IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 11, Issue 2 Ver. IV (Mar.- Apr.2016), PP 41-47
www.iosrjournals.org

Species Composition And Shoot Biomass Production In Parthenium Dominated Abandoned Fallowland.

R.Shikha[1] And A . K .Jha[2]
[1]*Department Of Botany J.P. University, Chapra – 841301*
Bihar , India

Abstract: *The present study was conducted in J.P.University campus, Chapra, Bihar,India to record the species composition and production of shoot biomassofPartheniumhysterophorus L. invaded vegetation development in abandoned cropland. A total number of 13 herbaceous species were recorded. In addation to Parthenium other herbaceous plant species were Dicanthiumannulatum,Oxalis corniculata,Cynodondactylon,Dactyloeteniumaegyptium,Tridaxprocumbens,Cyperusrotandus,Digitariasetigera, Phyllanthusniruri,Eleusineindica,Evolvulusalsinoides,CrotonsparsiflorusandAlysicarpusmonolifer.Phytosociolo gicalcharacteristics such as– frequency,density, abundance, live shoot biomass, relative frequency, relative density and relative dominance were determined quantitatively and qualitatively. In this studyPartheniumwas the most dominant species having highest IVI values (106.29). The co-dominant species wasDicanthiumannulatum(IVI= 45.68). Species richness, equitability and diversity values are lower than the values reported for tropical grassland vegetation of India. Shoot- biomass values were higher than the Indian grasslands.Thus,Parthenium showed aggressiveness and dominance in the newly developed vegetation.Parthenium is affecting the normal process of succession on abandonedagricuitural landby decreasing the species richness and plant diversity. Thus eradication ofPartheniumis essential to accelerate the normal process of vegetation development and shoot biomas produced by Parthenium may be utilized in other beneficial purposes.*

Keywords: *Abandoned agricultural land, Dominant species, Parthenium, Species Composition, Vegetation.*

I. Introduction

PartheniumhysterophorusL. is an annual herbaceous prolific weed belonging to Asteraceaefamily. Partheniumcame to India under US PL – 480 scheme and invaded all parts of India [23]. [45]forthe first time reported its existence in India. Partheniumis a native weed of Mexico and has been widely distributed to the different countries such as Australia, India, China, Kenya, Ethiopia, Nepal etc.through contaminated grains and farm machineries [30]. It has been widely distributed and created problems in countries like Kenya, Taiwan, India, west Indies, Nepal etc.[43]; [41]; [61]; [47]; [7]; [13]. This weed has achieved major status in India and Australia in last somedecades [35]; [16];[31]; [24]; [7].[15]has reported about two million hectares of land in India has been invaded byParthenium. The presence of Parthenium have the drastic effect on the agricultural crops and also causes health hazards in humanbeings and affects ecosystem and biodiversity [1]; [35];[29]. Partheniumis an aggressive colonizer, production of large amount of seeds;shows allelopathic effects; induces changes in the physical, chemical and biological properties of soil; replaces palatablegrasses in rangelands and its manualremoval is difficult [57]; [39]; [61]; [36];[37]; [4]; [5]; [53]; [55]; [6]; [7]; [62]; [27]; [2]; [3]; [63]; [38]. [57]have showed that Parthenium was the most major problem in rangeland and croplandin the Eastern Ethiopia.Partheniumfastlygrows and is comfortable on alkaline to neutral clay soils [10]. [34]have reported that the spread of seeds and their ability to remain viable in the soil for many years pose one of the most complex problems for control and this fact makes eradication difficult for many seed producing Parthenium.

In the humanbeings it causes various types of allergies particularly through pollengrainslike contact dermatitis, hay fever, asthma and bronchitis [35];[64]. [54]havementioned that pesticides like atrazine, 2,4-D metribuzin, paraquat,trifiuralin and diphenamiddonotshow any effect. Parthenium secrets certain allelochemicalssuch as: phenolic acids, caffeic acid, vanillic acid, ferruclicacid, chlorogenic acid, paracaumeric acid, para hydroxyl benzoic acid[21]; [11], and other important chemicals such as pseudoguaionolides, parthenin, anhydroparthenin, ambrosin, cronopilin and damsin which haveadverse effect on the growth ofplants which grow in its vicinity. [25]reported that secondary metabolites are released through volatilization, leaching, root exudation anddecomposition of plant residues in the soil. [14]have reported two life cycles in one year in Parthenium from March to June and from July to November in North-Western Indian Himalayas(H.P.).They produce enormous number of seeds which are very small in size and also light in weight and can survive as seed bank in soil for years.Partheniumis an annual plant with a deep tap-root and an erect much-branched stem.Itusually grows 1-2 m. tall. Mature stems are greenish and longitudinally grooved, covered with small stiff

hairs(trichomes). Leaves are simple, pale green, lobed, sessile, irregularly dissected. The numberof leaves per plant is 6 to 55. The flowers are arranged in capitulam, creamy white in colour, borne in profusion at the tips of the stem. Small flower heads are arranged in clusters and its colour changes to lightbrown, when seeds aremature. Flowering can occur at any time of the year, but is most common during the rainy season. Each flower contains five seeds, whichare wedge-shaped, black, 2mm long with thin white scales.

Partheniumcommonly called as congress grass or carrot weed, feverfew, ragweed Partheniumand white top. In India, it is locally known as GajarGhans. It contains special characters such as: high germination ability, large seed production capacities, high survival rate, extreme adaptability in different habitats, easy dispersal of seeds, high allelopathic impact and completes life-cycles within four weeks [49]; [50]; [51].

In Bihar particularly atChapra no ecological study onPartheniuminvaded vegetation has been done. It is invading fallowland, cropland, wasteland, roadsides etc. on large scale. Nine years ago in about 240 ha of cropland, J.P.University campus Chapra was established. In abandoned cropland of this University campus natural herbaceous vegetation development started. But at the same time invasion of P.hysterophorus occupied the whole area. Thus the natural process of plant succession was badly affected by invasion of P.hysterophorus. The whole area is occupied by this aggressive exotic species. The main aim of this study was to analyse the species composition and shoot biomass estimation of Parthenium in the abandoned cropland. To know the formation of plant community associated with Partheniumis essential. Howmuch shoot biomass is produced by Parthenium that can be useful in other purposes. Therefore, the present study was conductedin abandoned cropland to knowtheeffect ofPartheniumon species composition of early vegetation developed in fallowland and level of production of shoot biomass by Parthenium which can be used in other beneficial purposes.

II. Materialsandmethods

The species composition and shoot biomass estimation study was conducted in J.P. University Chapracampus in the month of September, 2015. The university campus was established about nine years ago inabout 240haland where earlier croppingwas done. In this fallowland herbaceous vegetation has developed but the invasive species Parthenium has invaded the campus on large scale.The study site is situated between25^0 36'- 26^0 15' N latitude and 84^0 25'- 85^0 15' E longitude. The climate is hot and dry. Annual rainfall normally varies from 66to 126 cm in rainy season. The maximum and minimum temperature ranges from$6^{0c}$to 45^{0c}. The relative humidity ranges from 39 to 90 per cent in the months of May and December, respectively. Sampling was done for the study of vegetation invaded by Parthenium. Randomely ten quadrates of 50 X 50cm^2 sizes were placed in the vegetation. All herbaceous plants at the soil surface were harvested. Harvested samples of each quadrate were kept in separate polyethylene bags. Samples were brought to the laboratory and samples of each quadratewere separated species wiseand their numbers were counted. We tookfresh weight through the electronic balance and were oven-dried at $80^{0c}$for 24hrs. and again dry weight was taken.

The following quantitative and qualitative analyses of plants were done: frequency, density, abundance, relative frequency, relative density, relativedominance, importancevalue index, species richness, species diversity and equitability.

Frequency, density and abundance were calculated following the formulae proposed by [8] as given below:

$$\text{Frequency}(\%) = \frac{\text{Totalno .ofquadratesinwhichspeciesoccurred}}{\text{Totalno .ofquadratesstudied}} \text{ X } 100$$

$$\text{Density} = \frac{\text{Totalno .ofIndividualsofaspecies}}{\text{Totalno .ofquadratesstudied}}$$

$$\text{Abundance} = \frac{\text{Totalno .ofIndividualsofthespecies}}{\text{Totalno .ofquadratesinwhichspeciesoccurred}}$$

Relative frequency, relative density and relative dominance were determined following the formula of [42]as given below:

$$\text{Relative frequency (\%)} = \frac{\text{No .ofoccurrenceofthespecies}}{\text{No .ofoccurrenceofallspecies}} \text{ X } 100$$

$$\text{Relative density (\%)} = \frac{\text{No .ofindividualsofthespecies}}{\text{Totalno .ofindividualsofallspecies}} \text{ X } 100$$

$$\text{Relative dominance (\%)} = \frac{\text{Totalshootbiomassofthespecies}}{\text{Totalshootbiomassofall species}} \text{ X } 100$$

The ImportanceValue Index (IVI) was the sum of the relative frequency (RF), relative density (RD) and relative dominance (RDo) [9], [42].
Species richness was calculated following the formula [32]:

$$\frac{S-1}{\ln N}$$

Where, S = Total no.of species in the given stand or sample,
N = Total shoot biomass of all the species in that sample.

Species diversitywas calculated following the formula as [48]:

$H = \sum_{I=1}^{S} (Ni / N) \log_2 (Ni / N)$

Where, Ni was the total shoot biomass of individuals of species,
i and N was the total shoot biomass of all species in that site.

Equitability (EC)was calculated following the formula [32]:

$$EC = \frac{S}{\ln ni - \ln ns}$$

Where, Sis the total no. of species in the site; and ni and ns, the shoot biomass values of most and least important species, respectively.

III. Results

There was a veryhigh infestation ofP.hysterophorusin thepresent study site. A total number of 13 plant species were recorded, in which P.hysterophorus is the most dominant species. Other species were Dicanthiumannulatum,Oxalis corniculata,Cynodondactylon,Dactyloeteniumaegyptium, Tridaxprocumbens, Cyperusrotandus,Digitariasetigera,Phyllanthusniruri,Eleusineindica,Evolvulusalsinoides,Croton sparsiflorus and Alysicarpusmonolifer .

Frequency -: The frequencyvalue for Parthenium was 100% .The frequency valuesof other species ranged from 10 to 100 % . It was minimum (10%) for C .sparsiflorusand A . monolifer where as it was maximum (100 %) for O . corniculata .

Density -: The density value forPartheniumwas 188.4 m^{-2}. The density valuesof other speciesranged from 0.4 to 402.4 m^{-2}. The minimum value (0.4 m^{-2}) was recorded for C. sparasiflorus and maximum valuewas 402.4 m^{-2}forD . annulatum .

Abundance-: The abundance value forParthenium was 188.4. The abundance values of other species ranged from 4 to 447.11. The minimum value 4 was recorded for C. sparsiflorus and maximum value was (447.11) for D .annulatum .

Live Shoot Biomass -: The live shoot biomass value for Parthenium was 3205.32 gm^{-2}. The biomass values for other species ranged from 1 to 330.72 gm^{-2}. It was minimum 1 gm^{-2} for A .monoliferwhere as the maximum value was 330.72 gm^{-2} for D. annulatum .

Relative frequency -: The value for relative frequency of Parthenium was 14.70 %. The relative frequency values of other species ranged from 1.47 to 14.70 %. The minimum value 1.47 % was recorded for C .sparsiflorusand A . monoliferwhere as maximum value was 14.70% for O . corniculata .

Relative Density -: The relative density value for Parthenium was 11.31% . The relative density of other species ranged from 0.02 to 24.17% . The lowest value 0.02% was recorded forC .sparasiflorus and highest value was 24.17% for D . annulatum .

Relative Dominance -: The relative dominance value for Parthenium was 80.28% . The relative dominance values of other species ranged from 0.2 to 8.28% . The minimum value 0.2% was recorded for C .sparsiflorus and A . monoliferwhere as the maximum value 8.28% was recorded for D . annulatum.

Importance Value Index -: The IVI value for Partheniumwas 106.29 . The IVI value of co-dominant speciesD .annulatum was 45.68 . Thus the community developed after nine years of abandonment of cropland infested with Parthenium was Partheniumhysterophorus -DicanthiumannulatumCommunity.

The species richness, species diversity and equitability values were recorded, respectively as 1.45, 0.19 and 1.61 for the study sites.

Table 1.Species composition and shoot biomass attributes of Parthenium invaded fallowland after nine years of abandonment.

Name of Species	Frequency (%)	Density (m^{-2})	Abundance	Live Shoot Biomass (gm^{-2})	RF (%)	RD (%)	RDo (%)	IVI
Partheniumhysterophorus	100	188.4	188.4	3205.32	14.70	11.31	80.28	106.29
Dicanthiumannulatum	90	402.4	447.11	330.72	13.23	24.17	8.28	45.68
Oxalis corniculata	100	354.8	354.8	107.6	14.70	21.31	2.69	38.7
Cynodondactylon	90	279.2	310.22	127.92	13.23	16.77	3.20	33.2
Dactylocteniumaegyptium	60	142.8	238	67.24	8.82	8.57	1.68	19.07
Tridaxprocumbens	80	78.8	98.5	54.28	11.7	4.73	1.35	17.84
Cyperusrotandus	30	110.8	369.33	11.12	4.41	6.65	0.27	11.33
Digitariasetigera	20	72.4	362	62.44	2.94	4.34	1.56	8.84
Phyllanthusniruri	40	22.4	56	9.48	5.88	1.37	0.23	7.48
Eleusineindica	30	1.6	5.33	2.00	4.41	0.09	0.05	4.55
Evolvulusalsinoides	20	10	50	12	2.94	0.60	0.30	3.84
Croton sparsiflorus	10	0.4	4	1.12	1.47	0.02	0.02	1.53
Alysicarpusmonolifer	10	0.8	8	1.00	1.47	0.04	0.02	1.51
Total	680	1664.8	2491.69	3992.24	99.98	99.94	99.93	299.86

Table 2. Certain selected characteristics of Partheniuminvaded fallowlandsafter nine years of abandonment.

Species richness	Species diversity	Equitability
1.45	0.196	1.61

IV. Discussion

This study revealed that the frequency of Parthenium in invaded sites in University campus was 100% . [28]have studied the distribution and effect of Parthenium in Meharisub-watershed of Rajouri forest range of Jammu&Kashmir. They have reported highest frequency (92%) for Partheniumhaving relative frequency of 36.54% followed by Cannabissativa(25.23%) and rest of the other species having less than 12.15%. However, in the present study frequency for other species it ranged from 10 to 100%. The relative frequency value was only 14.70% for Parthenium and for other species it ranged from 1.47 to 14.70% in the present study. These values are lower than the values reported by [28]. [33]has studied the effect of P . hysterophorus on plant diversity at Shakti Nagar in Banda district of U.P. . He has reported highest frequency of 98% for Parthenium and rest of the other species showed 10 – 64% frequency, having the highest relative frequency of 29% followed by Apludomutica (19.16%) and rest of the other species having less than 6% relative frequency.[22]has studied the ecological and socioeconomic impacts of P.hysterophorusinvasion in two urban areas in Nepal. He has reported 100% frequency for P.hysterophorus, Euphorbia hirta, Imperatacylindricaland Trifoliumrepens in Partheniuminvaded site and 0 to 62% for rest of the other species at Hetaudasite, whereas the highest frequency (100%) at Bharatpur area for Partheniuminvaded site was for only P.hysterophorusand rest of the other species showed 0 to 94% frequency. [46]havestudied thedistribution status and the impact of Partheniumweed at Gedeo zone (Southern Ethiopia). They have reported highest frequency and relative frequency 140% and 100% for Partheniumand forother species these values ranged from 50 to 135% and 35.7 to 96.4% , respectively. [44]have studied the prevalence of invasive Parthenium weed in district Hafizabad, Pakistan and have mentioned frequency and relative frequency of Parthenium 51% and 2.45% , respectively. Frequency and relative frequency of other species ranged from 5 to 79% and 0.24 to 3.80% ,respectively.

The density value in the present study for Parthenium was recorded $188.4m^{-2}$ and for other species it ranged from 0.4 to 402.4 m^{-2}. The relative density was only 11.31% for Partheniumand for other species it was 0.02 to 24.17% . Density value for Partheniumin the present study was higher but relative density was lower than reported by [33]. Mishra has reported the highest density of 52 m^{-2} for Parthenium and rest of the other species showed 0.1 to 38 m^{-2}density , having highest relative density of 47.97 % for Parthenium and rest of the other species showed 0.09 to 35.05% relative density. [56]have reported that the density value for Partheniumstudied in the five sites changes in different grasslands of Karnal, Haryana in relation to sodicity levels of the soil. The highest density of 436 m^{-2} for Cynodondactylon in site 1 and for other species it ranged from 0 to 207 m^{-2}. Density values for Parthenium in Nepal at Bharatpur and Hetauda sites were 48 and 298 m^{-2}, respectively reported by [22]. There was significant differences in the density of Parthenium. Density values for Parthenium in Bharatpur area, Nepal ranged from 19 to 69 m^{-2}[22]; in Kathmandu valley 11 to 47 m^{-2}[20]; 55 m^{-2}in eastern Ethiopia [58]; 1.5 to 38 m^{-2}in grassland of Central Nepal [59]; and 0.55 m^{-2}

infallowlands [61]. [19]have studied the invasion of noxious alien weed P.hysterophorus in grazing lands of Lahore, Pakistan. They have reported that highest density and relative density 16.8% and 15.59% for Parthenium . Rest of the other species these values ranged from 0.02 to 7.8% and 0.018 to 7.236, respectively. [44]have mentioned that density and relative density values for Parthenium in Pakistan at Hafizabad district was 1.55 and 3.31% and for other species these values ranged from 0.10 to 2.46 and 0.12 to 4.75%, respectively. [28]have reported that the highest relative density values for Partheniumin Mehari sub- watershed site was 62.75% and for other species ranged from 00.61 to 14.51%. Kumar et al. have reported the highest relative abundance was 36.54% for Parthenium and for rest of other species it ranged from 02.74 to 25.23% .[17]have studied the impact of Partheniumon species diversity in GamoGofa, Ethiopia. They have showed that the IVI values for Parthenium ranged from 58.4 to 100.9 . [28]have mentioned the highest IVI values for Parthenium was 129.56 and for rest of other species ranged from 007.30 to 047.72 . [18]have showed that Parthenium was highly dominant species with very high IVI in the area studied by them. [26]also confirmed that importance value data (IVI) showed the superiority of Parthenium at all the locations studied. [27]said that the high IVI of the weed in general is attributed to its competitive ability, allelopathy and strong adaptive and reproductive potential. Species richness values in Nepal at Bharatpur and Hetauda sites were 9 and 9 , respectively reported by [22] whereas these values ranged from 29 to 40 [46]. However, in the present study it was 1.61 only. [17]have showed that the species diversity values for Patthenium invaded area ranged from 1.15 to 1.73 and species dominance values ranged from 0.24 to 0.50 . [46]have reported that the species diversity values for Partheniumranged from 1.6 to 3.41 .In the present study shoot biomass value of Parthenium was 3205.32 gm^{-2} and for other species 1 to 330.72 gm^{-2}. In tropical grasslands of Indiathe maximum and minimum values for shoot biomass rangedfrom 76 to 3296 and 0 to 871 gm^{-2} [52].Thus except for Parthenium the total shoot biomass of other species was 786.92 gm^{-2} which is less than the values reported for Indian grasslands. Thus in the present study the total live shoot biomass values was 3992.24 gm^{-2} out of which Parthenium contributed 80.28%. [16]has reported that P. hysterophorus reduces pasture productivity by 90% . Dwindling effect of P . hysterophorus on grass biomass of grasslands of Queensland, Australia has also been reported by [12]. [60]have concluded that Parthenium invasion causes changes in above ground vegetation and below ground soil nutrient contents, disturbing the grassland ecosystem in Nepal . Thus Parthenium is affecting the levels of biodiversity, plant productivity, species composition and normal course of plant succession. Parthenium exhibits the ability to invade and adapt to new habitats and reduces the number of indigenous plants and biodiversity in India [40]. In the present study species richness in Partheniuminvaded site was 1.45. However in Partheniumnon-invaded site species richness values have been reported from 1.64 to 2.73 from Chapra (Kumari and Jha. communicated). Thus invasion of Partheniumdecreased species richness and species diversity which affects the normal course of primary plant succession fallowland.

V. Conclusion

Species composition and shoot biomass study of herbaceous vegetation developed after nine years of abandonment of cropland invaded by P. hysterophorus L. indicated that the aggressive species Parthenium has dominated the vegetation having highest IVI value. In the present study Parthenium showed higher frequency, relative frequency and IVI values compared to other studies [28],[33] but lower values for relative density and abundance compared to other studies [33]. Parthenium affected the species richness, diversity and equitability of the plant species. Thus, eradication of Parthenium is essential.

VI. Acknowledgement

We are highly thankful to the Head,Teachingmembers of the Department of Botany, J.P.UniversityChapra, Bihar, India, and research colleagues of our laboratory who supported directly or indirectly in the present study.

Refrences

[1]. S. W. Adkins, Sowerby M. S.Sowerby, Allelopathic potential of the weed. Partheniumhysterophorus L. in Australia. Plant Protection Quarterly 11,1996, 20-23.
[2]. Anonymous,Weeds of National Significance. Parthenium weed (Partheniumhysterophorus) Strategic plan. National Weeds Strategy Executive Committee, Lanuceston. 19 p, 2000.
[3]. S.Ayele,The impact of Parthenium (Partheniumhysterophorus L.) on the range ecosystem dynamics of the Jijigarangeland, Ethiopia (M.A. Dissertation)Department of animal sciences,Schoolof Graduate Studies, Haramaya University.117p, 2007.
[4]. D. R.Batish, H. P. Singh,R. K.Kohli, D. B.Saxena,S.Kaura,Allelopathic effects of parthenin against two weedy species, Avenafatua and Bidenspilosa. Environmental and Experimental Botany 47(2), 2002a, 149-155.
[5]. D.R. Batish, H.P. Singh, D.B. Saxena, R.K. Kohli,V.Arrora, Effect of Parthenin – a Sesquiterpene lactone from Partheniumhysterophorus L. on early growth and physiology of Ageratumconyzoides.Journal of Chemical Ecology.28, 2002b, 2169-2179.
[6]. D.R. Batish, H.P. Singh, J.K. Pandher, V. Arrora, R.K. Kohli,Phytotoxic effect of Parthenium residues on the selected soil properties and growth of chickpea and radish. Weed Biology and Management 2(2), 2002c, 73-78.

[7]. P.C. Bhowmik, D. Sarkar,N.T.Yaduraju,The status of PartheniumhysterophorusL. and its potential management. Ecoprint 14, 2007, l-17.

[8]. J.T. Curtis, R.P. MCIntosh,The interrelations of certain analytic and synthetic phytosociologicalcharacters. Ecology 31, 1950, 434-455.
[9]. S.J.T. Curtis,The vegetation of Wisconsin. University of Wisconsin press, Madison, U.S.A, 1959.
[10]. I.J. Dale, Parthenium weed in America. Report on the ecology of Partheniumhysterophorus in south central and north America. Australian Weeds. 1, 1981,8-14.
[11]. B. Das, R.Das,Chemical investigation in Partheniumhysterophorus L. an allelopathic plant .Allelopathy Journal, 2, 1995, 99-104.
[12]. K.Dhileepan, Biological control of Parthenium(Partheniumhysterophorus) in Australian rangeland translates to improved grass production. Weed Science.55, 2007,497-501.
[13]. K.Dhileepan,Managing Parthenium weed across diverse landscapes: Prospects and Limitations. In Inderjit (ed.) Management of Invasive Weeds. 5, 2009,227-259.
[14]. K.S. Dogra, S.K. Shood,R. Sharma,Distribution, biology and ecology of Partheniumhysterophorus L. (congress grass) an invasive species in the North – Western Indian Himalaya (Himachal Pradesh). African Journal of Plant Science 5(11), 2011,682-687.
[15]. P. Dwivedi, V. Vivekanand, R. Ganguly, Singh R.P. Singh,Parthenium sp. as a plant biomass for the production of alkalitolerant xylanase from mutant Penicilliumoxalicum SAU – 3.510 in submerged fermentation . Biomass Energy . 33, 2009, 581-588.
[16]. Evans H. C. Evans,Partheniumhysterophorus : a review of its weed status and the possibilities for biological control. Biocontrol 18(3), 1997, 89-98.
[17]. N. Gebrehiwot, L.Berhanu,Impact of Partheniumon species diversity in GamoGofa, Ethiopia, Scholarly Journal of Agricultural Science 5(7), 2015,226-231.
[18]. L.Q. Huy, R. N. Seghal,Invasion of Partheniumhysterophorus in chire – pine forests and its allelopathic effects. Abstracts of an Int. Workshop on protocols and Methodologies in Allelopathy, April 2-4,2004 in Palampur (HP) India.CSK HP Agriculture University Palampur (HP) India:International.Allelo. Soc; p.52.
[19]. A. Javaid, S. Safique, S. Shafique, Invasion of noxious alien weed Partheniumhysterophorus L. in grazing lands of Lahore; Pakistan. The Journal of Animal and Plant Sciences. 19(3), 2009, 149-153.
[20]. S.Joshi, Reproductive Efficiency and Biomass Allocation of Invasive weed , Partheniumhysterophorus L. [M.Sc Dissertation], Central Department of Botany, Tribhuan University, Ksthmandu, Nepal. 2005, 69p.
[21]. S.D. Kanchan, Jayachandra,Allelopathic effects of PartheniumhysterophorusL.4.Identification of inhibitors. Plant and Soil.55, 1980, 67-75.
[22]. D.Karki,Ecological and Socio-Economic impacts of Partheniumhysterophorus L. Invasive in two Urban areas in Nepal.[M.Sc. Dissertation] Institute of Science and Technology, TribhuanUniversity,Nepal. 2009.
[23]. M. Kaur, N. K. Aggarwal, V. Kumar, R.Dhiman,Effects and management of Partheniumhysterophorus. A weed of Global Significance. International Scholarly Research Notices.2014,1-12.
[24]. N. Kaushik, M. Biplas, A. K.Singha Roy,PartheniumhysterophorusL. : A global view of its weed status and biodiversity. In proceeding of the second International conference on Parthenium management, Bangalore,India, 2005 5-7.
[25]. M. A. Khalaj, M. Amiri, M.H. Azimi,Allelopathy ; physiological and sustainable agriculture impact aspects.International Journal of Agronomy and Plant Production , 415, 2013, 950-962.
[26]. H. Khan, K.B.Marwat, G.Hassen, M.A. Khan,S.Hashmi,Distribution of Partheniumweed in Peshawar Valley, Khyber Pakhtunkhwa- Pakistan.Pakstan Journal of Botany, 46(1), 2014, 81-90.
[27]. R. K. Kohli,D. Rani,Partheniumhysterophorusa review. A journal of Research Bulletin (Science), Punjab University. 44, 1994, 105-149.
[28]. D. Kumar, J. Ahmed, S. Singh, Distribution and effect of Partheniumhysterophorus L. in Mehari sub-watershed of Rajouri Forest Range, J&K. International Journal of Scientific Research.2(6), 2013,304-306.
[29]. P. Kumari, P.K. Sahu,M.Y. Soni, P.Awasthi, Impact of PartheniumhysterophorusL. invasion on species diversity of cultivated fields of Bilaspur(C.G.) India. Agricultural Sciences, 5, 2014, 754-764.
[30]. R. N. Mack,Lansdale W. M. Lansdale,Humans are global plant dispersers: getting more than we have bargained for. Bioscience 51, 2001, 95-102.
[31]. M.Mahadevappa, Ecology, distribution, menace and management of Parthenium . In Proceedings of the 1st International Conference on Parthenium Management; Karnataka, India, 1997, 6-8,University of Agricultural Science,Dahrwad.
[32]. R.Margalef,Information Theory in Ecology Gen. Syst. 3, 1958, 36-71.
[33]. A. Mishra, Partheniumhysterophorus:Anoxious weed for plant diversity. International Journal of Scientific Research. 2(9), 2013, 23-24.
[34]. J. Monaco, S. C. Thomas, Weller,F. M. Aston, Weed biology and ecology.2001, pp.13 31.In: Weed Science. Principles and Practices 4th ed. Academic Publisher,USA.
[35]. S. C. Navie, R. E. MC Fadyen ,F. D. Panetta, S.W. Adkins,The biology of Australian weed.27. Partheniumhysterophorus L. Plant Protection Quaterly, 11, 1996, 76-88.
[36]. P.Oudhia,Allelopathic effect of some obnoxious weeds on germination of soybean, Indian Journal of Plant Physiology 5(3), 2000a, 295-296.
[37]. P.Oudhia,Allelopathic effects ofPartheniumhysterophorus L. and AgeratumConyzoides on wheat var. Sujata. Crop Research 20(3), 2000b, 563-566.
[38]. P.Oudhia, Partheniumhysterophorus L.: Traditional Medicinal Uses.http://www.hort.purdue.edu/new Crop/CropFact Sheets/parthenium. html, 2001.
[39]. D. K. Pandey, L. M. S. Pani, S. C. Joshi,Growth reproduction and photosynthesis of ragweed Parthenin (Partheniumhysterophorus L.). Weed Science 51, 2003, 191-201.
[40]. S. Patel,Harmful and beneficial aspects of Partheniumhysterophorus : an update.Biotech : 1(1), 2011, 1-9.
[41]. C. I. Peng, L. A. HU, M. T. Kao,Unwelcome naturalisation of Partheniumhysterophorus L. (Asteraceae) in Tiwan. Journal of Tiwan Museum.41, 1988, 95-101.
[42]. E. A. Phillips,Methods of Vegetation Study. Holt, Rinehart and Winston, Inc. New York, USA, 1959.
[43]. J. Picman, A. K.Picman,Autotoxicity in PartheniumhysterophorusL. and its possible role in control of germination. Biochemistry, Systematics and Ecology 12, 1984, 287-297.
[44]. T. Riaz,A.Javaid,Prevalence of invasive Parthenium weed in District Hafizabaad, Pakistan.The Journal of Animal & Plant Sciences. 20(2), 2010, 90-93.

[45]. W.Roxburg,Hortusbengalensis or a catalogue of the plants growing in the Honorable East India Company's Botanic Garden at Calcutta. The Mission Press, Serampore,India, 1814.

[46]. T. Seta, A.Abreham , M.Fisseha, B. Alemayehu,Distribution status and the impact of Parthenium weed (Partheniumhysterophorus L.) at Gedeo Zone (Southern Ethiopia). African Journal of Agricultural Research. 8(4), 2013, 386-397.
[47]. A. Shabbir, R.Bajwa,Distribution of Parthenium weed (Partheniumhysterophorus L.),an alien invasive weed species threatening the biodiversity of Islamabad. Weed Biology and Management. 6: 2006, 89-95.
[48]. C. E. Shannon, Weaver, The Mathematical Theory of Communication. University of Illinois press, Urbana,1963, 117p.
[49]. R.Shikha,A.K.Jha, Evaluation of effect of leaf extract of Partheniumhysterophorus L. on seed germination, seedling growth and fresh weight of Phaseolusmungo. American Journal of Research Communication. 4(2), 2016a, 86-103.
[50]. R.Shikha, A.K.Jha, Allelopathic effect of leaf extract of Partheniumhysterophorus L. on seed germination and growth of Ciceraeritinum L. International Journal of Science and Research. 5(3), 2016b, 652-655.
[51]. R.Shikha,A.K.Jha, Allelopathic activity of Partheniumhysterophorus L. leaf extract on Pisumsativum. International Journalof Recent Scientific Research. 7(3), 2016c, 9461-9466.
[52]. J.S.Singh, M.C.Joshi, Primary production. In: R.T. Coupland (Ed.) Grassland Ecosystems of the World. Analysis of Grasslands and their Uses. CambridgUniversity Press. 1979, 197-218.
[53]. H.B.Singh, D.R.Batish, J.K.Pandher, R.K.Kohli, Assessment of allelopathic properties of Partheniumhysterophorus L. residues, Agricultural Ecosystem and Environment. 95(2-3), 2003, 537-541.
[54]. S.Singh, A.Yadav, R.S.Balyan, R.K.Malik, M.ingh,Control of ragweed Parthenium (Partheniumhysterophorus)and associated weeds. Weed Technology. 18, 2004, 658-664.
[55]. H.P.Singh, D.R. Batish, J.K. Pandher, R.K.Kohli,Phytotoxic effects of Partheniumhysterophorus L. residues on three Brassicaspecies.Weed Biology and Management. 5, 2005, 105-109.

[56]. A.Sinha, R.S.Rana, S.R.Gupta, Phytosociological analysis of some natural grassland communities of sodic soils. TropicalEcology. 29(2), 1988, 136-145.
[57]. T. Tamado, P. Milberg, Weed flora in arable fields of eastern Ethiopia with emphasis on the occurrence of Partheniumhysterophorus .Weed Research40, 2000, 507-521.
[58]. T.Tamado, W.Schutz, P.Milberg, Germination ecology of the weed Partheniumhysterophorus L. in eastern Ethiopia. Annals of Applied Biology.140, 2002, 263-270.
[59]. B.Timsina,Impact of Partheniumhysterophorus L. invasion on soil and plant species composition of Grassland of Central Nepal [M.Sc. Dissertation] Central Department of Botany, Tribhuvan University, Kathmandu, Nepal. 2007, X + 61p.
[60]. B. Timsina, B.B. Shrestha, M.B. Rokaya, Z.Munzbergova, Impact of Partheniumhysterophorus L. invasion on plant species composition and soil properties of grassland communities in Nepal. Floral Morphol Distribution FunctEcol Plants. 2011.
[61]. S. Tiwari, B. Adhikari,M. Siwakoti, K.Subedi,An Inventory and Assessment of Invasive Alien Plant species of Nepal. IUCN – The world Conservation Union, Nepal. 2005,115p.
[62]. G. D. Tudor, A. L. Ford, T. R. Armstrong, K. K.Bromage,Taints in meat from sheep grazing Parthenium weed. Australian Journal of Experimental Agriculture and Animal Husbandry 22(115),1982, 43-46.
[63]. K. E.Wegari,Perceived Socio-Economic Impact of Parthenium Weed and Its Effect on Crop Production in Babile, Haramaya and Tulo Districts, East and West Hararge Zone, Ethiopia [M.A. Dissertation] Department of Rural Development and Agricultural Extension, School of Graduate Studies Haramaya University. 2008, 88p.
[64]. M. Wiesner, T. Taye, A. Hoffmann, P. Wilfried,C. Buettner,J. Mewis,C.Ulrichs,Impact of the pan- tropical weed Partheniumhysterophorus L. on human health in Ethiopia. [Abstract]International Research on Food Security, Natural Resource Management and Rural Development. October 9-11.2007, Witzenhausen, 2007, pp.174.