Pak. J. Weed Sci. Res. 18(1): 107-126, 2012

PHYTOSOCIOLOGICAL ATTRIBUTES OF WEED FLORA IN MAJOR CROPS OF NORTH COASTAL ANDHRA PRADESH, INDIA

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ABSTRACT

The cultivated fields of North Coastal Andhra Pradesh region are infested with a large number of weeds that result in heavy crop yield losses. Rice is the most dominant crop of this area. The rice variety i.e. Srikakulam sannalu (RGL-2537) having crop duration of 150-165 days (Srikakulam district), the groundnut crop variety i.e. JL-24 having crop duration of 105-110 days (Vizianagaram district) and sugarcane crop variety i.e. Viswamitra (87A 298) having a duration of 10 months (Visakhapatnam district) were selected for the phytosociological investigations. The studies were conducted before weeding during Kharif season (i.e. June-October, 2007). Random quadrat method was adopted for studying the phytosociological attributes of the weeds. In each field site, 20 quadrats of 100 cm^2 size were laid down and hence a sum of 60 quadrats were randomly thrown for each crop in the three districts. A total of 200 herbaceous plant species (i.e. 65 in rice, 78 in sugarcane, and 57 in groundnut) occurred in the three major cropping systems. This number constitutes 70.8% of the total number of the weed species of the world. Wolffia globosa was most abundant weed species in the rice fields, Cyperus rotundus was the most important species in sugarcane and groundnut crops. The majority of the weed species encountered in the crop fields were recorded as A, B, C, and D frequency classes and hence the weed vegetation was declared as heterogeneous. Phytosociological attributes and ecology of the weeds of this region has to be communicated to the concerned public and private organizations, and farmers for effective weed management and better crop yields. It is also helpful for designing a suitable weed control technology for the studied area.

Keywords: Biodiversity, groundnut, India, phytosociology, rice, sugarcane, weeds.

INTRODUCTION

Weeds are unwanted and undesirable plants growing in a place where some other desirable plants are grown or where no plantation is

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needed at all. The plants growing in agricultural fields, having more negative values, and competing with the main crops for soil, water, nutrients etc. are known as weeds (Ali *et al.*, 2003; Muzik, 1970). However, weed is a relative term loaded with value endowed by human beings in relation to their own activities and it is an anthro-centric concept rather than an absolute quality. In nature, there is no plant which is useless that can be considered as weed, but plants of small growth are generally considered as weeds and certain characters have been associated with such plants. Weeds will usually have, with few exceptions, short vegetative phase, high reproductive output, and capable of limiting the crop yields (Ghaffoor, 2004). Keeping in view the weedy characters and the concept of weed from the point of agro ecosystems management, the term weed is used here describing the herbaceous plant species growing in the crop fields and agrestals. Workers like Dangwal *et al*. (2011) and Prayaga *et al.* (2007) have also worked on weed flora and their management in other areas of India.

The north coastal Andhra Pradesh area is composed of a diverse flora of weeds severely infesting all the crops of the region. A very few reports on crop weeds, their distribution pattern and ecological status have been published in the district's floras; however, no authentic or comprehensive study on the weed species of this region has been taken up so far. Further, in spite of the diversity in crops and weeds flora no detailed floristic and phytosociological studies on the weeds in crop fields of the region under consideration have been worked out. The present work has thus been assumed to be helpful in designing a suitable weed control technology for the area. Therefore, the present investigation on pytosociological studies of weed flora in crop fields of north coastal Andhra Pradesh has been undertaken.

MATERIALS AND METHODS

Study area

Andhra Pradesh is the fifth largest state in India with an area of 2, 75,909 sq. km. The 23 districts of the state are generally grouped in to three geographically distinct regions called as (1) Circars of Coastal Andhra (covering 9 districts), (2) Rayalaseema (encompassing 4 districts), and (3) Telangana (including 10 districts).

North Coastal Andhra Pradesh is situated between 17^0 10' to 19^0 10' N latitudes and 81^0 53' to 84^0 50' E longitudes. It is sorrounded on the north by Orissa state, on the South by East Godavari district, the eastern part bordering with Bay of Bengal and on the West by East Godavari district and part of Orissa (Fig. 1). This state comprises of three districts i.e. Srikakulam, Vizianagaram and Visakhapatnam districts. The irrigated and rain fed area under cultivation is about

85,2700 ha in the three districts (having a total geographical area of 23,48,612 ha). The major river systems used for irrigation purpose are Vamsadhara, Nagavalli, Janjavathi, Champavathi,Vegavathi, Vattigadda, Gosthani, Sarada, Varaha and Thandava. The soils are red loamy and alluvial. The area is divided into coastal land, plain land and hilly land areas. The main crops are rice, sugarcane, groundnut, fingermillet, sesamum, sorghum, pearl millet and jute etc.

Land use

The land utilization of this region (in hectares) for various aspects is furnished in Table-1 as Net sown area, Land put to non agricultural uses, Current fallow lands etc.

Figure 1. Map of North Coastal Andhra Pradesh, India.

Agriculture

It has been noticed that net area shown varies from year to year. The cropping pattern also varies with the effect of climate, soil and other irrigation facilities. The food crops occupy an important place, among them rice is important. Sugarcane, and groundnut crops are commercially important. The details of crop-wise and season-wise cultivation during 2006-07 is furnished in Table-2.

Table-1. Land use pattern in three districts during 2006-07 (Area in ha).

S.No	Land use category	SKLM	VZM	VSP	Total	% area
1.	Net sown area	278713	285570	288450	852733	36.60
2.	Forests	68641	111969	441166	621776	26.68
3.	Land put to non agricultural uses	93582	72320	101048	266950	11.45
4.	Barren and Un cultivable	50410	77753	130938	259101	11.12
5.	Permanent pastures and grazing lands	930	4899	2968	8797	0.37
6.	Other fallow lands	6598	11185	32075	49858	2.13
7.	Current fallow lands	79993	50214	73493	203700	8.74
8.	Cultivable waste	605	3551	11183	15339	0.65
9.	Miscellaneous tree crops land	4228	7577	34779	46584	1.99
Total geographical area		**583700**	**630038**	**1116100**	**2348612**	
% of area		25.05	27.04	49.90	100	

SKLM= Srikakulam, VZM= Vizianagaram, VSP= Visakhapatnam
Source: Chief Planning Officer; Srikakulam, Vizianagaram, Visakhapatnam (2006-2007)

Table-2. Crop-wise, Season-wise cultivation (2006-2007)(Area in ha).

S.No	Crop	Srikakulam		Vizianagaram		Visakhapatnam	
1.		**Kharif**	**Rabi**	**Kharif**	**Rabi**	**Kharif**	**Rabi**
2.	Paddy	64414	2045	94336	3750	83953	3009
3.	Jowar	188	26	339	37	1221	133
4.	Bajra	3123	-	376	973	12174	0
5.	Maize	957	983	3609	5692	6906	1320
6.	Ragi	450	1137	5624	1184	30026	704
7.	Horse gram	-	11257	15470	17987	116	4751
8.	Green gram	971	32841	790	14680	2142	2430
9.	Black gram	408	42908	773	10010	2528	2730
10.	Red gram	1,126		1507	-	4263	2
11.	Bengal gram	-	-	-	-	0	87
12.	Cow gram	-	-	-	-	1313	712
13.	Other Pulses	-	-	-	93	1057	69
14.	Chilies	-	2930	286	1946	876	2344
15.	Curcuma	790	-	897	-	1672	-
16.	Sugarcane	7240	-	18077	-	41739	-
17.	Potatoes	-	-	-	-	100	69
18.	Onions	-	1303	-	180	52	153
19.	Ground nut	26228	6873	37883	3626	7668	1077
20.	Sesamum	2142	1235	16139	4274	5873	2672
21.	Sun flower	56	3044	-	2890	3	67
22.	Castor	-	9	-	8	4	-
23.	Cotton	666		17734		1584	0
24.	Tobacco	-	17	-	1352	-	766
25.	Mesta	12349	-	38958	-	98	-

Source: Chief Planning Officer; Srikakulam, Vizianagaram, Visakhapatnam

Climatic seasons

In agriculture point of view it has been taken three seasons depending upon the climatic conditions are mentioned below.

1. Kharif season (June-October)
2. Rabi season (November- February)
3. Summer season (March-May)

South west monsoon is the principal rainy season contributing maximum amount (80%) of total annual rainfall for kharif crops. This region being a rainfed area, the agricultural operations commence during the months of June/ July and crops will come for harvest in October/ November. Rainfall in October month also contributes maximum prosperity for the crops. Hence the kharif season is taken from June to October. The winter months come under rabi season. Environmental characters have been recorded in the study area (Fig. 2-4).

The present study was aimed at providing an inventory of the arable land weeds and phytosociological attributes of major cultivars in North coastal Andhra Pradesh. The methodology adopted is as fallows.

Phytosociological studies

Rice (*Oryza sativa*) groundnut (*Arachis hypogaea*) and sugarcane (*Saccharum officinarum*) crops are significant crops in North Coastal Andhra Pradesh both in terms of acreage as well as productivity. Hence, phytosociological studies were conducted in these three crop fields. Typically, rice and sugarcane crops represent irrigated fields whereas groundnut crop represents dry fields. Rice is the most dominant crop of this area. The rice variety 'Srikakulam sannalu' (RGL 2537) having a duration of 150-165 days (Srikakulam district), variety of ground nut crop (JL-24) with duration of 105-110 days (Vizianagaram district) and 'Viswamitra' variety (87A 298) of sugarcane crop with a duration of 10 months (Visakhapatnam district) were selected for the phytosociological investigations. The studies were conducted before weeding during Kharif season (from June to October) of 2007.

For each crop, three crop dominant mandals (tehsils) were selected for the phytosociological studies. The location of field sites and period of study of three crops are as follows:

Crop / Period of study	Field site-1	Field site-2	Field site -3
Rice crop (2007)	Palakonda (Mandal)	Narasannapeta (Mandal)	Nandigam (Mandal)
Ground nut (2006)	Pusapatirega (Mandal)	Cheepurapalli (Mandal)	Gajapathinagaram (Mandal)
Sugarcane (2006)	Anakapalli (Mandal)	Kasimkota (Mandal)	Munagapaka (Mandal)

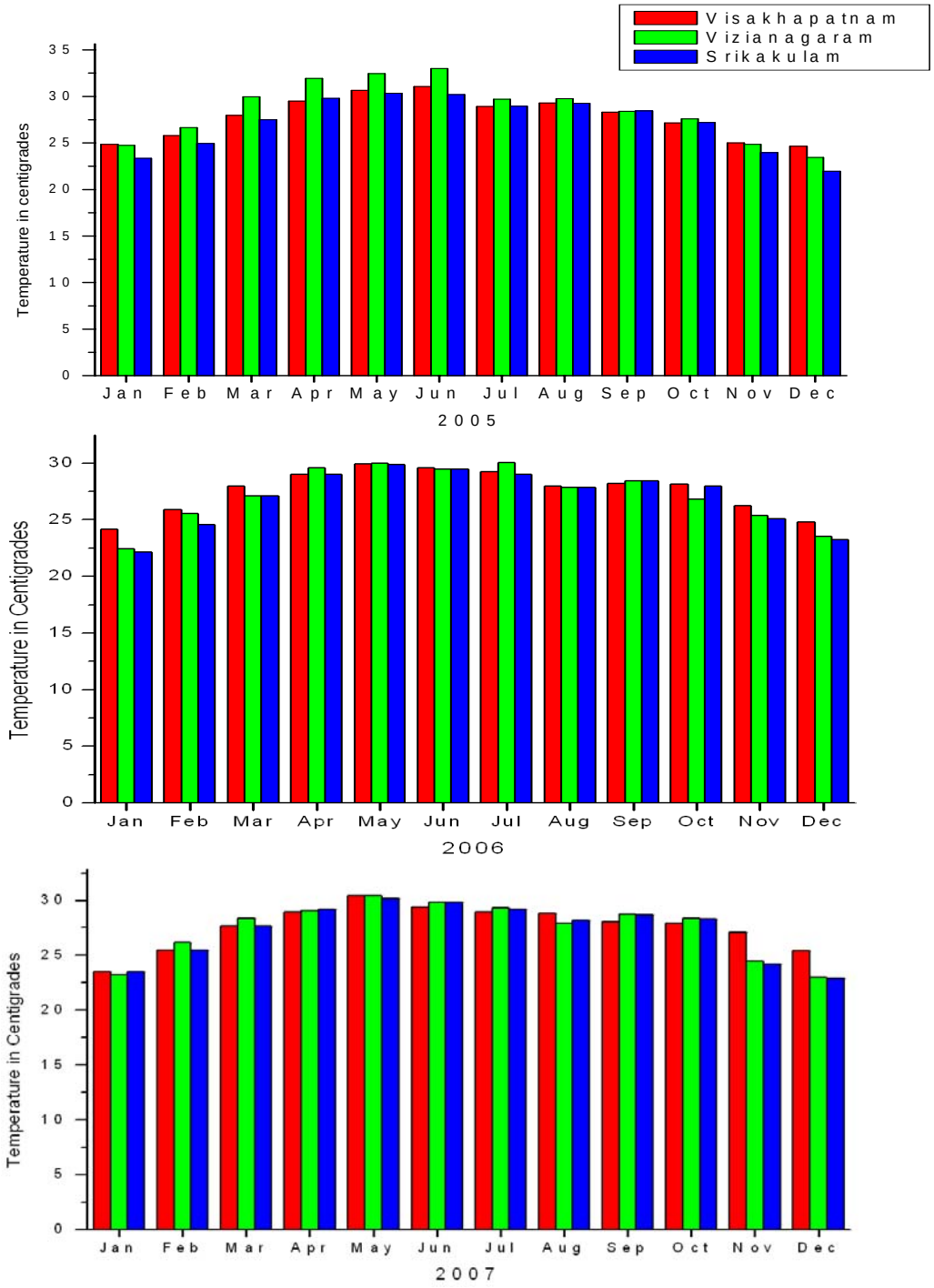

Figure 2. Temperatures recorded during the years 2005, 2006 and 2007.

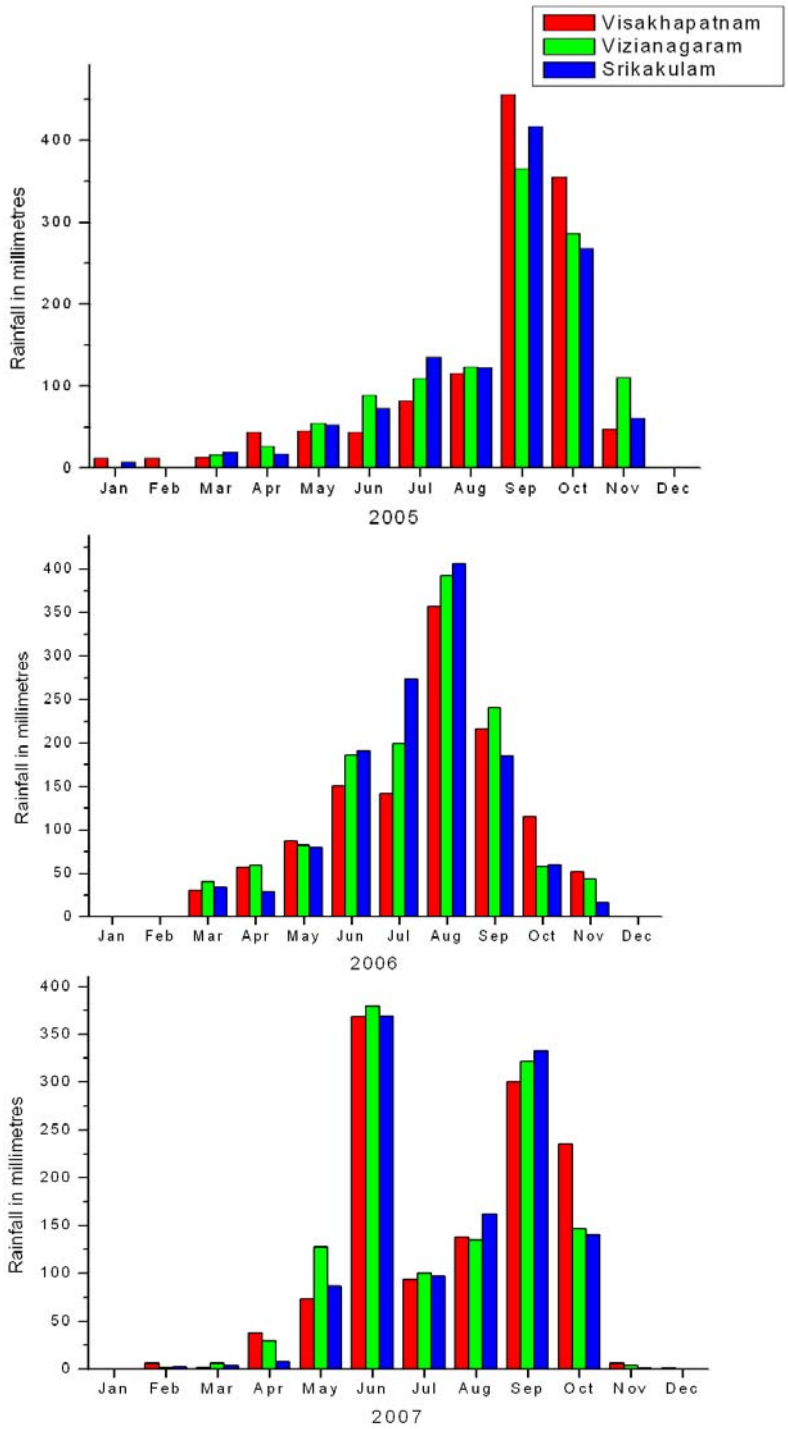

Figure 3. Rainfall recorded during the years of 2005, 2006 and 2007

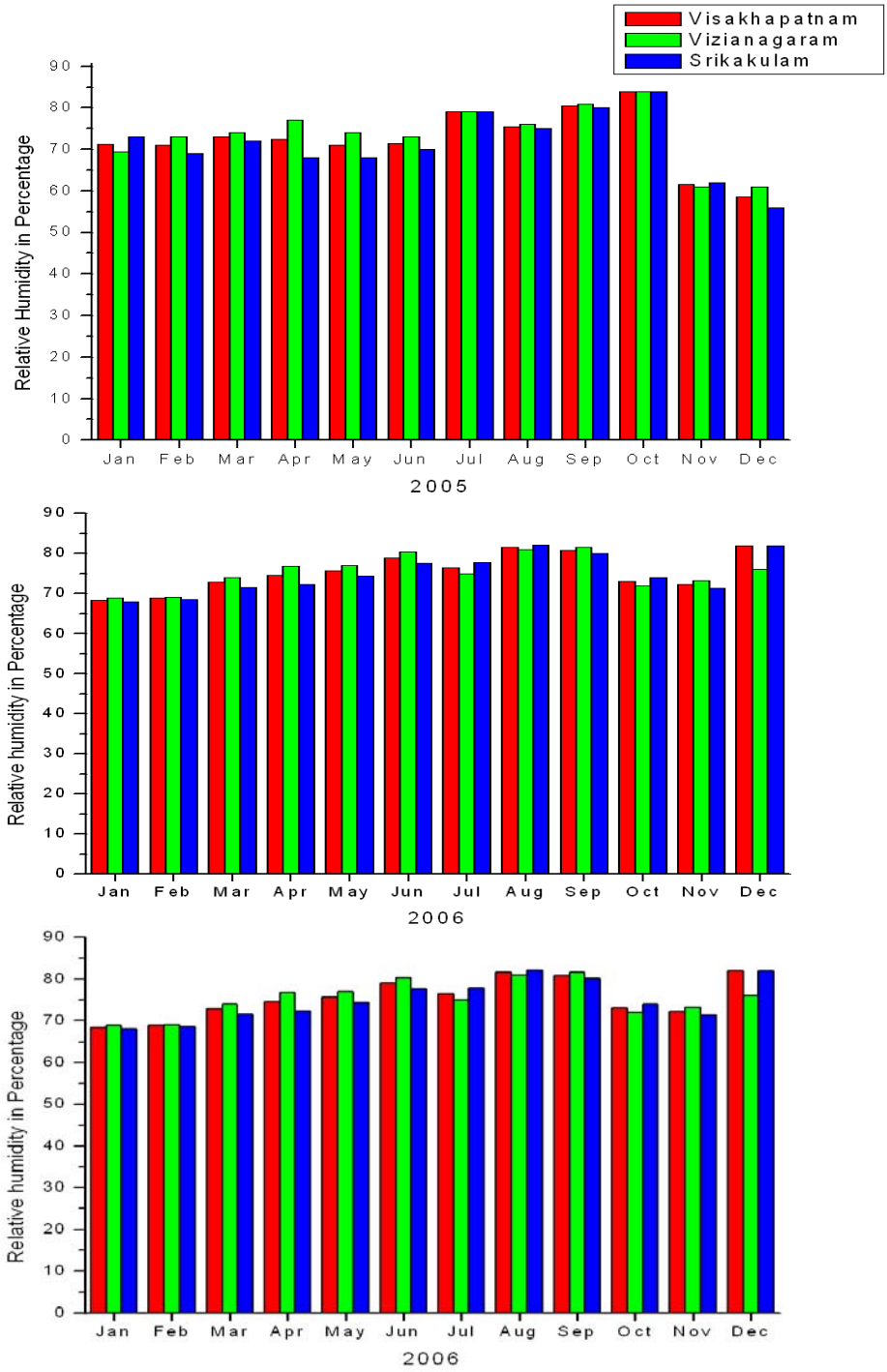

Figure 4. Relative humidity recorded during the years of 2005, 2006 and 2007

All the weeds encountered in the field sites of the above crop fields were carefully collected and identified. Random quadrat method was adopted for studying phytosociological attributes of weeds. In each field site, 20 quadrats of 100 cm^2 were laid down and hence a sum of 60 quadrats for each crop. All the weeds from each quadrat were collected separately in polythene bags. All the plant species encountered in 60 quadrats of each crop were listed. The phytosociological attributes: abundance, density and frequency and their relative values and importance value index (IVI) were calculated according to the principles of Curtis and McIntosh (1950), Misra (1968) and Dombois and Ellenberg (1974). The following were the different formulae for calculation of the relevant attributes.

$$\text{Frequency (\%)} = \frac{\text{Total number of quadrats in which the species occur x 100}}{\text{Total number of quadrats studied}}$$

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats studied}}$$

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats in which the species occurred}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of individuals of a species x 100}}{\text{Total frequency of all species}}$$

$$\text{Relative density} = \frac{\text{Density of individuals of a species x 100}}{\text{Total density of all species}}$$

$$\text{Relative abundance} = \frac{\text{Abundance of individuals of a species x 100}}{\text{Total abundance of all species}}$$

$$\text{Importance Value Index} = \text{Relative density} + \text{Relative frequency} + \text{Relative abundance}$$

Based on Raunkiaer (1934), the frequency classes of weed species were determined. Accordingly there were five frequency classes, i.e. 'A' class with the species of frequency ranging from 1-20%; 'B' class 21-40%; 'C' class 41-60%; 'D' class 61-80% and 'E' class 81-100%. Furthermore, the weed community frequency patterns were compared with the normal frequency pattern of Raunkiaer (A>B>C>=D<E). Based on the frequency pattern of the community, the homogeneity and heterogeneity of the vegetation were determined. If the values are high with respect to B, C and D, then the community is said to be heterogeneous where as higher values of E indicates the homogeneous nature.

Identification of specimens

After completing the weed collection from the crop fields, the specimens were identified by comparing with the authentic certified specimens at the Andhra University herbarium, Department of Botany and Central National Herbarium (CAL) Howrah (for some grasses). Later, these identifications were checked again at the regional herbarium or in the laboratory with the help of floras, monographs and

other relevant literature and consequently the correct name was provided to each plant. Each plant was critically studied and identified using the 'Flora of British India' (Hooker, 1872-1897), 'Flora of Presidency of Madras' (Gamble and Fischer, 1915-1935), The grasses of Burma, Ceylone, India and Pakistan (Bor, 1960), 'Forest flora of Andhra Pradesh' (Reddy *et al.*, 1991), 'Flora of Andhra Pradesh' (Pullaiah and Chennaiah, 1997), and district floras of Srikakulam (Rao and Sriramualu, 1986), Visakhapatnam (Rao and Kumari, 2002) and Vizianagaram (Venkaiah, 2004).

RESULTS AND DISCUSSION

The weed species encountered in the three selected crop fields i.e., rice, sugar cane and groundnut in Srikakulam, Vizianagaram, Visakhapatnam districts during the kharif season were provided in Tables 3-5.

Rice

Abundance, Density, Frequency and their relative values for determining the distribution pattern and Importance Value Index (IVI) of the weeds encountered in rice crop fields are presented in Table-3. A total of 65 weed species (29 dicots, 36 monocots) were recorded from the 60 randomly theown quadrats combining three field sites. *Wolffia globosa* was the most abundant weed in rice fields followed by *Polygonum glabrum*, *Chloris montana, Fimbristylis miliace, Aeschynomene indica* and C*oix lacrymajobi*. The Important Value Index calculated for the individual weed species encountered in the rice crop fields revealed interesting results. *Wolffia globosa* was the most important species followed by *Echinochloa cruss-galli, Cyperus rotundus, Cynodon dactylon* and *Dactyloctenium aegyptium*.

Sugarcane

In the sugarcane crop fields, a total of 78 species (67 dicots, 11 monocots) were recorded in all the randomly thrown 60 quadrats. The data pertaining to abundance, density, frequency of weeds are presented in Table-4. *Merremia hederacea, Acalypha lanceolata* were the most abundant species followed by *Phyllanthus amarus, Boerhaavia diffusa* and *Gomphrena serrata.* Importance Value Index (IVI) of individuals weed species encountered in the sugarcane crop fields were identified. *Cyperus rotundus* was the most important species followed by *Phyllanthus amarus, Dactyloctenium aegyptium, Tribulus terrestris* and *Parthenium hysterophorus*.

Groundnut

A total No. of 57 weed species (47 dicots, 10 monocots) were recorded in all 60 quadrats. The data pertaining to abundance, density, frequency of weeds are presented in Table-5. *Mollugo cerviana* is the most abundant species followed by *Phyllanthus maderaspatensis, Cyperus rotundus,* and *Phyllanthus amarus.*

Table-3. Pytosociological attributes of rice weeds.

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
1.	*Aeschynomene indica* L.	4	6	1.5	0.1	6.67	1.64	0.7	0.56	2.9
2.	*Ageratum conyzoides* L.	16	18	1.12	0.3	26.67	1.22	2.1	2.25	5.57
3.	*Ammannia baccifera* L.	17	18	1.05	0.3	28.33	1.15	2.1	2.39	5.64
4.	*Aponogeton echinatus* Roxb.	5	6	1.2	0.1	8.33	1.31	0.7	0.7	2.71
5.	*Aponogeton natans* (L.) Engler&Krause	4	4	1	0.07	6.67	1.09	0.49	0.56	2.14
6.	*Bacopa monnieri* Wettst	28	32	1.14	0.53	46.67	1.24	3.71	3.94	8.89
7.	*Basilicum polystachyon* (L.) Moench	8	10	1.25	0.17	13.33	1.36	1.19	1.12	3.67
8.	*Chloris barbata* (L.) Sw	7	10	1.43	0.17	11.67	1.56	1.19	0.98	3.73
9.	*Chloris montana* Link	6	11	1.83	0.18	10	2	1.26	0.84	4.1
10.	*Coix lacrymajobi* L.	4	6	1.5	0.1	6.67	1.64	0.7	0.56	2.9
11.	*Commelina erecta* L.	5	6	1.2	0.1	8.33	1.31	0.7	0.7	2.7
12.	*Commelina longifolia* Lamk	16	18	1.13	0.3	26.65	1.23	2.1	2.19	5.52
13.	*Cynodon dactylon (*L.) Pers	38	38	1	0.63	63.33	1.09	4.41	5.34	10.84
14.	*Cyperus difformis* L.	13	13	1	0.22	21.67	1.09	1.54	1.83	4.46
15.	*Cyperus diffusus* Vahl	16	18	1.13	0.3	26.67	1.23	2.1	2.25	5.58
16.	*Cyperus iria* L.	17	19	1.12	0.32	28.33	1.22	2.24	2.39	5.85
17.	*Cyperus rotundus* L.	37	44	1.19	0.73	61.67	1.3	5.11	5.2	11.61
18.	*Dactyloctenium aegyptium* (L.)P.Beauv.	32	36	1.13	0.6	53.33	1.23	4.2	4.5	9.93
19.	*Dentella repens* (L.)Forst.&Forst.f	22	22	1	0.37	36.67	1.09	2.59	3.09	6.77
20.	*Echinochloa colona* (L.) Link.	2	2	1	0.03	3.33	1.09	0.21	0.28	1.58
21.	*Echinochloa crusgalli* (L.)Beauv	42	58	1.38	0.97	70	1.51	6.79	5.9	14.2
22.	*Eclipta prostrata* (L.)L.	24	28	1.16	0.47	40	1.27	3.29	3.37	7.93
23.	*Eichhornia crassipes* (Mark.)Solms	13	13	1	0.22	21.67	1.09	1.54	1.83	4.46
24.	*Eleusine indica* (L.)Gaerth	7	8	1.14	0.13	11.67	1.24	0.91	0.98	3.13
25.	*Eragrostis atrovirens*	1	1	1	0.02	1.67	1.09	0.14	0.14	1.37
26.	*Eragrostis diarrhena* (Schult.)Steud.	4	4	1	0.07	6.67	1.09	0.49	0.56	2.14
27.	*Fimbristylis dichotoma* (L.)Vahl	6	7	1.17	0.12	10	1.28	0.84	0.84	2.96
28.	*Fimbristylis bisumbellata* (Forssk.)Bubani	2	2	1	0.03	3.33	1.09	0.21	0.28	1.58
29.	*Fimbristylis miliacea* (L.) Vahl	8	12	1.5	0.2	13.33	1.64	1.4	1.12	4.16
30.	*Gynura lycopersifolia* DC	6	8	1.33	0.13	10	1.45	0.91	0.84	3.2
31.	*Hedyotis corymbosa* (L.) Lamk	14	19	1.35	0.32	23.33	1.47	2.24	1.97	5.68
32.	*Hydrolea zeylanica* (L.) Vahl	2	2	1	0.03	3.33	1.09	0.21	0.28	1.58
33.	*Hygrophila auriculata* (Schum.)Heine	16	18	1.12	0.3	26.66	1.22	2.1	2.25	5.57
34.	*Ipomoea aquatic* Forsk	5	5	1	0.08	8.33	1.09	0.56	0.7	2.35
35.	*Ischaemum indicum* Merr	5	6	1.2	0.1	8.33	1.31	0.7	0.7	2.71

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
36.	*Ischaemum rugosum* Salisb	4	5	1.25	0.08	6.67	1.36	0.56	0.56	2.48
37.	*Lemna gibba* L.	6	8	1.33	0.13	10	1.45	0.91	0.84	3.2
38.	*Limnophila indica* (L.)Druce	3	3	1	0.05	5	1.09	0.35	0.42	1.86
39.	*Limnophila rugosa* (Roth)Merr	16	18	1.12	0.3	26.67	1.22	2.1	2.25	5.57
40.	*Lindernia antipoda* (L.)Alston	15	16	1.06	0.26	25	1.16	1.82	2.1	5.08
41.	*Lindernia ciliate* (Colsm.) Pennell	8	8	1	0.13	13.33	1.09	0.91	1.12	3.12
42.	*Lindernia crustacean* (L.)F.Muell	11	14	1.27	0.23	18.33	1.39	1.61	1.55	4.55
43.	*Ludwigia octovalvis* (Willd.)Bold	8	10	1.25	0.17	13.33	1.36	1.19	1.12	3.67
44.	*Ludwigia perennis* L.	14	16	1.14	0.27	23.33	1.24	1.89	1.97	5.1
45.	*Marsilia quadrifolia* L.	6	6	1	0.1	10	1.09	0.7	0.84	2.63
46.	*Monochoria hastate (*L.)Solms-Laub	6	6	1	0.1	10	1.09	0.7	0.84	2.63
47.	*Monochoria vaginalis* (Burm.f.)Presl	4	4	1	0.07	6.67	1.09	0.49	0.56	2.14
48.	*Nymphoides hydrophylla* (Lour.)O.Ktze	6	6	1	0.1	10	1.09	0.7	0.84	2.63
49.	*Ottelia alismoides* (L.)Pers	5	6	1.2	0.1	8.33	1.31	0.7	0.7	2.7
50.	*Panicum repens* L	6	7	1.17	0.12	10	1.28	0.84	0.84	2.96
51.	*Paspalidium flavidum* (Retz.)Camus	10	11	1.1	0.18	16.67	1.2	1.26	1.4	3.86
52.	*Paspalidium punctatum* (Burm.f.) Camus	8	10	1.25	0.17	13.33	1.36	1.19	1.14	3.67
53.	*Pennisetum polystachyon* (L.) Schult.	2	2	1	0.03	3.33	1.09	0.21	0.28	1.58
54.	*Phyla nodiflora* (L.) Greene	24	24	1	0.4	40	1.09	2.8	3.37	7.26
55.	*Pistia stratiotes* L.	2	2	1	0.03	3.33	1.09	0.21	0.28	1.58
56.	*Polygala arvensis* Willd.	15	20	1.33	0.33	25	1.45	2.31	2.1	5.86
57.	*Polygonum barbatum* L.	18	24	1.33	0.4	30	1.45	2.8	2.53	6.78
58.	*Polygonum glabrum* Willd.	4	9	2.25	0.15	6.67	2.46	1.05	0.56	4.07
59.	*Polygonum hydropiper* L.	5	5	1	0.08	8.33	1.09	0.56	0.7	2.35
60.	*Polygonum plebeium* R.Br.	4	5	1.25	0.08	6.67	1.36	0.56	0.56	2.48
61.	*Portulaca quadrifida* L.	13	13	1	0.21	21.67	1.09	1.47	1.83	4.39
62.	*Pycreus polystachyos* (Rottb.) Beauv	13	16	1.23	0.27	21.67	1.34	1.9	1.82	5.06
63.	*Rotala densiflora* (Roem.&Schult.) Koehne	16	17	1.06	0.28	26.67	1.16	1.96	2.25	5.37
64.	*Wolffia globosa*(Roxb.)Hartog& Plas	2	33	16.5	0.55	3.33	18.02	3.85	0.28	22.15
65.	*Xanthium strumarium* L.	5	6	1.2	0.1	8.33	1.31	0.7	0.7	2.71

TOI = Total Occurrence of Individuals, **RA** = Relative Abundance, **TNI** = Total Number of Individuals, **RD** = Relative Density, **A** = Abundance, **RF** = Relative Frequency, **D** = Density, **IVI** = Importance Value Index, and **F** = Frequency

Table-4. Phytosociological attributes of sugarcane weeds.

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
1.	*Abutilon indicum* (L.) Sweet	11	11	1	0.18	18.3	1.06	0.65	0.79	2.5
2.	*Acalypha indica* L.	28	36	1.28	0.6	46.6	1.35	2.16	2.02	5.53
3.	*Acalypha alnifolia* Willd.	2	2	1	0.03	3.3	1.06	0.11	0.16	1.31
4.	*Acalypha lanceolata* Willd.	1	2	2	0.03	1.6	2.11	0.11	0.06	2.28
5.	*Achyranthes aspera* L.	14	15	1.07	0.25	23.3	1.13	0.9	1.01	3.04
6.	*Aerva lanata* L.	28	36	1.28	0.6	46.7	1.35	2.16	2.02	5.53
7.	*Alternanthera pungens* Kunth	26	34	1.3	0.56	43.3	1.37	2.01	1.88	5.26
8.	*Amaranthus spinosus* L.	25	33	1.32	0.55	41.6	1.4	1.98	1.8	5.18
9.	*Amaranthus viridis* L.	18	22	1.22	0.36	30	1.29	1.29	1.3	3.88
10.	*Argemone mexicana* L	18	18	1`	0.3	30	1.06	1.07	1.3	3.43
11.	*Aristolochia bracteolata* Lam.	1	1	1	0.01	1.6	1.06	0.03	0.06	1.15
12.	*Boerhavia diffusa* L.	17	20	1.77	0.33	28.3	1.87	1.19	1.22	4.28
13.	*Cardiospermum halicacabum* L.	23	23	1	0.38	38.3	1.06	1.36	1.66	4.08
14.	*Cassia auriculata* L.	9	9	1	0.31	15	1.06	1.11	0.65	2.82
15.	*Cassia occidentalis* L.	26	28	1.07	0.46	43.3	1.13	1.65	1.88	4.66
16.	*Celosia argentea* L.	24	32	1.33	0.53	40	1.41	1.9	1.73	5.04
17.	*Centella asiatica* (L.) Urban	14	18	1.28	0.3	23.3	1.35	1.08	1.01	3.44
18.	*Chrozophora rottleri (*Geis.) Sprl	2	3	1.5	0.05	3.3	1.59	0.18	0.14	1.91
19.	*Cleome chelidonii* L.f.	8	8	1	0.13	13.3	1.06	0.46	0.58	2.1
20.	*Cleome gynandra* L.	16	16	1	0.26	26.6	1.06	0.93	1.15	3.14
21.	*Cleome viscosa* L.	31	34	1.09	0.56	51.6	1.15	2.01	2.24	5.4
22.	*Clitoria ternatea* L.	18	18	1	0.3	30	1.06	1.08	1.3	3.44
23.	*Coccinia grandis* (L.)Voigt	18	18	1	0.3	30	1.06	1.08	1.3	3.44
24.	*Cocculus hirsutus*(L.) Diels	9	9	1	0.15	15	1.06	0.54	0.65	2.25
25.	*Commelina benghalensis* L.	23	28	1.21	0.46	38.3	1.28	1.65	1.66	4.59
26.	*Corchorus trilocularis* L.	11	13	1.18	0.21	18.3	1.25	0.75	0.79	2.79
27.	*Crotalaria verrucosa* Wt. & Arn.	26	30	1.15	0.5	43.3	1.22	1.8	1.88	4.9
28.	*Croton banplandianum* Bail	21	26	1.23	0.43	35	1.3	1.54	1.52	4.36
29.	*Cymbopogon coloratus* (Hook.f)Stapf	9	11	1.22	0.18	15	1.29	0.65	0.65	2.59
30.	*Cynodon dactylon* (L.)Pers	38	38	1	0.63	63	1.06	2.26	2.73	6.05
31.	*Cyperus difformis* L.	18	18	1	0.3	30	1.06	1.08	1.3	3.43
32.	*Cyperus diffusus* Vahl	22	26	1.18	0.43	36	1.25	1.54	1.56	4.35
33.	*Cyperus rotundus* L.	46	72	1.56	1.2	76	1.65	4.31	3.3	9.26
34.	*Dactyloctenium aegyptium* L.	37	43	1.16	0.71	61	1.23	2.55	2.64	6.42
35.	*Desmodium triflorum* (L.) DC	7	7	1	0.11	11.6	1.06	0.39	0.5	1.95

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
36.	*Digitaria ciliaris* (Retz.) Koel	6	8	1.32	0.13	10	1.4	0.47	0.43	2.3
37.	*Digitaria sanguinalis*(L.) Scop	2	2	1	0.01	3.3	1.06	0.03	0.14	1.23
38.	*Emilia sonchifolia* (L.) DC	2	3	1.5	0.05	3.55	1.59	0.18	0.14	1.91
39.	*Euphorbia hirta* L.	22	28	1.27	0.46	36	1.34	1.65	1.56	3.95
40.	*Evolvulus alsinoides* L.	17	17	1	0.28	28.3	1.06	1	1.23	3.29
41.	*Gomphrena serrata* L.	9	16	1.77	0.26	15	1.87	0.93	0.65	3.45
42.	*Heliotropium indicum* L.	18	22	1.22	0.37	30	1.29	1.32	1.3	3.91
43.	*Hybanthus ennaespermus* (L.) F.V.Muell	21	28	1.33	0.46	35	1.41	1.65	1.52	4.58
44.	*Indoneesiella echioides* L.	15	17	1.13	0.28	25	1.19	1	1.08	3.27
45.	*Ipomoea pestigridis* L.	1	1	1	0.02	1.7	1.06	0.07	0.07	1.2
46.	*Jatropha gossypiifolia* L.	1	1	1	0.01	16	1.06	0.03	0.03	1.15
47.	*Kyllinga nemoralis* (Forst & Forst. f) Hutchins	26	35	1.34	0.58	43.3	1.42	2.08	1.88	5.38
48.	*Lantana camara* L.	7	11	1.57	0.18	11.7	1.66	0.65	0.5	2.81
49.	*Leucas aspera* (Willd.) Link	6	8	1.33	0.13	10	1.41	0.47	0.43	2.31
50.	*Merremia gangetica* (L.) Cub.	26	26	1	0.43	43.3	1.06	1.54	1.88	4.48
51.	*Merremia hederacea* (Burm.f.) Hallier.f	1	2	2	0.03	1.7	2.11	0.11	0.07	2.29
52.	*Merremia tridentata* (L.) Hallier.f	12	18	1.5	0.3	20	1.59	1.08	0.94	3.61
53.	*Mimosa pudica* L.	22	24	1.09	0.4	36.6	1.15	1.44	1.59	4.18
54.	*Mollugo nudicaulis* Lam.	28	34	1.21	0.56	46.6	1.28	2.01	2.02	5.31
55.	*Parthenium hysterophorus* L.	36	42	1.16	0.7	60	1.23	2.52	2.6	6.35
56.	*Passiflora foetida* L.	10	10	1	0.16	16.6	1.06	0.57	0.72	2.35
57.	*Pavonia zeylanica* (L.) Cav	20	22	1.1	0.36	33.3	1.16	1.3	1.44	3.9
58.	*Pedalium murex* L.	24	28	1.16	0.47	40	1.23	1.69	1.73	4.65
59.	*Phyllanthus amarus* Schum.&Thonn.	36	64	1.77	1.06	60	1.87	3.81	2.6	8.28
60.	*Phyllanthus debilis* L.	18	23	1.27	0.38	30	1.34	1.36	1.3	4
61.	*Phyllanthus virgatus* Forst.	14	19	1.35	0.31	23.3	1.43	1.11	1.01	3.55
62.	*Physalis minima* L.	11	12	1.09	0.2	18.3	1.15	0.72	0.79	2.66
63.	*Rostellularia procumbens* (L.) Nees	28	42	1.5	0.7	46.7	1.59	2.52	2.02	6.13
64.	*Ruellia tuberosa* L.	9	10	1.1	0.17	15	1.16	0.61	0.65	2.42
65.	*Sebastiania chamaelea* (L.)Muell.Arg	11	11	1	0.18	18.3	1.06	0.65	0.79	2.49
66.	*Sida cordifolia* L.	23	24	1.04	0.4	38.3	1.1	1.44	1.66	4.2
67.	*Solanum nigrum* L.	12	14	1.16	0.23	20	1.23	0.82	0.87	2.92
68.	*Spermacoce hispida* (L.) K.Schum	33	38	1.15	0.63	55	1.22	2.26	2.38	5.86
69.	*Sphaeranthus indicus* L.	19	24	1.26	0.4	31.7	1.33	1.44	1.37	4.14
70.	*Stachytarpheta jamaicensis* (L.)Vahl	9	12	1.33	0.2	15	1.41	0.72	0.65	2.78

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
71.	*Tephrosia purpurea* (L.) Pers	31	34	1.09	0.56	51.6	1.15	2.01	2.23	5.39
72.	*Tonningia axillaries* (L.) O. Ktze	21	24	1.14	0.4	35	1.21	1.44	1.52	4.17
73.	*Trianthema portulacastrum* L.	32	36	1.12	0.6	53.3	1.18	2.16	2.31	5.65
74.	*Tribulus terrestris* L.	32	44	1.37	0.73	53.3	1.45	2.62	2.31	6.38
75.	*Tridax procumbens* L.	26	30	1.15	0.5	43.3	1.22	1.8	1.88	4.9
76.	*Vernonia cinerea* (L.) Less.	34	42	1.23	0.7	56.7	1.3	2.52	2.46	6.28
77.	*Waltheria indica* L.	8	8	1	0.13	13.3	1.06	0.47	0.58	2.11
78.	*Wattakaka volubilis* (L.f) Stapf	1	1	1	0.02	1.7	1.06	0.07	0.07	1.2

Table-5. Phytosociological attributes of groundnut weeds.

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
1.	*Alysicarpus bupleurifolius* (L.) DC	1	1	1	0.02	1.7	1.54	0.11	0.11	1.76
2.	*Alysicarpus monilifera* (L.) DC	6	6	1	0.1	10	1.54	0.55	0.65	2.74
3.	*Arundinella ciliata* (Roxb.) Miq	21	26	1.24	0.43	35	1.91	2.37	2.29	6.57
4.	*Blainvillea acmella* (L.) Philipson	1	1	1	0.02	1.7	1.54	0.11	0.11	1.76
5.	*Boerhavia diffusa* L.	31	36	1.16	0.6	51.67	1.79	3.31	3.38	8.48
6.	*Brachiaria distachya* (L.) Stapf	34	38	1.12	0.63	56.67	1.72	3.47	3.71	8.9
7.	*Brachiaria reptans* (L.) Gardn. & Hubb	16	16	1	0.27	26.67	1.54	1.49	1.74	4.77
8.	*Bulbostylis barbata* (Rottb.) Cl	16	18	1.12	0.3	26.67	1.72	1.65	1.75	5.12
9.	*Cassia absus* L.	14	16	1.14	0.27	23.3	1.76	1.49	1.53	4.78
10.	*Celosia argentea* L.	44	52	1.18	0.87	73.33	1.82	4.8	4.8	11.42
11.	*Cleome aspera* DC	6	8	1.33	0.13	10	2.05	0.72	0.65	3.42
12.	*Cleome gynandra* L.	14	15	1.07	0.25	23.33	1.65	1.38	1.53	4.56
13	*Cleome monophylla* L.	16	17	1.06	0.28	26.7	1.64	1.54	1.75	4.93
14.	*Cleome viscosa* L.	30	38	1.27	0.63	50	1.96	3.47	3.28	8.71
15.	*Clitoria ternatea* L.	4	4	1	0.06	6.7	1.54	0.33	0.44	2.31
16.	*Coldenia procumbens* L.	14	16	1.14	0.27	23.33	1.76	1.49	1.52	4.77
17	*Commelina benghalensis* L.	27	32	1.18	0.53	45	1.82	2.92	2.95	7.69
18.	*Corchorus aestuans* L.	13	13	1	0.21	21.7	1.54	1.16	1.42	4.12
19.	*Croton banplandianum* Bail	28	34	1.21	0.57	46.67	1.87	3.14	3.05	8.06
20.	*Cucumis sativa* L.	3	3	1	0.05	5	1.54	0.28	0.33	2.15
21.	*Cynodon dactylon* (L.) Pers	42	48	1.42	0.8	70	2.19	4.41	4.59	11.19
22.	*Cyperus rotundus* L.	44	75	1.7	1.25	73.33	2.62	6.89	4.8	14.31
23.	*Dactyloctenium aegyptium* (L.) Beauv	20	20	1	0.33	33.33	1.54	1.82	2.18	5.54
24.	*Datura stramonium* L.	7	7	1	0.12	11.67	1.54	0.66	0.76	2.96

S.No	Name of the species	TOI	TNI	A	D	F	RA	RD	RF	IVI
25.	*Digera muricata* (L.) Mart	41	48	1.17	0.8	68.33	1.8	4.41	4.48	10.69
26.	*Euphorbia hirta* L.	19	26	1.37	0.43	31.67	2.11	2.37	2.07	6.55
27.	*Evolvulus nummularius* (L.) L.f.	18	18	1	0.3	30	1.54	1.65	1.97	5.16
28.	*Gisekia pharnaceoides* L.	26	27	1.03	0.45	43.3	1.59	2.48	2.84	6.91
29.	*Goniogyna hirta* (Willd.)Ali	6	7	1.16	0.11	10	1.79	0.61	0.65	3.05
30.	*Grangea maderaspatana* (L.)Poir.	2	2	1	0.03	3.33	1.54	0.16	0.22	1.92
31.	*Indigofera aspalathoides* Vahl	19	20	1.05	0.33	31.7	1.62	1.82	2.08	5.08
32.	*Indigofera hirsuta* L.	8	9	1.13	0.15	13.3	1.74	0.83	0.87	3.44
33.	*Luecas cephalotes* (Roth)Spreng.	24	27	1.12	0.45	40	1.72	2.48	2.62	6.82
34.	*Mollugo cerviana* (L.) Ser	1	2	2	0.03	1.7	3.08	0.17	0.11	3.36
35	*Momordica dioica* Willd.	4	5	1.25	0.08	6.7	1.93	0.44	0.44	2.81
36.	*Ocimum gratissimum* L.	8	9	1.12	0.15	13.33	1.72	0.82	0.87	3.41
37.	*Parthenium hysterophorus* L.	36	38	1.05	0.63	60	1.62	3.47	3.93	9.02
38.	*Phyllanthus amarus* Schum. & Thonn	24	36	1.5	0.6	40	2.31	3.31	2.62	8.24
39.	*Phyllanthus debilis* L.	16	18	1.12	0.3	26.67	1.72	1.65	1.74	5.11
40.	*Phyllanthus maderaspatensis* L.	8	14	1.75	0.23	13.33	2.7	1.27	0.87	4.84
41.	*Pupalia lappacea* (L.) Juss.	11	11	1	0.18	18.33	1.54	0.99	1.2	3.73
42.	*Scoparia dulcis* L.	26	28	1.08	0.47	43.33	1.67	2.59	2.84	7.1
43	*Sebastiania chamaelea* (L.) Muell. Arg	9	9	1	0.15	15	1.54	0.83	0.98	3.35
44.	*Setaria intermedia* Roem. & Schult	7	7	1	0.12	11.67	1.54	0.66	0.76	2.96
45.	*Sida acuta* Burm.f	21	21	1	0.35	35	1.54	1.93	2.29	5.76
46.	*Solanum surattense* Burm.f	6	6	1	0.1	10	1.54	0.55	0.65	2.74
47.	*Striga asiatica* (L.) O. Ktze	9	9	1	0.15	15	1.54	0.82	0.98	3.34
48.	*Synedrella nodiflora* (L.) Gaertn	11	12	1.09	0.2	18.33	1.68	1.1	1.2	3.98
49.	*Tephrosia pumila* (Lam.) Pers.	4	4	1	0.6	6.7	1.54	3.31	0.44	5.29
50.	*Tephrosia tinctoria* Pers	7	7	1	0.12	11.7	1.54	0.66	0.77	2.97
51.	*Tephrosia villosa* (L.) Pers	11	11	1	0.18	18.3	1.54	0.99	1.2	3.73
52.	*Tonningia axillaris* (L.) O.Ktze.	22	22	1	0.37	36.67	1.54	2.04	2.4	5.98
53.	*Trichodesma indicum* (L.) R.Br.	13	16	1.23	0.27	21.67	1.9	1.49	1.42	4.81
54.	*Tridax procumbens* L.	34	36	1.06	0.6	56.67	1.64	3.31	3.71	8.66
55.	*Triumfetta rhomboidea* Jacq.	6	7	1.16	0.11	10	1.79	0.61	0.65	3.05
56.	*Ziziphus mauritiana* Lam.	3	3	1	0.05	5	1.54	0.28	0.33	2.15
57.	*Ziziphus oenoplia* (L.) Mill	3	3	1	0.05	5	1.54	0.28	0.33	2.15

Important Value Index (IVI) of individual weed species encountered in the groundnut crop fields identified *Cyperus rotundus* as the most important species followed by *Celosia argentea, Cynodon dactylon, Digera muricata* and *Parthenium hysterophorus*.

Frequency Classes of weed species

The frequency classes of weed species studied in the selected crops(Table-6), the rice crop field revealed interesting results. Out of 65 weed species, 40 species fall under A category followed by B (20), C (2) and D (3), while none of the species was recorded under E category. In sugarcane fields A (29), B(27), C (19), D (3) and no single species under E category was observed. Similarly, in groundnut crop out of 57 species A (25) , B(19), C(9), D (4) and no single species under E category was categorized. Rice A >B >C < D, Sugarcane A >B >C> D, and groundnut crop A >B >C> D. With these results it was clearly showed that majority of the weed species encountered in the three crop fields fall under A, B, C and D frequency classes and hence the weed vegetation is heterogeneous.

Table-6. Frequency classes.

S. No	Frequency classes	Rice crop	Sugarcane crop	Groundnut crop
1	A:01-20	40	29	25
2	B:21-40	20	27	19
3	C:41-60	2	19	9
4	D:61-80	3	3	4
5	E:81-100	-	-	-
6	Total	65	78	57

Frequency formulae

Rice crop	A>B>C<D
Sugarcane crop	A>B>C>D
Groundnut crop	A>B>C>D

From the results obtained it is clearly established that most of the weed species encountered in the three crop fields fall under A,B,C and D frequency classes and hence the weed vegetation is relatively heterogeneous.

Of the 250,000 plant species in the world, about 250 species have been regarded as the prominent weeds in agricultural and non agricultural systems of the world and these weed species are responsible for the serious economic losses in cultivated crops throughout the wolrd(Rao, 1986; Alstrom, 1996). The present study has recorded 177 herbaceous plant species which occur in three major cropping systems of the North Coastal Andhra Pradesh. This number

constitutes 70.8% of the total number of the weed species of the world.

It is generally agreed that a weed plant species with density of more than one per m^2 may have perceptible impact on the crop. Such species in the rice, sugarcane, groundnut cropping system of present study include *Cyperus rotundus, Cyanodon dactylon, Echinochloa crusgalli, Trianthema portulacastrum, Eclipta alba, Heliotropium indicum, Cleome chelidonii, C.viscosa, Euphorbia hirta*, and *Phyllanthus amarus*. Some of these species like *T. portulacastrum, C. dactylon and C. rotundus* have been shown to be the dominant weeds in different agroclimatic zones of the Andhra Pradesh state (Singh and Rao, 1973). *Cleome viscosa, C. chelodonii, Eclipta alba, Trianthema portulacstrum* and *Heliotropium indicum* species are find aplace among the agrestals recorded as common or most common India (Tadulingam and Narayana, 1932; Singh and Rao, 1973; Sen, 1981; Rao, 1986) these weeds are equally represented in the study area.

In rice crop the IVI calculated for the individual weed species shows that *Wolffia globosa* was with the highest IVI followed by *Echinochloa crus galli*, *Cyperus rotundus* , *Cynodon dactylon* and *Dactyloctenium aegyptium. Cyperus rotundus* was with high IVI followed by *Phyllanthus amarus*, *Dactyloctenium aegyptium and Parthenium hysterophorus* in the sugarcane crop. *Cyperus rotundus* was with high IVI followed by *Celosia argentea, Cynodon dactylon*, *Digera muricata and Parthenium hysterophorus* in groundnut crop. Quantitative analysis showed that *Cyperus rotundus* was the most important weed in sugarcane and groundnut fields whereas *Wolffia globosa* was in the rice fields, similar reports have been recorded in the state (Lakshmiah, 2006). Sedges and grasses are with high IVI in rice, sugarcane, groundnut and tobacco fields (Rajeswaramma, 2001).

Cyperus rotundus, commonly called as the 'purplenut sedge', is one of the prominent weed of the present study. This weed is the native of India but has become cosmopolitan, spread over most of the tropic countries, and is treated as the world's worst weed (Holm *et al.*, 1977). It attains dominance most conspicuously on irrigated lands and becomes serious problem in large number of irrigated crops. It is one of the weeds that appear immediately after sowing and may compete heavily with the crop plants for nutrients and water.

It is well known that weed competition in the food crops is one of the major causes of low productivity and therefore it become essential to protect the crop from the weed infestation. Most of the crops infested with heavy weeds during the irrigation period and due to the adequate supply of nutrients. These factors like irrigation and supply of nutrients causes enormous growth of weeds. During this period their uptake of water and nutrients will be high and competition with the crop will be expected to be high. Based on the data of the

number of species in vegetative phase, it is suggested to remove all the weed flora in 30 to 60 days intervals after sowing.

CONCLUSION

The results obtained from this study clearly established the fact that the diversity of weeds were high and significant. A thorough perusal of literature pertaining to other weed floras of different areas of India has also revealed the highest concentration of weeds in this region compared with other areas. The knowledge and information regarding the taxonomy, Phytosociological attributes and ecology of the weeds of North Coastal Andhra Pradesh region will be communicated to the concerned governmental and non-governmental organizations and farmers for effective weed management and for better crop yielding. It is also helpful in designing suitable weed control technology for this area.

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