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STRUCTURE AND TIV POTENTIAL OF PLANT DIVERSITY UNDER *Leucaena* CANOPY WITH REFERENCE TO HERBAL - MEDICINAL ECONOMY IN SEMI ARID ZONE

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ABSTRACT

The study work was carried out in *Leucaena* plantation sites located in and around Jhansi. Three sites of *Leucaena* plantation were selected i.e. *Leucaena* plantation at seasonal standing water (SSW site), *Leucaena* plantation (LP site) at forest site, and *Leucaena* plantation along the perennial water stream (PWS site). The study showed that density of *Leucaena* was maximum at PWS site and minimum at PS site. The density, canopy cover, sapling density, seedling density of *Leucaena* tree was highest at PWS site as compared to other sites. Number of plant species, families and genus were highest at SSW site. SSW site showed highest economic importance for medicine as compared to food, fodder, fiber and oil yielding species. Total important value (TIV) with reference to medicinal properties was also highest at SSW site as compared to other sites. Few plant species contained resin, fatty oil, riboflavin, saponins, tannis etc. The main indications for medicinal plants use were against common cough/cold, fever, skin diseases, inflammation, eye problem, chronic diseases and digestion problem in general and as tranquilizers. The present analysis projects that majority of herb species were medicinally important and a high number of medicinal plants owing broad-spectrum medicinal value for the major human population of the semi arid region. The present study revealed that *Leucaena* developed and harbours the herb diversity at less moisture content site.

Keywords: medicinal value, canopy, total important value, taxonomic diversity.

INTRODUCTION

Forests are the essential and most precious renewable natural resource and have played key roles in the lives of people living in both mountains and lowland areas by supplying fresh water and oxygen as well as repositories of terrestrial biological diversities (Kala, 2004). The age-old traditional values attached with the various forest types and the varieties of forest products (i.e.,medicinal plants) have gained tremendous importance in the present century (Stein, 2004). Today, this resource is in imminent danger due to adverse abiotic and biotic stresses resulting from population explosion, industrial development, agriculture and global warming (Bawa and Dayanandan, 1998; Brown and Stedman-Edwards, 1998).

Every country has the responsibility to conserve, restore and sustainably use the biological diversity within its jurisdiction. India one of mega diversity center of the world, the innumerable life forms and growth forms harboured by the forests, deserts, mountains, other land, and oceans fulfill the human requirement for life. But there are innumerable species, the potential of which is not as yet known. MoEF, (2004) stated that it would therefore be prudent to not only conserve the species we already have information about, but also species we have not yet identified and described from economic point of view.

Economic valuation of goods and services provided by a species or ecosystem or landscape is from viewed as an observed or uncalled for attempt because of immense value. Which at present are mains beyond comprehension (Anonymous, 2003). The value of biodiversity as a source of pharmaceutically active substances has been explored. This value is now being cited as one of the many arguments for conserving natural habitats in general and tropical forests in particular, which contain the largest number of plant species (Singh *et al*., 2003). According to the World Health Organization, 80% of World's population depends on traditional medicines, derived from plant sources for primary healthcare (Singh *et al.*, 2003). This interrelationship may be an advantage for conservation, sustainable utilization and development of new therapeutic agents. Yesilada (2006) has highlighted the cultural heritage and rich floral wealth of knowledge on age-old folk medicines in Middle East.

The importance of medicinal plants in traditional healthcare practices, providing clues to new areas of research and in biodiversity conservation is now well recognized (Uniyal *et al.*, 2006). Khoshoo (1994) stated that plants are under ruthless extraction either legally or illegally. In addition survey, collection and regular monitoring of the resources with special reference to changing scenario of overall progress may be a useful aspect. Hemlata, (2006) suggested that quantification and economic assessment of diversity, in traditional wisdom is important. Keeping this in view the present study was initiated under *Leucaena* canopy. The study aimed to look into the diversity of plant resources that are used or may be useful for curing various ailments.

Leucaena leucocephala belongs to family Leguminosae and sub family Mimosaceae is known as the “Miracle tree” due to its paramount economic importance. The plant native of southern Mexico and Central America and spreaded throughout the tropics and subtropics, including India and is naturalized in India. It grown vigorously at lower altitudes of the country prefers annual

rainfall between 500mm and 2000mm but able to withstand long periods of drought. It is important species for semi arid region. It is popular due to its fast growth, quick regeneration, multiple uses, and easy inter-plantation with field crops, fast return and high profit, nitrogen fixation and soil improvement properties (Pathak *et al.*, 1982).

In present study, evaluation of a *Leucaena* canopy has become important as for ecological point of view as well as economical point of view for semi arid region. An attempt has been made to provide the structure of the ground vegetation and potential of important medicinal and aromatic plants in *Leucaena* canopy occurring as a plantation in different edaphic locations in semiarid zone.

DESCRIPTION OF STUDY AREA

The study was conducted at around Jhansi located at an elevation of 300m above the sea level and situated between 24º11, -26°27' North latitude and 78 º 17-81 º 34' longitudes. Three study sites were selected (15-17 years old plantation) i.e. *Leucaena* plantation at seasonal standing water (SSW site), *Leucaena* plantation (LP site) at forest site, *Leucaena* plantation along the perennial water stream (PWS site).

The climate of this area was semiarid and average maximum temperature varies from 19.6 (January) to 47.2Cº (May) April, May and June were the hottest months. Maximum relative humidity was recorded during the month of July (95.2%), while it was found minimum (55.2%) during the month of January. Maximum rainfall was observed during the month of July/August (175.2mm).

The site characteristics are depicted in Table-1.The comparison among the sites showed that the moisture content and available nitrogen concentration in soil was significantly much more at PWS site located along the water stream. Organic Carbon was maximum at LP site. Plant diversity was maximum at PWS site.

METHODOLOGY

Phytosociology of vegetation at three sites was carried out which deals with plants species co-occurrence or in other words compositional patterns of the plant community (Kent and Coker, 1992). *Leucaena* canopy and ground flora were studied by quadrat method following by Mishra (1968) at three sites.

Different economic values can be assigned to the different uses of plant. Here importance value has been derived based on primary uses like forage for live stock, medicinal use, human food, fuel, wood, timber, charcoal *etc.* following by Belal and Springuel (1996). Economic importance of various species present at all sites are discussed or calculated with the help of literature the wealth of India (1992) and personal communication.

RESULTS AND DISCUSSIONS

India one of the 12-mega diversity centers in the world ranked in 10th position in the world and 4th in Asia in plant diversity (Singh *et. al.*, 2003), harbouring 49000 species of flowering and non-flowering plants representing about 12% of the world's recorded flora. Husain *et al.*, (1984) reported that about 15000 to 20000 plants species have been reported to have high medicinal value, of which 30% are considered endemic to India. Conserving native suitable species is of high importance in reclamation of degraded rangelands of arid environments. To do this, first of all it is necessary to collect and define suitable species of semi arid zone is the understanding of the ecological characteristics of species.

The present investigation deals with phytodiversity. Three sites of *Leucaena* plantation were selected i.e., *Leucaena* plantation at seasonal standing water (SSW site), *Leucaena* plantation (LP site) at forest site, *Leucaena* plantation along the perennial water stream (PWS site). The vegetational compositions under the *Leucaena* canopy were carried out (Table-1) at all study sites. bservationOs showed that the tree, sapling and seedling density; canopy cover of *Leucaena* was highest at PWS site as compared to other sites (Table-1). Where as Basal area of *Leucaena* was maximum at SSW site. Data reflected that the moisture content and available nitrogen concentration in soil was significantly much more at PWS site (located along the water stream) than other sites. It appeared that soil moisture and total nitrogen %, might be major effective factors, which promotes the germination as well as growth of *Leucaena*. Here light might be not functioned as limiting factor. Although Kobayashi *et al.*, (2000) stated that effects of soil surface disturbance and light level on seedling emergence were examined in a temperate deciduous broadleaved secondary forest in central Japan. He reported that effect of soil disturbance on total density and number of emerged species was greater than that of a high light level.

In general, total number of herbs species in three sites was recorded 35 comprising of 30 genus and 17 families. Among them 17 species were common and 18 were uncommon (Table-3). Investigation on the relationship between vegetational patterns and environment is a primary objective of community ecology. Forests which have a highly heterogeneous environment in both space and time governed by the over canopy species (Wollum and Youngberg, 1964). In response herbs of a great Variety come to occupy forest understories (Anderson, 1961). Saxena and Singh (1978) added that not only the forest types but individual tree species are known to influence the ground flora growing underneath. So the diversification of ground vegetation at study site might be due to overcome by influence.

In the study, at SSW site 22 herbs species were noticed belonging to 14 families. Among them Asteraceae, Gramineae and Papilionaceae were dominated with 3 species; At LP site 22 herb species from 13 families with the domination of Gramineae (5 species), Asteraceae (3 species) and at PWS site 18 herb species were recorded from 9 families, here Asteraceae was dominant, followed by Gramineae, Papilionaceae, Amarantaceae etc (Table-2).

Across three sites, species richness of the ground flora was highest at SSW site. The proportion of family to genera and species to genera was recorded maximum at

SML site than at LP site and minimum at PWS site (Table-2). It might be due to higher tree density at PWS site, significant radiation and precipitation were unable to reach the ground floor, which explain less genetic diversity and plant population of herbs at the site. The result showed that species had dissimilarity in all sites. It can be stated that species composition changed with respect to edaphic mono-climatic factors varied in similar forest types. Bhaskar and Dasappa (1986) reported that the network of roots affect the development of underground vegetation under *Eucalyptus* plantation. Similar observations have been reported in present study. It is, therefore, concluded from the results that less density of *Leucaena* plantation could be helpful in growth and development of undergrowth vegetation.

The analysis of distribution pattern of individual species indicated that majority of herbs were contagiously distributed. It may be pointed out that majority of herb reproduce vegetatively in addition to sexually while tree reproduce through seeds. Therefore, it is evident that distribution pattern of a species it not only related to the method of reproduction it adopts, it may also changes with the age of species.

The economic valuations across sites are depicted in Figure-1a. Most of the plants (90%) had medicinal importance at SSW site and rests of the plants were subsequently important for oil, food, fiber and fodder respectively. Almost similar pattern for economic importance of the plants were allocated at rest of sites (Figure-1a).

Plants useful for treatment of various diseases are depicted in (Figure-1b). In the tropical countries stomach and digestives problem are major problem due to various reasons like polluted water etc. In the present study we found that (72%) plants might be useful for solving the problem of digestion. The rest of the plants might be useful for other diseases.

Asteraceae, Gramineae, Nyctanginaceae, Solanaceae, Amarantheaceae showed broad spectrum for treating various diseases (Figure-1c).Members of these families were significantly important for chronic and skin diseases, cough/cold, fever, eyes and digestive problems etc. One third member of these families was important for the treatment of digestive and chronic diseases at LP and PWS sites respectively (Figure-1c).

SSW site got highest TIV in reference to medicinal properties as compare to other sites (Table-1 and Figure-1d). It might be due to the presence of less fertile soil and moisture content but high temperature condition fevered the herb diversity. Overall perception about the total importance of value (TIV %) of ground vegetation and the taxonomic diversity had significant positive co-relation. There SSW site showed maximum TIV% as compare to rest of sites. So it is cleared that there are multiple effect of climatic, edaphic and vegetation of ground flora at the site.

Naranjo, (1981) and H. N. Elsohly, (1997) gave a long list of plants that are used in folk medicine in each country, possessing pharmacodynamic chemicals such as alkaloids, glycosides to a lesser degree, and essential oils and other substances. The study showed that most of plants contain Alkaloids, Carbohydrates, Lipids, Proteins, Carotenes, Vitamins and mineral elements (Table-4). Few of plants species contain resin, fatty oil, riboflavin, saponins, tannis etc. (Table- 4).

Table-5 showed the co- relations among different parameters. In the study, soil moisture content showed positive relation with tree, sapling and seedling density; canopy cover and basal area of *Leucaena*. Soil moisture content also positively related with soil organic carbon, total nitrogen (%) and phosphorus (%). The findings showed that fiber and oil yielding species richness increased with soil moisture content. While species richness of food and carbohydrate yielding plants decreases with increasing soil moisture content. So it was indicating that these parameters were well adapted in dry soil.

Soil nutrients (total nitrogen and phosphorus (%)) had also followed the similar pattern. But soil nitrogen had negative co-relation with organic carbon in soil, fiber, fodder and alkaloids yielding species. *Leucaena* tree density had pronounced effect on its sapling and seedling growth. Whereas *Leucaena* tree density had negative relation with fiber fodder and alkaloids yielding species.

The findings showed that the soil nutrients\soil fertility promotes the *Leucaena* growth and its canopy but it suppresses the herb vegetation. Dence canopy of *Leucaena* casts shade on ground vegetation that adversely effects the germination and growth of herb species and this finally causes reduction in the herbal diversity and economy. So *Leucaena* canopy should be maintained in sparse conditions with less fertile and dry soil for maintaining high herbal diversity as well as herbal economy.

CONCLUSIONS

Biodiversity, an essential part of our daily lives, constitutes resources upon which families, communities, nations and future generations depend. Dry lands (arid and semi- arid areas) cover approximately 40 per cent of the Earth's land surface. Although they are not as species-rich as more temperate or humid regions, but much of this natural biodiversity is fragile, and held in a delicate balance that is easily affected by natural and human-induced environmental changes. The importance of conserving dryland biodiversity is more apparent when we consider that half the approximately two billion people living in drylands are mired in poverty, and that all of them are directly and indirectly affected by the 'wellbeing' of local biodiversity (World resources instt. 2005).

The recovery of the knowledge and practices associated with diversity of plant resources are part of an important strategy linked to the conservation of biodiversity, Studies on the knowledge and use of natural resources by local populations may contribute to finding economic alternatives for populations, especially in terms of the use of natural resources for treating health problems.

The present study indicated that a significant plant diversity harbouring by *Leucaena* useful for updating

the floristic information of this region. In this context *Leucaena* makes its individuality so important because it is popular due to its fast growth, quick regeneration, multiple uses, and easy interplantation with field crops, fast return and high profit, nitrogen fixation and soil improvement properties. *Leucaena* foliage is a valuable supplement to grass pasture. *Leucaena* forage has high contents of crude protein and N-free extract. *Leucaena* leaf meal is a rich source of potassium, calcium, carotene and vitamins.

As present study reveals that *Leucaena* developed and harbours the herb diversity at less moisture content site. So if we developed its canopy on wasteland area there may be valuable addition in forest regeneration programs promoted by different agencies in the region. Since present study also revealed a good proportion of taxa of medicinal value under *Leucaena* canopy.

Keeping the above importance the present study recommended *Leucaena* for the conservation and commercial cultivation on priority basis.

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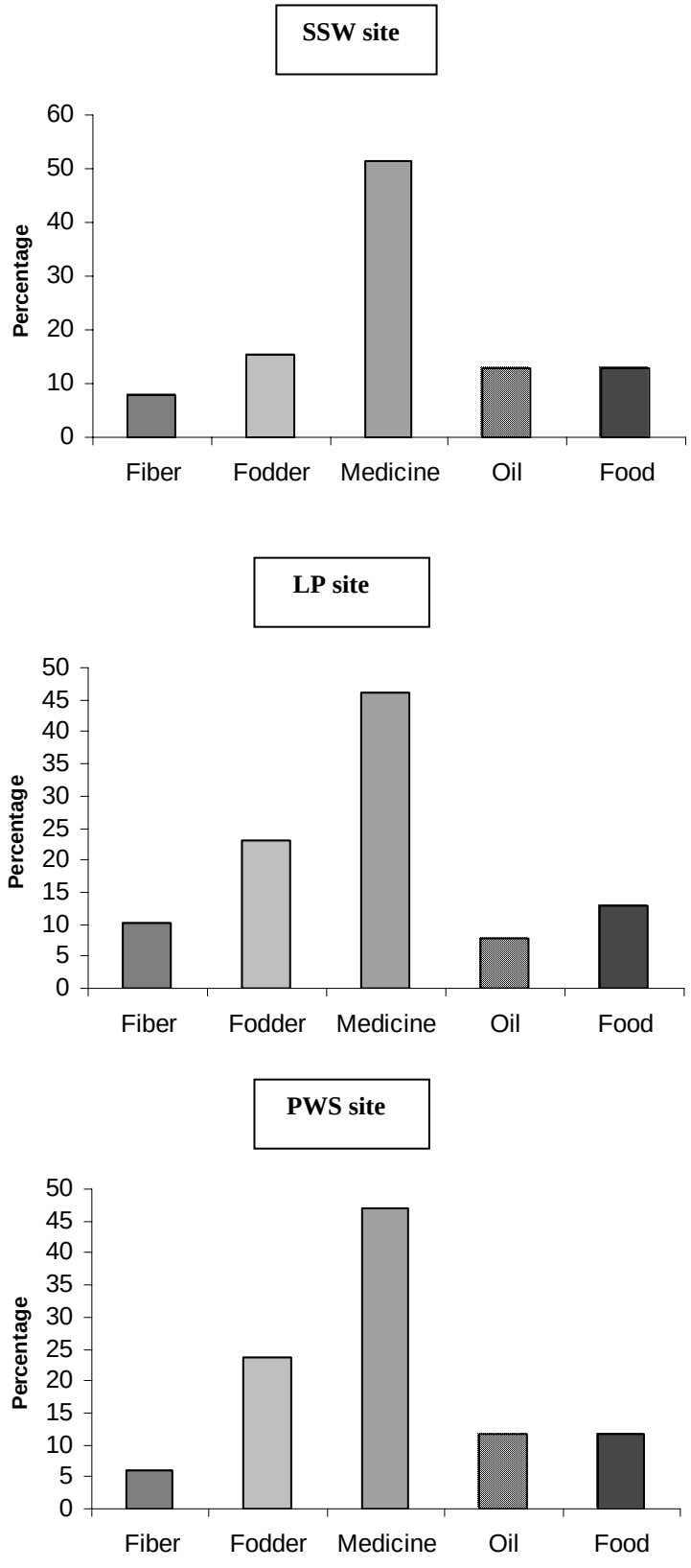
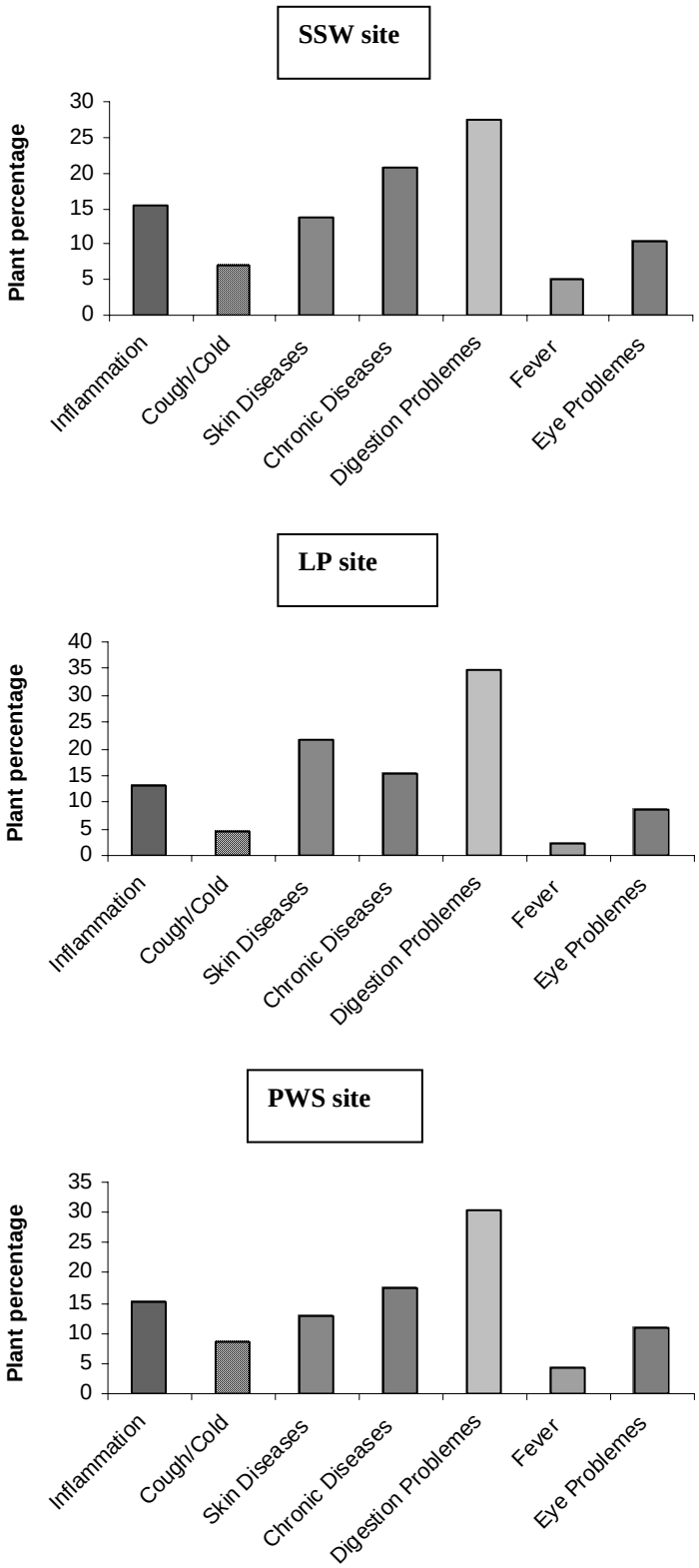


SSW site - *Leucaena* plantation at seasonal standing water, LP site- *Leucaena* plantation at forest site, PWS site- *Leucaena* plantation along the perennial water stream

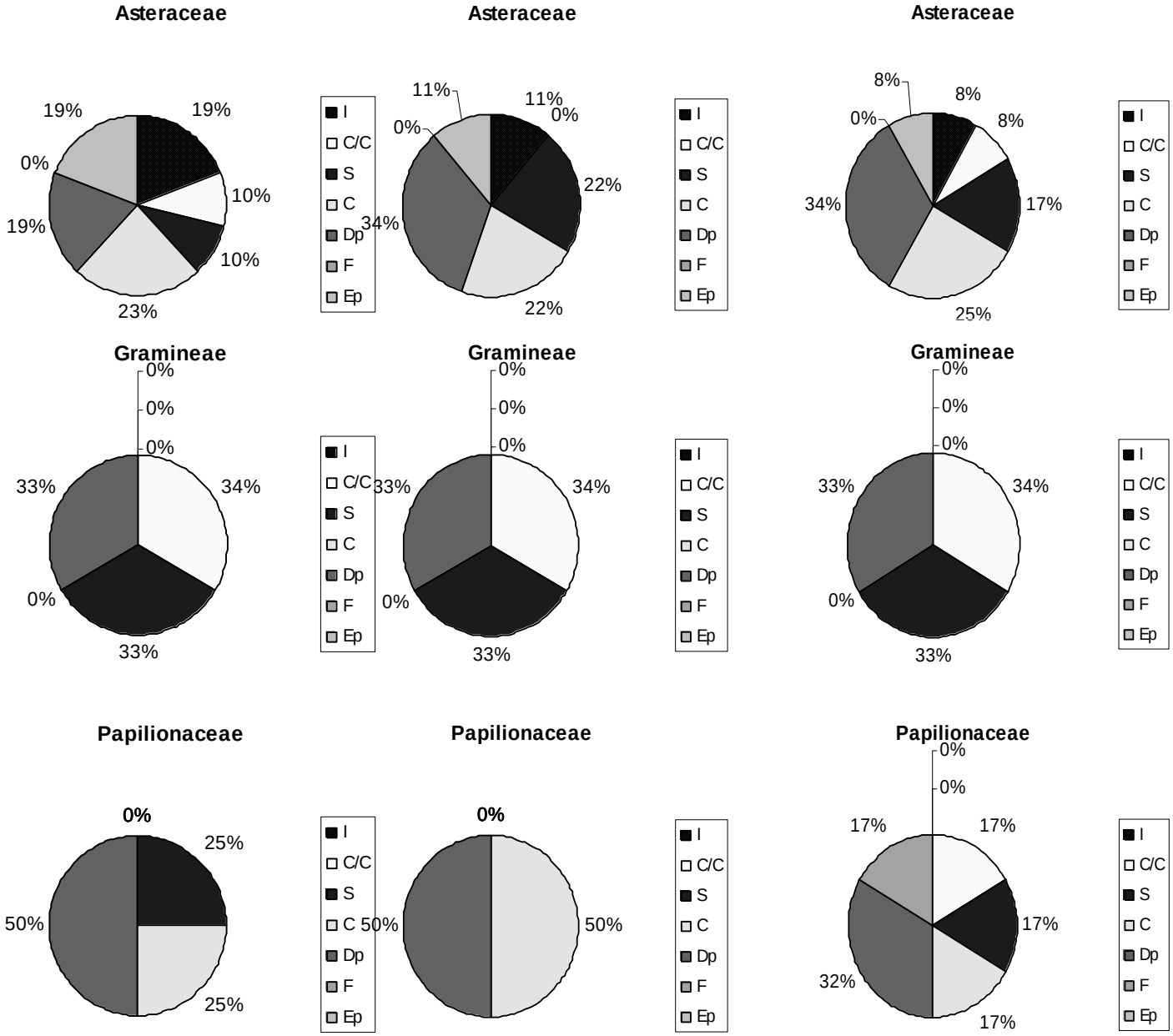
Figure-1a. Statistics of economic importance of herb species at three study sites.



SSW site - *Leucaena* plantation at seasonal standing water, LP site- *Leucaena* plantation at forest site, PWS site- *Leucaena* plantation along the perennial water stream

Figure-1b. Therupeutical indications of medicinal plants at three sites.

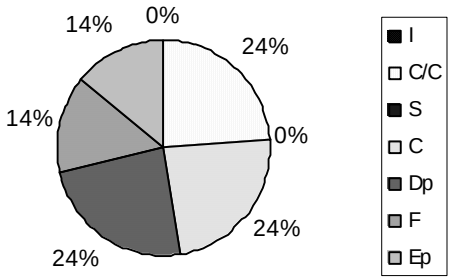
SSW site ***LP site*** ***PWS site***



I-Inflammation, C/C-Cough/Cold, S-Skin diseases, C-Chronic disease, Dp-Digestive problems, F-Fever, Ep-Eye problem.

SSW site ***LP site*** ***PWS site***

Euphorbiaceae



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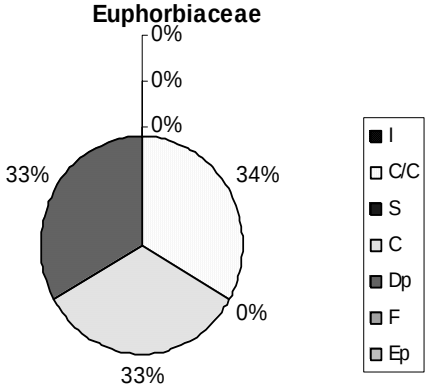
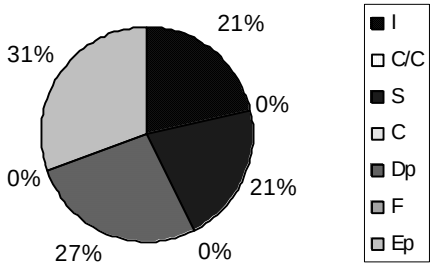
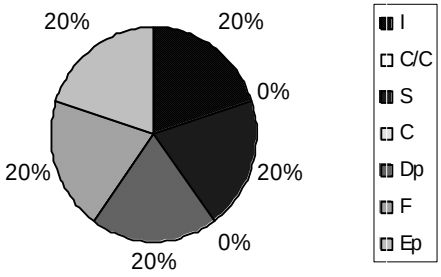
Euphorbiaceae



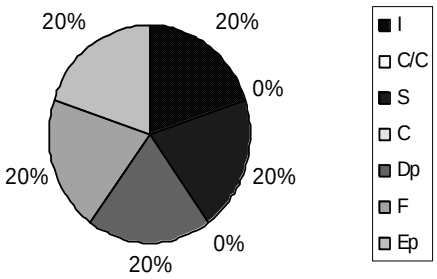
Soalanaceae



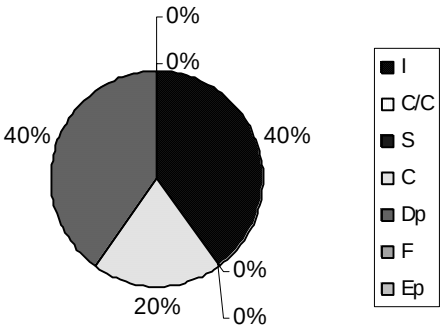
Soalanaceae



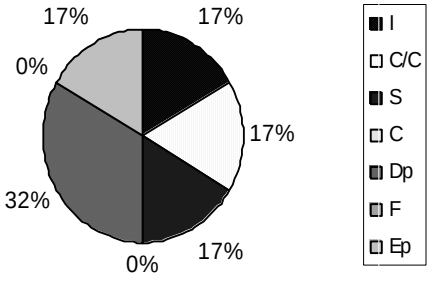
Soalanaceae



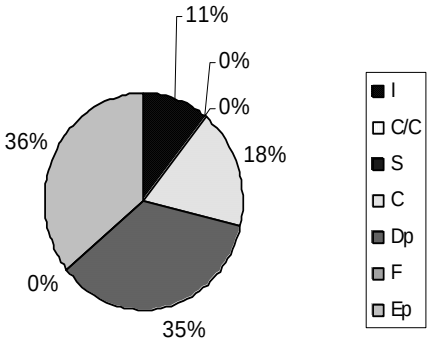
Amaranthaceae



Amaranthaceae



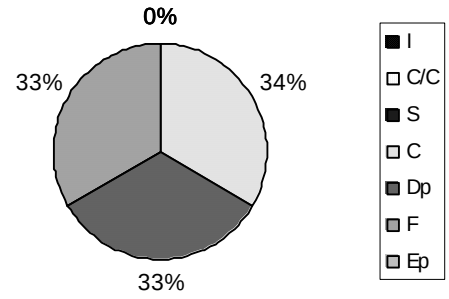
Amaranthaceae



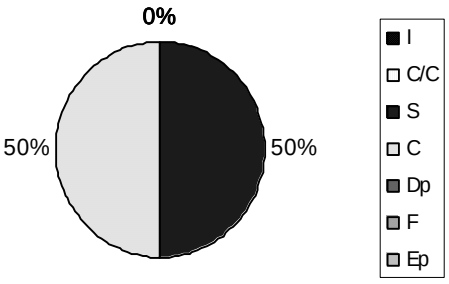
I-Inflammation, C/C-Cough/Cold, S-Skin diseases, C-Chronic disease, Dp-Digestive problems, F-Fever, Ep-Eye problem.

SSW site ***LP site*** ***PWS site***

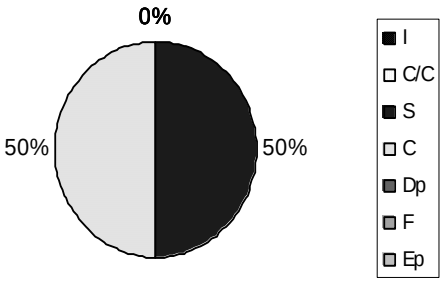
Rubiaceae



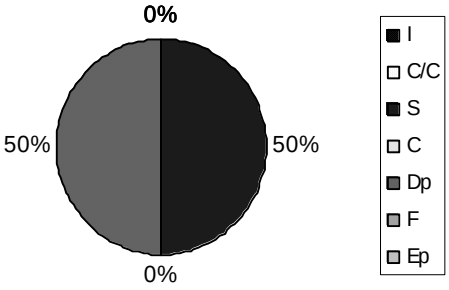
Commelinaceae



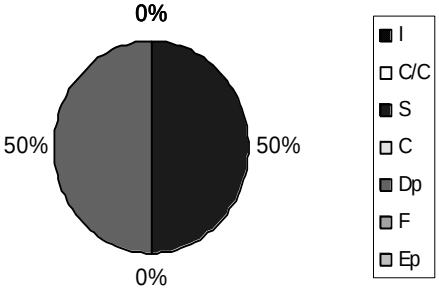
Commelinaceae



Cyperaceae



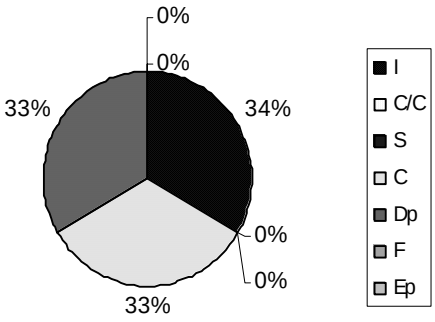
Cyperaceae



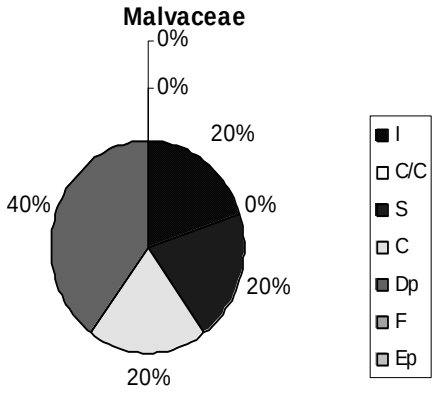
I-Inflammation, C/C-Cough/Cold, S-Skin diseases, C-Chronic disease, Dp-Digestive problems, F-Fever, Ep-Eye problem.

SSW site ***LP site*** ***PWS site***

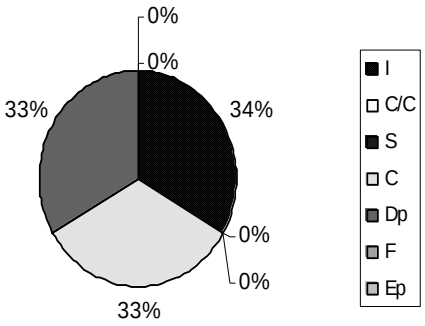
Malvaceae



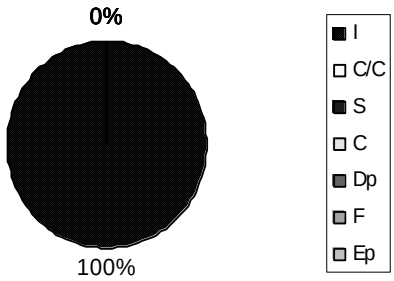
Malvaceae



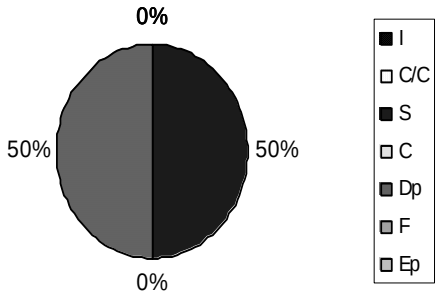
Malvaceae



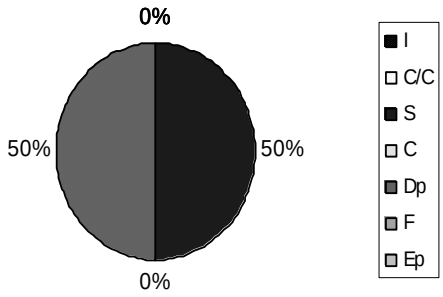
Polygonaceae



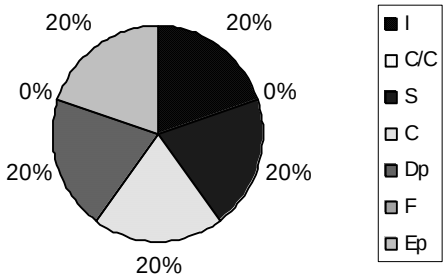
Polygonaceae



Polygonaceae



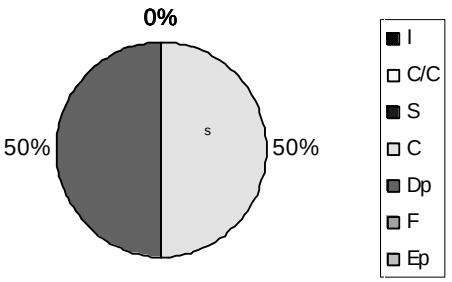
Primulaceae



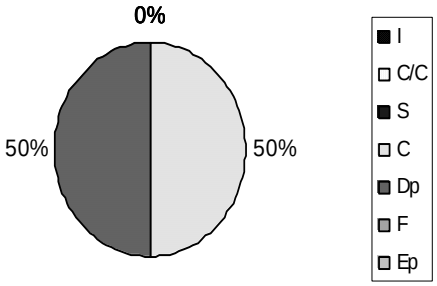
I-Inflammation, C/C-Cough/Cold, S-Skin diseases, C-Chronic disease, Dp-Digestive problems, F-Fever, Ep-Eye problem

SSW site ***LP site*** ***PWS site***

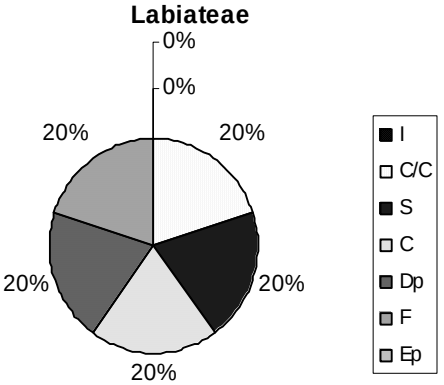
Apocynaceae



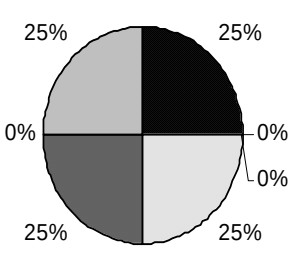
Apocynaceae



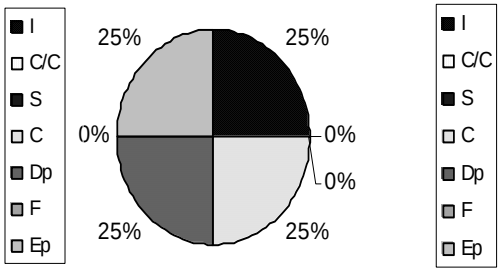
Labiateae



Nyctaginaceae

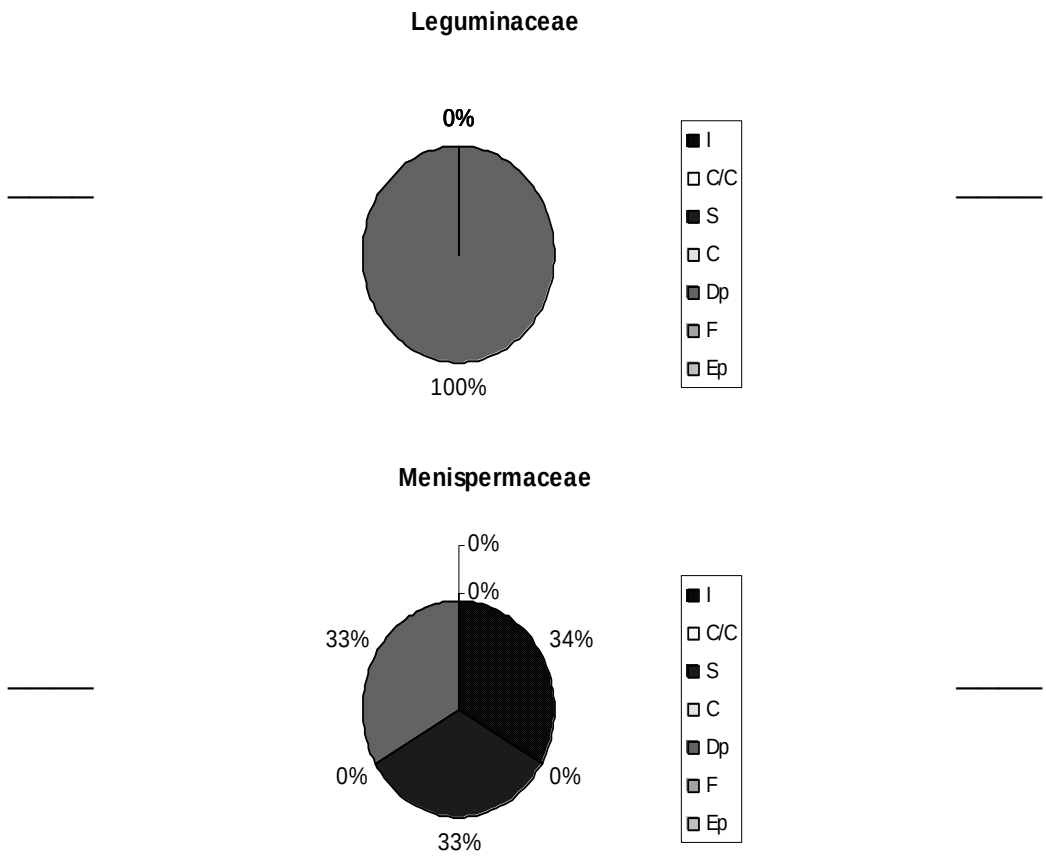


Nyctaginaceae



I-Inflammation, C/C-Cough/Cold, S-Skin diseases, C-Chronic disease, Dp-Digestive problems, F-Fever, Ep-Eye problem

SSW site ***LP site*** ***PWS site***



I-Inflammation, C/C-Cough/Cold, S-Skin diseases, C-Chronic disease, Dp-Digestive problems, F-Fever, Ep-Eye problem

Figure-1c. Potential of plant families used for treating various diseases at three different sites.

Table-1. Site characteristics and phytosociology of the vegetation at three sites.

S. No.	Parameters	SSW site	LP site	PWS site
1.	Soil Moisture content (%)	53	45	62
2.	Water holding capacity (%)	46	49	51
3.	Organic Carbon (%)	2.80	3.09	2.44
4.	Available Nitrogen (%)	2.04	1.83	2.17
5.	Available phosphorous (%)	2.127	0.7067	3.0633
Leuceana				
6.	Seedling density (seedlings / hac)	3480	1420	3970
7.	Seedling density (seedlings / hac)	2500	1980	3310
8.	Sapling density (trees / hac)	1870	1590	2430
9.	Canopy cover average (cm)	161.69	127.04	294.61
10.	Basal area average (cm^2/ha)	.832	.0768	.863
Herb layer				
11.	Total number of herb species	22	22	18
12.	Total number of families	14	13	9
13.	Total number of Genus	21	20	18
14.	Total important value (TIV % Average)	5.73	2.55	3.33

SSW site - *Leucaena* plantation at seasonal standing water, LP site- *Leucaena* plantation at forest site, PWS site- *Leucaena* plantation along the perennial water stream

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Table-2. Distribution of family, genus and species at three sites.

	SSW site		LP site		PWS site	
Family	**Genus**	**Species**	**Genus**	**Species**	**Genus**	**Species**
Asteraceae	3	3	3	3	4	4
Gramineae	3	3	4	5	3	3
Paplionaceae	3	3	2	2	3	3
Amaranthaceae	2	2	2	2	3	3
Rubiaceae	1	1	-	-	-	0
Solanaceae	1	1	1	1	1	1
Commelinaceae	1	1	1	1	-	-
Cyperaceae	1	1	1	1	-	-
Malvaceae	1	2	1	2	1	1
Euphorbiaceae	1	1	-	-	1	1
Polygonaceae	1	1	1	1	1	1
Primulaceae	1	1	-	-	-	-
Labiatae	1	1	-	-	-	-
Apocynaceae	1	1	1	1	-	-
Menispermaceae	-	-	1	1	-	-
Nyctaginaceae	-	-	1	1	1	1
Leguminosae	-	-	1	1	-	-

SSW site - *Leucaena* plantation at seasonal standing water, LP site- *Leucaena* plantation at forest site, PWS site- *Leucaena* plantation along the perennial water stream

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Table-3. Comparative view of common and uncommon species at three sites.

Total No. of species in all sites	Common species in all sites	Un-common species in all sites
62	17	19

Table-4. Information about chemical compounds present in medicinal plants at the study area.

S. No.	Species	Family	Chemical compounds
1.	*Ageratum conyzoids*	Asteraceae	Alkaloids, Saponins, essential oil
2.	*Parthenium hysterophorus*	Asteraceae	All plants part contains toxin substances.
3.	*Sonchus oleraceus*	Asteraceae	Protein, carbohydrate, fat, vitamin-C
4.	*Sonchus arvensis*	Asteraceae	Fatty oil, carbohydrate, some minerals
5.	*Cichorium intybus*	Asteraceae	Carbohydrate, cichorin, bitter substances
6.	*Cynodon dactylon*	Gramineae	Alkaloides, Tannins, Vitamin–C, Flavanoids, β-carotene, lipids, carbohydrates
7.	*Pancium maximum*	Gramineae	Carotene, vitamin – B, C, tocopheral and some minerals
8.	*Setaria glauca*	Gramineae	Crude protein, ether, carbohydrates, some minerals.
9.	*Setaria italica*	Gramineae	Vitamin A, protein, riboflavin, lipids
10.	*Dicanthium annulatum*	Gramineae	Carbohydrate, protein, some minerals.
11.	*Melilotus alba*	Papilionaceae	Carbohydrates and some amount of resin.
12.	*Trifolium alexandrinum*	Papilionaceae	Crude fat, carbohydrate, amino acid and mineral elements.
13.	*Rhynchosia minima*	Papilionaceae	Crude protein, ether, some minerals
14.	*Alysicarpus veginalis*	Papilionaceae	Protein, carbohydrate, minerals
15.	*Phaseolus aconitifolia*	Papilionaceae	Protein, minerals, riboflavin, lipid.
16.	*Alternanthera sessile*	Amaranthaceae	Protein, minerals, lipid, β-sistostery
17.	*Celosia argentae*	Amaranthaceae	Fatty oil, vitamins, Anthocyanine, carbohydrate.
19.	*Aerva tomentosa*	Amaranthaceae	Fat, carbohydrates, protein, silicates, lipid
20.	*Sida acuta*	Malvaceae	Alkaloids
21.	*Sida cordifolia*	Malvaceae	Alkaloids, fatty oil, resin
22.	*Sida veronicaefilia*	Malvaceae	Alkaloids, lipid
23.	*Salanum nigrum*	Solanaceae	Lipid, vitamin-C, Alkaloids, carbohydrates
24.	*Oldenlandia corymbose*	Rubiaceae	Alkaloids, Protein
25.	*Commelina benghalansis*	Commenliaceae	Lipid, carbohydrates
26.	*Cyperus rotundus*	Cyperaceae	Essential oil, lipid, carbohydrates
27.	*Euphoriba hirta*	Euphorbiaceae	Lipids, Flavonoid, terpenoids,

			choline
28.	*Poligonum plebeium*	Polygonaceae	Glycosids, lipids
29.	*Rumex dentatus*	Polygonaceae	Lipid, vitamin-C, β-carotene, minerals
30.	*Ocimum sanctum*	Labiatae	Alkaloids, essential oil
31.	*Carsia spinarum*	Apocynaceae	Carbohydrates, vitamin-C, tannins, protein, minerals
32.	*Boerhavia diffusa*	Nyctaginaceae	Alkaloids, lipid, moulding hormones, carbohydrates, β-sistosteryl
33.	*Anagallis arevensis*	Primulaceae	Saponins, tannins, cucurbitacins
34.	*Cocculus hirsutus*	Menispermaceae	Alkaloids
35.	*Desmodium montarium*	Leguminosae	Ash, Nitrogen, crude, protein, alkaloids

Table-5. Correlation among different parameters at three study sites.

S. No.	Parameters	Parameters	Regression coefficient
	(x)	(Y)	(r)
1	Soil moisture content	Total No. of herb species	-.882 *
2	-	Seedling density (*Leucaena*)	.930*
3	-	Sapling density (*Leucaena*)	.995 **
4	-	Tree density (*Leucaena*)	.987 **
5	-	Canopy cover (*Leucaena*)	.957 *
7	-	Soil Nitrogen (%)	.984*
8	-	Soil Phosphorus (%)	.988 **
9	-	Fiber yielding species	.991 **
10	-	Food yielding species	-.882 *
11	-	Mineral elements yielding species	.940 *
12	Nitrogen content	Seedling density (*Leucaena*)	.980*
13	-	Sapling density (*Leucaena*)	.964*
14	-	Tree density (*Leucaena*)	.945*
15	-	Canopy cover (*Leucaena*)	.892*
16	-	Basel area (*Leucaena*)	.940*
17	-	Soil Organic Carbon (%)	-.979*
18	-	Soil Phosphorus (%)	.999 **
19	-	Fiber yielding species	-.999
20	-	Alkaloids yielding species	-.957
21	-	Carbohydrates yielding species	.929*
22	-	Mineral elements yielding species	.866 *
23	Tree density	Total No. of herbs	-.945 *
24	-	No. of family	-.866 *
25	-	Seedling density (*Leucaena*)	.862 *
26	-	Sapling density (*Leucaena*)	.998 **
30	-	Soil Organic Carbon (%)	.945 *
31	-	Soil Phosphorus (%)	.953 *
32	-	Fiber yielding species	-.958*
33	-	Food yielding species	-.945*
34	-	Alkaloids yielding species	-.999
35	-	Mineral elements yielding species	.982 *
34	Seedling density *(Leucaena)*	Sapling density (*Leucaena)*	.983 *
35	-	Fiber yielding species	-.971 *
36	-	Alkaloids yielding species	-.880 *
37	-	Carbohydrates yielding species	.983 *

* Significant ** Most significant