

## RESPONSE OF *PUERARIA* COVER CROP TO INOCULATION WITH AM FUNGI AND PHOSPHORUS IN UPLAND SOIL OF RUBBER PLANTATION AREAS IN BANGLADESH

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The use of leguminous cover crop to provide an excellent formation for the cultivation of tree crop is a standard practice in the plantation sector.<sup>(1)</sup> This cover crop is the key factor to maintain soil fertility and prevent soil erosion in the rubber plantation. Large areas of upland soils of the greater Chittagong, Chittagong Hill Tracts, Sylhet and Mymensingh districts are under rubber cultivation. *Pueraria* is grown as ground cover in the above rubber plantations. *Pueraria* is a leguminous crop. Legumes are able to take up most of their requirement of nitrogen and phosphorus via nodules and endomycorrhiza. This complex tripartite system of host, nodule and endomycorrhizal symbionts has many interesting facets including the genetic make-up of the host and the sources of phosphate utilized by mycorrhizal fungi.<sup>(2)</sup> Legume root nodules also contain a form of hemoglobin, which must somehow be involved in the nitrogen-fixation process.<sup>(3)</sup> Usually, rubber planters apply 5.5 kg P/ha to establish leguminous crop.<sup>(4)</sup> Arbuscular mycorrhizal (AM) fungi are well-known to improve plant phosphorus nutrition especially in soils of low phosphorus availability.<sup>(5-7)</sup> No information concerning the effect of AM fungi and phosphorus on growth, dry matter yield and nutrient uptake by *Pueraria* under edaphic and climatic conditions of Bangladesh is available. Therefore, the objective of this study was to evaluate the effect of inoculation with *Glomus mosseae* and two levels of phosphorus on growth, nodulation and nitrogen accumulation in *Pueraria* cover crop grown in upland soils of Karnajhora Rubber Estate, Sherpur, Bangladesh.

Composite soil sample (0 - 15 cm depth) was collected from 1995 planting areas of Karnajhora Rubber Estate from the hill top. Samples were air dried, ground, sieved (< 2 mm) and stored in polythene bags. Some physicochemical properties of the soil were determined following standard methods. The particle size distribution was: sand 43.2%, silt 33.5% and clay 23.3%, texture-loam, water holding capacity 26.7%. pH 5.5, organic matter 1.8%, total N 0.06%. Available N,P,S,K were 42.0, 4.6, 21.2 and 77.5 mg/kg soil, respectively.

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Fifteen hundred gram soil was used per earthen pot (13 cm height × 19 cm diameter). Forty gram crude inoculum of *Glomus mosseae* (fragments of heavily infected maize, root, soil and hypae etc.) were applied to the surface of 1400 g soil in the pots as a thin layer and then 100g soil was spread over the surface of the inoculum. An equivalent amount of soil was added in treatments where no *G. mosseae* was inoculated. Phosphorus as triple superphosphate was mixed thoroughly with soil at the rates of 2.75 and 5.5 kg P/ha. Treatments having three replications were: (i) Control (without *G. mosseae* and P), (ii) *Glomus mosseae* (iii) 2.75 kg P/ha and (iv) 5.5 kg P/ha. The pots were arranged in a randomized complete block design in a net house in the Department of Soil, Water & Environment, University of Dhaka. Seeds of *Pueraria* were soaked in water and six seeds were sown in each pot. Water was added in every morning. The height of the individual plant was measured from the soil level to the tip of the leaflet. Plants were harvested as shoot and root after 35 days of sowing. After washing the roots, root segments of 1 cm long were stained to evaluate the mycorrhizal colonization.<sup>(8)</sup> The stained root pieces were observed under a microscope. The presence or absence of infection in the root pieces was recorded and then percentage infection was calculated.<sup>(9)</sup> Nodules were counted. Shoots and roots were air dried, oven dried (65°C) for 72 hours, weighed, ground (< 1 mm) in a mechanical grinder and stored in air tight polythene bags. The total N uptake by roots and shoots was determined using micro-distillation apparatus.<sup>(10)</sup> Statistical analysis of the results were carried out and respective LSDs indicated at the bottom of the Table 1.

**Table 1. Effects of inoculation with *Glomus mosseae* and phosphorus on height, dry matter production, root nodules, root colonization and uptake of N by the shoot and root of *Pueraria* cover crop.**

Treatments	Plant height (cm)	Shoot		Root		No. of root nodules (/pot)	Root colonization (%)
		Dry wt. (g/pot)	N uptake (mg/pot)	Dry wt. (g/pot)	N uptake (mg/pot)		
(i) Control (without <i>G. mosseae</i> and P)	18.4 <sup>a</sup>	0.42 <sup>a</sup>	9.2 <sup>a</sup>	0.11 <sup>a</sup>	1.1 <sup>a</sup>	5 <sup>a</sup>	nil
(ii) <i>Glomus mosseae</i>	20.8 <sup>b</sup>	0.68 <sup>b</sup>	10.7 <sup>b</sup>	0.23 <sup>b</sup>	2.7 <sup>b</sup>	26 <sup>b</sup>	19
(iii) 2.75 kg P/ha	20.2 <sup>b</sup>	0.63 <sup>c</sup>	9.7 <sup>c</sup>	0.21 <sup>b</sup>	2.3 <sup>b</sup>	11 <sup>c</sup>	nil
(iv) 5.5 kg P/ha	20.7 <sup>b</sup>	0.69 <sup>b</sup>	10.6 <sup>b</sup>	0.22 <sup>b</sup>	2.6 <sup>b</sup>	19 <sup>d</sup>	nil
LSD at 5% level	1.51	0.04	0.45	0.05	0.73	1.44	

<sup>a,b,c</sup> Data bearing different superscripts within the same column differ significantly.

Plant growth was assessed in terms of plant height and dry matter production (Table 1). The highest plant growth in terms of height (20.8 cm) was significantly ( $p < 0.05$ ) greater in soils with *Glomus mosseae* treatment than the control treatment. Dry matter yield of roots (0.23 g/pot) and number of root nodules (26 nodule/pot) were also significantly ( $p < 0.05$ ) higher following treatment with AM fungi. Dry matter yield of shoots was highest

in case of AM fungi and 5.5 kg P/ha. It was significantly ( $p < 0.05$ ) different from the other treatments, i.e., 2.75 kg P/ha and control (Table 1). Redshaw<sup>(1)</sup> also observed that *Pueraria* cover crop was the best suited for upland soils.

Highest nitrogen uptake by roots and shoots were 2.7 and 10.7 mg/pot, respectively, following treatment with AM fungi and varied significantly ( $p < 0.05$ ) from the other treatments. Lathwell<sup>(11)</sup> observed that the total nitrogen accumulation in the above ground dry matter of *Pueraria* varied in a few weeks to a few months from 60 to 112 kg N/ha. No mycorrhizal infection was observed in plants which were not inoculated with *G. mosseae*. The degree of infection correlated well with growth and nitrogen uptake (Table 1).

Dry matter yield and N uptake by roots and shoots, root nodules of *Pueraria* were significantly higher in *G. mosseae* inoculated soils than in uninoculated one. Soil fertility with respect to nitrogen can be maintained by rotating plantings of nitrogen-consuming plants with cultivation of legumes. The nitrogen-fixing bacteria in legumes live in symbiotic association forming a special structure in the roots called root nodule which has a major role in fixing atmospheric nitrogen in.<sup>(3)</sup> Therefore, it may be concluded that *G. mosseae* fungi should be maintained to save costly phosphatic fertilizer in upland rubber growing soils of Bangladesh.

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