



Biodiversity And Phytosociological Analysis Of Vegetation In Abandoned Fallow Land On The J. P.University Campus, Chapra, Bihar.

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Abstract:

The floristic composition, life form and live shoot biomass estimate of a grassland community developed in abandoned cropland after about nine years at Jai Prakash University Chapra (25°36' - 26°15'N lat. and 84°24' - 85°15'E long.) were studied. The floristic composition of the grassland community was composed of 14 species *Dichanthium annulatum* and *Desmodium triflorum* were the dominant species. Other important species were *Euphorbia hirta* and *Indigofera linifolia* during the study period. The IVI values ranged from 45.72 – 69.95 in two study sites. The shoot biomass values ranged from 15.36 to 26.83gm⁻² for *Desmodium triflorum* and *Dichanthium annulatum* respectively. The species richness and equitability values 2.1 to 2.5 and 5.7 to 7.5 respectively at two study sites.

Index Terms - Abandoned cropland, Species composition, Importance value index, Species richness, Equitability and Live shoot biomass.

I. INTRODUCTION

In ecosystem vegetation is an important component that affect the entire environment Billings (1952); Shahid and Joshi (2016). Ecologically the land at which graminoid (Poaceae) species is dominated, such land is called as Grassland. In india grasslands occupy 39.81 per cent (12121thousand ha) area of the total Indian subcontinent Singh (1987). Distribution of grassland is predominantly governed by climatic factor and it occurs in all type of soil Whyte (1968). In India most of the works on grassland ecosystems have been reported by Pandeya et al. (1977), Singh and Yadava (1974), Sinha et al.(1991), Ramakrishnan and Ram (1988), Mishra and Mishra (1984) etc. In different seasons herbaceous vegetation structure changes in a cyclic manner. Herbaceous vegetation structure changes are mostly governed by moisture, heat and rainfall. Phytosociological analysis plays a crucial role in a vegetation study Singh et al. (2017). According to Mishra (1997) different plant species interact among themselves and their environment leads to the formation of discrete vegetation structures. Plant diversity and ecosystem health are closely interconnected, particularly in urban areas because they are already affected by anthropogenic pressure Schafer (2011), therefore vegetation is the first step towards ecosystem conservation.

Since 2006 cultivation of crops has been banned in J. P. University Campus, Chapra and the campus is now a fallowland. Only within nine years the vegetation has developed which is a grassland type. Of a particular area phytosociology is a quantitative study of the vegetation structure; they show quantitative relationship between a few dominant species, and that identifying a large number of rare species and control the community Sharma and Pandey (2010). Today, Intensification, abandonment and afforestation are affecting the grassland ecosystem. Because of this change grassland study is very poor. Hence our research is aimed at filling these knowledge gaps. If agricultural use is abandoned the variable ecosystem would be lost. According to Busch G. (2006) increases farmland and agricultural intensification can occur alongside extensive farmland abandonment and agricultural intensification has been identified as a driver of this abandonment Burgi M, Tumer MG (2002), Mottet A, Ladet S, Coque N, Gibon A (2006). Changes are a complex phenomenon because abandonment of agricultural land represents a change of land use and land cover. According to scientific literature there are three types of drivers of agricultural land abandonment. The first type is ecological drivers. Under ecological drivers has a different factor such as elevation, geological substrate, slope, aspect, fertility, soil depth, soil erosion, climate and climate change when they constrain agricultural production. The second type is socio - economic drivers. It refers to market, incentives, migration and rural depopulation, technology, industrialization land tenure systems and security, farm characterization, farmer age, accessibility and proximity to cities. The third type is unadopted agricultural systems and land mismanagement leading to soil degradation, frequent flooding, over-exploitation and productivity Duffy PD, Ursic SJ. (1991), Douglas T, Critchley D, Park G. (1996), Parrotta JA, Tumbal JW, Jones N (1997), Nagumo F. (1999).

Agricultural lands abandonment is mainly linked to five problems -

- a) Promotion of vegetation homogenization and reduction of landscape heterogeneity often associated with increased fire frequency,
- b) Soil erosion and desertification,
- c) Decrease water stocks,
- d) Population of adopted species reduced and biodiversity loss,
- e) Harm of cultural and aesthetic values.

In the some parts of the world soil erosion is a major problem linked to land abandonment but not everywhere. Abandoned farmland undergoes secondary succession, where open areas are initially colonized by pioneer plant species. For large extension of farmland when abandonment is simultaneous it leads to vegetation homogenization Lasanta – Martinez T, Vicente – Serrano SM, Cuadrat – Prats JM, (2005) and a reduction in landscape heterogeneity Hochll F, Lehringer S, Konold W (2005). According to Lloret F, Mari G (2001) reduced landscape heterogeneity increases the spread of disturbances. Some hydrological changes occur at the watershed scale when abandoned agricultural land gains vegetation cover. According to Pinto – Correia T (2000), van Eetvelde V, Antrop M (2004), Antop M (2005) many cultural landscapes have historical cultured, recreational, scenic and aesthetic importance. From revegetation of abandonment agricultural land a lots number of benefits obtained. After land abandonment afforestation practices are successful so soil properties improve. The present study was aimed to know the species composition and live shoot biomass level of grassland vegetation developed after nine years of abandonment of cultivation in the Jai Parkash University campus, Chapra, Bihar, India. Data on such studies are not available in the Indo – Gangetic plains of Bihar.

II. MATERIALS AND METHODS

The study was conducted at two openly grazed vegetation sites (Site I and Site II). Site I was moderately grazed and site II was intensively grazed. The sites were situated between (25°36' – 26°15' N lat. And 84°24' - 85°15' E long.). Harvest method was employed for the determination of frequency, density, abundance and biomass of plant species. Ten quadrates of size 50 cm X 50 cm were randomly thrown in the selected study area in rainy seasons in August 2019. Plants were harvested 1 cm above the ground surface, packed in polyethylene bags separately and brought to the laboratory. Plant species were identified following standard monograph of Haines (1961). For measuring biomass, plants were harvested from plots randomly located in a grid. The harvested material was separated into species. The samples were oven-dried to constant weight.

Measurement of Frequency, Density and Abundance

The phytosociological attributes of the data for community developed in the study sites were analysed; and data for following parameters such as frequency, density, abundance, relative frequency, relative density and relative abundance were collected following Misra (1968). Following formulae were followed for analysis of phytosociological characteristics of the community:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrates in which species occurred}}{\text{Total number of quadrates studied}} \times 100$$

$$\text{Relative Frequency (\%)} = \frac{\text{Number of occurrence of the species}}{\text{Number of occurrence of all species}} \times 100$$

$$\text{Density (m}^{-2}\text{)} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates studied}}$$

$$\text{Relative Density (\%)} = \frac{\text{Total number of individuals of the species}}{\text{Number of individuals of all species}} \times 100$$

$$\text{Abundance (m}^{-2}\text{)} = \frac{\text{Total no. of individuals of a species in all quadrates}}{\text{Total no. of quadrates in which species occurred}}$$

$$\text{Relative Biomass (\%)} = \frac{\text{Shoot biomass of a species}}{\text{Total shoot biomass of all species}} \times 100$$

$$\text{Species richness} = S - 1 / \ln N$$

where S = Total number of species and N = Total shoot biomass of all species

$$\text{Shannon - Wiener diversity index (H')} = \sum (N_i/N \log_2 (N_i/N))$$

where N_i = Total shoot biomass of individuals of species i and N was the total shoot biomass of all species.

$$\text{Species equitability (E}_c\text{)} = S / \ln n_i - \ln n_s$$

Where S is the total number of species in the site, and n_i and n_s , the shoot biomass values of most and least important species respectively.

III. RESULTS AND DISCUSSION

The present study deals with the Phytosociological attributes of an openly grazed vegetation development in two sites (I and II) after nine years of abandonment of cultivation in the University campus of J. P. University, Chapra. The maximum number of species were recorded at site I whereas this value at was site II. Although following 14 species were recorded in both sites.

Cynodon dactylon (L.) Pers., *Cyperus rotundus*(L.), *Desmodium triflorum* (L.) DC, *Indigofera linifolia* (L.f) Retz, *Dichanthium annulatum* (Forssk.) Stapf, *Eleusine indica* (L.) Gaerth, *Alysicarpus monilifer* Desv., *Parthenium hysterophorus* L., *Euphorbia hirta* (L.) Millsp, *Croton sparsiflorus* (L.), *Evolvulus nummularius* (L.), *Sporobolus diander* (Retz), *Malvastrum coromandelianum* (L.) Garcke, *Evolvulus alsinoides* Linn

Frequency: The value for frequency ranged from 20 to 90 (%) at site I and from 30 to 90 (%) at site II. (Table 1 & 2). In site I maximum value (90%) was recorded for *Cynodon dactylon*, *Desmodium triflorum*, *Dichanthium annulatum*, *Eleusine indica*, and minimum *Euphorbia hirta*, *Sporobolus diander*, *Malvastrum coromandelianum*, *Evolvulus alsinoides*. In site II maximum value (90%) was recorded for *Cyperus rotundus*, *Desmodium triflorum*, *Dichanthium annulatum* , *Eleusine indica* and minimum (30%) for *Alysicarpus monilifer*, *Euphorbia hirta*.

Density: The values for density ranged from 2.8 to 351.2 m⁻² in site I and from 9.6 to 245.2 m⁻² in site II (Table 1 & 2). In site I maximum value (351.2 m⁻²) recorded for *Dichanthium annulatum* and minimum (2.8 m⁻²) recorded for *Sporobolus diander* In site II maximum value (245.2 m⁻²) was recorded for *Dichanthium annulatum* and minimum (9.6 m⁻²) for *Parthenium hysterophorus*.

Abundance: The value for abundance ranged from 11.33 to 820 in site I and from 19.2 to 272.4 in site II (Table 1 & 2). In site I maximum value (820) was recorded for *Euphorbia hirta* and minimum 11.33 for *Croton sparsiflorus*. In site II maximum value (272.4) was recorded for *Dichanthium annulatum* and minimum (19.2) for *Parthenium hysterophorus*.

Biomass: The live shoot biomass ranged from 0.46 to 26.83 gm⁻² in site I and from 0.22 to 15.36 gm⁻² in site II for individual species (Table 1 & 2). In site I maximum value (26.83 gm⁻²) was recorded for *Dichanthium annulatum* and minimum (0.46 gm⁻²) for *Evolvulus alsinoides*. In site II maximum value (15.36gm⁻²) was recorded for *Desmodium triflorum* and minimum (0.22 gm⁻²) *Euphorbia hirta*.

Relative frequency: The values for relative frequency ranged from 2.43 to 10.97 % in site I and 4.83 to 14.51 % in site II. In site I maximum value (10.97%) was recorded for *Cynodon dactylon*, *Desmodium triflorum*, *Dichanthium annulatum*, *Eleusine indica* and minimum (2.43%) for *Euphorbia hirta*, *Sporobolus diander*, *Malvastrum coromandelianum*, *Evolvulus alsinoides* . In site II maximum value (14.51%) was recorded for *Cyperus rotundus*, *Desmodium triflorum*, *Dichanthium annulatum*, *Eleusine indica* and minimum (4.83%) for *Euphorbia h.irta*.

Relative density: The values for relative density ranged from 0.15 to 20.03 % in site I and from 1.02 to 26.16 % in site II (Table 1 & 2). In site I maximum value (20.03 %) was recorded from *Dichanthium annulatum* and minimum (0.15%) for *Sporobolus diander*. In site II maximum value (26.16%) was recorded for *Dichanthium annulatum* and minimum (1.02%) for *Parthenium hysterophorus*.

Relative biomass: The values for relative biomass ranged from 0.25 to 14.53 % in site I and 0.51 to 35.03% in site II (Table 1 & 2). In site I maximum value (14.53%) was recorded for *Dichanthium annulatum* and minimum (0.25%) for *Evolvulus alsinoides*. In site II maximum value (35.03%) was recorded for *Desmodium triflorum* and minimum (0.51%) for *Euphorbia hirta*.

Important Value Index (IVI): IVI values ranged from 3.1 to 45.72 in site I and from 10.03 69.95 in site II (Table 1 & 2). In site I maximum value (45.72) was recorded for *Dichanthium annulatum* and minimum (3.1) for *Sporobolus diander*. In site II maximum value (69.95) was recorded for *Dichanthium annulatum* and minimum (10.03) for *Alysicarpus monilifer*.

Table 3.1: Phytosociological characteristics of vegetation in Fallowland developed after nine years of abandonment of cropping at site I

Plant Species	Frequency (%)	Relative Frequency (%)	Density (m ⁻²)	Relative Density (%)	Abundance (m ⁻²)	Relative Abundance (%)	IVI (%)	Biomass(gm-2)	Relative Biomass
<i>Cynodon dactylon</i> (L.) Pers.	90	10.97	288.4	16.46	32.04	1.209	28.63	25.78	14.25
<i>Cyperus rotundus</i> (L.)	70	8.53	14.4	0.822	20.571	0.77	10.12	3.22	1.77
<i>Desmodium triflorum</i> (L.) DC	90	10.97	221.6	12.65	246.2	9.29	32.91	19.91	11
<i>Indigofera linifolia</i> (L. f) Retz	70	8.53	18	1.02	25.71	0.97	10.52	13.56	7.49
<i>Dichanthium annulatum</i> (Forssk.) Stapf	90	10.97	351.2	20.03	390.2	14.72	45.72	26.83	14.53
<i>Eleusine indica</i> (L.) Gaerth	90	10.97	262.8	14.99	292	11.02	36.98	21.52	11.89
<i>Alysicarpus monilifer</i> Desv.	60	7.31	52.20	2.97	85.3	3.22	13.5	11.42	6.31
<i>Parthenium hysterophorus</i> L	80	9.75	248.2	14.16	310.2	11.70	35.61	9.70	5.36
<i>Euphorbia hirta</i> (L.) Millsp	20	2.43	164	9.35	820	30.95	42.73	9.57	5.29
<i>Croton sparsiflorus</i> (L.)	60	7.31	6.80	0.387	11.33	0.42	8.11	22.81	12.61
<i>Evolvulus nummularius</i> (L.)	40	4.87	83.8	4.78	209.5	7.90	17.64	6.05	3.34
<i>Sporobolus diander</i> (Retz)	20	2.43	2.8	0.15	14	0.52	3.1	6.45	3.56
<i>Malvastrum coromandelianum</i> (L.) Garcke.	20	2.43	32	1.82	160	6.03	10.28	3.7	2.04
<i>Evolvulus alsinoides</i> (Linn.) Linn	20	2.43	6.4	0.36	32	1.20	3.99	0.46	0.25

Table 3.2: Phytosociological characteristics of vegetation in Fallowland developed after nine years of abandonment of cropping at site II

Plant Species	Frequency (%)	Relative Frequency (%)	Density (m ⁻²)	Relative Density (%)	Abundance (m ⁻²)	Relative Abundance (%)	IVI (%)	Biomass (gm-2)	Relative Biomass
<i>Cynodon dactylon</i> (L.) Pers.	80	12.90	25.2	2.68	31.5	3.38	18.96	1.552	3.54
<i>Cyperus rotundus</i> (L.)	90	14.51	54	5.75	60	6.45	26.70	1.48	3.38
<i>Desmodium triflorum</i> (L.) DC	90	14.51	125.2	13.35	139.11	14.95	42.81	15.36	35.03
<i>Indigofera linifolia</i> (L. f) Retz	70	11.29	120	12.79	171.4	18.43	42.51	5.94	13.54
<i>Dichanthium annulatum</i> (Forssk.) Stapf	90	14.51	245.2	26.15	272.4	29.29	69.95	10.42	23.76
<i>Eleusine indica</i> (L.) Gaerth	90	14.51	107.2	11.4	119.1	12.80	38.71	6.57	14.98
<i>Alysicarpus monilifer</i> Desv.	30	4.83	11.2	1.19	37.3	4.01	10.03	1.56	3.55
<i>Parthenium hysterophorus</i> L	50	8.06	9.6	1.02	19.2	2.06	11.14	0.76	1.73
<i>Euphorbia hirta</i> (L.) Millsp	30	4.83	240	25.59	80	8.60	39.02	0.224	0.51
<i>Croton sparsiflorus</i> (L.)	0	0	0	0	0	0	0	0	0
<i>Evolvulus nummularius</i> (L.)	0	0	0	0	0	0	0	0	0
<i>Sporobolus diander</i> (Retz)	0	0	0	0	0	0	0	0	0
<i>Malvastrum coromandelianum</i> (L.) Garcke.	0	0	0	0	0	0	0	0	0
<i>Evolvulus alsinoides</i> (Linn.) Linn	0	0	0	0	0	0	0	0	0

Table 3.3: Community formation and Diversity indices of grassland at Site I and Site II.

Variables	Site I	Site II
Community Formation	<i>D. annulatum</i> – <i>E. hirta</i>	<i>D. annulatum</i> – <i>D. triflorum</i>
Total number of species	14	9
Species common to both sites	9	
Species richness	2.5	2.1
Equitability	5.7	7.5

Dichanthium annulatum had maximum important at both the sites followed by *Euphorbia hirta* at site I and *Desmodium triflorum* at site II. Species richness values were 2.5 2.1 at sites I and II respectively. The equitability values ranged from 5.7 to 7.5 (Table 3).

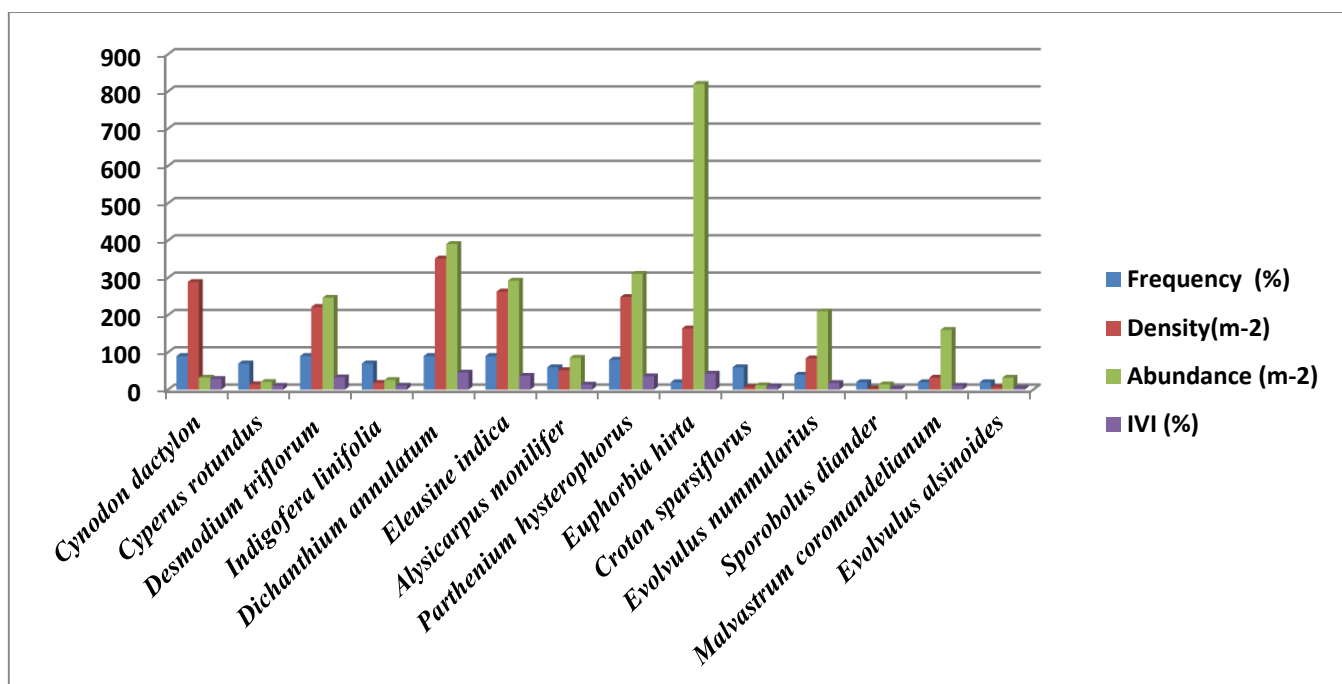
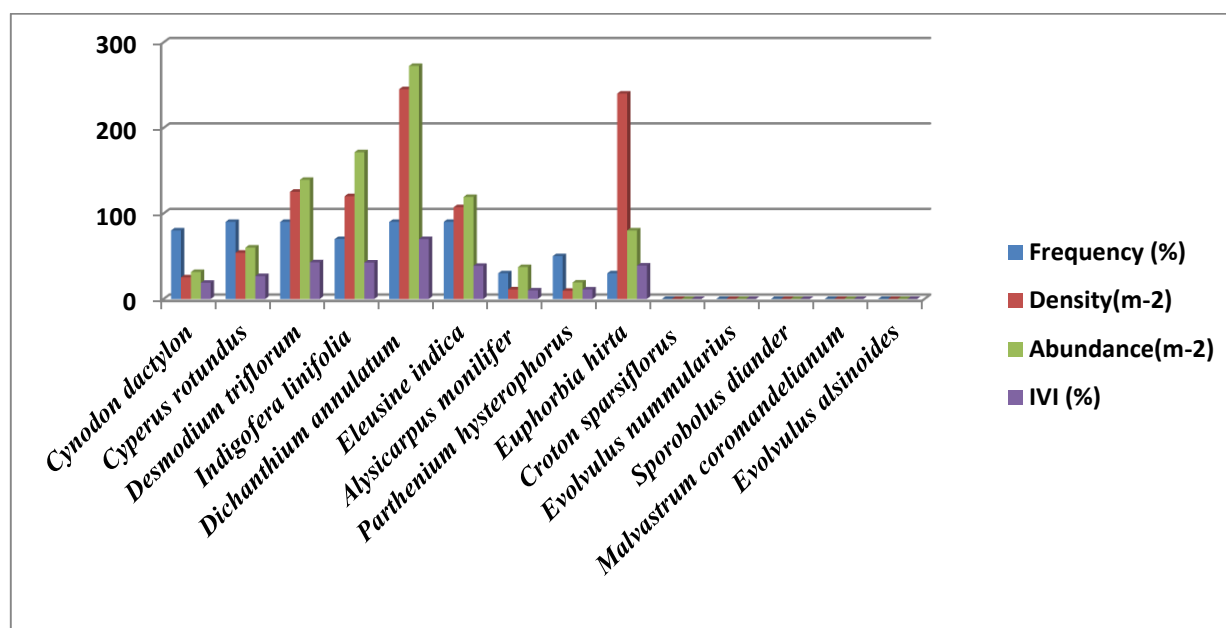
Figure 1: Frequency (%), Density (m⁻²), Abundance (m⁻²) and IVI (%) of plant species in Site I

Figure 2: Frequency (%), Density (m^{-2}), Abundance (m^{-2}) and IVI (%) of plant species in Site II.

The present investigation deals with the floristic composition of the vegetation in rainy season (Site I & II) in Jai Prakash University Campus, Chapra. The herbaceous grass - dominated community of study sites contain high percentage of hemicryptophytes, cryptophytes, and chaemophytes that appears as a result of grazing and browsing in the area. Generally grasslands are rich in hemicryptophytes (Braun Blanquet, 1932). The maximum percentage of hemicryptophytes and the absence of phanerophytes and therophytic species are attributed to the influence of periodicity, soil characteristics, climatic conditions, and biotic interferences. Similar findings were also reported in grasslands of India (Singh and Ambasht 1995, Abdar 2013, Bark and Misra 1997). In the present study at two sites relatively higher number of species at site I can be attributed to moderate grazing. The much higher abundance and dominance of species like *Cynodon dactylon*, *Desmodium triflorum*, *Dichanthium annulatum*, *Indigofera linifolia* at site II may be related to their characteristic growth pattern showing profuse sprouting and flowering even at highly disturbed sites.

The value for frequency ranged from 20 to 90 (%) at site I and from 30 to 90 (%) at site II. In site I maximum value (90%) was recorded for *Cynodon dactylon*, *Desmodium triflorum*, *Dichanthium annulatum*, *Eleusine indica*, and minimum *Euphorbia hirta*, *Sporobolus diander*, *Malvastrum coromandelianum*, *Evolvulus alsinoides*. In site II maximum value (90%) was recorded for *Cyperus rotundus*, *Desmodium triflorum*, *Dichanthium annulatum*, *Eleusine indica* and minimum (30%) for *Alysicarpus monilifer*, *Euphorbia hirta*. The density values ranged from 2.8 to 351.2 m^{-2} in site I and from 9.6 to 245.2 m^{-2} in site II. In site I maximum value (351.2 m^{-2}) recorded for *Dichanthium annulatum* and minimum (2.8 m^{-2}) recorded for *Sporobolus diander*. In site II maximum value (245.2 m^{-2}) was recorded for *Dichanthium annulatum* and minimum (9.6 m^{-2}) for *Parthenium hysterophorus*. However in Varanasi density values ranged from 1963 to 11055 m^{-2} (Singh 1967), in Kurushetra values ranged from 471 to 2143 m^{-2} (Singh and Yadava, 1974), in Ujjain values ranged from 104 to 862 m^{-2} (Misra 1973), and in Ratlam values ranged from 21 to 4700 m^{-2} (Billore 1973). The IVI values ranged from 3.1 to 45.72 in site I and from 10.03 to 69.95 in site II. On the basis of IVI values in the present study at site I *D. annulatum* – *E. hirta* and at site II *D. annulatum* *D. triflorum* community have developed after nine years of abandonment of cropland. Singh and Yadava (1974) found in their study of grassland vegetation at Kurushetra that the density of certain species peaked during the rainy season. The live shoot biomass ranged from 0.46 to 26.83 gm^{-2} in site I and from 0.22 to 15.36 gm^{-2} in site II. Pandeya (1974) has reported live shoot biomass value for *Cenchrus ciliaris* dominated grassland from 0 to 228 gm^{-2} at Rajlkot, India. Kumar and Joshi (1972) have reported live shoot biomass values for mixed grass dominated grassland from 35 to 76 gm^{-2} at Pilani, India; 105 to 1974 gm^{-2} at Kurushetra Singh and Yadava (1974), 24 to 457 gm^{-2} at Ujjain (Misra 1973), 1 to 363 gm^{-2} at Ratlam Billore (1973).

IV. CONCLUSION

In the moderate grazing site I had more number of species than the intensively grazed site II. A decrease in the overall number of species was a result of intensive grazing. The life form studies indicated a hemicryptophytes flora. The live shoot biomass values in growing season is less than the other studies conducted in India *P. hysterophorus* is invading the study sites aggressively affecting the plant diversity in the study sites. Hence, for the natural succession to proceed more rapidly, intensive grazing must be controlled and *Parthenium hysterophorus* needs to be removed.

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