NODULATION, NITROGENASE ACTIVITY AND MAJOR NUTRIENT CONSTITUENTS OF COMMON COVER CROP LEGUMES DURING EARLY GROWTH

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SUMMARY

P. phaseoloides, grown in pots showed a high potential to fix atmospheric nitrogen when compared to its counterparts such as *D. ovalifolium* and *M. invisa*. The nodule dry matter yield for *Pueraria* was 0. 375g plant^{-1} while *Desmodium* and *Mimosa* yielded only 0. 186g plant^{-1} and 0. 130g plant^{-1} respectively. Nitrogenase activities were around 10. 0 /u moles plant^{-1} hour^{-1} for *D. ovalifolium* and *M. invisa* whereas *P. phaseoloides* and much higher activity of about 25 /u moles plant^{-1} h^{-1}. With regard to major nutrient contents, all three test plants had a more or less similar percentage phosphorus and potassium content. *D. ovalifolium* had a significantly ($P < 0.05$) lower percentage nitrogen content compared to *Pueraria* and *Mimosa*.

Key words:

Nodulation, nitrogenase activity, major nutrient constituents, *Pueraria*, *Desmodium*, *Mimosa*

INTRODUCTION

The legumes which are recommended as ground covers in rubber plantations of Sri Lanka are fast growing and very efficient in protecting soils against erosion. For instance, *Pueraria phaseoloides* (Roxb) *Benth.* spreads and colonizes rapidly by runners which root at the nodes. On suitable soils with adequate rainfall it can form a carpet over more than 60 cm deep (Skerman, 1977). It completely covers the soil shading it from sun, preventing the direct impact of rain and ensuring adequate protection against soil erosion. The other counterparts such as *Desmodium ovalifolium* (pratn) Wall. ex Ridley and *Mimosa invisa* (Mart cx.), also provide satisfactory ground cover although they do not spread as rapidly as *p. phaseoloides* (Anon, 1978; Imrie et al., 1983). These aspects of the cover crops have received a reasonable amount of attention during the past few decades, especially under humid tropical conditions (Schofield, 1945; Waston *et al.*, 1964; Rijkebusch, 1967; Tan *et al.*, 1976).

The main advantage of legumes over grasses and weeds as ground covers, is the ability of the former to fix atmospheric nitrogen. But although legumes have been cultivated as cover crops under rubber for several decades in Sri Lanka, very little attention has been paid to their nitrogen fixing performance. However, it has been well established that nitrogen fixation during early growth of legumes is critical for the successful establishment of the cover. Hence this investigation was undertaken to obtain a basic knowledge mainly on the nodulation and nitrogenase activity of common cover crops during their early growth.

MATERIALS AND METHODS

I Plant culture

Test plants, *P. phaseoloides*, *D. ovalifolium* and *M. invisa*, were grown in soil from Agalawatta soil series (total N 0. 326%, Org C 1. 8% pH 4 . 1) in 5 kg pots. Basal nutrients without nitrogen (Brockwell, 1980) were added to the soil to make sure that there were no limiting nutrients.

Acid treated seeds (Waidyanatha and Ariyaratna, 1976) of test plants were planted in each pot at about 2 cm depth. Pots were maintained in the glass house for 3 1/2 months; their position changing once a week to minimize the variations in green house environment.

II Assay techniques

Tops were removed and dry matter yield was determined after oven drying the samples at 80°C for 2 days. Nitrogen content phosphorus content and potassium content were measured using semi - micro Kjeldahl distillation, Vando Molybdate-yellow method and Technicon flamephotometer IV respectively

Acetylene reduction activity was measured in root systems with intact nodules using one hour incubation period. Separation of acetylene and ethylene was achieved on a proapk N glass column (80 – 100 mesh) run at 100°C in a Packard Model 642 chromatograph with a hydrogen flame ionization detector. The temperature of the injector and detector were 130°C and 190°C respectively. one millilitre samples were used for analytical purposes. Four replicates were used for each test plant.

RESULTS AND DISCUSSION

Although *P. phaseoloides* produced the maximum dry matter yield (6. 17 g. plant^{-1}) the differences were not significant ($P < 0.5$) compared with the dry matter production of *Mimosa* and *Desmodium* which yielded 5. 52 g plant^{-1} and 5. 14 g plant^{-1} respectively (Fig. 2).

The percentage nitrogen content of *Pueraria* and *Mimosa* were 3. 67% and 3. 82% respectively, whereas *Desmodium* had a significantly ($5 < 0.05$) lower nitrogen content at 2. 29% (Fig. 1). The potassium and phosphorus levels were more or less similar in all three test plants (Fig. 1). The phosphorus content varied from 0. 179% to 0. 209% and potassium from 1. 14% to 1. 48% depending on the plant species.

With regard to total nitrogen content, *P. Phaseoloides* produced the highest yield equal to 225 mg N plant^{-1} while *M. invisa* produced 211 mg of nitrogen plant^{-1}, which was not significantly ($P < 0.05$) different from the value for *P. phaseoloides*. A significantly ($P < 0.05$) lower total nitrogen content was observed in *D. ovalifolium* which produced 117 mg of nitrogen plant^{-1}. There was no marked difference in the total phosphorus content with all three test plants; the value ranged from 9. 13 to 13. 0 mg of phosphorus plant^{-1} depending on the plant species (Fig. 1).

Although there was no significant ($P < 0.05$) difference in percentage potassium content in three species, *P. phaseoloides* contained significantly ($P < 0.05$) more total potassium equal to 90 . 9 mg k plant^{-1} compared to *M. invisa* and *D. ovalifolium* which contained 71 . 5 and 58 . 7 mg k plant^{-1} respectively (Fig. 1).

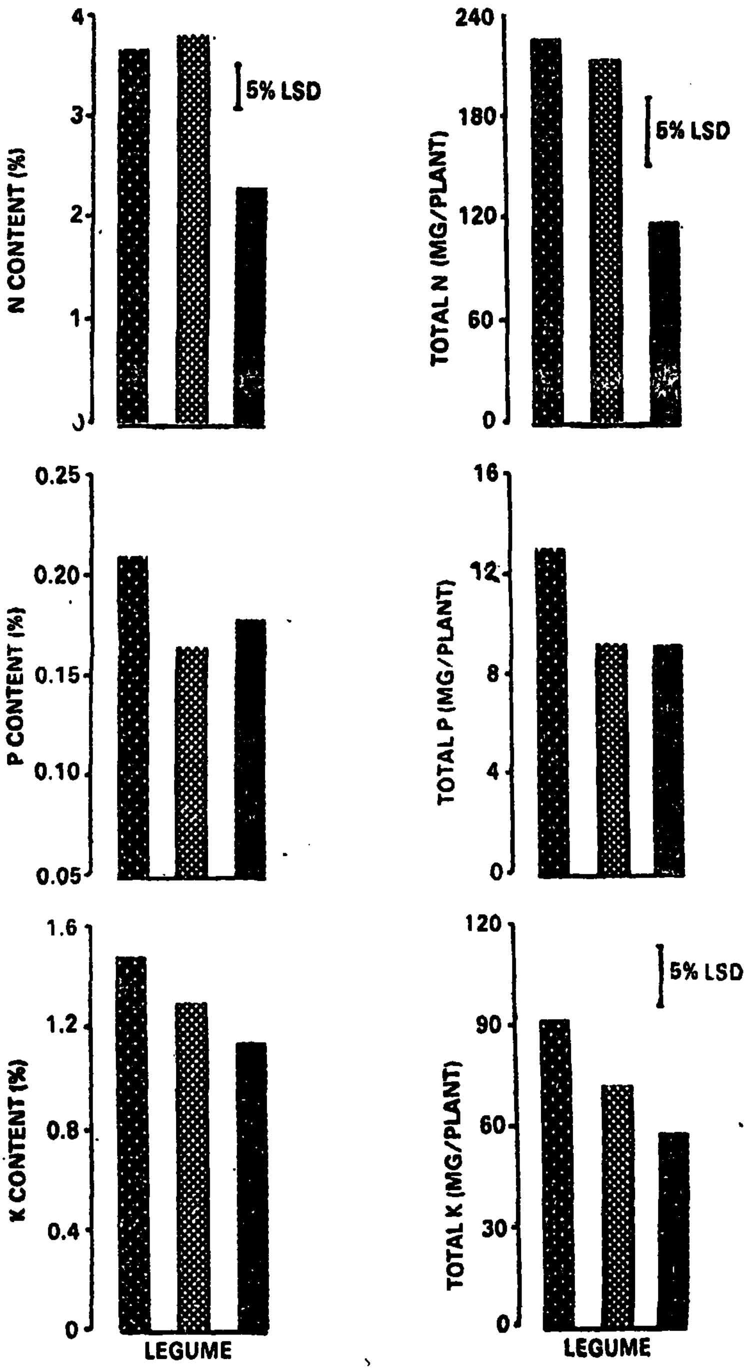

Figure 1 Contents of major nutrients in

P phaseoloides ▩ M. invisa ▩ and D ovalifolium ■ grown in pots.

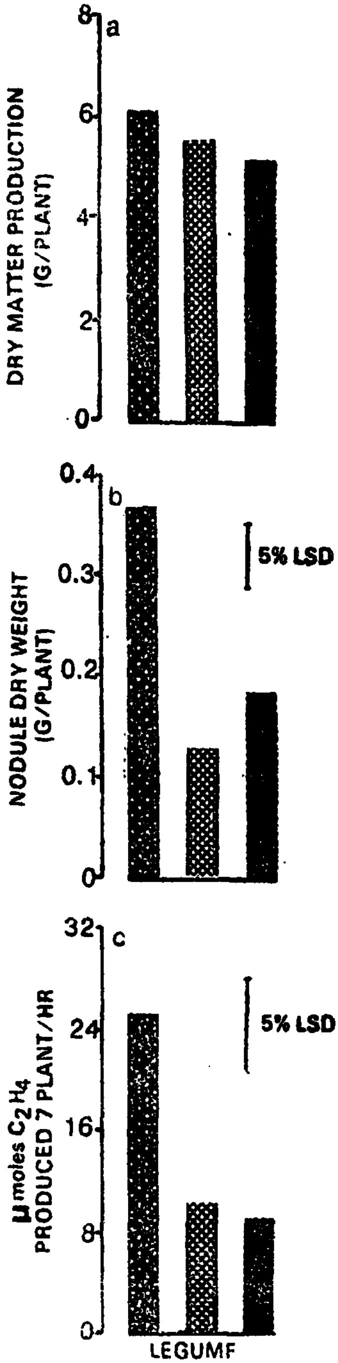

Figure 2 Dry matter production (a), nodulation (b), and acetylene reduction (c) by P phaseoloides

M invisa and D ovalifolium

grown in pots

Nodulation and nitrogenase activities were significantly ($P < 0.05$). lower in both *Desmodium* and *Mimosa* compared to *Pueraria* (Fig. 2). The nodule dry matter yield for *Pueraria* was 0 . 375 g $plant^{-1}$ *Desmodium* and *Mimosa* yielded only 0 . 186 g $plant^{-1}$ and 0- 130 g $plant^{-1}$ respectively. Nitrogenase activities were around 10 . 0 /u moles $plant^{-1}$ $hour^{-1}$ for *D. ovalifolium* and *M. invisa*, whereas *P. phaseoloides* had a much higher activity of abuout 25 /u moles $plant^{-1}$ h^{-1} (Fig. 2).

These observations suggest the high potential of *P. phseoloides* to fix atmospheric nitrogen during early growth compared to its counterparts, such as *M. invisa* and *D. ovalifolium.* With regard to major nutrient contents in the plant *P. phaseoloides*, was in parallel with the other legumes in percentage phosphorus and potassium content while percentage nitrogen was significantly ($P < 0.05$) greater in *P. phaseoloides* compared to *D. ovalifolium.*

This outstanding value of *P. phaseoloides* as a leguminous cover crop has also been demonstrated from field experiments carried out in the wet tropics. In those investigations contribution of *Pueraria* litter into the nitrogen economy of soil has been studied. For instance, when 18 month's growth of *Pueraria* and other legumes were ploughed into the soil in the wet tropical cost of Queensland, the highest soil No_3 - N values were found in plots with *P. phaseolodes* (Schofield, 1945). After 32 days the No_3 – N values in *Pueraria* plots were 69 ppm whereas *Calopogonium*, *Centrosema* and *Stylosanthes* gave 3 . 5, 5 . 3 and 2 . 0 ppm N respectively. Cultivation of *Pueraria* as an inter - row crop with Sisal in Tanzania added 635 kg of Nitrogen ha^{-1} to the soil (Rijkebusch, 1967) and in Malaysian rubber plantations they provided a total of about 695 kg nitrogen ha^{-1} to the soil through their litter from third to eighth year after planting (Tan *et al.*, 1975).

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