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Research Article

EFFECT OF DIFFERENT DOSES OF NITROGEN AND PHOSPHORUS FERTILIZERS ON NITROGENASE ACTIVITY IN NODULE OF *ALBIZIA LEBBECK* BENTH.

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ABSTRACT
Different levels of Nitrogen and phosphorus fertilizers were applied in combination with a low and suitable dose of nitrogen to observe the Nitrogenase activity in the nodules of *Albizia lebbeck* plants under pot culture condition in the nursery. The maximum number of nodules per plant was recorded in the month of September. The highest number of nodules per plant was recorded in N 40 + P 100 kg/ha treatment during September and the lowest value in the control treatment. The nodular nitrogenase activity was recorded from July to September and further followed a decline until December. With the onset of spring, nitrogenase activity increased with the formation of new nodules from March onwards. In nitrogenase activity a large and small peak was recorded in the month of September and April/May respectively. N40+P100 treated plants performed best over others in respect of nodular nitrogen activity. No activity was observed from December to February. On the basis of relative comparison of different doses of nitrogen and phosphorus on individual plants, it was observed that in most of the treatments low nitrogen and phosphorus doses i.e., N40+P100 showed comparatively higher biomass compared to higher doses. The best results were recorded in N40 + P100 Kg/h treatments.

Keywords: *Nitrogenase, Nodule, Nitrogen & Phosphorus Fertilizer*

INTRODUCTION
A continuous tree growth depends upon the availability and maintenance of nitrogen pool and its efficient use. Nitrogen is generally known as an important element, center to plant growth, because of its role in the metabolism of various vital substances viz. Proteins, amino acid, nucleic acids, vitamins and other growth regulating substances. Nitrogen fixation is the major route by which gaseous nitrogen is introduced into the ecosystem and the ability to carry out this process is confined to certain groups of micro organisms (Dalton, 1980). Total Global biological nitrogen fixation is approximately 17.2 X 10^7 tons/year. This figure is approximately three times that of industrially fixed N, which clearly demonstrates the significance of biological nitrogen fixation in the biomass production and natural cycle (Ishizuka, 1992). The relative contribution of symbiotic or associative nitrogen fixing system to the total global level has been assessed to be in the order of 70% symbiotic as compared to 30% in non-symbiotic nitrogen fixing systems (Paul, 1988).
Nitrogen is a key element required for plant growth. The symptoms of soil N deficiency ranges from poor yield to crop failure. Traditionally, soil N deficiency has been addressed by applying fertilizers. It is well-recognized fact that the nitrogenous fertilizers have been largely responsible for the enhancement of grain production after Second World War and subsequently for the success of the Green Revolution in Asia. Although, the possible benefits that can be realized by the application of fertilizer as a basal dose have not been fully appreciated in indigenous species (Mishra and Chauhan, 1997). However, there is still a wide gap in fertilizer consumption per unit area of land between the developing and developed countries (Danso, 1992).
Low fertility is one of the major problems in establishing vegetation on the degraded barren land. Since nitrogen is generally deficient in these soils therefore, the reforestation can be accomplished either increasing the input or using such species which can utilize atmospheric nitrogen apart from soil nitrogen,

for its growth and development and regularly enrich the soil nitrogen status. The agriculture production in India has increased more than three times during the last 55 years and one of the most important factors responsible for this has been the wide spread use of nitrogenous fertilizers (Pokhriyal *et al.*, 1987).

Albizia lebbeck Benth. is multipurpose, fast growing nitrogen fixing tree species used under various afforestation programmes. It is being used for building furniture, boats, suitable for farm implements, panels, and other woodwork and also in railway carriages. It has been proved successful in strip, plantation along canals, roadside, railway line avenues, railway lines and as shelter belts for wind breaks in Rajasthan, Punjab, Haryana, Uttar Pradesh and Madhya Pradesh etc.

Nodule biomass plays an important role in the nitrogen fixation activity of the plants. Among the four species, *Leucaena* performed best, followed by *Albizia*, *Acacia* and *Dalbergia*. The nodule wt. Pl^{-1} and nitrogenase activity Pl^{-1} was *Leucaena* as compared to *Albizia*, *Acacia* and *Dalbergia*. Nodule no. pl^{-1} and nitrogenase activity nodule was also markedly higher in *Leucaena* as compared to *Albizia*, *Acacia* and *Dalbergia* (Pokhriyal *et al.*, 1987). Plant height has also shown similar trend as that of nitrogenase activity per plant in all the four species. The height of *Leucaena* was 191.3% and 30.8% more than that of *Albizia*, *Acacia* and *Dalbergia* respectively.

Nitrogen and phosphorus are the two major plant nutrients and their combined effects were beneficial for the plants better than either of the group alone. The pro biotic influence of associative nitrogen fixers have been thoroughly reviewed by Abbett and Robson (1982) in agricultural crops. However, no such efforts were taken up in forestry species. Generally, crop yield in any environment is the yield potential of that crop modified by responses of productivity to the prevailing conditions to which the crop is subjected. Nutrient relations with crop clearly reflect the interplay between improvement in yield potential and application of fertilizers. Phosphorus is a structural component of a number of vital compounds, related with energy transfer molecules and genetic information system. High phosphorus levels favor nodulation initially, overall moderate amount of phosphorus fertilizer yield highest nodule biomass (Kessel *et al.* 1983).

MATERIALS AND METHODS

The present investigation was carried out to study the response of nitrogen and phosphorus fertilizers with respect to nodulation, nitrogen fixation, assimilation and growth behavior in *Albizia lebbeck* seedlings at nursery stages. The experiment was performed to assess the effect of N and P singly and in combination (NXP) doses on *Albizia lebbeck* seedlings under nursery condition.

The procedures adopted for this study are described as follows:

Experimental Details

Treatments:

After four months of transplanting i.e., June uniform size plants were divided in to six groups containing atleast 70 pots each. The nitrogen and phosphorus treatments were applied as follows:

1. T0:- Control
2. T1:- 40 kg N/ha.
3. T2: 100 kg P/ha.
4. T3:- 200 kg P/ha.
5. T4:- 100 kgP X 40 kg N/ha.
6. T5:- 200 kg P X 40 kg N/ha.

Nitrogenase activity

The plants were harvested and nodulated roots were washed with the help of regulated water pressure so as to minimize the damage. Nitrogenase activity was determined by estimating the acegylene ethylene reduction assay as described earlier by Hardy *et al*, (1968). The quantification of acetylene and its reduction product (i.e., ethylene was assessed by Gas Chromatograph (Ms CIC Gas Chromatograph Model ACD).

RESULT AND DISCUSSION

Nodular Nitrogenase Activity

The observations on nodular Nitrogenase (n moles C_2H_2 reduced g^{-1} fresh wt. h^{-1} and PI^{-1} h^{-1}) activity was recorded from July to September and further followed a decline till the month of December. Again with the onset of spring, nitrogenase activity started increasing with the formation of new nodules from March onwards. In nitrogenase (n molesC_2H_2 reduced g^{-1} fresh wt. h^{-1} and PI^{-1} h^{-1}) activity, a large and a small peak were recorded in the month of September and April respectively. N40+P100 treated plants performed best over others in respect of nodular nitrogenase activity. Maximum nitrogenase activity was recorded in N40+P100 (1108.49 n moles) followed by N40 (932.54 n moles), P100 (703.80 n moles), P200 (598.23 n moles), N40+P200 (1055.71 n moles) and control (545.45 n moles). Among different months, the highest nitrogenase activity was recorded in August and no activity was noticed in December to February.

Total Nitrogenase (n moles C_2H_2 reduced PI^{-1} h^{-1}) activity per plant was observed to be maximum in the month of August and decreased thereafter, in all the treatments. Nitrogenase activity was observed absent during December, January and February due to absence of nodule. From Anova table it was noticed that the effect of N significantly in August, October and March to June. For P is significant in July, August and March to June. The interaction to N+P is significant in month of July and August.

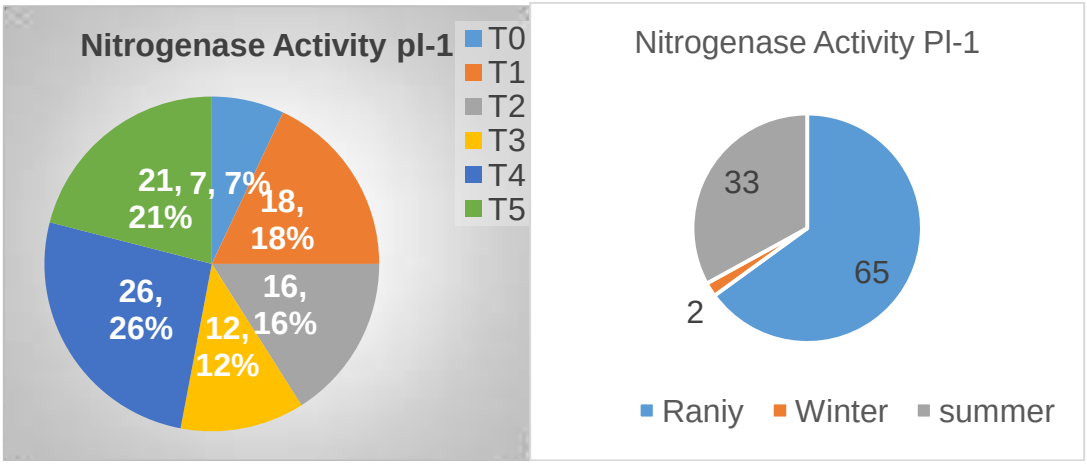

Figure 1: Diagram representing percent distribution of total Nitrogenase activity per plant different treatments and seasons in *Albizia lebbeck* seedling

Root nodulation and nitrogen fixation of tree species are significantly influenced by climatic conditions (Gibson and Jordon, 1983). The NFTs 3/02widely distributed fixation behavior. Maximum nitrogenase activity in *Acacia, Ougenia* and *Robinia* was observed during summer season, whereas, in other three species *i.e., Albizia*, *Dalbergia* and *Pongamia* during rainy season. Earlier Pokhriyal *et al.*, (1991), Chaukiyal (1994), Uniyal (1998), Singh (1999) and Chauhan (2000) also reported almost similar results for *Albizia, Dalbergia* and *Pongamia.*

Maximum nitrogenase activity (n moles C_2H_2 reduced /gm fresh weight/h) was observed in the month of January in case of *Acacia catechu*. Two peaks, a large and small, were observed in August and April respectively. Total nitrogenase activity (n moles C_2H_2 reduced/plant/h) followed a similar trend (Pokhriyal *et al.*, 1990).

Total nitrogenase activity declined with the decrease in soil moisture. Earlier Bharadwaj (1976) reported increased nodulation and nitrogen fixation by *Sesbania aculata* with an increase in soil moisture up to 25%. Similar results for fresh and dry weights of leaf, stem, root and nodules were also observed for *Albizia procera* (Pokhriayl *et al.*, 1989).

CONCLUSION

It is evident from the results derived in the present study that the higher N+P dose were not found to be effective as regards the nitrogen assimilation, fixation and growth parameters are concerned in *Albizia lebbeck* seedlings. Therefore, an excessive nitrogen fertilizer application in the leguminous tree species like *Albizia lebbeck* should be either avoided or applied in splits after assessing the requirement to maintain a consistent availability of nitrogen to maintain soil fertility. On the basis of these studies the best results were recorded in N40+P100 kg/h treatments as compared to others. Initially, low N starter dose will be helpful in boosting up the seedling growth whereas, excessive N fertilizer application will inhibit the process of biological nitrogen fixation on one hand and deplete it through volatization and leaching and polluting atmosphere and soil respectively to the other. Plants growth can be maintained by adopting suitable agronomic management practices, so that a demand and supply is well maintained and plant can fully utilize the fertilizer applied and other hand can draw the benefits of atmospheric nitrogen fixation simultaneously by establishing strong host parasite relationship. The perfect on of these techniques will ultimately give a package for the plantation programmes and to increase the productivity depending on the agro climatic sites of the country.

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