive influence of P on nodule number and nodule dry weight was reported by Srivastava and Verma (1985). The results of the present study are also in conformity with the above findings.

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