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Parthenium a greatest threaten transforming into a healer for certain diseases, drug producer and farmer's helper

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***Abstract*—Parthenium hysterophorus is a noxious weed in America , Asia and Australia with no economic importance revealed till last few decades. This wed is considered to be a cause of allergic respiratory problems, contact dermitits, mutagenicity in humans and livestock. Crop production is drastically reduced because of its allelipathic nature. Certain pulses and cereals were not growing at their full because of the presence of parthenium growing near them. Also dominance of this weed threatens biodiversity which is effecting whole world. Eradication of Parthernium hysterophorus by burning , chemical herbicides, eucalyptus oil and biological control by leaf-feeding beetle, stem-galling moth, stem-boring weevil and fungi have been carried out with variable degrees of success. This eradication was necessary to avoid its harms as it is directly or indirectly affecting social health as well as economy of farmers by causing diseases and reducing crop production. But recently many innovative uses of this notorious plant have been discovered. It confers many health benefits, like remedy for skin inflammation, rheumatic pain, diarrhea, urinary tract infections, dysentery, malaria and neuralgia. Its prospect as nano-medicine is being carried out with some preliminary success so far . Removal of heavy metals and dye from the environment, eradication of aquatic weeds, additives in cattle manure for biogas production, as biopesticide, as green manure and compost are to name a few of some other potentials.**

***Index Terms*—Parthenium, dermatitis, allelopathy, mutagenicity, biopesticide, neuralgia.**

I. INTRODUCTION

Parthenium hysterophorus L. popularly known as "Congress grass", "Carrot weed", "Gajarghass" or "Parthenium has drawn much public attention and caused grave concern to administrative machinery of India in recent years. It is a poisonous, allergic, and aggressive weed belonging to Asteraceae(Compositae). This noxious herbaceous plant, a native of West Indies, North and South America, is suspected to have crept into India along with imported wheat from USA under PL-480 programme i.e (Public Law 480 passed in 1954 to give food, grains to developing countries) sometimes in early 1950 (Tripathiet.al, 1991) .

In general it grows through out the year but optimal temperature for its fast and peak growth ranges from 25-30 degrees celcius. In Haryana and North West India, it germinates mainly in the months of February-March, attains peak growth in June-July and produces seeds at maturity in September-October. This weed is not only threat to agriculture but is also known to cause hazards to human health and also toxic to the cattle. The chemical analysis of this weed indicates that all the parts, including trichomes and pollen contain toxins called 'sesquiterpine lactones', the major component of which the Parthenin and several other ferulic acids.

Keeping in mind its threaten to human beings(including farmers) and livestock it was felt necessary to find out how the congress grass(P. hysterophorus L) could be eradicated , its effects on germination of seeds and plants which grow in its vicinity and to unravel the beneficial aspects of this weed.

Co-relating the population of plants surrounding Pratheniumhysterophorus L. species:

A survey of the different locations of Faridabad (Haryana) district was done for various locations as follow :

1.Bhadkal Lake Faridabad:

Total Area : 1 kanal (approx)

The co-relation of plants surrounding P.hysterophorus L. in Bhadkal lake are shown in table:

Table 1

s.no.	Name of plant	Botanical Name	No. of plants
1.	Parthenium hysterophorus	*Parthenium hysterophorus L.*	25
2.	Ashoka Tree	*Saraca indica*	8
3.	Ber	*Zizyphus jujuba*	3
4.	NeelaFulnu	*Ageratum conyzoides*	50
5.	Khair	*Acacia catechu*	25
6.	Teak	*Tectona grandis*	3

Basal area or ground is covered with lawn grass.

Concentration	Duration	*Phaseolus radiatus*	*Brassica compestris*
10%	After 24 hours	Breaking seed coat =5 Ungerminated =95	Nil
15%	Afetr 24 hours	Breaking seed coat =3, Ungerminated=97	Nil
20%	After 24 hours	Breaking seed coat =2 Ungerminated =98	Nil

2. Sector- 21 (Vacant Plot):-
Total Area : 100 sq.yards
The co- relation of plants surrounding *P. hysterophorus L* .in Sector -21 are shown in table

Table 2

This was a swampy area in straight line on the road side.
Pulses and oil seeds observed using extract of Parthenium:-
The selected pulse and oil yielding seed like Udaddaal (*Phaseolusradiatus*) and mustard seeds (*Brassica compestris)* are allowed to germinate in petri dish to see the Observation is done after 24 hours.
Preparation of dried leaf extract
We collected the green leaves of *P. hysterophorus L.* species and dried them in an oven at 60 degrees temperature for 24 hours. After that we crushed the dried leaves, and then taken the weight of crushed leaves.
Requirement:
Weight of leaves / volume = 4 gm
Ethanol = 180 ml
Distilled water = 20 ml

PROCEDURE:
Take 4 gm of dried leaves of *Parthenium* species and crush them until they become powder. Put the powder into a beaker. Add 180 ml ethanol and 20 ml of distilled water into the beaker. Leaves the material in the beaker for an hour. Then filter the material. The liquid left out in the beaker after filtering is known as leaf extract of *P. hysterophorus L.* The extract is ready for practical work. The results of dried leaf extract of*Phaseolusradiatus* and *Brassica compestris* are shown in table 3.
Preparation of wet leaf extract:
Now we will prepare wet leaf extract in the same way as we prepared for dried leaf extract. But in this case freshly plucked leaves from the *Parthenium* species and crushed them for the preparation of leaf extract.
Requirement:
Green leaves of *Parthenium* =4 gm
Ethanol =180 ml
Distilled water = 20 ml
Wet leaf extract is ready for work now. The results of wet leaf extract for *Phaseolus radiates* and *Brassica compestris* are shown in table 4

Dried seeds in (dry leaf extract):
No. of pulse seeds and oil seeds = 100 (in each Petri dish)
Example: *Phaseolusradiatus* = 100
Brassica compestris = 100
Water = 10 ml (in each petri dish)
Leaf extract is used in following percentage, 10% , 15% and 20%.

Table 3

S.no.	Name of plant	Botanical name	No. of plants
1.	Parthenium hysterophorus in vegetative stage	*Parthenium hysterophorus L.*	150
2.	Khair trees	*Acacia catechu*	5
3.	Argemone	*Argemone maxicana*	15
4.	Aak	*Calotropis procera*	6

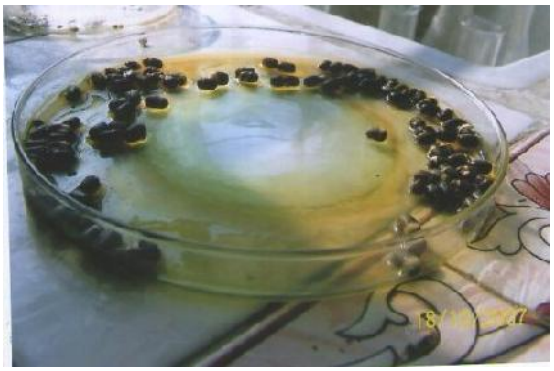
This table shows that the leaves of *P. hysterophorus L.* inhibit the germination of seeds.
Dried seeds in (wet leaf extract):
No. of pulses and oil seeds =100 (in each petri dish)
Example = *Phaseolusradiatus* = 100
Brassica compestris =10

Water =10 ml (in each petri dish)
Leaf extract is used in the following percentage, 10 %, 15 % and 20 %.

Table-4

Concentration	Duration	*Phaseolus radiates*	*Brassica compestris*
10 %	24 hours	Radicle = 9 breaking, Seed coat =24 and Ungerminated seeds =67	Nil
15 %	24 hours	Radicle =7 breaking, Seed coat =21 and Ungerminated seeds =72	Nil
20 %	24 hours	Radicle 4 breaking, Seed coat =22 and Ungerminated seeds =74	Nil

Wet leaf extract using upon dried seeds of *Phaseolu sradiatus* in 15 % concentration after 24 hours.



Wet leaf extract using upon dried seeds of *Phaseolusradiatus* in 20 % concentration after 24 hours.

Dried leaf extract using upon dried seeds of *Phaseolus radiatus* and *Brassica compestris* in 10 % concentration after 24 hours.

Dried leaf extract using upon dried seeds of *Phaseolus radiatus* and *Brassica compestris* in 15 % concentration after 24 hours.

Dried leaf extract using upon dried seeds of *Phaseolus radiates* and *Brassica compestris*in 20 % concentration after 24 hours.

HEALTH BENEFITS OF *P. HYSTEROPHORUS*

The decoction of *P. hysterophorus*has been used in traditional medicine to treat fever, diarrhoea, neurologic disorders, urinary tract infections, dysentery, malaria and as emmenagogue (Surib-Fakim et al. 1996). Ethnobotanically, it is used by some tribes as remedy for inflammation, eczema, skin rashes, herpes, rheumatic pain, cold, heart trouble and gynaecological ailments. *Partheniumhysterophorus* has been found to be pharmacologically active as analgesic in muscular rheumatism, therapeutic for neuralgia and as vermifuge (Maishi et al. 1998). This weed is also reported as promising remedy against hepaticamoebiasis. Parthenin, the major constituent of the plant, exhibits significant medicinal attributes includinganticancer property (Venkataiah et al. 2003). The methanol extract of the flowers showed significantantitumouractivity andparthenin exhibited cytotoxic properties against T cell leukaemia, HL-60 andHela cancer cell lines (Das et al. 2007). Previously, Ramos et al. (2002) had established theantitum our potential of*P. hysterophorus* extracts in vitro and in vivo with positive results in terms oftumour size reduction and overall survival of cell lines.

Aqueous extract of *P. hysterophorus* hashypoglycaemic activity against alloxan -induced diabetic rats (Patel et al. 2008). So, flower extract of this weed can be used for developing drug for diabetes mellitus.

Parashar et al. (2009) reported the synthesis of silver nanoparticles by reducing silver ions present in the aqueous solution of silver nitrate complex using the extract of *P. hysterophorus.* This discovery can promote this noxious plant into a valuable weed for nanotechnology-based industries in future. Applications of such eco-friendly nanoparticles in bactericidal, wound healing and other medical and electronic applications makes this method potentially exciting for the large-scale synthesis of other nanomaterials.

Role of *P. hysterophorus* in enhancement of crop productivity

Allelopathycan be used to increase crop production at minimal expenses and to diminish the current reliance on synthetic agrochemicals that degrade the environmental quality. The allelochemicals can be exploited as herbicides, insecticides, nematicides, fungicides and growth regulator. Pesticidalpotential has been established in terms of ovicidal and anti-fleedant effects (Datta and Saxena2001). The allele chemicals also provide defense against herbivorous predators.

Kishor et al. (2010) prepared compost of *P. hysterophorus* in 14 weeks and assessed its manure value. Compost from this weed on application in soil enhanced its moisture level more than nitrogen, phosphorus and potassium (NPK) alone. Anaerobic digestion of partheniumdried solids biodegrades the plant growth and conserves the NPK content. This can be applied as organic manure (Gunaseelan1998).Javaid (2008) used *P. hysterophorus* weed as green manure for maize and mung bean production. The highest root and shoot biomass in maize was obtained in 3% green manure treatment, which was significantly greater than that obtained in the control and equivalent to that obtained in the NPK fertilizer treatments.

The effect of *P. hysterophorus*green manure and EM (effective microorganisms), a biofertilizer, on wheat (*Triticumaestivum* L.) cultivation waste died. Highest root biomass was recorded in 3% green manure-amended treatment. Spike length, number of grains per spike and grain yield gradually increased by increasing the quantity of green manure. There was 43–253% increase in grain yield over control due to various green manure treatments as compared with 96% increase due to NPK fertilizers over control (Javaid and Shah 2010). *Partheniumhysterophorus* being rich in N, P, K, Ca, Mg and chlorophyll content isideally suited for composting. Ordinary*P. hysterophorus* compost cannot sufficiently reduce theallelopathic effects of high levels of parthenin and phenolics, which impede the early growth, development and dry matter yield of both monocot and dicot plants. For maximum exploitation of the nutrient contents of *P. hysterophorus*, without incurring the ill effects of phenolics, millipede *Harphaphehaydeniana*-mediated novel composting procedure was tried. Thismilli-compost (MC) was more effective than ordinary parthenium compost (OPC) (Apurva et

al. 2010). So, if tapped properly, this weed can contribute to a gronomic process.

P. hysterophorous as additive with cattle manure in biogas production

In the wake of oil crisis, energy generation frombiowastesby anaerobic digestion has attracted immense attention. Energy crops are likely to be future sources of digester feed stocks formethane generation.*Partheniumhysterophorus*was mixed with cattle manure at a 10% level and allowed to digest anaerobically at room temperature in 3-l batch digesters. The chemical changes during the course of digestion and the effect of digested slurry (inoculum) on biogas production were investigated and significant increase in methane content was achieved. The methane content of the gas varied between 60 and 70% (Gunaseelan1987). *Partheniumhysterophorus*should be seriously considered as a substrate for the production of biogas in India via anaerobic digestion, considering the abundance of this weed and large quantity of livestock.

P. hysterophorus for welfare of livestock

Partheniumhysterophorus can be used as a flea-repellent for dogs (Maishi et al. 1998). This weed is a valuable source of potash, oxalic acids and high-quality protein (HQP) which can be used in animal feed (Mane et al. 1986).

DISCUSSION

Mechanical, chemical and biological control strategies have been proved futile individually to curb proliferation of *P.hysterophorus*. So, integrated approaches are warranted to restrict the invasion of this weed. To address this problem, public awareness has to be developed and participatory approach to control the invasive weeds should be adopted.

There is the need to encourage the research on the utilization potential of this weed and to evaluate its efficacy on field trials. The target of "control through utilization" can be achieved through joint efforts of researchers, farmers, governmental and non-governmental agencies. The discovery of the uses of this weed also could pave the way for indirect eradication of the weed.At present, although *P.hysterophorus* is considered a weed, its new uses are coming to the forefront.Nanomedicine,biopecticide, green manure potential, agent for bioremediation of toxic metals and dyes, herbicide, cheap substrate for enzyme production and source of biogas are some of the recently discovered implications of *P.hysterophorus*.

This weed is available in four continents in abundance. Their industrial processing costs are low and devoid of any environmental hazards. The increased utilization of *P. hysterophorus* biomass as energy source and raw materials is necessary in the long term, as fossil fuels are limited. Similarly, its use as manure and pesticide can be appreciated in the wake of the problems posed by chemicals. Isolation and chemical investigation of the compounds in *P. hysterophorus* are required to decipher their properties and predict their applications. In this regard, it is touted to become a boon for the human beings, animals and crops in near future.

REFERENCE

1. Ajmal M, Rao RAK, Ahmad R, Khan MA. Adsorption studies on *Parthenium hysterophorous* weed: removal and recovery of Cd(II) from wastewater. J Haz Mat B. 2006;135:242–248. doi: 10.1016/j.jhazmat.2005.11.054

2. Akhtar N, Satyam A, Anand V, Verma KK, Khatri R, Sharma A. Dysregulation of T_H type cytokines in the patients of Parthenium induced contact dermatitis. ClinChimicaActa. 2010;411:2024–2028. doi: 10.1016/j.cca.2010.08.030

3. Akter A, Zuberi MI. Invasive alien species in Northern Bangladesh: identification, inventory and impacts. Int J BiodiversConserv. 2009;15:129–134.

4. Apurva P, Sinha SK, Thakur PC. Composting an obnoxious weed, *Parthenium hysterophorus* L., with the help of a millipede, *Harpaphehaydeniana*. Asian J ExpBiol Sci. 2010;1:337–343.

5. Belz RG, Reinhardt CF, Foxcroft LC, Hurle K. Residue allelopathy in *Parthenium hysterophorus* L.—does parthenin play a leading role? Crop Prot. 2007;26:237–245. doi: 10.1016/j.cropro.2005.06.009.

6. Chhabra BR, Kohli JC, Dhillon RS (1999) Threeambrosanolides from *Parthenium hysterophorus*. Phytochemistry 52:1331–1334.

7. Das B, Reddy VS, Krishnaiah M, Sharma AVS, Ravi Kumar K, Rao JV, Sridhar V. Acetylated pseudoguaianolides from *Partheniumhysterophorus* and their cytotoxic activity. Phytochemistry. 2007;68:2029–2034. doi: 10.1016/j.phytochem.2007.05.002.

8. Datta S, Saxena DB. Pesticidal properties of parthenin (from *Parthenium hysterophorus*) and related compounds. Pest Manag Sci. 2001;57:95–101. doi: 10.1002/1526-4998(200101)57:1<95::AID-PS248>3.0.CO;2-J.

9. Fuente JR, Novara L, Alarcon SR, Diaz OJ, Uriburu ML, Sosa VE. Chemotaxonomy of Parthenium*: P. hysterophorus–P. glomeratum*. Phytochemistry. 1997;45:1185–1188. doi: 10.1016/S0031-9422(97)00086-1.

10. Dhileepan K. Seasonal variation in the effectiveness of the leaf-feeding beetle *Zygo gramma bicolorata* (Coleoptera: Chrysomelidae) and stem-galling moth *Epiblema strenuana* (Lepidoptera: Tortricidae) as biocontrol agents on the weed *Parthenium hysterophorus* (Asteraceae) Bull Entomol Res. 2003;93:393–401. doi: 10.1079/BER200325.

11. Dhileepan K. Current status of the stem-boring weevil *Listronotussetosipennis* (Coleoptera: Curculionidae) introduced against the weed *Parthenium hysterophorus* (Asteraceae) in Australia. BiocontrolSci Technol. 2003;13:3–12. doi: 10.1080/0958315021000054340.

12. Dhileepan K. Biological control of Parthenium (*Parthenium Hysterophorus*) in Australian rangeland translates to improved grass production. Weed Sci. 2007;55:497–501. doi: 10.1614/WS-07-045.1.
13. Dhileepan K, Strathie L. *Parthenium hysterophorus* L. (Asteraceae) In: Muniappan R, Reddy DVR, Raman A, editors. Biological control of tropical weeds using arthropods. UK: Cambridge University Press; 2009. pp. 272–316.
14. Dwivedi P, Vivekanand V, Ganguly R, Singh RP. Parthenium sp. as a plant biomass for the production of alkali tolerant xylanase from mutant *Penicillium oxalicum* SAU_E-3.510 in submerged fermentation.Biomass Energy. 2009;33:581–588. doi: 10.1016/j.biombioe.2008.09.001.
15. Evans H. *Partheniumhysterophorus*: a review of its weed status and the possibilities for biological control. Biocontrol News Inf. 1997;18:389–398.
16. Fauzi MT, Tomley J, Dart PJ, Ogle HJ, Adkins SW. The Rust *Pucciniaabrupta* var. *partheniicol*a, a potential biocontrol agent of Parthenium weed: environmental requirements for disease progress. Biol Control. 1999;14:141–145. doi: 10.1006/bcon.1998.0680.
17. Ganesh PS, Sanjeevi R, Gajalakshmi S, Ramasamy EV, Abbasi SA. Recovery of methane-rich gas from solid-feed anaerobic digestion of ipomoea (*Ipomoea carnea)*Bioresour Technol. 2008;99:812–818. doi: 10.1016/j.biortech.2007.01.024.
18. Grichar WJ. Weed control and grain sorghum tolerance to flumioxazin. Crop Prot. 2006;25:174–177. doi: 10.1016/j.cropro.2005.03.015.
19. Gunaseelan VN. Parthenium as an additive with cattle manure in biogas production.Biol Wastes. 1987;21:195–202. doi: 10.1016/0269-7483(87)90125-X.
20. Gunaseelan VN. Impact of anaerobic digestion of inhibition potential of *Parthenium*soids.Biomass Bioenergy. 1998;14:179–184. doi: 10.1016/S0961-9534(97)10019-8.
21. Gupta N, Martin BM, Metcalfe DD, SubbaRao PV. Identification of a novel hydroxyproline-rich glycoprotein as the major allergen in Parthenium pollen.J Allergy ClinImmunol. 1996;98:903–912. doi: 10.1016/S0091-6749(96)80006-6.
22. Javaid A (2008) Use of partheniumweed as green manure for maize and mungbean production. Philipp AgricSci 91(4)
23. Javaid A, Shah MBM. Growth and yield response of wheat to EM (effective microorganisms) and parthenium green manure. Afr J Biotechnol. 2010;9:3373–3381.
24. Kishor P, Ghosh AK, Singh S, Maury BR. Potential use of parthenium (*Partheniumhysterophorus* L.) in agriculture. Asian J Agric Res. 2010;4:220–225. doi: 10.3923/ajar.2010.220.225.
25. Kohli RK, Batish DR, Singh HP. Eucalyptus oils for the control of Parthenium (*Partheniumhysterophorus* L.) Crop Prot. 1998;17:119–122. doi: 10.1016/S0261-2194(97)00095-1.
26. Kuhad RC, Gupta R, Khasa YP, Singh A. Bioethanol production from *Lantanacamara* (red sage): pretreatment, saccharification and fermentation. Bioresour Technol. 2010;101:8348–8354. doi: 10.1016/j.biortech.2010.06.043.
27. Kumar M, Kumar S (2010) Effect of *Partheniumhysterophorus* ash on growth and biomass of *Phaseolusmungo*.Acad Arena 2(1)
28. Lakshmi C, Srinivas CR. Parthenium: A wide angle view. Ind J DermatolVenereolLeprol. 2007;73:296–306. doi: 10.4103/0378-6323.35732.
29. Lata H, Garg VK, Gupta RK. Removal of a basic dye from aqueous solution by adsorption using *Partheniumhysterophorus*: an agricultural waste. Dyes Pigment. 2007;74:653–658. doi: 10.1016/j.dyepig.2006.04.007.
30. Lata H, Garg VK, Gupta RK. Sequestration of nickel from aqueous solution onto activated carbon prepared from *Partheniumhysterophorus* L. J Haz Mat. 2008;157:503–509. doi: 10.1016/j.jhazmat.2008.01.011.
31. Maishi AI, Ali PKS, Chaghtai SA, Khan G. A proving of *Partheniumhysterophorus*, L. Brit Homoeopath J. 1998;87:17–21. doi: 10.1016/S0007-0785(98)80005-7.
32. Mane JD, Jadav SJ, Ramaiah NA. Production of oxalic acid from dry powder of *Partheniumhysterophorus* L. J Agric Food Chem. 1986;34:989–990. doi: 10.1021/jf00072a014.
33. Misra L, Laatsch H. Triterpenoids, essential oil and photo-oxidative 28 → 13-lactonization of oleanolic acid from *Lantana camara*. Phytochemistry. 2000;54:969–974. doi: 10.1016/S0031-9422(00)00131-X.
34. Morin L, Reid AM, Sims-Chilton NM, Buckley YM, Dhileepan K, Hastwell GT, Nordblom TL, Raghu S. Review of approaches to evaluate the effectiveness of weed biological control agents. Biol Control. 2009;5:1–15. doi: 10.1016/j.biocontrol.2009.05.017.
35. Narasimban TR, Murthy BSK, Harindramath N, Rao PVS.Characterization of a toxin from *Partheniumhysterophorus* and its mode of excretion in animals.J Biosci. 1984;6:729–738. doi: 10.1007/BF02702716.
36. Oudhia P, Pandey N, Tripathi RS.Allelopathic effects of obnoxious weeds on germination and seedling vigour of hybrid rice.Int Rice Res Notes. 1999;24:36.
37. Pandey DK. Inhibition of salvinia (*Salviniamolesta* Mitchell) by parthenium (*Partheniumhysterophorus* L.). I. Effect of leaf residue and allelochemicals. J Chem Biol. 1994;19:2651–2662.
38. Parashar V, Parashar R, Sharma B, Pandey A. Parthenium leaf extract mediated synthesis of silver nano particles: a novel approach towards weed utilization. Digest J NanomaterBiostruct. 2009;4:45–50.
39. Patel VS, Chitra VP, Prasanna L, Krishnaraju V. Hypoglycemic effect of aqueous extract of *Partheniumhysterophorus* L. in normal and alloxan induced diabetic rats. Ind J Pharmacol. 2008;40:183–185. doi: 10.4103/0253-7613.43167.
40. Patel AK, Singh VK, Yadav RP, Moir AJG, Jagannadham MV.Purification and characterization of a new chitinase from

latex of *Ipomoea carnea*.ProcBiochem. 2010;45:675–681. doi: 10.1016/j.procbio.2009.12.016.
41. Rajeshwari S, Subburam V. Activated parthenium carbon as an adsorbent for the removal of dyes and heavy metal ions from aqueous solution. Bioresour Technol. 2002;85:205–206. doi: 10.1016/S0960-8524(02)00089-5.
42. Rajkumar EDM, Kumar NVN, Haran NVH, Ram NVS.Antagonistic effect of *P. hysterophorus* on succinate dehydrogenase of sheep liver. J Environ Biol. 1988;9:231–237.
43. Ramos A, Rivero R, Victoria MC, Visozo A, Piloto J, Garcıa A. Assessment of mutagenicity in *Partheniumhysterophorus* L. J Ethnopharmacol. 2001;77:25–30. doi: 10.1016/S0378-8741(01)002.
44. Ramos A, Rivero R, Visozo A, Piloto J, Garcia A. Parthenin, a sesquiterpene lactone of *Partheniumhysterophorus* L. is a high toxicity clastogen. Mut Res. 2002;514:19–27.
45. Sathish R, Vyawahare B, Natarajan K (2011) Antiulcerogenic activity of *Lantana camara* leaves on gastric and duodenal ulcers in experimental rats. J Ethnopharmacol. doi:10.1016/j.jep.2010.11.049.
46. Sharma VK, Sethuraman G, Bhat R. Evolution of clinical pattern of parthenium dermatitis: a study of 74 cases. Contact Dermat. 2005;53:84–88. doi: 10.1111/j.0105-1873.2005.00652.x.
47. Singh HP, Batish DR, Pandher JK, Kohli RK. Assessment of allelopathic properties of *Partheniumhysterophorus* residues.AgricEcosys Environ. 2003;9:537–541. doi: 10.1016/S0167-8809(02)00202-5.
48. Singh RK, Kumar S, Kumar S, Kumar A. Development of parthenium based activated carbon and its utilization for adsorptive removal of p-cresol from aqueous solution. J Haz Mat. 2008;155:523–535. doi: 10.1016/j.jhazmat.2007.11.117.
49. Sriramarao P, Prakash O, Metcalfe D, SubbaRao P. The use of murine polyclonal anti-idiotypic antibodies as surrogate allergens in the diagnosis of *Parthenium* hypersensitivity.J Allergy ClinImmunol. 1993;92:567–580. doi: 10.1016/0091-6749(93)90081-P.
50. Surib-Fakim A, Swerab MD, Gueho J, Dullo E. Medicinal plants of Rodrigues. Int J Pharmacogn. 1996;34:2–14. doi: 10.1076/phbi.34.1.2.13177.
51. Tamado T, Milberg P. Control of parthenium (*Partheniumhysterophorus*) in grain sorghum (*Sorghum bicolor*) in the smallholder farming system in eastern Ethiopia. Weed Technol. 2004;18:100–105. doi: 10.1614/WT-03-033R.
52. Tefera T. Allelopathic effects of *Partheniumhysterophorus* extracts on seed germination and seedling growth of *Eragrostistef*. J. Agron Crop Sci. 2002;188:306–310. doi: 10.1046/j.1439-037X.2002.00564.x.
53. Timsina B, Shrestha BB, Rokaya MB, Munzbergova Z (2011) Impact of *Partheniumhysterophorus* L. invasion on plant species composition and soil properties of grassland communities in Nepal. Flora Morphol Distribution FunctEcol Plants. doi:10.1016/j.flora.2010.09.004.
54. Towers GHN, SubbhaRao PV (1992) Impact of the pan-Tropical weed, *P. hysteroporus* L. on human affairs. In: Richardson RG (ed) Proceedings of the first international weed control congress, Melbourne, Australia, Weed science society of Victoria, pp 134–138.
55. Venkataiah B, Ramesh C, Ravindranath N, Das B. Charminarone, a seco-pseudoguaianolide from *Partheniumhysterophorus*. Phytochemistry. 2003;63:383–386.
56. Yadav N, Saha P, Jabeen S, Kumara S, Kumara S, Verma SK, Raipat BS, Sinha MP (2010) Effect of methanolic extract of *P. hysterophorus* L. on haematological parameters in wistar albino rat. Bioscan 2:357–363.