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EFFECT OF ALTITUDE ON THE ESTABLISHMENT OF TWO COVER CROPS IN MEGHALAYA

The genus *Rhizobium* infects the roots of legume plants, thereby forming nodular structures. This is probably the best known symbiotic relationship associated with nitrogen fixation. *Pueraria phaseoloides* and *Mucuna bracteata* are two such leguminous crops having specific *Rhizobium* strains and forming nodules. Establishment of these plants as cover crops during the initial stages of growth of rubber in the fields is a widely accepted agromanagement practice. Besides fixing the atmospheric nitrogen, the cover crops also play an important role in soil conservation and suppression of weed growth. It also helps in preserving soil fertility (Kothandaraman *et al.*, 1984). Sharma and Purohit (1978) have carried out a study at different altitudes to assess the effect of altitude on nodule formation in a leguminous crop. For the present study, seeds of *M. bracteata* and *P. phaseoloides* were collected and their suitability for establishment as cover crops in rubber plantations under Garo Hills (Meghalaya) conditions were studied.

The two sites were located at the experiment farms of the Regional Research Station, Meghalaya at Ganolgre (600 m above MSL) and Darechikgre (1200 m above MSL) in the West Garo Hills of Meghalaya. Both the locations fall within the latitude of 25°-26° N and longitude of 90°-91°E.

Seeds of *Pueraria phaseoloides* and *Mucuna bracteata* were sown separately in polybags and at two leaf stage they were thinned to four seedlings per bag. Many replicates of these sets were maintained at the two altitudes (600 m and 1200 m above MSL). Plants from six bags each of *Pueraria* and *Mucuna* were randomly harvested at monthly intervals from each site for recording nodulation and other growth parameters. The total number of nodules were counted after washing thoroughly in running tap water. The height of plants as well as the total biomass were also recorded. The plant parts were dried at 80°C in a hot air oven for 48 h for recording total dry matter.

Monthly mean weather at the two locations are persented in Table 1. Both the locations had similar rainfall distribution during the experimental period. Mean maximum and minimum temperature recorded at the higher altitude was lower by about 4°C and 3°C respectively than the lower altitude. Relative humidity recorded at botn the locations was more or less same.

P. phaseoloides showed similar growth pattern at both the elevations. Nodule formation was early and significantly higher number of nodules was observed at the higher elevations (Table 5), whereas nodulation was delayed by 30 days at the lower elevation. In *M. bracteata* also the formation of nodules was delayed by 30 days at lower elevation but the number of nodules produced at both the elevations was not significantly different. Thereafter, the number of nodules increased with increase in age. Sharma and Purohit (1978) while studying the effect of different altitudes on nodulation of *Glycine soja*, observed that the growth and nodulation was more at an altitude of 4500 ft when compared to

Table 1. **Mean months weather data during the experimental period**

Months	Temperature °C		Humidity (%)	Total rainfall (mm)
	Maxi.	Mini.		
GANOLGRE				
May	29.5	20.6	75.5	763.8
June	29.6	22.7	80.8	582.6
July	29.3	22.7	84.2	599.8
August	28.3	22.4	85.8	899.6
September	29.7	21.1	83.2	489.6
DARECHIKGRE				
May	24.9	19.6	81.2	818.7
June	25.9	18.6	81.5	812.1
July	25.5	20.2	87.7	843.2
August	25.9	20.4	86.1	781.2
September	25.8	19.8	83.4	283.5

plants grown either at 8500 ft or 1700 ft. The delay in nodulation observed in the present study may be attributed to temperature during the period of growth, the average minimum and maximum temperatures recorded being 18.6°C and 29.7°C respectively (Table 1). Roughly and Date (1986) observed that the time taken for the first nodule to appear was determined independently by the strain and temperature. A similar view was also put forth by Dart *et al.*, (1973). Further, it has also been observed that though the number of nodules formed were very few in *M. bracteata*, they were quite larger as compared to those in *P. phaseoloides*. In a similar study, Kothandaraman *et al.* (1984) reported the formation of a few number of nodules in *M. bracteata* with sizes varying from 0.2 to 2.0 cm.

The total number of nodules, leaf area, root and shoot growth and the total dry matter production of both the crops increased with increase in the age of the plants (Tables 2 to 6). Nambiar and Rao (1987) reported that the nodule number and mass increased with the age of plants. However, no significant difference in shoot growth, biomass production and leaf area was obtained in *P. phaseoloides* after four months of its establishment at both the altitudes. In contrast, a significant difference in these parameters was noticed in *M. bracteata* at the two altitudes (Tables 2 to 6).

Table 2. **Effect of altitude* on root growth**

Treatment	Root length (cm)			
	June	July	August	September
Mucuna - 1	7.53	14.3	22.0	37.2
Mucuna - 2	4.79	9.8	14.2'	27.2
Pueraria - 1	13.93	24.9	38.5	39.2
Pueraria - 2	9.51	19.6	28.0	33.0
S.E.±	0.33	0.97	1.15	1.11
C.D (P=0.01)	0.85	3.4	4.1	3.98

*1 = 600 m; 2 = 1200 m

Table 3. **Effect of altitude* on shoot growth**

Treatment	Shoot length (cm)			
	June	July	August	September
Mucuna – 1	5.20	9.50	15.60	19.98
Mucuna – 2	2.05	3.99	5.98	10.98
Pueraria – 1	0.82	2.09	2.52	5.91
Pueraria – 2	0.51	1.67	2.82	5.55
S. Em. ±	0.14	0.29	0.31	1.03
C. D. (P=0.01)	0.51	1.03	1.09	3.86

* 1 = 600 m; 2 = 1200 m

Table 4. **Effect of altitude* on biomass production**

Treatment	Biomass production (g/plant)			
	June	July	August	Setpember
Mucuna – 1	1.04	2.26	3.44	17.41
Mucuna – 2	0.71	1.42	1.90	7.67
Pueraria – 1	0.79	0.96	1.23	1.66
Pueraria – 2	0.61	1.30	1.46	2.24
S. Em. ±	0.06	0.13	0.25	0.71
C. D. (P = 0.01)	0.20	0.46	0.89	2.53

* 1 = 600 m; 2 = 1200 m

Table 5. **Effect of altitude* on nodulation**

Treatment	Number of nodules			
	June	July	August	September
Mucuna – 1	0.00	2.17	6.50	3.33
Mucuna – 2	0.00	1.83	5.00	3.83
Pueraria – 1	0.00	2.33	3.67	5.17
Pueraria – 2	3.17	10.50	13.17	17.50
S. Em. ±	0.15	0.45	0.72	0.73
C.D.(P = 0.01)	0.55	1.61	2.56	2.62

* 1 = 600 m; 2 = 1200 m

After four months of establishment, the shoot length of *M. bracteata* was found to be 19.98 cm and 10.98 cm while it was only 5.91 cm and 5.55 cm in *P. phaseoloides* at 600 m and 1200 m respectively. Similarly, the total biomass (17.41 g at 600 m and 7.67 g at 1200 m) and leaf area (196.5 cm^2 at 600 m and 146.0 cm^2 at 1200 m) of *M. bracteata* were also quite high as compared to *P. phaseoloides* (Tables 3, 4 and 6).

Table 6. **Effect of altitude* of leaf area**

Treatment	Leaf area (cm^2)			
	June	July	August	September
Mucuna – 1	19.7	33.7	102.2	196.6
Mucuna – 2	1.7	5.0	54.3	146.0
Pueraria – 1	1.4	24.4	26.7	68.5
Pueraria – 2	0.9	1.9	64.5	60.4
S. Em. ±	0.7	0.8	6.1	11.5
C.D. (P = 0.01)	2.5	2.9	21.9	41.0

* 1 = 600 m; 2 = 1200 m

Thus results of the present study showed that in addition to *P. phaseoloides*, the wild creeper *M. bracteata* can also be used as a better cover crop for rubber plantation in the West Garo Hills of Meghalaya.

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