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RESEARCH ARTICLE

DISTRIBUTION PATTERN AND ECO-PHENOLOGICAL STUDIES WITH MEDICINAL VALUE OF PIPER LONGUM L.

M. D. Bhatt.

Department of Botany, Siddhanath Science Campus, Tribhuvan University, Mahendranagar, Nepal.

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Abstract

The study was conducted in three different sites i.e. site 1, site 2 and site 3. In the present research work, a total number of 67 plant species associated with *Piper longum* were recorded in different sites. The total density of plant species was 144.25 plant species m^{-2} at site 1, 156.3 plant species m^{-2} at site 2 and 237.6 plant species m^{-2} at site 3. The density of species associated with *Piper* at site 3 (237.64) revealed that it had more plant species than that of site 1 and site 2. The maximum density at site 1 was contributed by *Imperata cylindrica* (15.67 individuals m^{-2}) and minimum was that of *Azadirachta indica*, *Dalbergia sisso* and *Morus alba* having 0.33 individuals m^{-2} whereas at site 2, the maximum density was of *Commelina paludosa* (12.67 individuals m^{-2}) and minimum of *Azadirachta indica*, (0.33 individuals m^{-2}) and at site 3 maximum density was contributed by *Parthenium hysterophorus* (16.67 individuals m^{-2}) and minimum was by *Acacia catechu* (0.32 individuals m^{-2}). The mean height of *Piper* was recorded 101cm to 108 cm with well drained sandy soil of p^H ranged 5.8 to 7.6. Similarly, the maximum and minimum IVI was occupied by *Cynodon dactylon* (24.49) and *Acacia catechu* (3.95) species respectively at site 1, the maximum and minimum IVI was occupied by *Cynodon dactylon* (23.11) and *Chenopodium ficifolium* (4.01) and *Azadirachta indica* (4.01) species respectively at site 2, and the maximum and minimum IVI was occupied by *Imperata cylindrica* (22.87) and *Acacia catechu* (3.39) species, respectively at site 3. The plant has been used traditionally to cure different severe diseases and uplifts the economic status of many local people.

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Introduction:-

Nepal lies on the southern slope of central Himalayas and occupies a total area of 1,47,181 sq. km. between the latitudes 26° 22' and 30° 27' N and the 80° 40' and 80° 12' E. The average length of the country is 885 km east to west and the width varies 145 km - 241 km from north to south. About 86% of the total land area is covered by hills and high mountains, and the remaining 14% are flat lands of Terai. The country is extremely rich in terms of floral diversity in proportion to its size. Nepal comprises only 0.09% of the total land area on global scale but it possesses 2.7% of the world's recorded flowering plants. A total of 5,856 species of flowering plants, 28 species of gymnosperms, 853 species of bryophytes and 380 species of pteridophytes have been recorded from Nepal (Wilson,

Corresponding Author: - M. D. Bhatt.

Address: - Department of Botany, Siddhanath Science Campus, Tribhuvan University,
 Mahendranagar, Nepal.

1998, 1992; Akiyama et al., 1998 and Koba et al, 1994). The great range of biochemical variation forms tropical to alpine zones brings richness in biodiversity in Nepal.

The vegetation of Nepal classified on the basis of bioclimatic variation by Stearn (1960), Banaergi (1963). Ecologically, Stainton (1972) and Dobremez (1976) divide Nepal in to six bioclimatic zones. Nepal, the Himalayan country is rich in medicinal plant resources. Himalayan medicinal plants are very popular since the Vedic period. The detailed study of all plants is still unknown. Although the enumeration, morphology, distribution and medicinal uses are known but chemical aspect of economically important is still behind.

Herbal medicine is an age-old practice. Nonetheless, with only 10% of the earth is estimated 2, 50,000 species of higher plants considered medicinal and the lower plants still unexplored. Plants will continue to be the sleeping giant of drug development and serve mankind in the days to come. Plants and their products are important resources for the development of country but peoples are involving in commercial exploitation. In order to protect the medicinal plants of Nepal, it is necessary to first identify them, study their natural distribution, assess their population status and then to take scientific measures to ensure their conservation and cultivation. Due to over use of forested areas and medicinal plants, some plants species have already become rare, endangered, threatened and meet the criteria for red data listing.

There are several medicinal plant species which are widely used by local people in hilly and rural areas of which the species *Piper longum* is of South Asian origin. *Piper longum* is commonly found in tropical humid moist places (Sumy et al., 2000), slender aromatic climbing shrubs with perennial woody roots where relative humidity is high (Kritikar & Basu, 1980; Rastogi & Malhotra, 1993). Flowers grow in solitary spikes (Rastogi & Malhotra, 1993, Banerjee et al., 1999; Viswananthan, 1995). The fruit contains a large number of alkaloids and related compounds, the most abundant of which is piperine, followed by methyl piperine, pipernonaline, piperettine, asarinine, pellitorine, piperundecalidine, piperlongumine, piper longuminine, etc (Kritikar and Basu, 1980). *Piper longum* cures cough, leprosy, diabetes, piles, colic indigestion, anaemia, thirst and dispels cardiac and spleen disorders, chronic fever and loss of appetite. Dried ripe fruits are official parts (Viswananthan, 1995). It is also used as antidote to snake bite and scorpion-sting (Sumy et al., 2000). Clinical studies have revealed that *Piper* is very effective in treatment of bronchial asthma in children (Dahanukar et al., 1984; Anshuman et al., 1984). The plant *Piper longum* is frequently found in natural habitats of Far Western Development Region of Nepal. This ecological study provides the understanding of species habitat, relationship, and present status of distribution, economic values, medicinal importance and commercial exploitation. Therefore, the present study was focused on detailed study of *Piper longum* as well as public attitude and participation in Kanchanpur to conserve biodiversity.

Materials and Methods:-

Geographically Far Western Development Region lies between 28° 31' to 30° 12' North latitudes and 80° 4' to 81° 45' East longitudes. The altitude varies from 176 to 7134 above the mean sea level (amsl) and region covers an area of 19,539 km², which is about 13.3% of the area of the country (Bhatt et al., 2007). The sites selected for the present study were located at 28° 32' to 29° 28' N latitudes and 80° 03' to 80° 33' E longitudes with an altitudinal range of 76 to 500 amsl of Far Western Nepal.

The study was carried out during July, 2016 to July, 2018 by systematic visits of the study site i.e. site 1 (Jhalari), site 2 (Brahmdev) and site 3 (Bagphanta) of Kanchanpur district at definite regular interval of a month. During the visits, the natural habit growth form, phenology, composition of plant species with *Piper* and present status of the *Piper* was determined by visual observation. Plant samples and seeds were collected for morphological and ecological studies. The sampled plants were analyzed for quantitative characters like plant height, leaf area, ratio of leaf length and breadth, circumference of stem etc. Quadrates of 1×1 m size were kept randomly in the study sites and listed the plant species. In each stands, three replicate was executed using the appropriate size of quadrates and their density, abundance, frequency, and important value index (IVI) were calculated as per Misra, 1968, Zobel et al. 1987, Curtis and McIntosh, 1951. The species with higher IVI value were considered as dominant species with *Piper*. Collected plant species were identified with the help of relevant literatures. Seed shape and colour was calculated from the average of 10 seeds of individual plants. The seed size of *Piper longum* was calculated as per the procedure in Zobel et al. (1987). The seed output was calculated as per the procedure given by Salisbury (1942).

Results:-

Distribution Pattern of Plant Species

Of the 67 species of plants recorded in the three sites of Kanchanpur, 36 species were found at site 1, 37 species at site 2 and 62 species at site 3 (Table 1). Out of the total plant species, the highest numbers of plant species were recorded at site 3. The common plant species recorded at all sites in association with *Piper longum* were *Achyranthus aspera*, *Ageratum conyzoids*, *Azadirachta indica*, *Blumea aromatica*, *Brachieria ramosa*, *Cassia tora*, *Chenopodium ficifolium*, *Cissampelos pareira*, *Clerodendrum indicum*, *Commelina benghalensis*, *Commelina paludosa*, *Cynodon dactylon*, *Dalbergia sisso*, *Desmodium triflorum*, *Euphorbia hirta*, *Dryopteris* spp, *Imperata cylindrica*, *Justicia procumbens*, *Lantana camara*, *Oxalis corniculata* and *Solanum nigrum*.

The percentage wise distribution of plant species at site 1 were 69.4% dicots species, 25% monocot species, and 5.6% pteridophytes. Similarly, there were 70.3% dicot species, 24.3% monocot species and 5.4% pteridophytes at site 2 and at site 3, 72.6% dicots 34.2% monocot species and 3.2% pteridophytes were recorded (Fig. 1).

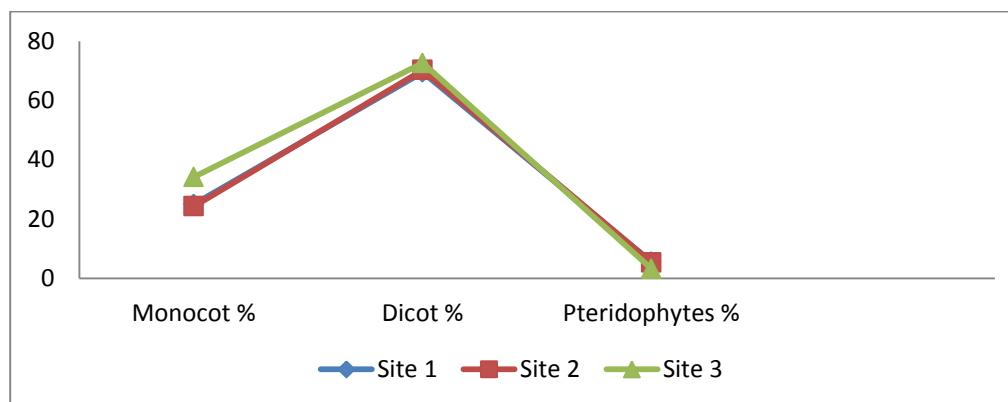


Fig. 1:-Analysis of plant groups in different study sites

The reported species belonged to 34 families: Poaceae/Graminae (11), Asteraceae/Compositae (9), Amaranthaceae (5), Leguminosae (4), Cyperaceae (2), Euphorbiaceae (2), Commelinaceae (2), Acanthaceae (2), Meliaceae (2), Fabaceae (2), Scrophulariaceae (2), Verbenaceae (2) and one species each belonged to Apiaceae, Convolvulaceae, Liliaceae, Asclepidaceae, Umbelliferae, Menispermaceae, Labiatae, Diocoreaceae, Dryopteridiaceae, Convolvulaceae, Moaraceae, Marsilaceae, Malvaceae, Myrtaceae, Oxalidaceae, Onagraceae, Papaveraceae, Portulacaceae, Polygonaceae, Primulaceae, Rhamnaceae, Rutaceae, Solanaceae and Verbenaceae including Piperaceae of *Piper longum* (Table 2).

Table 1:-List of plant species associated with *Piper longum* at the different sites of Kanchanpur (+ = Present, - = absent).

S.No.	Name of plant species	Local name	Family	Distribution of species		
				Site 1	Site 2	Site 3
1.	<i>Acacia catechu</i> (L.) Willd [#]	Khayer	Leguminosae	+	-	+
2.	<i>Achyranthes aspera</i> L. [†]	Datiwan	Amaranthaceae	+	+	+
3.	<i>Ageratum conyzoids</i> L. [†]	Ganey ghans	Compositae	+	+	+
4.	<i>Alternanthera sessilis</i> (L.) DC. ^{*#}	Bhiringi jahar	Amaranthaceae	-	-	+
5.	<i>Alysicarpus vaginalis</i> (L.) DC. ^{*#}	Chandre ghans	Leguminaceae	-	-	+
6.	<i>Amaranthus spinosus</i> L. [*]	Kande lunde	Amaranthaceae	-	+	+
7.	<i>Amaranthus viridis</i> L. ^{*#}	Seto lunde	Amaranthaceae	-	-	+
8.	<i>Argemone mexicana</i> L. [*]	Kande	Papaveraceae	-	+	+
9.	<i>Asparagus recemosus</i> Willd [#]	Kurilo	Liliaceae	+	-	+
10.	<i>Azadirachta indica</i> (Aiton) Dryand. [†]	Neem	Meliaceae	+	+	+
11.	<i>Blumea aromatica</i> L. [†]	Bisaune jhar	Asteraceae	+	+	+
12.	<i>Brachieria ramosa</i> (L.) Stapf. [†]	Likhe banso	Poaceae	+	+	+
13.	<i>Calotropis procera</i> Juss. ^{*#}	Aankh	Asclepiadaceae	-	-	+

14.	<i>Cassia tora</i> L. †	Khinkhine	Fabaceae	+	+	+
15.	<i>Centella asiatica</i> (L.) Urban. *	Ghodtapre	Umbelliferae	-	+	+
16.	<i>Chenopodium album</i> L. †	Bethua	Amaranthaceae	+	+	+
17.	<i>Cissampelos pareira</i> L. †	Musebeli	Menispermaceae	+	+	+
18.	<i>Clerodendrum indicum</i> (L.) Kuntze. †	Eklebir	Labiatae	+	+	+
19.	<i>Commelina benghalensis</i> (L.) †	Kaane jhar	Commelinaceae	+	+	+
20.	<i>Commelina paludosa</i> Blume †	Kaane jahar	Commelinaceae	+	+	+
21.	<i>Cynodon dactylon</i> (L.) Pers. †	Dubo	Gramineae	+	+	+
22.	<i>Cyperus esculentus</i> L. #	Mothe	Cyperaceae	+	-	+
23.	<i>Cyperus rotundus</i> L. †	Mothe	Cyperacera	+	+	+
24.	<i>Dactyloctenium aegyptium</i> (L.) Gaerth **	Makure jhar	Poaceae	-	-	+
25.	<i>Dalbergia sisso</i> Roxburgh. †	Sisam	Leguminosae	+	+	+
26.	<i>Desmodium triflorum</i> (L.) DC. †	Bute kanike	Fabaceae	+	+	+
27.	<i>Digitaria sanguinalis</i> (L.) Scop. **	Saano banso	Poaceae	-	-	+
28.	<i>Dioscorea deltoidea</i> Wallich ex Grisebach *	Bhyakur	Dioscoriaceae	-	+	-
29.	<i>Eclipta prostrata</i> L. **	Bhringraj	Asteraceae	-	-	+
30.	<i>Eleusine indica</i> (L.) Gaerth **	Kode jhar	Poaceae	-	-	+
31.	<i>Eragrotis tenella</i> (Retz.) Stapf **	Charidana	Poaceae	-	-	+
32.	<i>Eragrotis unioides</i> (Retz.) Nees ex steud. *	Banso	Poaceae	-	+	+
33.	<i>Euphorbia hirta</i> L. †	Dudhe	Euphorbiaceae	+	+	+
34.	<i>Evolvulus nummularius</i> (L.) L	Balu jhar	Convolvulaceae	-	+	+
35.	<i>Dryopteris</i> spp. L. †	Liudo	Polypodiaceae	+	+	+
36.	<i>Gnophalium pensylvanicum</i> Willd **	Gubo ghans	Asteraceae	-	-	+
37.	<i>Hemigraphis repanda</i> (L.) Hallierf. **	Ban-pan	Acanthaceae	-	-	+
38.	<i>Imperata cylindrica</i> (L.) P.Beuv. †	Siru	Gramineae	+	+	+
39.	<i>Justicia procumbens</i> L. †	Phool jhar	Acanthaceae	+	+	+
40.	<i>Lantana camara</i> (L.) Moldenke. †	Ban phaanda	Verbenaceae	+	+	+
41.	<i>Lindernia procumbens</i> (Krock.) Borbas **	Pitamari jhar	Scrophulariaceae	-	-	+
42.	<i>Lippia nudiflora</i> (L.) Rich	Bukkan	Verbenaceae	-	-	+
43.	<i>Ludwigia perennis</i> L. **	Lwang jhar	Onagraceae	-	-	+
44.	<i>Marselia minuta</i> L. †	Chaupatay	Marsilaceae	+	+	+
45.	<i>Mecardonia procumbens</i> (Miller) Small **	Malati jahar	Scrophulariaceae	-	-	+
46.	<i>Melia azedarach</i> L. #	Bakaino	Meliaceae	+	-	-
47.	<i>Mimosa pudica</i> L. **	Lajjawati	Leguminaceae	-	-	+
48.	<i>Morus alba</i> L. #	Kimu	Moraceae	+	-	+
49.	<i>Murraya koenigii</i> (L) Sprengel *	Curry patta	Rutaceae	-	+	-
50.	<i>Oxalis corniculata</i> L. †	Chari amilo	Oxalidaceae	+	+	+
51.	<i>Panicum decompositum</i> R.Br.	Chhate ghans	Poaceae	-	+	-
52.	<i>Parthenium hysterophorus</i> L.	Bahudal ghans	Asteraceae	-	+	+
53.	<i>Phyllanthus urinaria</i> L. #	Bhuin amala	Euphorbiaceae	+	-	+
54.	<i>Polygonum plebejum</i> R.Br. #	Sukul jhar	Polygonaceae	+	-	+
55.	<i>Piper longum</i> L. †	Pipali	Piperaceae	+	+	+
56.	<i>Portulaca oleraceae</i> L. **	Nundhiki	Portulacaceae	-	-	+
57.	<i>Primula veris</i> (L.) *	Pelo ghans	Primulaceae	-	+	+
58.	<i>Pumia aromatic</i> L. #	Jhuse ghans	Compositae	+	-	+
59.	<i>Saccharum ravennae</i> L. #	Kaans	Poaceae	+	-	+
60.	<i>Setaria pumila</i> (Poiret) Romer and Schultes **	Bhaale banso	Poaceae	-	-	+

61.	<i>Solanum nigrum</i> (L) [†]	Kali kuiyan	Solanaceae	+	+	+
62.	<i>Spilanthus paniculata</i> Wall. ex DC	Sirsire	Asteraceae	+	+	-
63.	<i>Syzygium cumini</i> (L) Skeels [#]	Jamun	Myrtaceae	+	-	+
64.	<i>Tridax procumbens</i> . L. [#]	Husure jhar	Asteraceae	+	-	+
65.	<i>Urena sinuate</i> L. ^{**}	Kuro	Malvaceae	-	-	+
66.	<i>Xanthium strumerium</i> L. [*]	Bhende kure	Compositae	-	+	+
67.	<i>Ziziphus jujube</i> (L) Gaertner [*]	Bayer	Rhamnaceae	-	+	+

* absent at site 1, # absent at site 2, ** absent at site 3 and † common at all sites.

Composition of plant Species

In the present finding, a total number of 67 plant species including *Piper longum* were recorded in different study sites. The total density of plant species was 144.25 individuals m⁻² at site 1, 156.33 individuals m⁻² at site 2 and 237.6 individuals m⁻² at site 3. The density of species at site 3 (237.64) revealed that it had more plant species than that of site 1 and site 2. At site 1 highest density was contributed by *Imperata cylindrica* (15.67 individuals m⁻²) and lowest was that of *Azadirachta indica*, *Dalbergia sisso* and *Morus alba* having 0.33 individuals m⁻² whereas at site 2, the highest density of *Commelina paludosa* (12.67 individuals m⁻²) and lowest by *Azadirachta indica*, (0.33 individuals m⁻²) and site 3 highest density was contributed by *Parthenium hysterophorus* (16.67 individuals m⁻²) and lowest was *Acacia catechu* (0.32 individuals m⁻²).

In the present study, the maximum and minimum IVI was occupied by *Cynodon dactylon* (24.49) and *Acacia catechu* (3.95) species respectively at site 1, the maximum and minimum IVI was occupied by *Cynodon dactylon* (23.11) and *Chenopodium ficifolium* (4.01) and *Azadirachta indica* (4.01) species respectively at site 2, and the maximum and minimum IVI was occupied by *Imperata cylindrica* (22.87) and *Acacia catechu* (3.39) species, respectively at site 3 (Table 2).

Table 2:-Composition of different plant species associated with *Piper longum* at different study sites with their density and Importance Value Index (IVI).

S.No.	Name of plant species	Family	Distribution of plant species at different sites					
			Site 1		Site 2		Site 3	
			D	IVI	D	IVI	D	IVI
1.	<i>Acacia catechu</i> (L.) Willd [#]	Leguminosae	0.50	3.95	-	-	0.32	3.39
2.	<i>Achyranthes aspera</i> L. [†]	Amaranthaceae	1.2	5.68	0.67	5.54	1.6	4.49
3.	<i>Ageratum conyzoids</i> L. [†]	Asteraceae	6.4	23.42	4.67	15.51	6.1	18.45
4.	<i>Alternanthera sessilis</i> (L.) DC. ^{**}	Amaranthaceae	-	-	-	-	12.33	15.38
5.	<i>Alysicarpus vaginalis</i> (L.) DC. ^{**}	Leguminaceae	-	-	-	-	1.0	4.49
6.	<i>Amaranthus spinosus</i> L. [*]	Amaranthaceae	-	-	11.33	15.14	0.67	4.28
7.	<i>Amaranthus viridis</i> L. ^{**}	Amaranthaceae	-	-	-	-	2.1	5.81
8.	<i>Argemone mexicana</i> L. [*]	Papaveraceae	-	-	1.2	5.84	1.33	5.38
9.	<i>Asparagus recemosus</i> Willd [#]	Liliaceae	1.3	5.68	-	-	0.67	4.28
10.	<i>Azadirachta indica</i> (Aiton) Dryand. [†]	Meliaceae	0.33	3.96	0.33	4.01	0.33	3.39
11.	<i>Blumea aromatica</i> L. [†]	Asteraceae	0.67	6.61	0.67	5.54	1.2	4.49
12.	<i>Brachieria ramosa</i> (L.) Stapf. [†]	Poaceae	9.67	19.22	8.67	17.43	7.4	16.5
13.	<i>Calotropis procera</i> Juss. ^{**}	Asclepiadaceae	-	-	-	-	0.67	4.28
14.	<i>Cassia tora</i> L. [†]	Fabaceae	1.69	7.42	1.4	5.84	1.33	5.38
15.	<i>Centella asiatica</i> (L.) Urban. [*]	Umbelliferae	-	-	1.67	7.68	11.0	17.49
16.	<i>Chenopodium album</i> L. [†]	Amaranthaceae	0.67	5.42	0.35	4.01	1.3	5.17
17.	<i>Cissampelos pareira</i> L. [†]	Menispermaceae	2.4	7.68	3.34	9.2	3.35	6.66
18.	<i>Clerodendrum indicum</i> (L) Kuntce. [†]	Labiatae	3.33	8.76	2.67	8.59	4.0	7.09

19.	<i>Commelina benghalensis</i> (L.) [†]	Commelinaceae	5.2	15.49	2.2	6.76	2.33	5.34
20.	<i>Commelina paludosa</i> Blume [†]	Commelinaceae	1.67	7.42	12.67	15.54	12.34	18.38
21.	<i>Cynodon dactylon</i> (L.) Pers. [†]	Gramineae	7.73	24.49	8.33	23.11	8.67	22.57
22.	<i>Cyperus esculentus</i> L. [#]	Cyperaceae	1.33	5.95	-	-	13.68	19.92
23.	<i>Cyperus rotundus</i> L. [†]	Cyperacera	11.0	20.68	12.67	21.46	13.0	19.49
24.	<i>Dactyloctenium aegypticum</i> (L.) Gaerth ^{*#}	Poaceae	-	-	-	-	10.1	15.17
25.	<i>Dalbergia sisso</i> Roxburgh. [†]	Leguminosae	0.33	3.96	1.2	5.84	0.87	4.28
26.	<i>Desmodium triflorum</i> (L.) DC. [†]	Fabaceae	3.33	8.76	3.33	6.46	2.33	6.02
27.	<i>Digitaria sanguinalis</i> (L.) Scop. ^{*#}	Poaceae	-	-	-	-	0.66	4.28
28.	<i>Dioscorea deltoidea</i> Wallich ex Grisebach [*]	Dioscoriaceae	-	-	1.1	5.84	-	-
29.	<i>Eclipta prostrata</i> L. ^{*#}	Asteraceae	-	-	-	-	1.35	5.38
30.	<i>Eleusine indica</i> (L.) Gaerth ^{*#}	Poaceae	-	-	-	-	1.49	5.38
31.	<i>Eragrotis tenella</i> (Retz.) Stapf ^{*#}	Poaceae	-	-	-	-	1.36	5.38
32.	<i>Eragrotis unioides</i> (Retz.) Nees ex steud. [*]	Poaceae	-	-	0.67	5.54	2.2	5.81
33.	<i>Euphorbia hirta</i> L. [†]	Euphorbiaceae	8.2	15.03	11.67	18.18	10.33	15.91
34.	<i>Evolvulus nummularius</i> (L.) L	Convolvulaceae	-	-	2.33	7.06	1.77	4.92
35.	<i>Dryopteris</i> spp. L. [†]	Polypodiaceae	1.67	7.42	1.68	7.68	2.33	6.02
36.	<i>Gnophalium pensylvanicum</i> Willd ^{*#}	Asteraceae	-	-	-	-	1.4	4.28
37.	<i>Hemigraphis repanda</i> (L.) Hallierf. ^{*#}	Acanthaceae	-	-	-	-	1.1	4.49
38.	<i>Imperata cylindrica</i> (L.). P. Beauv. [†]	Graminae	15.67	21.24	11.0	19.73	15.33	22.87
39.	<i>Justicia procumbens</i> L. [†]	Acanthaceae	2.7	7.68	1.36	6.14	1.67	4.92
40.	<i>Lantana camara</i> (L.) Moldenke. [†]	Verbenaceae	1.2	5.68	1.33	6.14	1.68	4.92
41.	<i>Lindernia procumbens</i> (Krock.) Borbas ^{*#}	Scrophulariaceae	-	-	-	-	1.67	4.92
42.	<i>Lippia nudiflora</i> (L.) Rich	Verbenaceae	-	-	-	-	2.33	6.02
43.	<i>Ludwigia perennis</i> L. ^{*#}	Onagraceae	-	-	-	-	1.33	4.7
44.	<i>Marselia minuta</i> L. [†]	Marsilaceae	2.33	7.95	3.34	9.2	3.2	6.45
45.	<i>Mecardonia procumbens</i> (Miller) Small ^{*#}	Scrophulariaceae	-	-	-	-	1.3	4.49
46.	<i>Melia azedarach</i> L. [#]	Meliaceae	1.3	5.68	-	-	-	-
47.	<i>Mimosa pudica</i> L. ^{*#}	Leguminaceae	-	-	-	-	2.33	6.02
48.	<i>Morus alba</i> L. [#]	Moraceae	0.33	3.96	-	-	0.67	4.28
49.	<i>Murraya koenigii</i> (L.) Sprengel [*]	Rutaceae	-	-	0.69	4.32	-	-
50.	<i>Oxalis corniculata</i> L. [†]	Oxalidaceae	7.33	17.92	8.67	18.26	10.67	19.12
51.	<i>Panicum decompositum</i> R.Br.	Poaceae	-	-	0.68	4.32	-	-
52.	<i>Parthenium hysterophorus</i> L.	Asteraceae	-	-	12.1	17.98	16.67	21.88
53.	<i>Phyllanthus urinaria</i> L. [#]	Euphorbiaceae	2.33	7.95	-	-	2.67	6.24
54.	<i>Polygonum plebejum</i> R. Br. [#]	Polygonaceae	0.67	4.23	-	-	1.1	4.49

55.	<i>Piper longum</i> L. [†]	Piperaceae	31.0	32.63	15.33	32.7	16.33	27.46
56.	<i>Portulica oleraceae</i> L. ^{*#}	Portulacaceae	-	-	-	-	0.67	3.6
57.	<i>Primula veris</i> (L.) [*]	Primulaceae	-	-	0.67	5.54	1.0	4.49
58.	<i>Pumia aromatic</i> L. [#]	Asteraceae	1.0	5.68	-	-	0.67	3.6
59.	<i>Saccharum ravennae</i> L. [#]	Poaceae	1.6	5.68	-	-	1.33	5.38
60.	<i>Setaria pumila</i> (Poiret) Romer and Schultes ^{*#}	Poaceae	-	-	-	-	0.67	4.28
61.	<i>Solanum nigrum</i> (L.) [†]	Solanaceae	2.33	7.95	2.67	8.59	4.67	7.52
62.	<i>Spilanthus paniculata</i> Wall. ex DC	Compositae	0.67	5.42	0.67	7.98	-	-
63.	<i>Syzygium cumini</i> (L) Skeels [#]	Myrtaceae	1.5	5.68	-	-	0.33	3.39
64.	<i>Tridax procumbens</i> L. [#]	Asteraceae	3.67	9.03	-	-	2.33	5.34
65.	<i>Urena sinuate</i> L. ^{*#}	Malvaceae	-	-	-	-	0.67	4.28
66.	<i>Xanthium strumarium</i> L. [*]	Asteraceae	-	-	2.33	8.28	1.67	4.92
67.	<i>Ziziphus jujube</i> (L) Gaertner [*]	Rhamnaceae	-	-	0.67	5.54	0.67	4.28
Total			144.25	-	156.33	-	237.64	-

Thus, on the basis of density and importance value index, 16 species of plants including *Piper longum* were recorded as dominant in all study sites (Table 2). Among them *Ageratum conyzoids*, *Alternanthera sessilis*, *Brachieria ramosa*, *Imperata cylindrica*, *Parthenium hysterophorus*, *Cyperus rotundus*, *Cyperus esculentus*, and *Cynodon dactylon* were reported as the world worst weeds in the world by Holm et al. (1977). Of the 16 most important species *Brachieria ramosa*, *Cynodon dactylon*, *Cyperus rotundus*, *Euphorbia hirta*, *Imperata cylindrica* and *Oxalis corniculata* were common at site 1, site 2 and site 3.

Eco-phenological Study of *Piper longum*

Plant height

Piper longum is a perennial herb. The flowering stage started from July-August and turned into fruiting stage in October-January. The harvesting was done in the month of November-January.

The height of the plant was varied among three different sites, i.e. site 1, site 2 and site 3. The average height of the plant at site 1 was found to be 108.1 ± 5.71 cm, 104.2 ± 5.84 cm was recorded at site 2 and the average height of plant recorded at site 3 was 101.8 ± 3 cm which was minimum among all three sites (Fig. 2).

Leaf area and Circumference of stem

Leaves of *Piper* were found to be broadly ovate, entire, glabrous and sub-acute with reticulate venation. They were dark green and shiny. The leaf area was recorded at the flowering stage of *Piper*. Ten plants were collected and their leaves were measured and average leaf area was calculated. The maximum leaf area was found at the site 1, i.e. 53.92 ± 3.46 cm² and then 50.43 ± 2.69 cm² at site 2 and minimum leaf area was recorded from the site 3, i.e. 49.43 ± 3.61 cm². Similarly, the mean leaf length and breadth ratio was recorded as 1.01, 0.93 and 0.92 at site 1, site 2 and site 3, respectively (Fig. 3). The circumference of stem of the *Piper* was found to be different among the different sites. The mean of the circumference of the stem was found to be 1.0 ± 0.83 cm at site 1, 0.9 ± 0.73 cm at site 2 and at site 3 it was reported as 0.83 ± 0.38 cm (Fig. 4).

Fig. 2:- Plant height (cm) of *Piper* in different study sites (mean \pm SE).

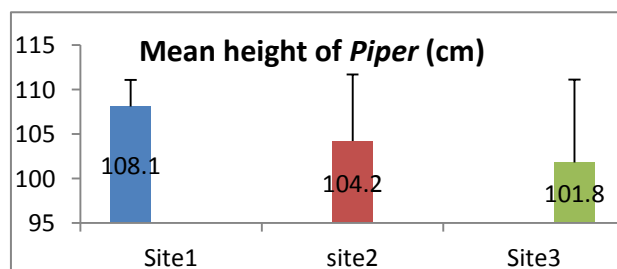
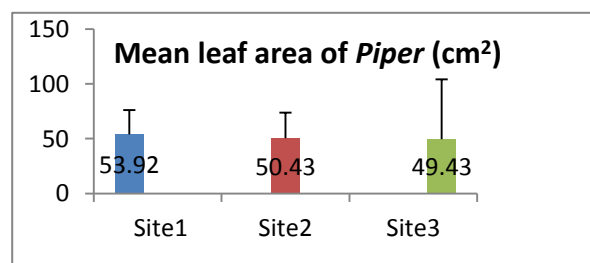


Fig.3:- Leaf area (cm²) of *Piper* in different study sites (mean \pm SE).



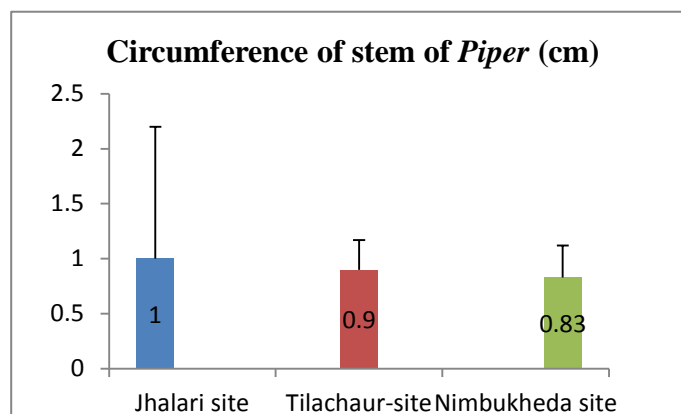


Fig. 4:-Circumference (cm²) of Piper of different study sites (mean±SE)

Reproductive Behaviours

Fruits were cylindrical, short and stout. They were shiny dark green when immature and turned darker at maturity. The average sizes of fruits taken from different sites i.e. site 1, site 2, and site 3 were found to be 1.79 ± 0.122 , 1.79 ± 0.095 and 1.65 ± 0.08 , respectively. The average size of 20 seeds of Piper longum was 1.21 ± 0.016 mm. Single spike of Piper produced 71.33 ± 1.49 , 67.67 ± 1.60 and 61.33 ± 1.93 average seed number at site 1, site 2, and site 3, respectively. The seed output per plant at site 1, site 2 and site 3 was found to be 827.42, 581.96 and 447.709, respectively.

Medicinal Value of Piper longum

Plants have been source of medicine for thousands of years. Piper longum is among the important medicinal plants used in various system of medicine. P. longum is a medicinal plant that has been used as therapeutic agent in the treatment of various pathological conditions. The specific effect of plant makes it more useful for animals and human beings. Because Piper longum is widely used in cooking and traditional medicine, it is generally assumed to be safe in moderate doses. The roots and fruits of Piper are generally used to cure different diseases. Leaves of Piper are used as hair tonic. Leaves are used to get rid of lice and dandruff. The root has a bitter, hot and sharp taste. It is used as a carminative, a tonic to liver, stomachic, abortifacient, emmenagogue, haematinic, diuretic, digestive and as a general tonic, useful in inflammation of liver, pains in joints, lumbago, snake bite, scorpion-sting and night blindness. A decoction of roots is given for swelling of joints of cattle.

The major alkaloid of long pepper is piperine. Piperine is antipyretic (reduces fever), hypotensive (lowers BP), restorative, liver protecting, CNS stimulant and improves drug availability. The roots are known as Pippalimula. The dried, immature, catkin-like fruits of the plant are known as Pippali. The unripe fruit is sweetish, cooling and useful in biliousness. The ripe fruit is sweet, pungent, a stomachic, aphrodisiac, alternative, laxative, antidiarrhoeic, antidysentric, is useful in asthma, bronchitis, abdominal complaints, fevers, leucoderma, urinary discharges, tumors, piles, diseases of the spleen, pains, inflammation, leprosy, epilepsy, insomnia, jaundice, hiccups, tuberculosis and reduces biliousness. The essential oil of Piper longum also shows antibacterial and antifungal action. Piper also helps to deal with indigestion, as it cleans the lining of the intestine, it helps to improve appetite. Piper is also used to treat menstrual cramps, infertility and libido, intellect and memory power. Piper longum is evenly used in both ayurvedic and allopathic medicinal values.

Discussion:-

In the present study, attempts were made to examine the plant species composition with Piper longum on their growth among the different sites of Kanchanpur, Far Western Nepal. It is used in over 320 classical compound, medicinal formulations and in many modern herbal formulations (Ravindran and Balachandran, 2005). Besides fruits, the roots and thicker parts of stem are cut and dried and used as an important drug in the Ayurvedic and Unani systems (Ali et al., 2007). Phoboo, Devkota and Jha (2008) studied the various aspects of medicinal plants of Nepal and its conservation efforts in context to Nepal. Piper mostly grows in hot and humid climatic conditions. It preferred well drained sandy soil rich in organic matter with pH 5.5-8.5 (Sumy et al., 2000).

The height of *Piper* was varied among three different sites. The average height of plant was recorded from range 102-108 cm. Minimum height was recorded from Nimbukheda-site due to the presence of associated species which inhibit the growth of the plant to some extent. The average leaf area was found to be 7.33 cm², 6.76 cm² and 6.9 cm² at site 1, site 2 and site 3, respectively. This value matches with the study of Kritkar and Basu (1935) who found the size of leaves as 6.0-9.0 cm² in India. The average sizes of fruits taken from different sites i.e. site 1, site 2, and site 3 were found to be 1.79 cm, 1.79 cm and 1.65 cm, respectively. The average size of 20 seeds of *Piper longum* was 1.21±0.016 mm, the shape of seed was oblong, and the colour was brown. The present distribution of *Piper* in Nepal was found in tropical regions at altitudes ranging from 100 to 1000 m from sea level. The study site of present work also lies between the altitudes of this range. The growth and reproduction cycle of *Piper* depends on climatic conditions such as humidity, available moisture, soil p^H and perennial life cycle. In the present study, the distribution pattern is more or less similar with the finding of Baral and Kurmi (2006).

The composition of plant species with *Piper* was varied among the different sites. In the present work 67 plant species from different 34 families including *Piper longum* were studied in all study sites of Kanchanpur. Among them 36 (53.73%) species of plant with *Piper* were recorded from Jhalari-site. Similarly, 37 (55.22%) and 62 (92.53%) plant species were recorded among Tilachaur-site and Nimbukheda-site, respectively. The composition of different species with *Piper* indicates the poor growth of *Piper longum* due to space, nutrient deficiency, light intensity, public involvement, cattle grazing, fodder collection, climatic conditions etc.

On the basis of density and IVI, 16 plant species including *Piper* were recorded as dominant (IVI >15) among study sites. *Ageratum conyzoids* (23.42) *Brachieria ramosa* (19.22) *Commelina benghalensis* (15.49), *Cynodon dactylon* (19.7), *Cyperus rotundus* (20.68), *Euphorbia hirta* (15.03), *Imperata cylindrica* (21.22), *Oxalis corniculata* (17.92), and *Piper longum* (32.63) were dominant at site 1. *Ageratum conyzoids* (15.51), *Amaranthus spinosus* (15.14), *Brachieria ramosa* (17.43), *Commelina paludosa* (15.54), *Cynodon dactylon* (23.11), *Cyperus rotundus* (21.46), *Euphorbia hirta* (18.18), *Imperata cylindrica* (19.73), *Oxalis corniculata* (18.26), *Parthenium hysterophorus* (17.98) and *Piper longum* (32.7) species were dominant at site 2 and *Ageratum conyzoids* (18.45), *Alternanthera sessilis*, *Brachieria ramosa* (16.5), *Centella asiatica* (17.49), *Commelina paludosa* (18.38), *Cynodon dactylon* (22.57), *Cyperus rotundus* (19.49), *Dactyloctenium aegyptium* (15.17), *Euphorbia hirta* (18.6), *Imperata cylindrica* (22.87), *Oxalis corniculata* (19.12), *Evolvulus nummularis* (46.6), *Parthenium hysterophorus* (21.88) and *Piper longum* (27.46) species at site 3.

Among them *Ageratum conyzoids*, *Alternanthera sessilis*, *Brachieria ramosa*, *Imperata cylindrica*, *Parthenium hysterophorus*, *Cyperus rotundus*, *Cyperus esculentus*, and *Cynodon dactylon* are reported as being the important species in the world by Holm et al. (1977). Of the 16 most important species *Brachieria ramosa*, *Cynodon dactylon*, *Cyperus rotundus*, *Euphorbia hirta*, *Imperata cylindrica* and *Oxalis corniculata* were common at site 1, site 2 and site 3.

Density of *Piper longum* was found to be 31.0 m⁻², 15.33 m⁻² and 16.33 m⁻² at Jhalari-site, Tilachaur-site and Nimbukheda-site, respectively. It might be due to the soil composition, humidity and favorable weather conditions that the density was highest in Jhalari-site.

Piper was used as medicine for both animal and human beings. According to Iyer (1983) it is also reported that pipali cures cough dyspnoea, ascites, leprosy, diabetes, piles, colic indigestion, anemia, thirst and dispels cardiac and splenic disorder, fever, loss of appetite and worm troubles. CSIR (1998) reported the medicinal uses of pipali as for diseases of respiratory tract, cough and bronchitis, asthma etc. In present work by interviewing with several related core groups, was found that *Piper* used in cough, common cold, fever, scorpion-sting and snake bite etc. This result was more or less similar to that of Chahal et al., (2011) who reported that the roots and fruits of the plant are used as an antidote to snake bite, scorpion stings, chronic bronchitis, cough and cold and the ripe fruits are used as an alternative to tonic.

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