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**In collaboration with IOBC working
group on biological control and
management of parthenium weed.**

Current spread, impact and management of parthenium weed in India

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Parthenium hysterophorus L., is commonly known as carrot weed in the Hindi speaking belt but known as Congress grass in other parts of India. The weed has spread throughout India after its noticeable occurrence in Pune (Maharashtra) in 1955. Now it has achieved the status of the countries "worst weed" owing to its allelopathic effects on agricultural crop production and harmful effects on people and animals. During the 1980s, parthenium weed used to be considered a weed of fallow and wasteland but now it has become a weed of every crop and also into the forested land. The severity of the parthenium weed problem has compelled researchers and people to form various action groups and societies to provide a forum for those in need and affected by parthenium weed.

The current spread of parthenium weed in India

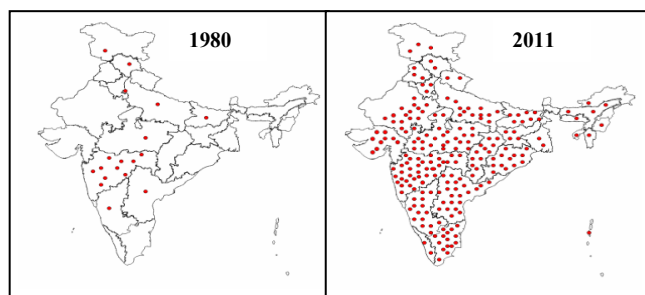
Parthenium weed has been reported from all states of India. In general, the overall spread in terms of density

and infestation level is that it is highest in Andhra Pradesh, Bihar, Chhatisgarh, Delhi, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Tamil Nadu and Uttar Pradesh. The spread and infestation level is medium in Assam, Gujarat, Himachal Pradesh, Jharkhand, Jammu & Kashmir, Uttarakhand, Orissa, West Bengal and Rajasthan states while spread is low in Andaman & Nicobar, Arunachal Pradesh, Daman and Diu, Goa, Kerala, Manipur, Mizoram, Meghalaya, Nagaland, Pondicherry and Sikkim (Table 1). Parthenium weed infestation is increasing rapidly over India and may be more serious than reported here. Although overall spread of parthenium weed has been reported to be low in certain areas such as Kerala and some states of the north-east, it is also true that in some parts of these states it is present in high abundance which might reflect its future potential for spread in these states. In India, parthenium weed has spread into regions having extremes in climate such as high temperature in Rajasthan, low temperature in the Punjab, Jammu & Kashmir and Himachal Pradesh, high rainfall in north-east India and high humidity in Kerala. Its presence is increasing in the coastal regions of Tamil Nadu, Orissa and Gujarat. Its abundance along road sides of Hut Bay in little Andaman in Andaman & Nicobar Islands is a pointer to its rapid establishment in these more isolated regions of India.

After its noticeable occurrence in 1955 in Pune, Maharashtra, it was estimated to have spread over about 5 million hectares of land by 1975. In a recently undertaken survey and collection of information from various sources from around India, the current spread of parthenium weed has been estimated to be around 35 million ha of land which includes wastelands, crop lands and forested lands. Until 1980 parthenium weed infestation was restricted mostly to uncultivable land. At that time it was not considered to be a problem in Rajasthan, Gujarat, Jammu & Kashmir, Kerala, Orissa, West Bengal and north-east states, but in a span of just 30 years, many arid areas in Rajasthan and hilly areas in Uttarakhand and Himachal Pradesh are now heavily infested with the weed. At present, parthenium weed has become widely distributed throughout India and no state is able to say that they are free of parthenium weed (Figure 1).

Table 1: Spread and level of infestation of parthenium weed in India.

Name of state	Spread and infestation level
Andaman & Nicobar islands	Low
Andhra Pradesh	High
Arunachal Pradesh	Low
Assam	Medium
Bihar	High
Chattishgarh	Medium
Chandigarh	Medium
Delhi	High
Goa	Low
Gujarat	Low
Haryana	High
Himachal Pradesh	Medium
Jammu & Kashmir	Medium
Jharkhand	Medium
Karnataka	High
Kerala	Low
Madhya Pradesh	High
Maharashtra	High
Manipur	Low
Meghalaya	Low
Mizoram	Low
Nagaland	Low
Orissa	Medium
Pondicherry	Medium
Punjab	High
Rajasthan	Medium
Sikkim	Low
Tamil Nadu	High
Uttar Pradesh	High
Uttaranchal	Medium

Figure.1. Spread of parthenium weed by 1980s and by 2011. Red dots showing a heavy occurrence in the state.**The current impacts of parthenium weed in various ecosystems**

Parthenium weed is able to make its impact in various ecosystems in different climates of India. It has been found responsible for the reduction in crop productivity, the deterioration of the environment, the loss of

community biodiversity and it is affecting the health of people and animals.

Agriculture and pastures ecosystems: In 1980s, parthenium weed was seldom noticed in crop lands but now it has spread into almost all types of cereal, pulse, cash crop, vegetable crops as well as pastures, forests and plantation ecosystems. In Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra etc., it has been considered a serious weed of crop lands. In agricultural fields, where only one crop is grown in a year, it grows profusely in the fallow period following the occurrence of mild rains. Its infestation is being reported in those crop lands which are being irrigated by canals systems indicating its ability to spread fast through irrigation water. On the bank of canal systems, parthenium weed grows profusely due to the good availability of moisture and because seeds are carried by canal water.

Orchards and forests ecosystems: Earlier, it was not considered a weed of orchards and forests but now it has spread rapidly into these areas too. Parthenium weed grows luxuriantly in orchards due to the less frequent weeding practices in such ecosystems. In Himachal Pradesh, parthenium weed has invaded the majority of apple orchards in the lower elevations. In Maharashtra, orange orchards have been invaded with parthenium weed causing problems to growers. Likewise, mango orchards in Uttar Pradesh, Madhya Pradesh and Maharashtra are frequently invaded by parthenium weed causing a nuisance to growers. The invasion of parthenium weed was reported in forest and wastelands with little or no growth of any other species with the local bio-diversity being threatened. In many forests, National Parks and plantation forests, the occurrence of this weed has been widely noticed. Parthenium weed has infested many National Parks of India including Pench (Figure 2), Rajaji, Kanha, Bandhavgarh etc.

Figure 2: Heavy parthenium weed infestation in Sal (*Shorea robusta*) forest in Pench National Park in Madhya Pradesh.

The severe infestation of parthenium weed has reduced the availability of palatable grasses to herbivores in Van Vihar National Park in Bhopal, Madhya Pradesh which has compelled the park authorities to undertake a large scale uprooting program. But the 3 year uprooting program, requiring a great deal of money, has not produced the desirable reduction in parthenium weed density. Parthenium weed has become a problem in forest nurseries in Madhya Pradesh. In Karnataka, parthenium weed along with lantana, chromolaena and some other exotic weeds has threatened the palatable vegetation availability to elephants. This situation has compelled the high court of India to instruct the states and central governments to constitute a task force to manage these weeds for the survival of the elephants.

Human and animal health: In India, this weed has been considered as one of the greatest source of dermatitis (Figure 3), asthma, nasal-dermal and naso-bronchial types of diseases in people. Many thousands of people in India are suffering due to this weed and in some people, the problem is so severe that they cannot go into the sun which increases the problem many fold due to photosensitive dermatitis induced by parthenium weed. In Jabalpur of Madhya Pradesh state, many such people were interviewed by the author and a few of them are now known to have died due to their parthenium weed allergies (Figure 4). Parthenium weed is not palatable to livestock due to its irritating odor, taste and presence of trichome hairs. However hungry cattle will eat the weed, but this will cause clinical signs such as those of salivation, anorexia, pruritus, alopecia and dermatitis. Gastro-intestinal irritation may result in diarrhea. In cattle, due to parthenium weed contact, there may be some loss of hair and a marked depigmentation of the skin. Milk yield is reduced when hungry cows eat the parthenium weed in pastures.

Figure 3: A person severely affected by parthenium weed.



Figure 4. The man in picture has died due to parthenium weed allergy.



Current parthenium weed management options in India

Ever since the weed became a menace, efforts have been being made to manage the weed by different methods. However, so far, no single method has been proven satisfactory as each method alone suffers from one or more limitations such as impracticability, temporary relief, environmental safety high cost, etc.

Mechanical and manual methods: This is one of the most common methods for management among the rural population of India. Farmers manage parthenium weed within their crop field by uprooting or hoeing the plants out. However, they don't care to manage the parthenium weed along the adjoining road side, wasteland or fallow land which soon causes re-infestation of the weed into their fields (Figure 5). It is hard to get labour solely for parthenium weed uprooting as labours fear the ill effects caused by this plant.

Chemical management: Chemical control of parthenium weed in India is gaining popularity. In wasteland and community land, glyphosate, 2,4-D and metribuzin are commonly used by representatives of villages and municipalities. The use of herbicides in different crop situations is low but farmer's use 2,4-D and metribuzin frequently in wheat and sugarcane crops to manage parthenium weed. Increasing enquiries by farmers who wish to manage parthenium weed in different crop situation is an indicator of an increasing interest in the use of the chemical approach in crop situations due to lower availability of labour and the high cost wages.

Figure 5: Unmanged parthenium weed near a managed crop land is the cause of crop reinfestation.



Biological management: Although parthenium weed in India is attacked by many indigenous viruses, fungi and insects in nature, very few of the indigenous natural enemies have emerged as suitable bioagents to manage parthenium weed. From many parts of India, a good number of pathogens have been reported to cause disease symptoms but so far none, or their products as mycoherbicides, have been commercialized. There is a vast potential for this approach in India. Likewise, the occurrence of parthenium weed phyllody is widespread in many parts of India but efforts have not yet been able to develop an effective host specific microorganism to initiate phyllody in this weed. Some of the important disease-causing fungi reported on parthenium weed are *Alternaria alternata*, *A. dianthi*, *A. macrosporus*, *Colletotrichum gleosporioides*, *C. capsici*, *Rhizoctonia solani*, *Fusarium oxysporum*, *F. nioniliforme*, *Oidium parthenii*, *Myrothecium roridum*, *Phoma herbamm*, *Sclerotium rolfsii* and *Sclerotinia sclerotiorum*.

Hundreds of insect species have been reported to feed on parthenium weed in India but none have emerged as potential bio-agents. Many insect species use parthenium weed as an alternate host and thereby cause severe problems to certain crops. In the Punjab and Haryana, parthenium weed has emerged as one of the most favorable alternate hosts for a mealy bug. In nature, widespread damage on parthenium weed was noticed by the stem boring cerembycids identified as *Nupserha* spp. After attack the parthenium weed stem becomes weak due to the insects feeding which causes a breaking of stem bearing flowers, thus helping to reduce seed set.

Biological control by the exotic insect *Zygogramma bicolorata*, imported from Mexico is becoming a popular management approach in India after reports of the successful establishment and subsequent widespread attack on this weed by this bioagent in

many states of India. Rigorous efforts have been made by the author during the past 10 years to distribute *Zygogramma bicolorata* beetles by post to different regions of India. This spreading of the agent has been to almost all of the states and has involved all 24 of the All India Coordinating Research on Weed Control Centre's, about 500 Krish Vigyan Kendra (Agricultural Science Center) Centre's located in main districts of India, many schools, municipalities and individuals. This approach has yielded good establishment and management of parthenium weed in many different climatic conditions of India.

At present, *Z. bicolorata* has established well in many parts of Delhi, the Punjab, Haryana, Uttar Pradesh, Himachal Pradesh, Uttarakhand, Madhya Pradesh, Bihar, Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal etc. Seeing the visible impact of biological control by this bio-agent, has now stimulated many government agencies to come forward and to re-release the bio-agent in more parthenium weed infested areas. The increasing interest of policy makers in biological control may be categorized as an indicator of success of biological control, particularly of *Z. bicolorata*,

Upon the request of the Agricultural Department of Nagpur district of Maharashtra, the author has released about 7 million adult beetles during the 2009 to 2011 seasons in the Nagpur region. This particular effort has yielded the establishment of the bio-agent in a large agriculture area infested with the parthenium weed. The success of the bio-agent has further awakened the interest of policy makers in biological control. The authorities of Van Vihar National Park, Bhopal, Madhya Pradesh has also approached the Directorate of Weed Science (DWSR) to release *Z. bicolorata* in the rainy season of 2012 for biological control of parthenium weed in the park where the lack of palatable grasses is threatening the survival of important herbivores.

The use of botanicals (suppressive plants) is also gaining importance in India for the biological control of parthenium weed in wasteland and along the roadside. Under a coordinating program undertaken on a large scale (sponsored by department of Biotechnology), many competitive plants have identified from India that can work in a wide range of climatic conditions. Among these botanicals *Cassia sericea* (= *C. uniflora*) and *Cassia tora* have wide adaptability for the different climatic conditions of India. After assessing the usefulness of botanicals, *Cassia tora* has been recommended to be grown to replace parthenium weed on wasteland, community land and from roadsides (Figure 6). In Jabalpur, Madhya Pradesh, suppression of parthenium weed growth by marigold has also shown encouraging results and this practice was also

advocated for parthenium suppression in residential areas, on big protected farms and in industrial areas.

Figure 6: On a road side (a) parthenium weed has been replaced by *Cassia tora* after its deliberate broadcasting of the seeds (b)



Management by utilization: Keeping in view that large scale utilization of parthenium weed may also be one of the effective methods to manage the weed, efforts have been made to utilize it. Parthenium weed extracts have been well documented for their insecticidal, nematocidal and herbicidal properties by many researchers. In addition, its textural characteristics of having long fibers which make it good for paper and particle board making. However, there are no reports of these characteristic properties being used and any utilization taking place. For example, paper and particle board can be made from mature plants, which have high fiber content, but keeping parthenium weed up to the maturity stage will add millions of seeds to the soil. The most practical use of parthenium weed in India so far has been through the production of compost and in vermicomposting along with other weeds. This method is being rapidly adopted by the farmers due to its simplicity (Figure 7).

Figure 7: Farmers using Parthenium for compost making



Management through awareness programs: It has been realized that parthenium weed cannot be managed by any single method alone. It also cannot be managed by farmers in their field if it is not also

managed in the surrounding land and wastelands. It can be managed effectively only by adopting integrated approaches involving people participation. In a nut shell, for effective parthenium weed management in a given geographical area, a serious effort must be made. To make the people of India aware of the parthenium weed menace the DWSR is undertaking a rigorous publicity campaign to make people aware and a “Parthenium Awareness Week” is now held every year since 2004, involving the 24 All India Coordinating Program on Weed Control Centres located in each state, as well as all the State Agricultural Universities, the 500 Krishi Vigyan Kendra Agriculture Science Centres located in almost all districts of India, many other institutes, NGOs, and schools etc. The DWSR has developed and distributed extension material, a video documentary and exhibition material to different stake holders with an appeal to observe some activity as they deem fit in that week. Many activities like live demonstrations, student rallies, uprooting programs, photo exhibitions, sowing botanicals, releasing bio-agents etc. are all undertaken throughout India during this week (Figure 8). This has attracted print and electronic media coverage of the events to help spread the awareness program to the masses (Figure 9)

Figure 8: Uprooting of parthenium weed through people participation



Figure 9: A student really shouting anti-parthenium weed slogans.



Figure 10: Mass media coverage in different statutes in the local languages of India diffusing the awareness of parthenium weed.



Original source of information:

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Parthenium weed in Chitwan National Park, Nepal

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Chitwan National Park of Nepal, a World Natural Heritage Site and a habitat of an endangered one-horned rhino has been facing the problem of multiple invasive plant species (Figure 11). *Chromolaena odorata* (locally called 'Banmara') and *Lantana camara* have been present in the Park for some time and in the last 10-25 years, *Mikania micrantha* (locally called 'Lahare Banmasa') has been rapidly expanding in grasslands, spring sides and forest fringes which are the key habitats of the rhino. The negative impact of *Mikania* on forage supply to and roaming behavior of the rhino has already been noticed. The next emerging threat of alien invasion to Chitwan National Park is parthenium weed. Mostly confined to urban and peri-urban areas of Nepal until a few years ago, parthenium weed is now expanding to natural habitats including national parks. A few years back, parthenium weed was confined to the Park's buffer zone areas at Sauraha, the main tourist destination popular for the sightseeing of wild life during elephant rides.

Figure 11: An endangered one-horned rhino in Chitwan National Park



Currently small to large patches of parthenium weed can be found inside the Park area along the elephant ride routes, vehicle tracks and trails, including the grasslands with short grasses (Figure 12). The area around the Elephant Breeding Centre, which lies in the buffer zone, is the most heavily infested site. Inside the park the abundance of parthenium weed is not yet at a damaging level (at least in the northern side of the park where I visited twice in 2011), but it appears to be expanding rapidly with possible adverse impact in near future to forage supply for herbivores.

Mapping the occurrence of parthenium weed in the entire Park area is, however, still to be done. Conservation officials at Biodiversity Conservation Center of National Trust for Nature Conservation (NTNC), a major stakeholder responsible for research and management within the Park, have noticed the arrival of parthenium weed inside the Park but are not yet well informed upon its possible negative impacts.

Figure 12: Luxurious growth of parthenium weed (white flowering) between the elephant shed and forest.



Figure 13: Distribution of copies of parthenium weed ID kit among remote communities in Nepal.



Figure 14: Author standing alongside a parthenium weed roadside infestation.



The Center has mapped the distribution of *Mikania* twice but has not considered parthenium weed yet in this mapping approach, and also has no immediate management plan to tackle this noxious weed. Fortunately, a leaf feeding beetle *Zygogramma bicolorata* has already reached to buffer zone area

(observed at Elephant Breeding Center in July 2011) but the population of beetles is still not large enough to cause massive defoliation of parthenium weed.

In December 3-9, 2011 Professor Steve Adkins visited the Tribuvan University, Kathmandu, Nepal and presented a seminar on invasive weeds with a focus on parthenium weed. Following a series of field visits and meetings, it was decided that an appropriate research strategy should be developed to study this weed in more detail, and an awareness and prevention campaign be developed within country to help combat this weed in the early years of its invasion.

Parthenium weed: An update from Khyber Pakhtunkhwa Province, Pakistan

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Parthenium weed is thought to have been introduced into the Khyber Pakhtunkhwa (KPK) Province from Islamabad, mainly through heavy public and goods vehicles, however, the exact means of its introduction into KPK is not yet known. Parthenium weed is mainly infesting the road sides in the various districts but also some of their cropping areas. There is a good chance that the weed will become a major problem in the cropping areas (particularly in the summer crops) in the near future as the weed is already displacing the roadside native vegetation efficiently and has started encroachment into the fields and scattered pastoral areas due to its strong suppressive and allelopathic nature.

Figure 15: Patchy infestations of parthenium weed in rice field along G.T road in district Bannu, KPK Province.



Recently the weed has been found to be present in three new districts (Chitral, Hango, Swat) of the KPK Province and one tribal territory (Frontier Regions of Bannu) with patchy, as well as denser, infestations. It is believed that the weed may have spread into these areas carried by the movement of military vehicles. However, there could be other methods of spread into these areas. Although, the weed has not been surveyed and reported from the Federally Administered Tribal Area (FATA) areas of North and South Waziristan, Khyber Agency, Bajawar Agency and Mohmand Agency, it is highly likely to be present in these areas due to the past and ongoing military activities in these regions. It is likely to have been introduced into Afghanistan from Pakistan through the Indus Highway with the transportation of fuel, food and equipment by NATO and American but no written proof is yet available.

Figure 16: Densely infested fodder cane (*Saccharum spontaneum* L.) a native perennial pasture along roadsides with parthenium weed in district Karak, KPK Province.



Karak, a district nearly 130 km south of Peshawar is heavily infested with parthenium weed (especially on the roadsides) and has been so for several years after its initial introduction of the weed into KPK Province. This district is divided into plain and hilly cropping areas. The plain cropping area grows crops such as wheat, chickpea, maize, sorghum etc. while the hilly area grows ground nuts and sorghum etc. The hilly area also has native pastures for livestock production (see Figure13 as an example). This year good summer rainfall helped germinate dense populations of parthenium weed along the roadsides and also in the unmanaged patchy native pastoral lands. This year for the first time, large populations of the leaf feeding beetle (*Zygogramma bicolorata*) were noticed feeding on the weed on the roadside. In some areas, the parthenium weed plants were completely defoliated by the beetle, however, no beetles were found in the

neighboring districts of Kohat and Bannu. This may have been due to Karak's climatic conditions which may not be suitable for the growth of *Zygogramma*. In the coming years it may be predicted that *Zygogramma* will spread from Karak into the adjacent districts, if the climatic conditions suit.

Parthenium weed problem in Bangladesh: A report on a visit of a weed expert

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Dr Steve Adkins, a Professor from the University of Queensland, Australia visited Bangladesh at the invitation of the Regional Agricultural Research Station (RARS), Jessore to discuss the emerging issue of parthenium weed. A team of scientists along with Dr Adkins visited a number of parthenium weed infested crops including potato, pea, bottle gourd, mustard and onion in the Jessore-Benapol area. After that, a visit was made to the Regional Wheat Research Centre (RWRC), Shyampur, Rajshahi, where the team also visited other weed problems such as Mikania vine infests crops of banana, beans etc. near Rajshahi

Figure 17 An awareness field workshop with farmers.



An awareness field workshop was organized and about 80 farmers from Krishi Pathagar, Kaligram, Maunda, Noagaon participated. Prof Adkins briefed them about the harmful effects of parthenium weed on human health as well as livestock and crops. Some journalists caught the key points and published those in the daily newspaper.

Dr Adkins delivered a lecture in a seminar held at Bangladesh Agricultural Research Council (BARC), Dhaka on parthenium weed where policy staff of the agricultural sector was present as were many senior agricultural scientists. This seminar was organized by Weed Science Society, Bangladesh (WSSB).

Figure 18: The parthenium weed seminar at BARC, Dhaka.



Overall the visit of Prof Adkins and his seminar presentation made the weed scientists and other related researchers, all realized the problem that parthenium weed poses upon crop production. Executive Chairman, BARC and President of WSSB along with all researchers paid heartiest thanks to Prof Steve Adkins for bringing this issue in front of the policy makers. All agreed that a research program needs to be formulated in the near future to help safeguard crop and human health along with that of livestock.

Parthenium weed in Bhutan

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Bhutan is situated on the southern slopes of the eastern Himalayas, locked between China to the north and India to the south and comprising a land area of 38,394 km². Bhutan has one of the most rugged mountain terrains in the world with elevations ranging from 160 m along its southern border to its highest peak of Kulha Gangri at 7,554 m above sea level (asl) along its northern border with Tibet. Bhutan has a very rich biodiversity with diverse ecosystems including many endemic and rare species. It is a region recognized as one of the 10 global biodiversity hotspots. The national environmental policy is to

maintain 60% forest cover for all time to come to ensure preservation of its rich biodiversity.

Although there is presently no scientific assessment of invasive alien plant species and their impacts within the country, some environmental and socio-economic impacts of invasive species are already being felt to some degree. For example, Bhutanese rice farmers are losing crops to the water weed *Potamogeton distinctus* and the terrestrial weeds like *Lantana camera*, *Parthenium hysterophorus*, and *Mikania micrantha* are invading the Bhutanese landscape, reducing biodiversity and primary production, just as they have done so in other parts of the world (NBC, 2009).

Figure 19: Roadsides growth of parthenium weed in Bhutan.



Parthenium hysterophorus L. is more commonly found between 200 to 1700 m asl, but more recently has been found at 2600 m asl (Adkins personal observation), an altitudinal upper limit similar to that seen in other countries such as Ethiopia and India. In Bhutan it is a dry land weed mainly below 1700 m asl (Districts of Punakha, Mongar, Trashigang, Wangdue and Trongsa). The present view is that it was introduced from Central America, via. India to Bhutan and has been present for at least 20 years when it was first identified as a weed of roadsides and waste places (Parker, 1992). It is now found growing profusely in open spaces near roadsides, on wasteland and also sometimes in cultivated land. In a BSc study (Tshering, 2011) visual observations on the presence of this weed were made from Sarpang (250 m asl) to Punakha (1400 m asl) within the Tsirang and Wangdue Districts. Between Sarpang and Tsirang, parthenium weed was absent, but road-side patches appeared between Tsirang and Wangdue, especially near settlements and road maintenance camps.

As yet only one national newspaper report has mentioned the weeds impacts upon human health. Bishal in the Kuensel newspaper reported parthenium weed to be causing sneezing and rash formation in students and teachers at the Gyalposhing High School in Mongar District. Until now these kinds of negative impacts of parthenium weed remain unreported. In December 9-15, 2011 Professor Steve Adkins visited the National Plant Protection Centre, Thimphu, Bhutan and presented a seminar on invasive weeds with a focus on parthenium weed. Following a series of field visits and meetings, it was decided that an appropriate research strategy should be developed to study this weed in Bhutan, and an awareness and prevention campaign be developed within country to help combat this weed in the early years of its invasion.

Figure 20: Prof Steve Adkins with Bhutan's invasive weed expert Mr Karma Chophyll.



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Parthenium weed eradication on the Chief Minister's agenda

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The spread of the invasive alien weed *Parthenium hysterophous* in the southern state of Tamil Nadu in India has attracted discussion in the state legislative assembly. Answering a question by one of the members in the assembly, the Honourable Chief Minister Dr. J. Jayalalitha said that the invasive spread of the weed in the state will be controlled through a state wide mass awareness and eradication campaign. Taking the cue from the chief of the state, the Honourable Minister for Agriculture K.A. Sengottian directed the Government Department of Agriculture to join hands with Universities, NGOs, farmers and common public in organising such campaigns throughout the state during the second half of August 2011.

Figure 21: Honourable minister Mrs.Selvi Ramajayam addressing the gathering.



Dr. RM. Kathiresan, Professor and Head of the Department of Agronomy, Annamalai University and Principal Investigator of the National Agricultural Innovation Project organized a state wide campaign with the participation of Vice-Chancellor Dr. M.

Ramanathan, Honourable State Ministers Mr. M.C. Sampath and Mrs. Selvi Ramajayam, Members of Legislative Assembly Mr. K. Balakrishnan and Mr. N. Murugumaran, Collector of Cuddalore District Mrs. Amuthavalli, IAS and Joint Director of Agriculture Mr. Elangovan on 28th August 2011.

Figure 22. Parthenium weed control through public participation in the state.



This program included manual removal, spraying of herbicides and release of insect bio-control agent *Zygogramma bicolorata* in the suburbs of Chidambaram town by all the dignitaries and a formal function marking the inauguration of the state wide campaign where in the dignitaries released brochures, distributed herbicides and insect bio-control agents for managing parthenium weed to participants including NGOS like Dhan Foundation, Farmers, Student Volunteers of National Service Scheme from the University and Common Public.

A report on the International Parthenium Weed Workshop, September 27, 2011, Cairns Australia.

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An International Parthenium Weed Workshop was held at the Sebel Hotel Cairns, Australia on the evening of the 27th September 2011 during the 23rd Asian Pacific Weed Science Society (APWSS) Conference held from 25-30th September 2011. The workshop theme was 'Towards Better International Collaboration' (Figure 17). The workshop was part of the activities of the International Parthenium Weed Network (IPaWN) and included brief country reports from most countries in

the Asian-Pacific region that have parthenium weed and discussed a number of emerging parthenium weed issues. The workshop also aimed to develop opportunities for international research collaboration. More than 50 delegates from 15 countries participated in the workshop. There were a total of nine country reports presented on matters to do with parthenium weed and its management in the different regions of the world.

Dr Steve Adkins, Chair, IPaWN, started off proceedings with a brief presentation summarizing what we know about the present distribution of parthenium weed around the globe highlighting the modes and speed of its spread, the kinds of habitats that are becoming infested, the impacts it is having upon crop and pasture production, and upon human and animal health. The presentation outlined the creation of IPaWN in 2009 and international coordination activities that have taken place in the past two years. The presentation concluded with a summary of the research collaborations that are presently underway around the globe and an open invitation to others to join into the future activities.

Figure 23: The workshop theme displayed at the venue.



Mr Asad Shabbir, Network Coordinator of IPaWN gave a presentation on the objectives, past activities and future plans of IPaWN. He reported that since its initiation in 2009, IPaWN has been a rapidly expanding network facilitating the exchange of information about parthenium weed and its management. The network was also working towards linking all regional working groups, institutions and other stakeholders with an interest in parthenium weed and its management into a common discussion group. To date there are about 200 members from more than 30 countries. He also reported that IPaWN produces a 6-monthly International Newsletter and other useful publications which are posted online to all network members.

Dr Yupeng Geng, Associate Professor in Plant Ecology at the Yunnan University, China gave a brief overview of the parthenium weed problem in China. He outlined the ongoing research work on the molecular ecology of different populations of parthenium weed in China and around the globe. Dr Geng also discussed his collaboration with Australian scientists working at CSIRO and invited other people to join in this collaborative effort.

Dr R. M. Kaithresan, Professor and Head of the Department of Agronomy, Annamalai University, India gave a brief country report on the parthenium weed problem in the Indian subcontinent. He pointed out that further spread of the weed in the India may be reduced, through a national awareness and eradication campaign. He also discussed the increasing human and animal health problems that are occurring in India and a need for a coordinated effort to tackle this problem.

Mr Henry Sweddy, in his country report pointed out that parthenium weed was a recent introduction to Tanzania, and unfortunately in a very short time was already threatening the countries natural communities and the wildlife within. He warned that weed has become a threat to the Serengeti ecosystem which is home to a wide range of iconic African plants and animals. Mr Sweddy pointed out that parthenium weed is already threatening human health in the town of Arusha and its soundings, and a joint effort is now needed to create awareness about the health issues related to this weed. People in Tanzania are using this weed as 'filler' within floral bouquets which is now an important mode for its spread to new areas and this should be discouraged.

Dr Buddhi Marambi, Professor of Weed Science within the Faculty of Agriculture, at the University of Peradeniya, Sri Lanka gave a detailed report on the location of the parthenium weed infestations in his country and their effects upon the agriculture, forestry and horticulture of the country, as well as its effects upon human and animal health. He showed in his presentation various sign boards inscribed in the local language describing the problems of parthenium weed.

Dr Israil Hossain, Principal Scientist at the Bangladesh Agricultural Research Institute spoke about the recent introduction of parthenium weed, presumably from India and its present day threat to agricultural crop production, with special reference to rice. Dr Hossain supported the view that international collaborative efforts are needed to manage parthenium weed and Bangladesh was keen to play a part in this.

Dr Gul Hassan, Professor of Weed Science at KPK Agricultural University, Peshawar, gave a detailed report on the presence of parthenium weed in Pakistan

with special reference to the North West region of the country. Dr Hassan described an international linkage project he co-chaired looking at parthenium weed management. This project involving three institutes, KPK Agricultural University, Peshawar, University of the Punjab, Lahore and the University of Queensland Brisbane, Australia. Dr Hassan pointed out the benefits of undertaking cross Institutional and cross-country collaboration on the weed.

Figure 24: Participants at the International Parthenium Weed Workshop.



Dr Sangita Shrestha, from Nepal Academy of Sciences gave a country report on parthenium weed problem in Nepal. Dr Shrestha highlighted the various issues related to parthenium weed in Nepal. She highlighted the human health problems and devastating effect of the weed on native plant communities especially the medicinal plants of Nepal. Dr Shrestha finally mentioned joint proposals on parthenium weed management involving Nepalese research institutes with the University of Queensland, Australia.

Ms. Annastasia Kawi a research scientist from Papua New Guinea (PNG) narrated a success story of parthenium weed eradication from PNG. The first incursion of parthenium weed was recorded in Lae, Morobe Province of Papua New Guinea (PNG) in 2001. An eradication program for parthenium weed was initiated and funded by the South Pacific Commission (SPC)'s Plant Protection Service and implemented by NAQIA and the National Agricultural Research Institute personnel based in Lae. The parthenium weed eradication program lasted for 5 years with the regular spraying of paraquat and glyphosate at the affected sites. A recent quarantine survey in November 2009 indicated that no parthenium weed was sighted at the same sites or elsewhere in Lae and it is officially declared that the weed has been eradicated from PNG.

Dr Tohru Tominaga, from the graduate school of agriculture, Kyoto University, Japan gave brief report on parthenium weed in Japan. In Japan, the invasion of

parthenium weed is restricted to the Okinawa Islands, located in the most southern parts of Japan, 26 to 27N, 127 30 to 128 30E. It is distributed mainly in road sides and waste lands, but there are no reports on the population size and its rate of spread. It is annual and/or biennial, flowers in summer to autumn and causes pollen allergy. Parthenium weed was firstly found in Okinawa c. 1972 (Tachikake and Nakamura, 2007). Recent global warming is likely to result in range expansion of the weed to other parts of Japan.

Dr Thi Lan Thi Nguyen from Department of Ecology and Evolution Biology University of Sciences Vietnam presented a country report on Vietnam. In Vietnam, parthenium weed has been present in the Hanoi and surrounding regions from about 1922. Infestations of parthenium weed are present along roadsides, in fallow land, from the north to the south of Vietnam. The weed is present in around the capital city, Hanoi, and in several protected areas (including Ba Be, Cat Ba, Xuan Son, Tam Dao, Cuc Phuong National Parks and Huong Son Protection Forest) in the north of Vietnam. A recent survey revealed that parthenium weed was present in many provinces in the north such as Cao Bang, Bac Kan, Son La, Thai Nguyen, Phu Tho, Vinh Phuc, Bac Ninh, Hanoi Capital, Hung Yen, Hai Duong, Hai Phong, Ha Nam, Nam Dinh, Hoa Binh and Ninh Binh. No parthenium weed was present from Ho Chi Minh City to the Mekong Delta, the most southerly region of Vietnam. However, parthenium weed was possible present at the rest of the North and the Central region of Vietnam.

Workshop recommendations: At the conclusion of the individual country reports, a discussion took place involving all the participants of the workshop. The following items were those that generated the greatest discussion and in some cases, led to recommendations being made. The need for International Collaboration was seen as being critical for a better understanding and management of the weed.

1. Evaluation of the economic losses incurred due to the weed is seen as being important to help convince donor agencies at local and international scale of the weeds importance.
2. Other countries which have recently been invaded by the weed should benefit from countries like Australian and India who have had experience in the management of this weed for more than 50 years. Special reference was made to, with special reference to the biological control program in Australia.
3. The need to educate the public about the health problems caused by the weed, caused by both physical contact and indirect contact through airborne matter. Countries should discourage the weed's usage in floral.
4. There is a need to identify locally adapted, high value, suppressive plants for the suppression of the growth of parthenium weed.

5. Encourage more people to join the IPaWN, contribute to the Newsletter and to develop a website
6. Use social media, such as Facebook and You Tube to promote the awareness and to disseminate information on parthenium weed.

Upcoming Conferences on Weed Science and Invasive Species

25th German Conference on Weed Biology and Weed Control

Dates: 12-15th March 2012
Venue: Braunschweig, Germany
Website: www.unkrauttagung.de

2nd International Ragweed Conference

Dates: 28-29th March 2012
Venue: Lyon, France
Website: <http://www.internationalragweedsociety.org>

Biennial Conference of Indian Society of Weed Science

Dates: 19-20th April, 2012
Venue: Thrissur Kerala, India
Website: <http://www.isws.in/downloads.php>

64th International Symposium on Crop Protection

Dates: 26th May 2012
Venue: Ghent, Belgium
Website: <http://www.iscp.ugent.be>

The VITH International Weed Science Congress

Dates: 17-22nd June 2012
Venue: Hangzhou, China
Website: http://www.iwss.info/Vith_congress.asp

18th Australasian Weeds Conference (18AWC)

Dates: 8-11th October 2012,
Venue: Melbourne, Australia
Website: <http://www.18awc.com/>

Recent Publications

Seemal, V., & Khan, A. U. (2011). Comparative studies on the competitive abilities of an exotic, *Parthenium hysterophorus* L., with co-existing species to determine the impacts of its invasion. *Pakistan Journal of Botany*, 43(5), 2365-2372.

Li, Z., Zhang, L., Che, H., Liu, H., Chi, M., Luo, D., Wu, Y. (2011). A disease associated with phytoplasma in *Parthenium hysterophorus*. *Phytoparasitica*, 39(4), 407-410.

Strathie, L. W., McConnachie, A. J., & Retief, E. (2011). Initiation of biological control against *Parthenium hysterophorus* L. (Asteraceae) in South Africa. *African Entomology*, 19(2), 378-392

Chamle, D. R., Dhale, D. A., & Mogle, U. P. (2011). Effect of Parthenium weed manures on rhizosphere mycoflora of maize. *Current Botany*, 2(4), 31-33.