717

Philip, A

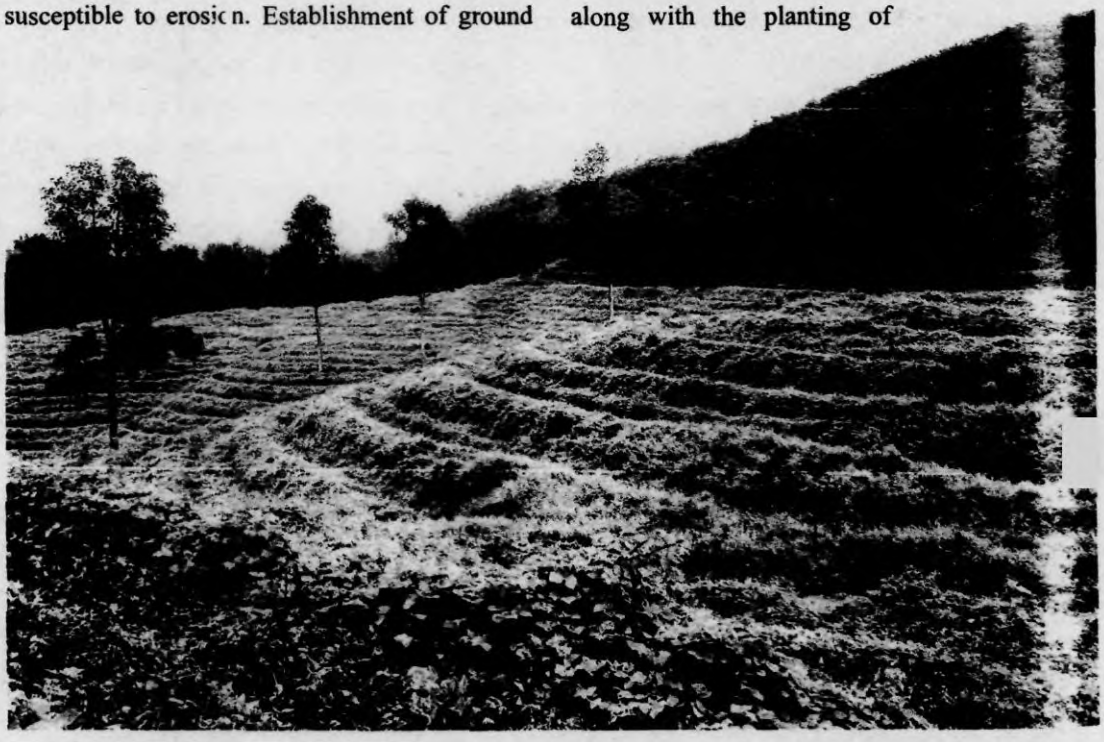
Relevance of leguminous cover crops in rubber cultivation

Annie Philip and Joshua Abraham
Rubber Research Institute of India, Rubber Board, Kottayam- 9

Introduction

Soil is a precious natural resource and its conservation is very important for agricultural sustainability. In India, most of the rubber plantations are located on slopes /hilly areas. These areas also receive high rainfall. The undulating topography and heavy rainfall make these soils susceptible to erosion. Establishment of ground cover in rubber plantations reduces erosion and conserve soil. Leguminous creepers are the most desirable plant species that can be established as ground cover in rubber plantation and this can be done along with the planting of

Annie Philip



*Corresponding author: Email: anniephilip@rubberboard.org.in

Pueraria phaseoloides

Mucuna bracteata

rubber. The thick cover of these legumes reduces runoff, thus minimising soil erosion.

Pueraria phaseoloides and *Mucuna bracteata* are the two common cover crops established in rubber plantations in India. *Pueraria* can be easily established in the field by sowing hot water treated seeds. This cover crop dries up during summer, but regenerates during the following monsoon season. It will not survive under shade conditions. It is palatable to cattle.

Mucuna bracteata can be established by sowing acid treated seeds or planting stem cuttings. Even though it is slow to establish, it grows fast and covers the field very quickly. *Mucuna* is shade tolerant and continues to persist in the mature field also. This cover crop is drought tolerant and not palatable to cattle. *Mucuna* can be established under partial shade (after removing intercrops) also.

Biomass production and nutrient accumulation

Pueraria phaseoloides and *Mucuna bracteata* vary in their dry matter production and nutrient content. Dry matter production was found to be higher for *Mucuna,* than *Pueraria* (Table 1). Nitrogen (N) content was more in *Mucuna* whereas potassium (K), calcium (Ca) and magnesium (Mg) contents were more in *Pueraria*. Phosphorus content was comparable in these two species (Philip *et al.*, 2005). It was found that cellulose was more in the litter of *Pueraria* compared to *Mucuna,* whereas polyphenols which are recalcitrant in nature was more in *Mucuna* than in *Pueraria* (Abraham and Chudek, 2008; Philip and Abraham, 2009).

Table 1. Dry matter production and nutrient accumulation of two year old cover crops

Cover crop	Dry matter production (t/ha)	Nutrient accumulation (kg/ha)				
		N	P	K	Ca	Mg
Pueraria phaseoloides	5.5	174	13	104	65	18
Mucuna bracteata	7.6	236	15	79	56	15

Benefits

Legume covers have many benefits such as organic matter enrichment, soil fertility enhancement and improving soil physical properties. In addition, they fix atmospheric nitrogen, suppress weed growth, reduce soil temperature and increase soil moisture.

The large litter turnover by these cover crops increases the soil organic matter status which in turn improves both physical and chemical properties of the soil. Field studies indicated that *Pueraria* litter decomposes faster than *Mucuna* litter. About 98 per cent of the nutrients in *Pueraria* litter were released within a year (Philip and Abraham, 2009).

Cover crop established fields showed more porosity, aggregate stability and water holding capacity than bare lands or pineapple intercropped fields ((Philip *et al.*, 2005 and Philip,2014). The improvement in soil structure and other physical properties result in a more favourable environment for root growth and proliferation.

The studies conducted at TR&T estate, Mundakayam showed that soil fertility was

Table 2

Pueraric	
Mucuna	
Bare lan	
SE#	
CD ##(0	

*OC- orga

enhance
such as
et al., 2
significa
Another
capacity
nodules
was repo

Table 2. Chemical properties of surface soil under two year old legume covers

	OC * (%)	CEC** cmol (+) kg^{-1}	Available nutrients (mg $100g^{-1}$soil)				pH
			P	K	Ca	Mg	
Pueraria	1.65	6.92	2.62	11.4	20.81	4.64	4.94
Mucuna	2.38	11.05	0.65	8.57	11.50	4.42	4.39
Bare land	1.46	6.52	1.01	5.86	14.38	3.07	4.64
SE#	0.10	0.60	0.55	0.78	2.21	0.61	0.09
CD ##(0.05)	0.29	1.77	1.63	2.30	6.50	NS	0.26

*OC- organic carbon **CEC- cation exchange capacity, # SE -Standard error, ##CD Critical difference

enhanced by the establishment of legume covers such as *Pueraria* and *Mucuna* (Table 2, Philip *et al.*, 2005). Soil pH under *Pueraria* was significantly higher than that under *Mucuna* .

Another advantage of these legume covers is their capacity to fix atmospheric nitrogen in their root nodules which later becomes available to plants. It was reported that about 58 and 70kg N ha^{-1} $year^{-1}$ was fixed by *Pueraria* and *Mucuna* respectively (Prasannakumari *et al.*, 2012). This will help in reducing the use of costly nitrogenous fertilizers. It is also reported that these legumes have the ability to solubilize phosphorus from the fixed pool (Prasannakumari *et al.*, 2008).

The luxuriant growth of cover crops suppresses weed growth in rubber plantations which in

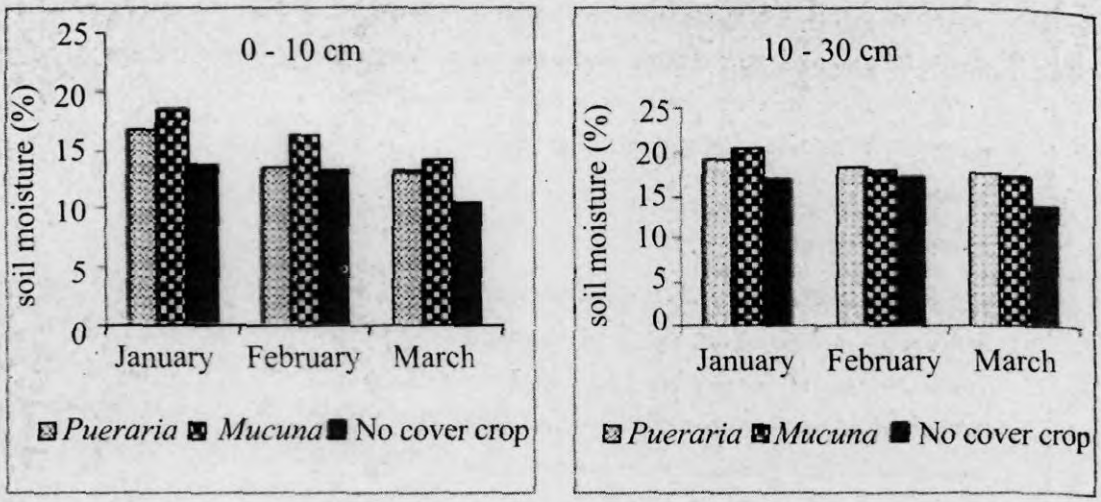


Fig 1. Soil moisture in immature plantation with different ground covers (TR&T, estate, Mundakayam)

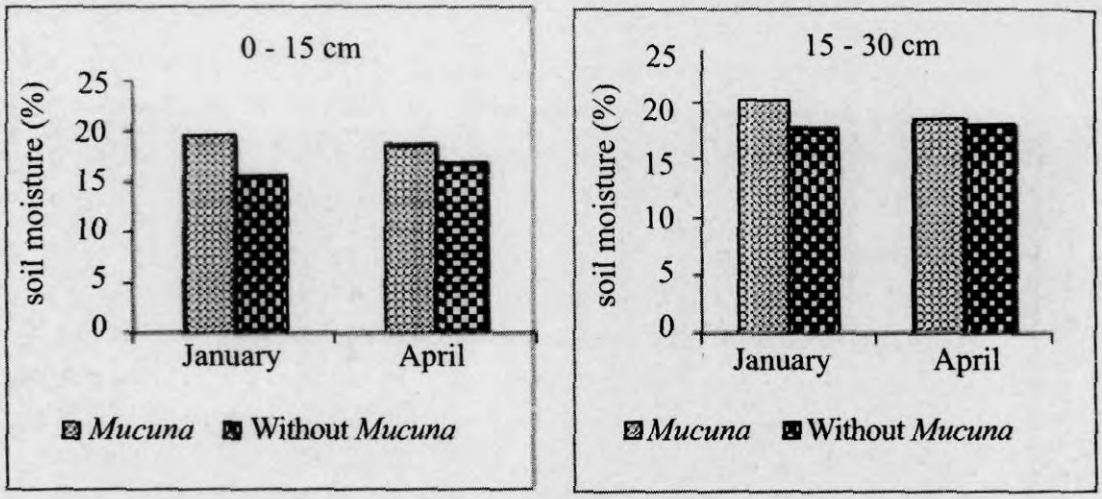


Fig 1. Soil moisture in mature plantation (Malankara estate)

turn reduces the weeding expenses. The dense vegetative cover of these legumes increased soil moisture also (Kothandaraman *et al*, 1989 and Fig.1, Fig.2).

The improvement in soil properties through the establishment of legume covers resulted in enhanced growth of young rubber and reduced the gestation period (Mathew *et al.*, 1989; Punnoose *et al.*, 1994).

Aftercare

For the quick establishment of covercrops ,manuring (165kg rock phosphate per hectare in two equal installments, the first, one month after sowing and the second, two months after the first application) is helpful. In areas where the soil is deficient in available potassium (<50 ppm), 50 kg muriate of potash also should be added along with 165kg rock phosphate. Weeding may be

carried out in the cover crop patches, in the initial stages, for the easy establishment. Cattle grazing and removal of vines for fodder should also be prevented for ensuring proper growth and ground spread.

Control of cover crop

Cover crop established in patches spread rapidly and cover the interspace within a year in most cases. Twining of cover crop vines on young rubber should be prevented and the plant bases also be kept free of cover crop in the initial 3-4 years. *Mucuna* can be effectively controlled by spraying 2,4 D 1.00 kg a.i. ha^{-1}.

Establishment of leguminous cover crops is an easily adoptable biological soil conservation method in rubber plantations which improves soil fertility as well. Farmers may take more care in adopting this less expensive agromanagement practice.

References

Abraham, J. and Chudek, J.A., 2008. Studies on litter characterization using 13C NMR and assessment of microbial activity in natural forest and plantation crops' (teak and rubber) soil ecosystems of Kerala, India. *Plant and Soil* 303: 265-273.

Kothandaraman. R., Mathew. Krishnakumar,A.K., Joseph K., Jayaratnam, K. and Sethuraj, M.R., 1989. Comparative efficiency of *Mucuna bracteata* D.C and *Puerariap haseoloides* Benth. on soil nutrient enrichment, microbial population and growth of *Hevea*. *Indian Journaal of Natural Rubber Research*.2.(2);147-150

Mathew, M., Punnoose, K. I., Potty, S.N.and George, E.S., 1989. A study of the response in yield and growth of rubber grown in association with legume and natural ground cover during immature phase. *Journal of Plantation Crops* (16): 433-441.

Philip, A., George E. S. and Punnoose, K. I., 2005. Comparative evaluation of dry matter production and nutrient accumulation in the shoots of *Pueraria phaseoloides* Benth and *Mucuna bracteata* D.C. grown as cover crop in an immature rubber (*Hevea brasiliensis*) plantation. *Natural Rubber Research*.18(1): 87-92.

Philip, A., George E. S. and Punnoose, K. I., 2005. Effect of *Pueraria phaseoloides* Benth and *Mucuna bracteata* on the physico-chemical properties of soils of immature rubber plantations.*Natural Rubber Research*.18(1): 93-100.

Philip, A and Abraham, J., 2009. Litter chemistry and decomposition in rubber plantations. *Natural Rubber Research*, 22 (1&2) : 10-16

Philip, A., 2014. Soil characterization of rubber ecosystems with special reference to soil organic matter. Ph.D thesis, M.G. University. 123p.

Prasannakumari, P., Jessy, M.D., Philip, A., Nair, A.N.S and Nair, N.U., 2008. Phosphorus mobilization by leguminous cover crops grown in rubber plantation. Abstracts.National conference on Organic farming in horticultural crops with special reference to plantation crops. CPCRI, Kasaragod, Kerala, 15-18, October, 2008.p 124.

Prasannakumari, P., Joseph, M., Jessy, M.D., Philip, A., 2012. Estimates of nitrogen fixation by leguminous cover crops grown in immature rubber plantations using 15N isotope dilution technique. Abstracts, International rubber conference,28-31 October,2012, Kovalam, Kerala, India. 144-146.

Punnoose, K.I., Mathew, M., Pothen, J., George E. S. and Lakshmanan, R., 1994. Response of rubber to fertilizer application in relation to type of ground cover maintained during immature phase. *Indian Journal of Natural Rubber Research*, 7(1): 38-45.