

# Influence of the Establishment of Cover Crops on the Floral Distribution in Rubber (*Hevea brasiliensis*) Plantation

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## ABSTRACT

This study was carried out to investigate influence of the establishment of cover crops on the floral distribution in rubber (*Hevea brasiliensis*) plantations. Two mature rubber areas, one planted with *Mucuna* and the other with *Pueraria* were selected from each of the two places, Rubber Research Institute Agalawatta and sub station at Kuruwita in Kalutara and Rathnapura administrative districts respectively. This was conducted during the January to May 2005. All species were identified with the help of the herbarium specimens. The relative density, relative frequency, and the summed dominance ratio of the flora were worked out for the determination of the ecological dominance of individual species. Altogether 29 species were recorded from *Mucuna* grown field. Only 20 and 21 species were found in Agalawatta and Kuruwita, respectively. Also 12 species were common to both area. In *Pueraria* grown fields 42 floral species were recorded, i.e. 37 from Agalawatta and 29 from Kuruwita, whilst 24 species were common to both areas.

*Digitaria timorensis* (kunth) Bal., *Syngonium podophyllum*, *Adiantum latifolium* Lam., *Isachne miliacea* and *Spermacoce latifolia* were the common and dominant species with *Mucuna* cover crop. *Exallage auricularia*, *Ottlochloa nodosa*, *Axonopus compressus*, *Mikania cordata*, *Paspalum conjugatum* and *Adiantum latifolium* Lam. were the common and dominant species with *Pueraria* cover crop. Poaceae was the most widely spread family in all four sites followed by Rubiaceae. Floral and family diversity were higher in *Pueraria* when compared with that in *Mucuna*.

**KEY WORDS:** Cover Crop, Floral Species, *Pueraria*, *Mucuna*.

## INTRODUCTION

Rubber (*Hevea brasiliensis*) tree significantly contributes to SriLankan economy by providing latex for natural rubber industry. It contributes 0.5% to total Gross Domestic Production (Anon, 2004). There are other benefits from rubber to the society providing timber, forest cover and employment opportunities. At present average yield per hectare is low. However potential yield has been recorded as 2000kg/ha by using proper cultivation practices.

Being a perennial crop, rubber usually takes 4-5 years for canopy development. At the initial stage this results in a poor protection of soil. Therefore, extra care should be taken to prevent soil erosion and to conserve soil fertility. Leguminous, non-leguminous or natural weed covers are commonly used for this purpose.

The main advantage of legumes cover over the natural weeds is the ability of legumes to fix atmospheric nitrogen. Additional application of nitrogenous fertilizer may be required when there is no leguminous ground cover.

Some of the most important leguminous cover crops used in rubber plantations are, *Pueraria phaseoloides*, *Mucuna bracteata*, *Desmodium ovalifolium*, *Calopogonium mucunoides*, *Centrosema pubescens* and *Stylosanthes gracillis*.

A cover crop consisting of two or more species of legume is often preferred because shade and drought resistance or other qualities of one may be offset by those of the others (Anon, 1995).

In most of rubber plantations in Sri Lanka, a mixture of cover crops can be seen during the immature phase of rubber and changes in the composition of legumes occur with the changes in environmental condition, particularly with the development of the rubber canopy. An ideal example

of this would be the replacement of *Pueraria phaseoloides*, which prefers direct sunlight, by shade tolerance *Desmodium ovalifolium* as the rubber tree matures. Some cover crops are tolerant to shade and some are susceptible. Shade tolerant varieties remain even after the plantation becomes mature. If there is no proper cover crop, other floral species become dominant. (Jayasinghe and Wettasinghe, 1989)

All plants require light, water, CO<sub>2</sub> and soil nutrients for growth and development. To fulfil their requirements they compete with each other. The competition given by some floral species result in some retardation of growth in the young rubber plants. The effect of this early growth retardation often persists for many years (Edgar, 1958) and may affect the productivity of rubber. To overcome this problem, care should always be taken to suppress the floral species, which can compete with rubber at any stage. As a practical measure for this, cover crop or any other floral species should be kept away from the base of rubber trees by circle or strip weeding (Edgar, 1958).

Legume cover crops established in inter-row areas of rubber have some benefits, such as increase in organic matter and nitrogen in soil, nutrients conservation and recycling, improvement of soil properties, protect soil from erosion, soil moisture conservation, facilitation for feeder root development and suppress growth of weeds. Therefore this will improve the yield and growth of rubber. (Samarappuli 1999)

Growth of leguminous covers is a standard practice in rubber plantations of Sri Lanka; but some planters do not practice this due to some constraints such as lack of planting material, high establishment cost, requirement of excess labour, etc.

**MATERIALS AND METHODS**

This study was carried out at Rubber Research Institute, Agalawatta and Kuruwita Substation, for a period of five months from January to May 2005.

Two mature rubber areas, one planted with *Mucuna* and the other with *Pueraria* were selected from each of the two places, Rubber Research Institute Agalawatta and sub station at Kuruwita in Kalutara and Rathnapura administrative districts respectively. Selected rubber lands were approximately of same age, planted in 1992 and 1993

Herbarium specimens were prepared from the collected plant materials from the study area and they were identified with the help of the herbarium specimens kept at the National Herbarium of the Royal Botanical Garden, Peradeniya.

Fifteen samples were taken from each hectare. A transect was established along the maximum possible length of the selected area as shown in the Figure 1.

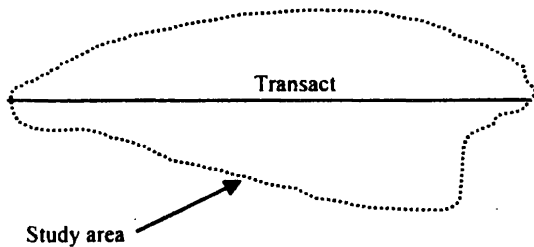


Figure 1. Sketch showing the transect

To determine the gap between two sample points, total length of transect was divided by the total number of samples. Iron quadrant with a size of 1m x 1m was used to take the samples. Plants species in each sample were removed and separated and finally counted. Data were recorded.

By using above data, the density (D) and percentage frequency (F) as well as the relative density (RD) and relative frequency (RF) were worked out for each flora species. To express the ecological significance of a floral species based on a single value (Thomas and Abraham, 1996) summed dominance ratio was worked out using RD and RF values. Relationships used in the estimation of above parameters are given below.

$$\text{Density} = \frac{\text{Total count of the species from all sites}}{\text{Number of sites where the species is present}}$$

$$\text{Frequency} = \frac{\text{Number of sites where the species occur}}{\text{Total number of sites surveyed}}$$

$$\text{Relative density (RD)} = \frac{\text{Density of a species}}{\text{Sum density of all species}}$$

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Sum frequency of all species}}$$

$$\text{Summed Dominance Ratio (SDR)} = \frac{\text{RD} + \text{RF}}{2}$$

**RESULTS AND DISCUSSION**

***The Floral Distribution in Rubber Clearings with *Mucuna bracteata* as the Cover Crop.***

In both Agalawatta and Kuruwita sites found 20 and 21 floral species respectively. Out of these 12 species were common to both sites, whilst eight species were found only at Agalawatta site and nine species only at Kuruwita site. Out of ten dominant species in each area five species were common to both areas. (Appendix 1)

*Ottochloa nodosa* was the most wide spread plant species in Agalawatta area. It has SDR of 12.0. This is a perennial grass with a creeping habit. It spreads on the surface of the soil and protects soil against the erosion. But it was not recorded in the group of first ten leading dominant species in Kuruwita area. Reason for this is unknown. *Adiantum latifolium lam* was the dominant plant species in Kuruwita area and had a SDR value of 14.2. It is a fern and belongs to family Pteridaceae. Roots of this species were distributed near the ground surface as a mat. It had the ability to hold soil particles and prevent soil erosion. In Agalawatta area *Digitaria timorensis (kunth) Bal.*, ranked second with a SDR value of 11.0. In Kuruwita area *Spermacoce latifolia* was the second ranking species using a SDR value of 11.9. (Appendix 1)

In Agalawatta area five species, *Ottochloa nodosa*, *Digitaria timorensis (kunth) Bal.*, *Commelina petersii*, *Exallage auricularia* and *Syngonium podophyllum* collectively had a SDR value of 51.1. These five species constituted more than 50 per cent of the flora in rubber plantations. Rest of the 15 floral species constituted the balance 48.9 per cent of SDR values. In Kuruwita area five species, *Adiantum latifolium lam*, *Spermacoce latifolia*, *Digitaria timorensis (kunth) Bal*, *Torenia travancorica Gamble*, and *Syngonium podophyllum* had a total SDR value of 50.3 and balance 49.7 per cent was constituted by 16 floral species. (Appendix 1)

***The Dominant Family Composition in Rubber Plantation with *Mucuna bracteata* as the Cover Crop.***

Poaceae was the most dominant family followed by Rubiaceae and Pteridaceae. These three families had a total SDR value of 55.1 this suggested that about 50 percent of the species in *Mucuna* grown area belonged to the three families, Poaceae, Rubiaceae and Pteridaceae (Figure 2) rest of the 12 families constituted other 44.9 per cent.

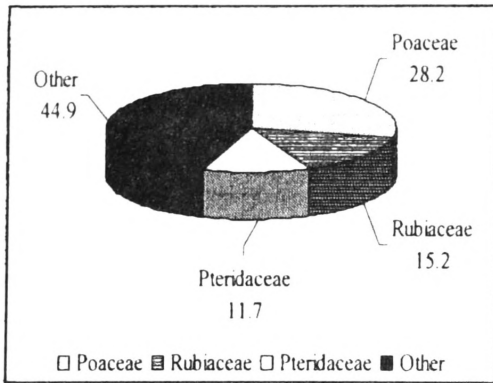


Figure 2. Family composition in rubber land grown with *Mucuna bracteata* as cover crop.

**The Floral Distribution in Rubber Clearings with *Pueraria phaseoloides*.**

In both Agalawatta and Kuruwita sites 37 and 29 floral species were found respectively. Out of these 24 species were common to both sites, whilst 13 species were specific to Agalawatta and five species recorded only in Kuruwita. Out of the ten most dominant species in each area six species were common to both areas. (Appendix 2)

*Exallage auricularia* was the wide spread species in Agalawatta and Kuruwita area with SDR values of 9.7 and 17.5 are respectively. This is a woody species, endemic to Sri Lanka. *Ottlochloa nodosa* ranked second with SDR values 9.6 and 9.8 in Agalawatta and Kuruwita areas respectively.

*Axonopus compressus* had a SDR value of 7.5 and it ranked third in Agalawatta area. It has a spreading nature and hence useful to reduce erosion in sloping terrains and also relished by cattle. *Digitaria timorensis (kunth) Bal.* ranked third in Kuruwita, with a SDR value of 8.9. (Appendix 2)

When the flora were ranked according to SDR values seven flora, *Exallage auricularia*, *Ottlochloa nodosa*, *Axonopus compressus*, *Mikania cordata*, *Spermacoce latifolia*, *Ageratum conyzoides* and *Paspalum conjugatum* constituted an SDR value of 51.3 in Agalawatta. That indicated more than 50 per cent of the flora in rubber plantations constituted by these species. Other 48.7 per cent of SDR values were constituted by the rest of 30 floral species.

In Kuruwita area five floral species, *Exallage auricularia*, *Ottlochloa nodosa*, *Digitaria timorensis (kunth) Bal.*, *Paspalum conjugatum* and *Isachne miliacea* constituted an SDR value of 53.0 indicating that more than 50 per cent of the species in rubber plantations constituted by these floral species. Other 47.0 was constituted by the rest of 24 species. (Appendix 2)

**The Dominant Family Composition in Rubber Plantation with *Pueraria phaseoloides* as cover crop.**

Poaceae was the most dominant family followed by Rubiaceae. These two families constituted an SDR value of 57.6 and suggested that more than 50 per cent of the families belonged to these two families in *Pueraria* grown area. Rest of the 21 families constituted other 42.4 per cent SDR value. (Figure. 3)

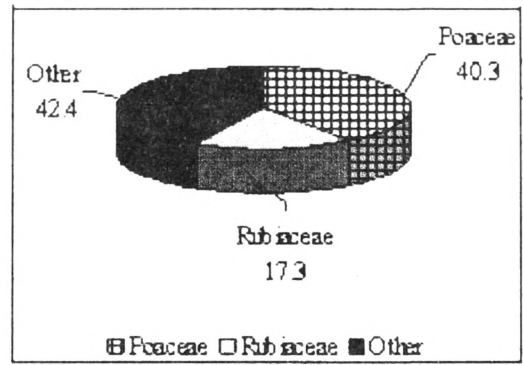


Figure.3. Family composition in rubber land grown with *Pueraria phaseoloides* cover crop

**Floral distribution in Agalawatta**

Floral distribution in Agalawatta is given in Figure 4. for *Pueraria* and *Mucuna* grown areas separately

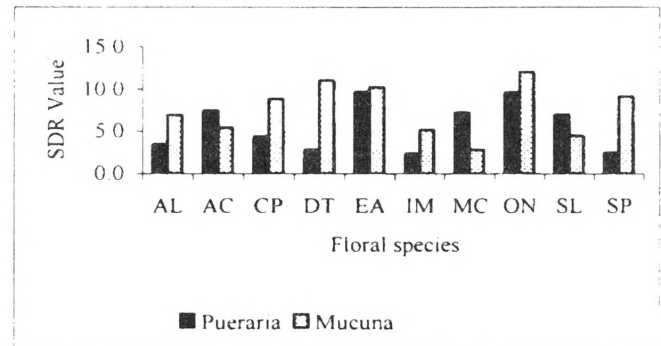


Figure 4. Floral distribution in Agalawatta

AL: *Adiantum latifolium Lam.*, AC: *Axonopus compressus*  
 CP: *Commelina petersii*, DT: *Digitaria timorensis (kunth) Bal.*, EA: *Exallage auricularia*. IM: *Isachne miliacea*, MC: *Mikania cordata*, ON: *Ottlochloa nodosa*, SL: *Spermacoce latifolia*, SP: *Syngonium podophyllum*

Dominant ratios of *Axonopus compressus*, *Mikania cordata* and *Spermacoce latifolia* were higher under the cover crop of *Pueraria* than *Mucuna*. The rest of the seven species showed higher dominant ratio with *Mucuna* cover crop.

**Floral distribution in Kuruwita**

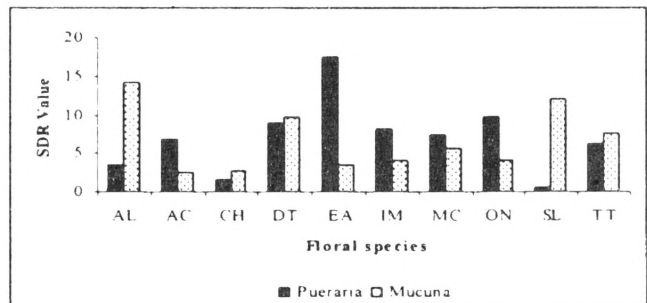


Figure 4. The dominant floral species in Kuruwita area

AL: *Adiantum latifolium lam.*, AC: *Axonopus compressus*, CH: *Caladium hortulanum*, DT: *Digitaria timorensis (kunth) Bal.*, EA: *Exallage auricularia*, IM: *Isachne miliacea*, MC: *Mikania cordata*, ON: *Ottlochloa nodosa*, SL: *Spermacoce latifolia*, TT: *Torenia travancorica Gamble*.

Floral distribution in Kuruwita is given in Figure.5 for *Pueraria* and *Mucuna* grown areas separately.

Dominant ratios of *Axonopus compressus*, *Exallage auricularia*, *Isachne miliacea*, *Mikania cordata* and *Ottlochloa nodosa* were higher under the cover crop of *Pueraria* than the *Mucuna*. The rest of the species showed higher dominant ratio with *Mucuna* cover crop.

#### **Species Specific to *Pueraria phaseoloides* Grown Field.**

Species *Asystasia variabilis*, *Caryota urens*, *Cuscuta chinensis*, *Cyathula prostrate*, *Cyperus rotundus*, *Cyrtococcum muricatum*, *Eupatorium odoratum*, *Justicia betonica*, *Pothos hookeri*, *Sauropus androgynus*, *Symplocos cochinchinensis*, *Zyzygium umbrosum*, *Lygodium Flexuosum*, *Selaginella spp*, *Oplismenus compositus* and *Mimosa pudica* were found only in *Pueraria* grown area.

*Eupatorium odoratum* was a serious threat to rubber because of its tall stature and quick growth resulting in serious competition with the crop for nutrients and water. The rubber growers too have identified this species as a serious problem as it hinders the routine agricultural operations of tapping and latex collection. *Cucuta chinensis* is a parasitic species. It spreads as mats on the other flora, growth of other species were weaker. *Pothos hookeri* is a climber. It was found climbing on the trunk of rubber tree thus it hindered the routine cultural practices such as tapping, manuring etc.

#### **Species Specific to *Mucuna bracteata* Grown Field.**

Species *Dieffenbachia Spp.*, *Pityrogramma dealbata*, *Desmodium ovalifolium*, *Vernonia cinera* (L.) Less and *Wedalia trilobata* were found only in *Mucuna* grown areas. *Desmodium ovalifolium* and *Wedalia trilobata* included under the ten dominant species.

### **CONCLUSIONS**

Poaceae was the most dominant family in all study areas, followed by Rubiaceae. Family diversity

was higher in *Pueraria* field when compared with *Mucuna* fields. Also floral diversity was higher in *Pueraria* field when compared with *Mucuna* fields.

### **ACKNOWLEDGEMENT**

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APPENDIX

Appendix.1. Distribution of flora in rubber plantations with *Mucuna bracteata*.

Floral Species	Family	Agalawatta(SDR Value)	Kuruwita(SDR Value)
<i>Ottlochloa nodosa</i>	Poaceae	* 12.0	4.0
<i>Digitaria timorensis</i> (kunth) Bal.	Poaceae	* 11.0	* 9.8
<i>Exallage auricularia</i>	Rubiaceae	* 10.2	3.6
<i>Syngonium podophyllum</i>	Araceae	* 9.1	* 6.8
<i>Adiantum latifolium</i> Lam.	Pteridaceae	* 6.9	* 14.2
<i>Axonopus compressus</i>	Poaceae	* 5.4	2.5
<i>Isachne miliacea</i>	Poaceae	* 5.2	* 4.0
<i>Spermaceoce latifolia</i>	Rubiaceae	* 4.5	* 11.9
<i>Mikania cordata</i>	Asteraceae	2.8	* 5.7
<i>Clidemia hirta</i>	Melastomataceae	1.9	1.7
<i>Centrosema pubesense</i>	Leguminosae	1.0	1.1
<i>Phyllanthus debilis</i>	Euphorbiaceae	1.0	1.9
<i>Commelina petersii</i>	Commelinaceae	* 8.8	-
<i>Wedalia trilobata</i>	Asteraceae	* 7.8	-
<i>Dieffenbachia</i> Spp.	Araceae	3.7	-
<i>Paspalum conjugatum</i>	Poaceae	2.6	-
<i>Pityrogramma dealbata</i>	Pteridaceae	2.4	-
<i>Ageratum conyzoides</i>	Asteraceae	1.3	-
<i>Vernonia cinera</i> (L.) Less	Asteraceae	1.3	-
<i>Metathelypteris flaccida</i>	Thelypteridaceae	1.0	-
<i>Caladium hortulanum</i>	Araceae	-	2.8
<i>Desmodium ovalifolium</i>	Leguminosae	-	* 4.1
<i>Desmodium triflorum</i>	Leguminosae	-	1.1
<i>Helminthostachys zeylanica</i>	Ophioglossaceae	-	1.4
<i>Kyllinga bulbosa</i>	Cyperaceae	-	* 6.2
<i>Lindenia nummularifolia</i>	Scrophulariaceae	-	* 5.2
<i>Nephrolepis</i> spp	Oleandraceae	-	2.2
<i>Torenia travancorica</i> Gamble	Scrophulariaceae	-	* 7.5
<i>Urena sinnata</i>	Malvaceae	-	2.1

SDR = Summed dominance ratio, \* Ten dominant species

Appendix 2. Distribution of flora in rubber plantations with *Pueraria phaseoloides*

Floral spp	Family	Agalawatta(SDR Value)	Kuruwita(SDR Value)
<i>Exallage auricularia</i>	Rubiaceae	* 9.7	* 17.5
<i>Ottlochloa nodosa</i>	Poaceae	* 9.6	* 9.8
<i>Axonopus compressus</i>	Poaceae	* 7.5	* 6.8
<i>Mikania cordata</i>	Asteraceae	* 7.2	* 7.3
<i>Spermaceoce latifolia</i>	Rubiaceae	* 7.0	0.5
<i>Ageratum conyzoides</i>	Asteraceae	* 5.7	0.4
<i>Paspalum conjugatum</i>	Poaceae	* 4.6	* 8.8
<i>Commelina petersii</i>	Commelinaceae	* 4.4	1.5
<i>Adiantum latifolium</i> Lam.	Pteridaceae	* 3.5	* 3.5
<i>Cyathula prostrate</i>	Amaranthaceae	3.0	1.2
<i>Digitaria timorensis</i> (kunth) Bal.	Poaceae	2.8	* 8.9
<i>Cyrtococcum muricatum</i>	Poaceae	2.7	* 7.3
<i>Isachne miliacea</i>	Poaceae	2.3	* 8.1
<i>Caryota urens</i>	Palmae	2.0	0.3
<i>Mimosa pudica</i>	Leguminosae	1.5	0.3
<i>Zyzygium umbrosum</i>	Myrtaceae	1.3	0.5
<i>Centrosema pubesense</i>	Leguminosae	1.2	3.1
<i>Lygodium flexuosum</i>	Schizaeaceae	1.0	0.3
<i>Urena sinnata</i>	Malvaceae	1.0	0.3
<i>Oplismenus compositus</i>	Poaceae	1.0	0.4
<i>Clidemia hirta</i>	Melastomataceae	0.5	0.4
<i>Phyllanthus debilis</i>	Euphorbiaceae	0.4	0.5
<i>Torenia travancorica</i> Gamble.	Scrophulariaceae	0.4	* 6.3
<i>Metathelypteris flaccida</i>	Thelypteridaceae	0.3	0.3
<i>Asystasia variabilis</i>	Acanthaceae	* 3.6	-
<i>Justicia betonica</i>	Acanthaceae	3.1	-
<i>Nephrolepis</i> spp	Oleandraceae	2.7	-
<i>Syngonium podophyllum</i>	Araceae	2.4	-
<i>Sauropus androgynus</i>	Euphorbiaceae	1.8	-
<i>Pothos hookeri</i>	Araceae	1.3	-
<i>Cuscuta chinensis</i>	Convolvulaceae	1.1	-
<i>Symplocos cochinchinensis</i>	Symplocaceae	0.9	-
<i>Cyperus rotundus</i>	Cyperaceae	0.8	-
<i>Gleichenia linearis</i> Burm.	Gleicheniaceae	0.6	-
<i>Havea brasiliensis</i>	Euphorbiaceae	0.4	-
<i>Desmodium triflorum</i>	Leguminosae	0.3	-
<i>Eupatorium odoratum</i>	Asteraceae	0.3	-
<i>Caladium hortulanum</i>	Araceae	-	1.5
<i>Helminthostachys zeylanica</i>	Ophioglossaceae	-	0.7
<i>Kyllinga bulbosa</i>	Cyperaceae	-	0.3
<i>Lindenia nummularifolia</i>	Scrophulariaceae	-	1.7
<i>Selaginella</i> spp	Selaginellaceae	-	1.6

SDR = Summed dominance ratio, \* Ten dominant species