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QUANTIFICATION OF MEDICINALLY VALUABLE WEEDS IN OIL PALM PLANTATIONS OF KERALA

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Abstract: The medicinally valuable weeds naturally growing in young, medium and mature plantations of oil palm were identified and quantified by stratified random sampling technique. Quantification of plants was done in comparison with that in the open condition. *Chrysopogon aciculatus* Trin. dominates in all the four strata. *Naregamia alata* Wight & Arn. is another dominant species in mature plantation. *Hemidesmus indicus* R. Br. occurs frequently in all the four strata. Another frequently occurring species in young oil palm plantation is *Elephantopus scaber* Linn. and in medium plantations is *Chromolaena odorata* King & Robinson. *Phyllanthus amarus* Schum.& Thonn. is very frequent in medium plantation and open condition. *Holostemma adakodien* Schult occurs frequently in mature plantation. Young oil palm plantation and open condition were found to be the most similar strata whereas mature plantation and open condition were the most dissimilar strata in vegetation pair-wise analysis. Medium oil palm plantation was found to have high concentration of dominance. Species diversity was the highest in mature oil palm plantation. Species evenness was maximum in open condition.

Keywords: Quantification, medicinal weeds, oil palm.

INTRODUCTION

The agro-climatic conditions prevailing in oil palm plantations of Kerala favour the luxuriant growth of weeds, as the plantations are located in areas, which were originally forests or adjacent places. The only cultural operation done in the interspace of oil palms is one or two slashing in a year. The root systems of weeds remain undisturbed during slashing. This results in luxuriant growth of the weed flora in oil palm plantations by the commencement of rain many of which are valuable and scare medicinal plants. The present study was conducted so as to unveil the possibility of using these weeds as an alternate source for medicinal plants.

MATERIALS AND METHODS

The study was carried out at selected oil palm plantations of the Oil Palm India Ltd located at Kulathupuzha, Kollam District, Kerala. Geographically the oil palm plantation at Kulathupuzha covers a total area of 390 ha. It is situated at a latitude of 9-10° N and longitude 76-77° E. Average annual rainfall during the last three years was 300–400 cm. Temperature ranged between 250 and 280°C. Palms in the plantation are spaced at 10 m in triangular planting system. The variety of oil palm planted is Tenera.

Collection of plant samples

Sampling technique

Stratified random sampling was done in four strata viz. young (<5 years), medium (5-11 years) and mature (>11 years) oil palm plantation and the open condition. The medicinally valuable weeds in the four strata were identified and quantified by the random sampling technique using 1.0 m^2 iron quadrat. The quadrat was thrown at random and all the plants inside the quadrat were collected and sorted. A total of 80 such sampling units were taken randomly giving sufficient representation to the area covered.

Study of vegetation parameters

Analytical characters were determined by means of list or census quadrat method. In this method, the plant species are listed and number of individuals of each species is counted. The vegetation parameters computed were absolute frequency (F), relative frequency (Rf) (%), absolute density (D), relative density (Rd) (%), importance value (IV = Rf + Rd), summed dominance ratio (SDR = IV/2) and abundance (Kandasamy, 1996)

Plant vegetation analysis

Plant vegetation analysis was done using the following indices viz. coefficient of community - if community X is compared to Y, the number of species common to both expressed as a per cent of the total number of X plus Y has been termed the coefficient of community (Pablico and Moody, 1983); site similarity, CN=2Nj/(Na+ Nb) where Nj = number of species common to both sites, Na = number of species found in site 1, Nb = number of species found in site 2 (Nambiar *et al.*, 1985); Simpson's

index, C = $\Sigma(Y/N)^2$; where Y=IV or SDR of a given species, N= sum of IV's or SDR's for all species in the sample (Whittaker, 1965); Shannon's index, H'= -PilnPi, where Pi = *nil* N (proportional abundance of the *i*th species) (Magurran,1988); and Evenness index, J = H'/H'max (Brower and Zar, 1977).

Table 1. Vegetation parameters of medicinally valuable weeds in different strata of oil palm plantations

Sl. No.	Name of plant	Strata of plantation															
		Young[a]				Medium[b]				Mature[c]				Open			
		Rd	Rf	IV	A	Rd	Rf	IV	A	Rd	Rf	IV	A	Rd	Rf	IV	A
1	*Abrus precatorius* Linn.	-	-	-	-	*	-	*	*	0.1	0.7	0.8	2.0	*	*	**	*
2	*Acanthospermum hispidum* DC.	-	-	-	-	*	*	*	*	*	*	*	*	0.7	1.9	2.7	3.0
3	*Ageratum conyzoides* Linn.	-	-	-	*	1.4	3.1	4.5	5.5	*	*	-	*	3.6	4.8	8.4	5.8
4	*Aristida setacea* Retz.	11.6	4.7	16.3	57.8	*	*	*	*	*	*	-	*	*	*	*	*
5	*Aristolochia indica* Linn.	*	*	*	-	*	*	*	*	0.1	0.7	0.8	2.0	*	*		*
6	*Asparagus racemosus* Willd.	*	*	*	*	*	*	*	*	0.2	1.9	2.1	1.0	*	*	-	*
7	*Atylosia goensis* Dalz.	*	*	*	*	0.1	1.6	1.7	1.0	0.2	1.9	2.1	1.0	*	*	*	*
8	*Biophytum sensitivum* DC.	*	*	*	*	*	*	*	*	0.1	0.7	0.8	2.0	*	*	-	*
9	*Bulbostylis barbata* Kunth.	*	*	*	*	*	*	*	*	*	-	-	-	2.1	2.9	5.0	5.7
10	*Calophyllum polyanthum* Wall. ex Choisy	*	*	*	-	*	-	*	*	0.1	0.7	0.7	1.0	-	*	*	-
11	*Calotropis gigantea* R. Br.	*	*	*	-	*	*	*	*	*	*	*	*	0.1	1.0	1.1	1.0
12	*Calycopteris floribunda* Poir.	*	*	*	-	0.3	3.1	3.4	1.0	0.1	0.7	0.7	1.0	*	*	*	*
13	*Careya arborea* Roxb.	0.3	3.7	4.0	1.8	*	*	*	-	0.1	0.7	0.7	1.0	*	*	*	*
14	*Cassia tora* Linn.	0.04	0.9	1.0	1.0	*	*	*	*	*	*	*	*	*	*	*	*
15	*Catunaregam spinosa* Tirvengadum	*	*	*	*	0.1	1.6	1.7	1.0	*	*	*	*	*	*	*	*
16	*Centella asiatica* (Linn.) Urban	*	*	*	*	*	*	*	*	0.5	1.3	1.8	5.0	*	*	-	-
17	*Chrysopogon aciculatus* Trin.	36.7	9.3	46.0	91.1	57-6	9.3	66.9	75.3	36.0	6.5	42.5	66.7	21.6	2.9	24.5	58.0
18	*Clerodendrum viscosum* Vent.	0.1	1.9	2.0	1.5	0.3	3.1	3.4	1.0	*	*	*	*	0.5	2.9	3.4	1.3
19	*Curculigo orchioides* Gaertn.	*	*	*	*	*	*	*	*	1.4	3.2	4.6	5.0	*	*	*	*
20	*Cyclea peltata* Hook.f.&Thoms.	0.2	2.8	3.0	1.3	0.3	3.9	4.2	1.0	0.2	1.3	1.5	2.0	0.5	3.9	4.3	1.0
21	*Cynodon dactylon* Pers.	*	*	*	*	*	*	-	*	-	*	-	*	3.8	2.9	6.7	10.3
22	*Cyperus rotundus* Linn.	1.1	3.7	4.9	7.0	*	*	*	*	*	*	-	*	*	*	*	*
23	*Desmodium gangeticum* DC.	*	*	-	*	0.2	2.3	2.5	1.0	-	*	-	*	0.3	1.9	2.2	1.0
24	*Desmodium triflorum* DC.	6.8	4.7	11.5	33.8	14.0	3.1	17.1	55	2.9	3.9	6.8	9.0	1.0	1.0	2.0	8.0

Table 1. Continued

Sl. No.	Name of plant	Strata of plantation															
		Young[a]				Medium[b]				Mature[c]				Open			
		Rd	Rf	IV	A	Rd	Rf	IV	A	Rd	Rf	IV	A	Rd	Rf	IV	A
25	*Elephantopus scaber* Linn.	5.2	5.6	10.8	21.3	2.0	3.1	5.1	7.8	2.1	3.2	5.3	7.6	12.4	4.8	17.2	20.0
26	*Emilia sonchifolia* DC.	0.7	2.8	3.5	5.7	0.1	0.8	0.9	2.0	0.6	3.9	4.5	1.8	3.2	4.8	8.0	5.2
27	*Evolvulus alsinoides* Linn.	0.1	1.9	2.0	1.0	2.4	3.9	6.2	7.4	*	-	*	*	*	*	*	*
28	*Hemidesmus indicus* R. Br.	1.0	5.6	6.6	4.2	1.5	5.4	6.9	3.3	1.3	3.9	5.2	4.0	2.9	5.8	8.6	3.8
29	*Hemionettis arafolia* Moore	-	*	-	*	*Ml*	2.3	2.6	1.7	0.7	2.6	M"	3.0	-	-	-	-
30	*Holostemma adakodien* Schult.	-	*	-	*	#	*	*	*	1.5	5.2	6.7	3.5	-	-	*	-
31	*llyptix suaveolens* Poit.	1.9	4.7	6.6	9.4	2.2	1.6	3.7	17.0	1.4	2.6	4.0	6.5	4.7	3.9	8.6	9.5
32	*Ipomoea sepiaria* Roxb.	*	*	*	*	*	*	-	*	0.1	0.7	0.7	1.0	*	*	*	*
33	*Lantana camara* Linn. var. *aculeata* (L.) Moldenk	0.1	1.9	2.0	1.0	*	*	-	*	*	*	*	*	0.4	2.9	3.3	1.0
34	*Mimosa pudica* Linn.	0.3	2.8	3.1	2.3	1.6	3.9	5.5	5.0	0.7	1.9	2.6	4.3	3.8	3.9	7.7	7.8
35	*Naregamia alata* Wight & Arn.	-	-	*	-	*	*	*	*	7.2	6.5	13.6	13.3	*	-	-	*
36	*Oldenlandia umbellata* Linn.	0.4	1.9	2.2	4.5	*	-	*	*	*	*	*	*	3.5	3.9	7.3	7.0
37	*Pergularia daemia* (Forssk.) Chiov.	*	*	*	*	*	*	*	*	0.1	0.7	0.7	0.0	*	*	*	*
38	*Phyllanthus amarus* Schum. & Thonn.	0.4	1.9	2.2	4.5	0.5	0.8	1.3	8.0	1.8	4.5	6.3	4.7	8.8	5.8	14.6	11.8
39	*Phyllanthus urinaria* Linn.	1.8	3.7	5.5	11.0	-	*	-	*	*	*	*	*	1.2	1.9	3.2	5.0
40	*Pleopeltis lanceolata* Kaulf.	*	-	*	*	-	*	-	*	0.2	0.7	0.8	3.0	*	*	*	*
41	*Pseudarthria viscida* (Linn.)	*	*	*	*	0.7	3.9	4.6	2.2	*	*	*	-	*	*	*	*
42	*Pterocarpus marsupium* Roxb	*	-	-	*	1.0	1.6	1.7	1.0	*	*	*	*	*	*	*	*
43	*Rauvolfia serpentina* (Linn.) Benth. ex. Kurz.	*	-	*	*	*	*	*	*	0.2	1.9	2.2	1.3	*	*	*	*
44	*Scoparia dulcis* Linn.	0.4	3.7	4.1	2.3	0.4	0.8	1.2	6.0	0.5	2.6	3.1	2.5	2.4	4.8	7.2	3.8
45	*Sebastiania chamaJea* (L.) Muell. Arg.	*	*	*	*	0.2	1.6	1.7	1.5	*	*	*	*	*	-	*	-
46	*Sida acuta Barm.* f.	*	*	*	*	0.2	0.8	1.0	3.0	0.4	1.9	2.4	2.7	1.6	2.9	4.5	4.3
47"	*Sida rhombifolia* Linn.	0.2	4.7	4.9	1.2	0.6	3.9	4.5	2.0	0.2	1.9	2.1	*To"*	0.6	2.9	3.5	1.7
48	*Solarium melongena* Linn. var. *insanum* (L.) Prain.	0.2	2.8	3.0	1.7	0.5	3.9	4.4	1.6	0.6	2.6	3.2	2.8	0.6	3.9	4.5	1.3
49	*Spermacoce hispida* Linn.	1.0	4.7	5.6	4.8	1.4	1.6	To"	11.0	0.7	0.7	1.3	12.0	5.1	3.9	8.9	10.3
50	*Spilanthes calva* DC.	0.3	1.9	2.2	4.0	*	*	-	*	*	*	*	*	*	*	*	*
51	*Stachytarpheta indica* Vahl.	*	*	-	*	*	*	-	*	0.2	1.9	2.1	1.0	*	*	*	*
52	*Terminalia crenulata* Heyne ex Roth	*	*	-	*	0.1	0.8	0.8	1.0	*	*	*	*	*	*	*	*
53	*Terminalia paniculata* Roth	0.1	"2.8"	2.9	1.0	0.2	2.3	2.5	1.0	0.1	0.7	0.7	1.0	*	*	*	*
54	*Torenia asiatica* Ktze. ex Schum	-	*	*	*	*	*	*	*	0.1	0.7	0.7	1.0	*	*	*	*
55	*Tragia involucrata* Linn.	*	*	*	-	0.1	0.8	0.8	1.0	*	*	*	*	*	*	*	*
56	*Tylophora indica* (Burm.f.) Merr.	-	*	*	-	0.5	2.3	2.8	2.3	*	*	*	*	*	*	*	*
57	*Urena lobata* Linn.	2.0	3.7	5.7	12.3	1.4	3.9	5.3	4.4	0.8	1.9	"M	5.0	0.4	1.0	11	3.0
58	*Vernonia cinerea* (Linn.) Less	0.4	2.8	3.2	3.3	0.9	2.3	3.2	47	1.1	3.9	5.0	3.3	4.6	4.8	9.4	7.4
59	*Vigna trilobata* Verde.	0.1	1.9	2.0	TO;	0.1	1.6	1.7	1.0	0.1	1.3	1.4	1.0	*	-	*	*
60	*Wrightia tinctoria* (Roxb.) R. Br.	*	*	*	*	-	*	*	*	0.1	0.7	0.7	1.0	*	*	*	*
61	*Zornia gibbosa* Spanoghe	*	*	#	*	0.3	1.6	1.9	2.5	0.4	2.6	3.0	1.8	*	*	*	*

a = Young (<5 years); b = Medium (5-11 years); c= Mature (> 11 years); Rd = Relative density; Rf = Relative frequency; IV = Importance value; A = Abundance; *Occurrence rare

Table 2. Medicinal properties of the weeds found in different strata of oil palm plantations

Sl. No.	Name of plant	Medicinal properties
1	*Abrus precatorius*	Roots and leaves - expectorant[a]
2	*Acanthospermum hispidum*	For skin diseases[a]
3	*Ageratum conyzoides*	Used in diarrhoea and dysentery[a]
4	*Aristida* sp.	Ointment for itch[a]
5	*Aristolochia indica*	Rhizome - bitter tonic; leaves - expectorant; seeds- for inflammation"
6	*Asparagus racemosus*	Tonic, diuretic"
7	*Atylosia goensis*	Febrifuge[a]
8	*Biophytum sensitivum*	Tonic, anti diabetic[a]
9	*Bulbostylis barbata*	Antidysenteric"
10	*Calophyllum polyanthum*	Gum - astringent[b]
11	*Calotropis gigantea*	Root bark - antidysenteric Leaves - febrifuge; flowers antiasthmatic[c]
12	*Calycopteris floribunda*	Leaves - astringent; laxative[a]
13	*Careya arborea*	Bark and fruit - astringent Flowers - demulcent[d]
14	*Cassia tora*	Purgative[a]
15	*Catunaregum spinosa*	Bark - astringent; fruit - anthelminthic Leaves - pulmonary infections[b]
16	*Centella asiatica*	Diuretic, tonic"
17	*Chrysopogon* sp.	Popular vermifuge"
18	*Clerodendrum viscosum*	Leaves - tonic, vermifuge[a]
19	*Curculigo orchioides*	Demulcent, diuretic"
20	*Cyclea peltata*	Leaves to stop bleeding; root - nerve tonic[b]
21	*Cynodon dactylon*	Diuretic, astringent[b]
22	*Cyperus rotundus*	Diuretic, diaphoretic[a]
23	*Desmodium gangeticum*	Roots - febrifuge, expectorant[a]
24	*Desmodium triflorum*	Antidysenteric"
25	*Elephantopus scaber*	Antidysenteric"
26	*Emilia sonchifolia*	Febrifuge[a]
27	*Evolvulus alsinoides*	Tonic, febrifuge"
28	*Hemidesmus indicus*	Roots-demulcent, diaphoretic"
29	*Hemionettis arafolia*	Applied to burns[a]
30	*Holostemma adakodien*	Roots - antidiabetic, expectorant"
31	*Hyptis suaveolens*	Stimulant, carminative"
32	*Ipomoea sepiaria*	Diuretic[a]
33	*Lantana camara* var. *aculeata*	Antiseptic"
34	*Mimosa pudica*	Roots - diuretic"
35	*Naregamia alata*	Emetic, expectorant"
36	*Oldenlandia umbellata*	Antiasthmatic[c]
37	*Pergularia daemia*	Emetic, expectorant[a]
38	*Phyllanthus amarus*	Roots - for jaundice[a]
39	*Phyllanthus urinaria*	Leaves—appetizer[a]

Table 2. Continued

40	*Pleopeltis lanceolata*	For colds[a]
41	*Pseudarthria viscida*	Roots - for rheumatism[a]
42	*Pterocarpus marsupium*	Antidysentric"
43	*Rauvolfia serpentina*	Roots - for nervous disorders[a]
44	*Scoparia dulcis*	Febrifuge[a]
45	*Sebastiania chamalea*	Antidiahorreal[a]
46	*Sida acuta*	Leaves - diuretic; roots - tonic[a]
47	*Sida rhombifolia*	Againstrheumatism"
48	*Solanum melongena* var. *insanum*	For chest troubles[d]
49	*Spermacoce hispida*	Leaves - against gall stones[a]
50	*Spilanthes calva*	Antidysentric, diuretic"
51	*Stachytarpheta indica*	Stomachic"
52	*Terminalia crenulata*	Bark - astringent, diuretic[b]
53	*Terminalia paniculata*	Bark - cardiac tonic, diuretic"
54	*Torenia asiatica*	Leaves - for gonorrhoea[a]
55	*Tragia involucrata*	Diaphoretic"
56	*Tylophora indica*	Antiasthmatic"
57	*Urena lobata*	Roots - diuretic; flowers expectorant[a]
58	*Vernonia cinerea*	Antimalarial[a]
59	*Vigna trilobata*	Leaves - sedative"
60	*Wrightia tinctoria*	Bark & seeds - used in flatulence and bilious troubles"
61	*Zornia gibbosa*	Antidysenteric[a]

a - CSIR (1986); b - Nambiar *et.al.* (1985); c - ICAR (1965); d - Kirtikar and Basu (1918)

RESULTS AND DISCUSSION

A total of 18 sampling units were taken in young plantation (Table 1). *Chrysopogon aciculatus* was the dominant species having highest relative density (36.7%) followed by *Aristida setacea* (11.6%). The dominance by these two species with their total contribution of 48.3 per cent of stand density and high I.V. indicates that these species utilize majority of space and resources. A very few grass species dominated the community numerically. This is in conformity with the findings of Sunitha *et al.* (1995) that grass weeds dominate the new oil palm plantations. *Cassia tora* was represented by a single individual and hence may be considered as rare. Parthasarathy and Karthikeyan (1997) had also considered species represented by one or two individuals as rare. High relative frequency was observed for *Chrysopogon aciculatus* (9.3%), *Elephantopus scaber* (5.6%) and *Hemidesmus indicus* (5.6%). It was lower for *Cassia tora* (0.9%). *Chrysopogon aciculatus* was the most abundant species in young oil palm plantation as is evident from its high importance value index (46.0) and abundance (91.1).

A total of 19 sampling units were taken in medium plantation (Table 1). The dominant species were *Chrysopogon aciculatus* having relative density 57.55 per cent followed by *Desmoduim triflorum*, 14.0 per cent. The relative densities of the two dominant species come to 71.6 per cent. A very few species thus dominate the plant community in medium aged plantation. The findings of Coomans (1971) and Sunitha *et al.* (1995) conform to this. *Terminalia crenulata* and *Tragia involucrata* were considered as rare species, since a single individual represented both. High relative frequency was observed for *Chrysopogon aciculatus* (9.3%) and *Hemidesmus indicus* (5.4%). *Chrysopogon aciculatus* is the most abundant species in medium oil palm plantation as is evident from its high importance value index (66.9) and abundance (75.3). A total of 25

sampling units were taken in mature plantation. The dominant species were *Chrysopogon aciculatus* having high relative density (36.0%) followed by *Naregamia alata* (7.2%). The relative densities of the two dominant species come to 43.2 per cent. Thus a very few species of grasses and dicotyledons dominate in mature oil palm plantation. This observation is similar to the conclusions made by Coomans (1971) and Sunitha *et al.* (1995). A number of rare species represented by a single individual were recorded in mature oil palm plantation. They were *Calophyllum polyanthum, Calycopteris floribunda, Careya arborea, Ipomoea sepiaria, Pergularia daemia, Terminalia paniculata, Torenia asiatica* and *Wrightia tinctoria.* High relative frequency was observed for *Chrysopogon aciculatus* (6.5%), *Holostemma adakodien* (5.2%) and *Naregamia alata* (6.5%). Lowest relative frequency of 0.7 per cent was observed for all the rare plant species. *Chrysopogon aciculatus* is the most abundant species in mature oil palm plantation as is evident from its high importance value index (42.5) and abundance (66.7).

A total of 18 sampling units were taken in open conditions (Table 1). The dominant species were *Chrysopogon aciculatus* having high relative density (21.6 %) followed by *Elephantopus scaber* (12.4%) and *Phyllanthus amarus* (8.8%). The total relative densities of the three dominant species together were 42.8 per cent. *Calotropis gigantea* and *Desmodium gangeticum* were the rare species represented by one and two individuals respectively. High relative frequency of 5.8 per cent was observed for *Chromolaena odorata, Hemidesmus indicus* and *Phyllanthus amarus. Chrysopogon aciculatus* was the most abundant species in open conditions as is evident from its high importance value index (24.5) and abundance (58.0). The medicinal properties of the weeds in different strata of oil palm plantations are given in Table 2.

Parameters used for medicinally valuable weed vegetation pair-wise analysis are given in Table 3. When the vegetation stands of pairs of sites were compared, young oil palm plantation and open conditions had a high coefficient of community (34.43). Sorenson's similarity index was also high for young and open condition (0.69). From the coefficient of community and Sorenson's similarity index, young oil palm plantation and open condition were found to be the most similar strata with more number of species in common. Mature plantation and open condition were found to be the most dissimilar strata in vegetation pair-wise analysis.

Table 3. Vegetation analysis pair-wise indices of medicinally valuable weeds

Strata of plantation	Coefficient of community	Sorenson's similarity index (CN)
Young (<5 years) and medium	30.43	0.61
Medium (5-11 years) and mature	30.12	0.60
Mature (>11 years) and open	22.67	0.45
Young and mature	26.32	0.52
Young and open	34.43	0.69
Medium and open	32.35	0.65

Table 4. Vegetation analysis indices of different strata of plantation sites

Strata	Simpson's index (C)	Shannon's index (H')	Evenness index (J)
Young (< 5 years)	0.08	2.17	0.44
Medium (5 – 11 years)	0.13	2.92	0.55
Mature (> 11 years)	0.09	2.97	0.54
Open	0.05	2.89	0.59

Parameters used for plantation site vegetation analysis are given in Table 4. The concentration of dominance as expressed by Simpson's index (C) was higher in medium oil palm plantation (0.13). Here the floristic diversity as expressed by Simpson's index was 0.13, which indicated that 13 pairs out of 100 taken at random were composed of different species. This is in conformity with the findings of Seetharam *et al.* (1999). Species diversity as expressed by Shannon's index was the highest in mature oil palm plantation (2.97) and least in young plantation (2.17). Shannon's index represents abundant species and Simpson's index represents very abundant species. Simpson's index gives more weightage to the common species but relatively little weightage to the rare species. It ranges in value from 0 to a maximum of l-(l/s), where s is the number of species (Raizada *et al.* 1998). Hence it was found that abundant species

occurred more in mature oil palm plantation and very abundant species occurred more in medium oil palm plantation. The distribution of individuals among the species is given by evenness index (J), which was maximum in open condition (0.59). Evenness is maximum when all species have the same number of individuals (Hurlbert, 1971). Hence it can be said that under open condition almost all species had equal number of individuals.

Chrysopogon aciculatus dominated in all the four strata with high relative density, frequency and importance value. *Naregamia alata* was another dominant and abundant species occurring in mature plantation. *Hemidesmus indicus* was found frequently in all the four strata. *Phyllanthus amarus* was very frequent in mature plantation and open conditions. *Holostemma adakodien* and *Naregamia alata* also occurred frequently in mature plantation. *Elephantopus scaber* was frequent in young plantation and *Chromolaena odorata* in medium plantation.

Young oil palm plantation and open condition were found to be the most similar strata with more number of species in common. Mature oil palm plantation and open condition were found to be the most dissimilar strata in vegetation pair-wise analysis. Medium plantation was found to have high concentration of dominance. Species diversity was the highest in mature oil palm plantation. Hence abundant species occur more in mature oil palm plantation and very abundant species more in medium oil palm plantation. The distribution of individuals among the species was maximum in open condition.

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