RNI: MAHENG/2016/68030 Vol. 4 Issue 1 Jan.-Feb. (2019): Page No.1-7 ISSN: 2456-5342 (print)

MGM's JAWAHARLAL NEHRU ENGINEERING COLLEGE

VISTA INTERNATIONAL JOURNAL ON ENERGY, ENVIRONMENT & ENGINEERING

VISTA

Parthenium Aerobiology: Deterioration of Air Quality

B. N. Pande

Emeritus Professor, Dept. of Architecture,
MGM's Jawaharlal Nehru Engineering College, Aurangabad (M.S.)
***Corresponding author email :** drbnpande@rediffmail.com Contact: +91-9422712461

ABSTRACT

Parthenium is an allergic aggressive and exotic weed, which grows in waste lands, orchards, forest lands, flood plains, agricultural areas, urban areas, overgrazed pastures and along road sides and railway tracks due to wider climatic adaptability, allelopathic effects on several plants. During the last 60 years, except in cold deserts, it has spread throughout the country.

In India, weed is reported to invade an estimated 35 million hectors of cropped and non cropped area comprising waste land (45%), pasture and grass land (45.3%), cropped area (12.92%) and forests (63%). Study conducted at Dr.Babasaheb Ambedkar Marathwada University, Aurangabadcampus has revealed that more than 4% individuals occupationally exposed to the Parthenium plants while 56% of them develop sensitization to the weed without apparently manifesting any dermatitis.

Judicious use of barrier creams on the exposed skin after washing the surface with non – medicated soap in consultation with doctor. The creams trap the antigens and therefore it should be disposed off carefully at 3-4 h intervals so as to avoid their accumulation on the skin. Interestingly, the patients suffering from Parthenium like allergy symptoms have been noticed cured and shifted to the Parthenium free areas.

Role of aerobiology and linking with Parthenium research in particular needs more attention. The prevalence of Parthenium pollen in air has been reported from all corners of India by Aero biologists. In Marathwada region, Aerobiological surveys were undertaken in order to report climatic adaptability and subsequent allelopathic effects of the Parthenium on plants, animals and human beings. The air quality is likely to deteriorate in days to come unless immediate corrective precautionary measures are put in place, due to proliferation of this weed keeping in view the climate change. The term "Parthenium Aerobiology" is proposed to bridge a gap between researchers and dermatologists.

Keywords: *Pollen allergy, Dermatitis, Human health, Parthenium*

1. Introduction :

Parthenium hysterophorus has been noticed as an isolated plant near Pune. Over a last 6 decades, it has spread all over country to variable extent. A plant belonging to sunflower family, originally it comes from south U.S., Argentina and Mexico. The plant was first noticed by Paranjape in 1956. Rao of BSI, gave a full botanical account of the plant.

At Jabalpur [1], Bhopal [2] and Bangalore [3], Aerobiological surveys of intramural environment were undertaken to study causal allergen of bronchial allergy.Role of aerobiology as such and linking with Parthenium research in particular needs more attention. The prevalence of Parthenium pollen in air has been reported from all corners of India by the aero biologists. The air quality is likely to deteriorate in days to come unless immediate corrective precautionary measures are put in place, due to proliferation of this weed keeping in view the climate change. The term "Parthenium Aerobiology" is proposed to bridge a gap between researchers and dermatologists.

Parthenium causes a very unusual and intractable skin disease. One does not have to come in actual direct contact with plant but mere the residence is enough to produce the damage in susceptible persons. The available medical treatment is not curative.The drugs used cause far more damage. Residing in the area which is free from the weed is the only known solution at present.

2. Health impacts on humans and livestock

P. hysterophorus causes various types of health hazards in both humans as well as livestock. The impact on food and feed crops is a major reason for concern as the pollen and dust of the weed produces allergic response in humans [4,5]. Dermatitis is an immune injury which manifests itself in form of itchy papules and lesions on the exposed parts of our body [6]. These impacts are on account of cytotoxicity of sesquiterpene parthenin [7]. Prolonged exposure to this weed manifests in form of asthma, eczema, skin inflammation, hay fever, blisters around the eyes. P. hysterophorus is also responsible for causing eruptions, diarrhea, choking, breathlessness and bronchitis [8]. The mutagenic potential of crude P. hysterophorus extract was assessed in Salmonella / microsome and mouse bone marrow/micronucleus. However, genotoxicity was not observed [9]. Further studies have found that dermatitis progresses from airborne contact to chronic actinic pattern [10]. Parthenium sensitive patients suffering from rhinitis with positive skin prick tests also responded to mAb-2 [11]. TH type cytokines are also involved in Parthenium dermatitis [12].

This weed exposure also results in systemic toxicity within livestock [13]. Animals feeding on P. hysterophorus have been found to suffer from diarrhea, loss of pigmentation and dermatitis. In buffalo and sheep studies have reported degenerative changes in both liver and kidneys [14]. Upon the consumption of this weed there is deterioration in milk and meat quality of cattle [15]. This extract also results in significant weakening of the immune system [16]. Skin testing of 140 patients was undertaken with antigens derived from pollen of Parthenium and other taxa in Aurangabad city [17] and the results are presented in Table (1,2 and 3) [17].

Table 1. Skin testing of 140 patients with the antigens of pollen of various taxa

Pollen type	Total No. of cases studied	No. of patients showing +veID+test	% of reactivity
Cynodon sp.	30	7	23.3
Cyperus sp.	20	4	20
Acacia sp.	17	5	29.4
Lantana sp.	25	8	32
Azadirachta sp.	34	11	32.3
Cassia sp.	27	10	37
Parthenium sp.	21	6	28.6
Moringa sp.	17	3	17.6
Bouganvilleasp.	20	5	25
Amaranthus sp.	70	21	30

Table 2.Results of skin tests with various pollen antigens

Pollen antigens tested	Total tests done	Skin response (%)					
		1+	2+	3+	4+	Total	Total % of 2+, 3+ & 4+
Amaranthus sp.	176	13.06	3.97	1.7	-	18.73	5.67
Argemine Sp.	138	3.62	2.17	-	7.26	3.64	-
Azadirachta sp.	131	11.36	3.78	1.51	-	16.65	5.29
Brassica sp.	107	9.34	7.47	1.86	-	18.87	9.33
Cassia sp.	270	8.88	8.14	2.22	-	19.24	10.36
Chenopdium sp.	77	12.98	2.23	1.49	0.74	7.74	4.16
Dodonia sp.	134	2.98	2.23	1.49	o.74	7.74	4.46
Eucalyptus sp.	17	17.64	-	-	-	17.64	-
Grass	567	11.28	5.64	194	-	18.86	7.58
Parthenium sp.	135	12.59	8.14	2.22	1.48	24.43	11.34
Prosopis sp.	118	11.01	3.38	-	-	14.39	2.7
Xanthium sp.	113	6.19	6.19	2.65	-	15.03	8.84

Table 3. Disease wise distribution of patients in Parthenium pollen

Disease	Male	Female	Total	%
Bronchial asthma	18	8	26	50.98
Allergic rhinitis	8	3	11	21.56
Allergic rhinitis with bronchial asthma	9	5	14	27.46
Total	35	16	51	100

3. Reducing agricultural and pasture productivity

Various research studies have conducted aerobiological and botanical surveys to understand pollen calendar and relation to allergic diseases in Bhopal [18], Madhya Pradesh, at Pune [19] and at Aurangabad [20]. A study examined the allelopathic characteristics of burnt and unburnt residues of this weed development onradish,chickpeas and rabi crops. Extracts were prepared from both the residues exerted toxicity towards length ofseedlings andtest crop dry weight. Unburnt residues were found to be more toxic than burnt residues and the effects were accounted to the presence of phenols [21].

Parthenin plays an important role in allelopathic interference with neighboring plants.It also possesses property of being germination as well as radicle growth inhibitor in different dicot and monocot plants [22]. The burning of this weed in fields decreased germination, growth in biomass and length of radicle and plumule in mung beans. Fields infested with P. hysterophorus reduced biomass growth, plumule, germination, and radicle length of Paseolus mungo.

In addition, it has resulted in poor fruiting of leguminous crops and reduced content of chlorophyll in the crop plants [15]. Parthenium hysterophorus is an alternate host for functioning of crop pests as source of inoculum. This weed acts as a reservoir plant of scarab beetle (sunflower pest). Parthenium hysterophorus identified to cause changes in vegetation above-ground level as well as changes in the soil nutrient contents below-ground soil and hence results in the disturbance of entire grassland in Nepal [23].

The study project was undertaken aerobiological as well as allergy [24] and involves geographic distribution,pollen seasonal production and its pollinosis effects on susceptible individuals. The advancement of technology and microscopy has ushered a new era in the field of palynology. P. hysterophorus is found to be a serious weed in pasture systems which reducescrop productivity by 90%. Also, it is a major weed in pasture lands of Queensland and New South Wales in Australia [25].

4. Impact of P. hysterophorus on the loss of biodiversity

The allelopathic properties and invasive capacity have made P. hysterophorus the potential effects of disrupting the natural ecosystem. It has major impact on the vegetation in the dominated areas of P. hysterophorus. It has caused change in the total habitat in Australian grasslands, banks of river, woodlands, and flood plains. This weed is a serious threat to biodiversity in India since it rapidly invades newer surroundings and substitutes the local speciesof the area. There iscomprehensive study on the Invasive Alien Species (IAS) [26] and their effect on various land use categories in Bangladesh(e.g. low land, road side, fallow land, homestead and railway track). P. hysterophorus has displayed its capability to invade and adapt to new habitats which affects reduction in the number of indigenous plants.

5. P. hysterophorus: Control and eradication strategies

P.hysterophorus have no particular use butgot multiple harmful effects in disturbing the ecosystem and loss of biodiversity. This weed eradication has become a major challenge to Government since it has got strong reproductive potential and epidemic proliferation in addition to the broad ecological range. Various physicochemical methods have been developed previously for the elimination of this weed. However, these methods have not been found to be economical, effective and ecological friendly. This weed biomass after uprooting isdumped at the periphery of the agricultural fields, roadsides and along the railway tracks. Generally, the weed biomass is burnt to check the diseases caused by its harmful lactone component.

The burning of this weed biomass is not advisable as it reduces the soil quality by causing declin in the organic matter [21]. In Ethiopia, the experiments were conducted to study P. hysterophorus growthon sorghum yield in small scale farmer holdings. The effects of hand hoeing and application of herbicides (2, 4-D) were compared and it was found that hand hoeing was more effective as compared to chemical herbicide [27].

6. Biological control of P. hysterophorus

In Australia, the study was conducted for analyzing the efficacy leaffeeding beetle (Zygogrammabicolorata) [24], stem-galling moth (Epiblemastrenuana) and stem-boring weevil (Listronotussetosipennis) introduced against P. hysterophorus weed as shown in Fig.1. The moth (Carmentaithacae) and leaf-rust (Puccinia melampodi) were introduced to eliminate this weed. This has resulted into a little success for eliminating this weed since the weed has strong potential of regeneration and the insect feeds only on weed foliage which has resulted into stimulation for further leafy proliferation [29]. The flowers and seeds are unaffected which are the main source of its dissemination.In North East India, the field trials were conducted showing Cassiasericea possesses capability to overgrow this weed while Marigold (Tageteserecta) was found to suppress its growth.

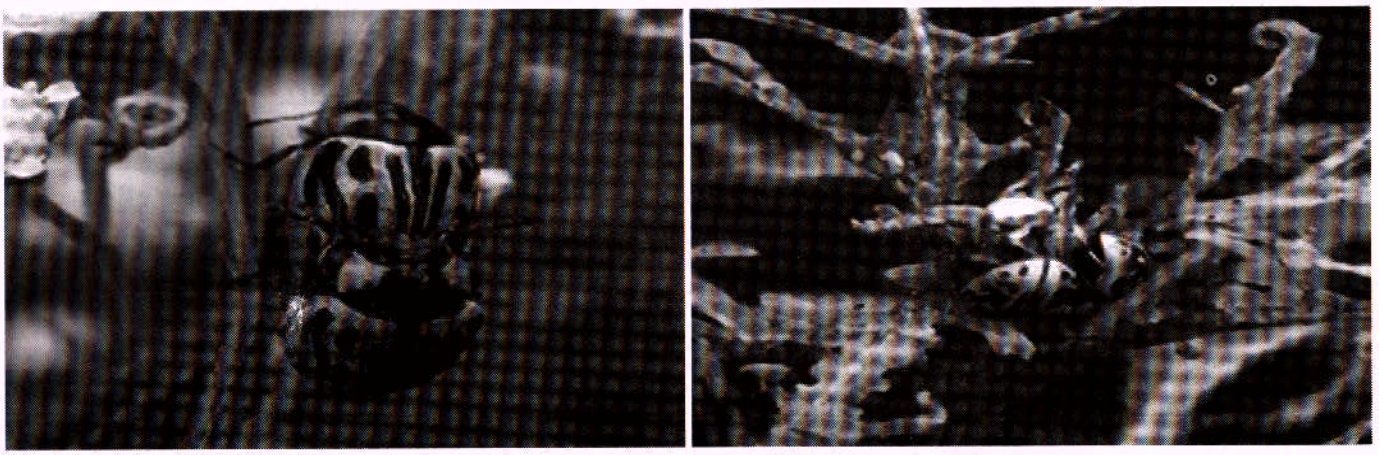

Fig. 1Bicontrol agents of P. hysterophorus for Zygogramma Bicolorata

7. Discussion

The control strategies (Physiochemical and biological) have not been found effective in controlling this weed. Therefore, it is necessary to utilize integrated approaches for inhibiting the proliferation of P.hysterophorus. The public awareness and participatory approach have been adopted to control the invasive growth of this weed [30].

Hence, it is necessary to undertake field trials for evaluating utilization P.hysterophorus. This weed utilization would be significant in controlling its proliferation. There is need for the joint collaboration between different stakeholders e.g. farmer, both Government and NGO agencies, scientists etc. The utilization potential of this plant could indirectly lay the way for its eradication. Presently, though P. hysterophorus is considered as a weed, newer applications are being discovered. Recently potential of this weed has been explored as green manure, biopecticide, herbicide, in Nanomedicine, in bioremediation of harmful dyes and metals, as an economical substrate for production of enzymes and as a source for biogas production.

8. Conclusions

This weed is in abundance across the world in four major continents. Industrial processing expenses are low as well as affordable and are ecofriendly. Largescale utilization of this weed biomass as energy sourceand raw material is important in the long run, as non-renewable fuels are in scarcity. In a similar manner, its application as manure and pesticide is appreciable in the current scenario of varied issues posed by chemicals. It is significant to isolate and chemically investigate the compounds in P. hysterophorus so that their properties are deciphered for predicting their applications. In this regard, it may be reasoned that in near future this weedmay be advantageous for humans, animals and crops.

References

[1] Pandey D.K.(1994), Effect of leaf residue parthenium (Parthenium and allelochemicals), Journal of Chemical Biology, 19:2651–2662.

[2] Tripathi D.M. (1976), Aeropalynological studies and survey with special reference to pollen calendar to study causal allergen of bronchial asthma of Bhopal. Ph.D. Thesis Barkatullah University, Bhopal, (MP).

[3] Agashe, S.N., Philip, E. and Anuradha, H.G.(1977), Aerobiological analysis of intramuralin Banglore environment and atopic allergy in Banglore, In Recent Trends in Aerobiology, Allergy and Immunology (ed. Aghashe. S.N.) Oxford and I.B.H. Publishing Pvt. Ltd. New Delhi.

[4] Gunaseelan V.N.(1987), Parthenium as an additive with cattle manure in biogas production. Biol Wastes. 21:195–202.

[5] Morin L., Reid A.M., Sims-Chilton N.M., Buckley Y.M., Dhileepan K., Hastwell G.T., Nordblom T.L., Raghu S.(2009), Review of approaches to evaluate the effectiveness of weed biological control agents, Biological Control, 5:1–15.

[6] Akhtar N., Satyam A., Anand V., Verma K.K., Khatri R., Sharma A. (2010), Dysregulation of TH type Cytokines in the patients of Parthenium induced contact dermatitis, Clin Chimica Acta. 411: 2024–2028.

[7] Narasimban T.R., Murthy B.S.K., Harindramath N, Rao P.V.S. (1984), Characterization of a toxin from Parthenium hysterophorus and its mode of excretion in animals, Journal of Bioscience, 6: 729–738.

[8] Towers G.H.N., Subbha Rao P.V. (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, 134–138.

[9] Ramos A, Rivero R, Visozo A, Piloto J, Garcia A. (2002), Parthenin, a sesquiterpene lactone of Parthenium hysterophorus L. is a high toxicity clastogen, Mut. Res. 514:19–27.

[10] Sharma V.K., Sethuraman G., Bhat R. (2005), Evolution of clinical pattern of parthenium dermatitis: A study of 74 cases, Contact Dermat. 53:84–88.

[11] Sriramarao P., Prakash O., Metcalfe D., Subba Rao P. (1993), The use of murine polyclonal anti-idiotypic antibodies as surrogate allergens in the diagnosis of Parthenium hypersensitivity, Journal of Allergy Clin Immunology, 92:567–580.

[12] Akter A., Zuberi M. I. (2009), Invasive alien species in Northern Bangladesh: identification, Inventory and Impacts, International Journal Biodiversity Conservation, 15: 129–134.

[13] Gunaseelan VN. (1987), Parthenium as an additive with cattle manure in biogas production. Biol Wastes. 21:195–202.

[14] Rajkumar E.D.M., Kumar N.V.N., Haran N.V.H., Ram N.V.S. (1988), Antagonistic effect of P. hysterophorus on succinate dehydrogenase of sheep liver, Journal of Environment Biology, 9:231–237.

[15] Lakshmi C, Srinivas CR. (2007), Parthenium: A wide angle view, Industrial Journal Dermatology VenereolLeprol., 73:296–306..

[16] 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

[17] Pande, B.N.(2012), Bioaerosls as Allergens, Bionano Frontier, 5(2): 164-169.

[18] Tripathi, D.M. (1976), Aeropalynological studies and survey with special reference to pollen calendar to study causal allergen of bronchial asthma of Bhopal. Ph.D. Thesis Barkatullah University, Bhopal, (MP).

[19] Tilak, S.T. (1989), Airborne pollen and fungal spores, Vaijayanti Prakashan, 312.

[20] Godbole, G. and B.N.Pande (2012), Atmospheric concentration of airborne pollen grain at Aurangabad, The Botanique 14(1):12-21.

[21] Singh H.P., Batish D.R., Pandher J.K., Kohli R.K., (2003), Assessment of allelopathic properties of Parthenium hysterophorus residues, Agricultural Ecosystem Environment, 9: 537–541.

[22] Gunaseelan VN. (1998), Impact of anaerobic digestion of inhibition potential of Parthenium, Biomass Bioenergy, 14:179–184.

[23] Timsina B., Shrestha B.B., Rokaya M.B. Munzbergova Z. (2011), Species composition and soil properties of grassland communities in Nepal: Impact of Parthenium hysterophorus L.

invasion on plant, Journal Flora (Jena), 206(3): 233-240.

[24] Kashinath,B., Majumdar, M.R. and Swati Gupta Bhattacharya (2006), A Textbook of Palynology (Basic and Applied), Nee Central Book Agency (P) Ltd. Kolkata.

[25] DhileepanK.(2007), Biological control of Parthenium (Parthenium Hysterophorus) in Australian rangeland translates to improved grass production, Weed Science, 55:497–501.

[26] Akter A., Zuberi M.I. (2009), Invasive alien species in Northern Bangladesh: Identification, inventory and impacts, International Journal Biodiversity Conservation, 15:129–134.

[27] Tamado T., Milberg P. (2004), Control of parthenium (Parthenium hysterophorus) in grain sorghum (Sorghum bicolor) in the smallholder farming system in eastern Ethiopia, Weed Technolology, 18: 100–105.

[28] Dhileepan K. (2003), Current status of the stem-boring weevil Listronotussetosipennis (Coleoptera: Curculionidae) introduced against the weed Parthenium hysterophorus (Asteraceae) in Australia, Biocontrol Science Technology, 13: 3–12.

[29] Dhileepan K, Strathie L. (2009), Parthenium hysterophorus L. (Asteraceae) In: Muniappan R, Reddy DVR, Raman A, Editors, Biological control of tropical weeds using arthropods, UK: Cambridge University Press; 2009, 272–316.

[30] Patel, S.A. (2011), Harmful and beneficial aspects of Parthenium hysterophorus: an update, Biotechnology, 1(1): 1-9.