INTERNATIONAL PARTHENIUM NEWS

Number 1, January 2010

International Parthenium Weed Network (IPaWN) launched !!!

The International Parthenium Weed Network (IPaWN) was recently launched following an overwhelmingly positive response to a circulation about the value of setting up such a group. This network will be devoted to creating awareness about the parthenium weed threat, and to sharing information on how to reduce its adverse impacts and how best to manage it. The Network already has over 100 members from 26 countries.

IPaWN is an initiative of the Tropical and Sub-tropical Weed Research Unit (TSWRU), at The University of Queensland, Australia. With research involvement in three continents, TSWRU has started to develop information packages on parthenium weed and send it out to more than 20 countries that have, or are at threat of getting, this menace.

Mission: IPaWN's mission is to coordinate and disseminate information regarding the global invasion of parthenium weed, its management, and its diverse impacts on agro-ecosystems, the environment and human and animal health.

Goal: The creation of an online community to support international collaboration on the parthenium weed problem and its management.

Objectives:

- To facilitate the exchange of information about parthenium weed and its management.
- To link different regional working groups, institutions and other stakeholders with an interest in parthenium weed and its management.
- To document new out-breaks of the weed and to recommend strategies to reduce further spared in those regions.
- To identify topics deserving of new research and to provide access to on-line resources such as identification kits, best practice documents, etc.

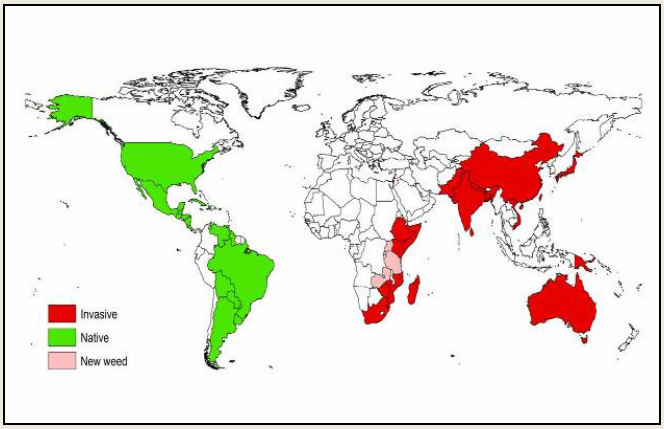
Meetings: IPaWN meetings are likely to be timetabled to coincide with major international conferences such as the International Weed Science Congress, the Asian-Pacific Weed Science Conference and the International Parthenium Weed Management Conference.

International e-newsletter: It was decided that the Australian Parthenium Weed Research Group and the Pakistan Parthenium Action Research Group would produce a joint electronic newsletter entitled 'International Parthenium News'. Hence this is the first issue of International Parthenium News.

Worldwide Distribution of Parthenium Weed

Parthenium weed has now invaded more than 20 countries around the globe (Figure 1), including five continents and numerous islands. Recent developments have indicated that African countries are at high risk of invasion. Parthenium weed is now also present in eight provinces of China and spreading at an alarming rate. The areas that are now most under threat are south east Asia, the Pacific and western Africa.

Figure 1. Known worldwide distribution of parthenium weed by country, as at November 2009.



(Map developed by Mr Asad Shabbir)

Research Highlights: Australia

This Australian project on sustainable management of invasive weeds has a focus on parthenium weed and consists of four components:

1) *Reproductive biology and seed dispersal –* to learn more about the invasive potential of parthenium weed by researching long distance seed dispersal by vehicles, water and animals, and by monitoring its impact upon native pasture communities.

2) *Competitive displacement –* to use competitive plants to displace the weed and to provide a more sustainable method of parthenium weed management in areas where the weed is well established and biological control agents are already present.

3) *Improved biological control –* to use competitive plants with biological control agents to obtain long term parthenium weed management.

4) *Reducing viable weed seed spread –* to detail the efficacy of various methods of removal of weed seeds from vehicles, including wash down facilities and to examine methods to kill seeds that get onto equipment.

This project involves one senior research scientist, Dr Chris O'Donnell, who has considerable experience working with parthenium weed and other invasive weeds, and four postgraduate students:

- **Ms Thi Nguyen** (writing her thesis on the reproductive biology of parthenium weed and its effect on native plant community biodiversity)
- **Mr Naeem Khan** (writing his thesis on the use competitive plants to provide a more sustainable method for parthenium weed management)
- **Mr Asad Shabbir** (writing his thesis on complementing additional strategies with the biological control to improve the management of parthenium weed)
- **Mr Ikramullah Khan** (writing his thesis on reducing viable weed seed spread)

The advisors to these student projects include Drs Steve Adkins, Chris O'Donnell, Sheldon Navie, and Doug George from the University of Queensland and Dr Dhileepan from the Queensland Department of Employment, Economic Development and Innovation. The new members just joined the team include Clementine Dufot (France), Amalia Belgeri-Garcia (Uruguay), Zahid Hanif (Pakistan), Nehemia Mahase (Lesoto) and An Do (Veitnam)

1) Reproductive biology and seed dispersal

Seed production was studied under two temperature regimes and two soil moisture levels. It was found that Warm/Wet conditions produced the highest number of seed, while the Cool/Wet conditions produced the lowest number of seed. A proportion of the seed produced was empty (i.e. unfilled) and some of the seed were also dormant.

Seed Dispersal – The spread of weed seed (including parthenium weed seed) was investigated by studying seedling germination from soil removed from vehicles at several wash down facilities. Results showed that large quantities of seed are removed from vehicles at all wash down facilities and this occurs in all seasons of the year. Monocot seeds out-numbered dicot seeds, with parthenium weed seed representing about 2% of the total.

Soil Seed Banks – The species composition and dynamics of the soil seed bank was studied at two sites (Moolayember Creek and Clermont), over two seasons (autumn and spring), and will continue for the next 2 years. This is part of a long-term study first set up in 1996. Samples collected from Moolayember Creek and Clermont in autumn 2008 confirmed that very large parthenium weed seed banks are still to be found at both sites even though biological control agents are to be found at the sites..

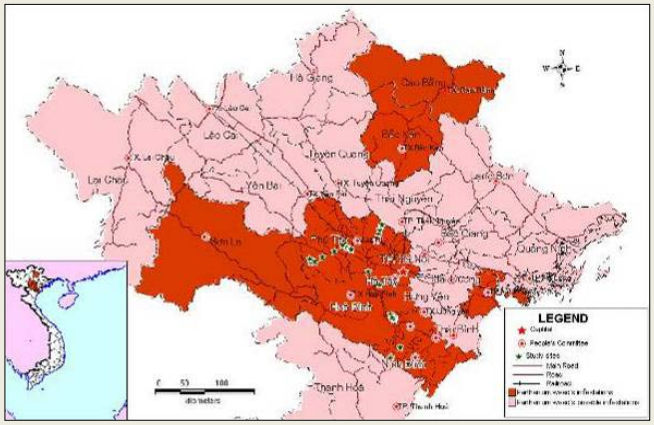
Community Biodiversity – The impact of parthenium weed upon species biodiversity and composition, both within the above-ground vegetation and in the soil seed bank, were assessed at a pastoral site in Kilcoy (Figure 2). This site has been infested with parthenium weed for more than 10 years. The study has shown that plant diversity (i.e. Shannon's index) is reduced even when parthenium weed is present at low levels (2 plants/m^2).

Figure 2. Collecting soil seed bank samples in the field at Kilcoy, south-eastern Queensland.

***International Linkages: Vietnam* –** As part of the International linkages program, a field trip was undertaken to Vietnam in October 2008. The aims of the trip were to visit sites where parthenium weed was known to be present, to discover new areas where the weed has spread to, to talk to people and gain information about its rate of spread and impact upon agriculture and the environment, to undertake preliminary assessment of the reproductive biology of the plant in Vietnam, and to draw some conclusions as to its relationship to the biotype found in Australia.

The results so far show that the genotype of parthenium weed found throughout Vietnam is similar, but has differences to parthenium weed populations found in Australia. The mapping activity has shown parthenium weed to be quite widespread in the north of the country, from where it may have been first introduced (Figure 3).

Figure 3: Distribution of parthenium weed in Vietnam, as determined by mapping and a literature search.



2) Competitive displacement

This project aims to: 1) screen 20 beneficial competitive plants in the glasshouse for their ability to displace parthenium weed and then select a number of these for further testing under field conditions; and to 2) predict the performance of the competitive plants under climate change scenarios.

***Glasshouse Screens* –** Twenty plant species have been tested in the glasshouse for their competitive ability against parthenium weed. Twelve plant species were found to have a low competitive ability, while eight plant species were more competitive.

***Injune Field Trial* –** Seven species selected from the glasshouse studies were tested at Injune to investigate their competitive ability against parthenium weed in the field. Out of the seven test species, five (three introduced and two native) were found to be competitive against parthenium weed in the field and two were not.

***Monto Field Trial* –** Seven species selected from the glasshouse studies were also tested at Monto to investigate their competitive ability against parthenium weed in the field. Out of the seven test species, five (three introduced and two native) were found to be competitive against parthenium weed in the field and two not.

***Climate Change Study* –** These trials were undertaken under two CO_2 levels: present atmospheric levels (i.e. 380 ppmv CO_2), and a level predicted for Queensland in 2050 (i.e. 550 ppmv CO_2). So far one plant species (i.e. purple pigeon grass, *Setaria incrassata*) has been tested. The competitive ability of this grass was reduced under the elevated CO_2 concentration. There was also a significant increase in the biomass of parthenium weed plants grown under elevated CO_2. The indications are that parthenium weed will become more of a problem in the future when CO_2 levels increase

3) Improved Biological Control

Early aims for this project were: 1) to understand how it might be possible to promote the efficacy of biological control agents by the planting of competitive plants; and 2) to identify biological control agents that are widespread and effective in Australia and show promise for introduction into Pakistan.

A study was initiated to quantify the combined effect of competitive pasture plants with biological control agents on parthenium weed growth and reproduction (seed production). This study involved two phases: a series of glasshouse experiments undertaken at the Alan Fletcher Research Station (AFRS) in Brisbane and two field trials carried out at Injune and Monto.

***Glasshouse Study* –** An experiment was set up at AFRS in mid October 2008 to quantify the combined effect of a biological control agent (*Zygogramma bicolorata*) with two competitive pasture plants (*Astrebla squarrosa* and *Clitoria ternatea*) on the vegetative and reproductive growth of parthenium weed. An addition series experimental protocol was used so a competitive index could be calculated. It was found that both pasture plants became more competitive in the presence of the biological control agent.

***Monto Field Trial* -** The field trial at Monto aimed to quantify the combined effect of biological control agents (those that were present in the field at that time) with two pasture plants (*Clitoria ternatea* and *Pennisetum ciliare*) on the vegetative growth of parthenium weed. It was noticed that the competitive plants suppressed the growth of parthenium weed, with *Pennisetum ciliare* producing the greatest biomass.

When biological agents were present the growth of parthenium weed was further suppressed, and the biomass of the competitive plants increased.

Injune Field Trial - A similar field trial at Injune aimed to quantify the combined effect of biological control agents with six pasture plants (*Astrebla squarrosa*, *Themeda triandra*, *Setaria incrassata*, *Pennisetum ciliare*, *Stylosanthes scabra* and *Clitoria ternatea*) on the vegetative growth of parthenium weed. Once again, it was evident that the competitive plants suppressed the growth of parthenium weed, especially in the presence of the biological control agents.

4) Reducing Viable Weed Seed Spread

This study aims to 1) assess the effectiveness of vehicle wash down facilities and develop improvements, and to 2) screen innovative methods to kill weed seeds that may be present on field equipment or in sludge removed from wash down facilities.

Seeds on Vehicles – This experiment is examined seed loads found on vehicles after week-long rural field trips. Several vehicles were cleaned, with mud from different parts of the vehicle collected. The samples from each part of the vehicle were broken up and spread onto trays partly filled with sterile soil and then placed in a glasshouse. Following wetting to field capacity, emerging seedlings were identified and counted. Typically > 250 weed seeds were found on vehicles with their location mainly on the underside or around the wheel arches

Efficacy of Hand-held Spray Units – This experiment examined how long it took to clean different kinds of mud from vehicles. In the first study, plates loaded with a black Gatton soil (baked for 4.5 hours at 40°C) were fixed to a utility vehicle and the vehicle washed with a Gerni hand-held spray unit (model 12A - pressure 11500 KPa, 10 L/minute) for either 10, 15 or 20 minutes. The initial findings suggest that >15 minutes is required to remove most mud for a vehicle.

Efficacy of Seed Kill with Heat – In these preliminary experiments, six weed species with seed of differing size and shape have been used. In an early experiment the effect of dry heat on dry, fully and partially imbibed seed of wild oat (*Avena fatua*) and parthenium weed was tested. Studies were also undertaken on seed retained within its fruit layers and on seed coated with mud. All air dry wild oat caryopses were killed by 100°C when the heat was applied for 5 hours. However, partially imbibed (or fully imbibed) seeds were killed by lower temperatures applied for much shorter periods of time. External layers (palea and lemma) did not protect seed from this heat treatment, but mud coated onto partly imbibed seeds did provide some degree of protection from the heat. All air dry parthenium weed seeds were killed by 125°C when the heat was applied for 1 hour or more. However, partially imbibed (or fully imbibed) seeds were killed by lower temperatures applied for shorter periods of time. External fruit layers did not protect parthenium weed seed from this heat treatment, but mud coated onto partly imbibed seeds did provide some degree of protection from the heat.

Research Highlights - Pakistan

A Pakistan-Australia Linkage Project involving three institutes NWFP Agricultural University (AUP), Peshawar, Pakistan' University of the Punjab (PU), Lahore, Pakistan' University of Queensland (UQ), Brisbane, Australia have a project entitled 'Biology, Ecology and Management of Parthenium (*Parthenium hysterophorus* L.): an invasive alien weed threatening agricultural and natural ecosystems in Pakistan'.

1) Sub-Focus 1: Ecological Survey

A study of the level of infestation, rate of spread, phytosociological impact and ecological effects of parthenium weed is being conducted in various districts of the central Punjab, Pakistan. The following is a summary of initial studies that have been carried out in some of these districts.

Figure 4: Visit of Pakistani team to the University of Queensland under the HEC linkage project

Lahore District -: Lahore is the second largest city in Pakistan and is the provincial capital of the Punjab. It has an area of 1,772 km^2 with mean maximum/minimum temperatures of 40.4/27.3°C.
The first phase of the ecological and phytosociological surveys was conducted between July 2008 and June

2009. Twelve localities were selected for the study. Fifty-nine weed species were recorded from 12 study localities. Parthenium weed was found in all localities and was the commonest species present.

Gujranwala District **-** Gujranwala is an important industrial and agricultural district of Pakistan and is famous for the production of basmati rice. It has an area of 3,622 km^2 and an average annual rainfall of 888 mm. Its mean maximum/minimum temperatures are 30.8/17.8°C.

The first phase of the ecological and phytosociological surveys of Gujranwala district were conducted between March 2009 and April 2009. A total of 39 weed species were recorded during sampling. Parthenium weed was found to be the most abundant weed in all four parts of this district (Gujranwala, Noshera Virkan, Wazirabad and Kamonky).

2) Sub-Focus 2: Biological Management

During the phytosociological surveys of the district of Lahore, plants with visible symptoms of disease were collected and brought back to the laboratory for further study. The diseased parts of the plants were inoculated directly onto a 2% MEA growth medium after surface sterilization. Sub-culturing was frequently done to obtain pure cultures of the fungal species present on parthenium weed. Fungal identification was made in collaboration with the Fungal Culture Bank of Pakistan staff. Conidial suspensions of the isolated pathogens were then inoculated onto healthy parthenium plants growing in pots to cross check Koch's postulates. The leaves and flowers of these plants were then cultured onto Petri dishes 3 weeks after inoculation for confirmation of pathogenicity.

The fungal species identified have previously been reported as disease-causing in various scenarios, and are considered opportunistic pathogens. For example, *Alternaria alternata* and *Alternaria pluriseptata* have been reported to cause leaf spot disease in parthenium weed. *Cladosporium cladosporioides*, a pathogen that usually infects wheat, was isolated from parthenium weed flowers that had a charred appearance.

3) Sub-Focus 3: Parthenium Weed Biotypes

During the surveys of the Lahore and Kasur districts of the Punjab province, five morphologically different parthenium weed types were identified. Their morphological characters were recorded, including leaf colour, leaf size and shape, stem colour, shape and thickness, flower (capitula) diameter, the number of disc and ray florets, and seed size and colour. Genomic DNA of thesebiotypes was isolated and visualised using agarose gel electrophoresis. Other genomic DNA samples were subjected to a RAPD analysis. The results showed that biotypes 1 and 3 were genetically close and separated from biotype 2, while biotype 4 and 5 were genetically close and separated from all other biotypes.

Research Highlights – Nepal

Graduate students at Tribhuvan University, Kathmandu have undertaken research into various aspects of parthenium weed biology, including leaf attributes, phenology, and allelopathy. Seed germination and invasion of grassland have also been examined. The team is lead by Dr Bharat Babu Shrestha central Department of Botany, Tribhuvan University.

1) Leaf attributes

Leaf attributes such as stomatal size, frequency, and index, leaf nitrogen content, specific leaf area and leaf dry matter content were all determined. Stomatal frequency and stomatal index were higher on the lower leaf surface than on the upper surface.

2) Allelopathy

The allelopathic effect of aqueous leaf extracts made from of parthenium weed were tested upon the germination, seedling elongation and seedling biomass of eight plants species (*Oryza sativa*, *Zea mays*, *Triticum aestivum*, *Raphanus sativus*, *Brassica campestris*, *Brassica oleracea* var. *botrytis*, *Artemisia dubia* and *Ageratina adenophora*). The cruciferous species (*Raphanus sativus*, *Brassica campestris* and *Brassica oleracea* var. *botrytis*) were the most sensitive species tested to the aqueous leaf extracts of parthenium weed.

3) Phenology

The phenology of parthenium weed was studied in the field. Parthenium weed was the most frequent species at the study site. Germination in the marked plots started in May. The plant was in the vegetative phase of growth for 4 weeks and in the reproductive phase for 12 to 16 weeks. Fruit development and seed maturation occurred within 1 to 2 weeks of flowering. Maximum seed production was observed in August. Flowering and fruiting continued even after the complete senescence of leaves. Whole plant senescence occurred between late September and October. Hence, the plant completed its life cycle within 16 to 18 weeks.

4) Invasion of Central Nepal grasslands

A study was undertaken in the grasslands in the Gorkha, Nuwakot and Kathmandu districts of Nepal to determine any changes in the physicochemical properties of the soil and plant community structure (i.e. species richness, density and important value) caused by parthenium weed invasion. These areas were all in the early stages of parthenium weed invasion (the weed had been present for 5 to 6 years). Plant

species richness was high in invaded plots, probably due to an increase in habitat heterogeneity during the initial stages of invasion. The non-invaded plots in all sites were dominated by the grass *Acrachne racemosa*, which formed a continuous mat and suppressed the growth of other species. Parthenium weed lacks a mat-forming habit, but creates shaded areas which favour the growth of plant species than can grow under a dense canopy at ground level. Many palatable species were negatively affected by parthenium weed invasion. Thus, protection of grazing lands from parthenium invasion is important to ensure a sustainable supply of fodder to livestock.

Research Highlights – Bangladesh

Parthenium weed was first identified in Bangladesh in May 2008 by Professor S.M. Rezaul Karim, from the Department of Agronomy, Bangladesh Agricultural University (BAU), Mymensingh. In June 2008, Prof. Steve Adkins inquired about the existence of any information on parthenium research in Bangladesh. Since then Professor Karim has been searching for information about the outbreak of parthenium weed in Bangladesh.

In a preliminary survey in the Jessore district, in the south-western part of Bangladesh, Professor Karim and Dr. B.L. Nag (Bangladesh Agricultural Research Institute, Jessore) found a heavy infestation of the weed along roadsides near the Indian border. The weed has presumably invaded this area from India and is present on roadsides between Jessore and Khulna (Figure 5).

Figure 5: Parthenium weed infestation in Bangladesh.

1) Raising Awareness in Bangladesh

Professor Karim presented a paper entitled "Parthenium weed (*Parthenium hysterophorus* L.): a threat for Bangladesh" in a seminar on *Impacts of Invasive Weeds* on 29 October 2008 at BAU, Mymensingh. This paper focused on the possible future impacts of the weed on human health, livestock production, pasture management and biodiversity in Bangladesh. Professor. Karim also presented a poster entitled "A New Invader Weed *Parthenium hysterophorus* L.: Threat for Bangladesh" at the *1st National Conference and Seminar of the Weed Science Society of Bangladesh* (WSSB) held on 8 November 2008 at Bangladesh Agricultural Research Council (BARC), in Dhaka.

2) Case Study

In April 2009, Dr. B.L. Nag collected parthenium plants from the field with his bare hands. Following this contact with parthenium weed, Dr. Nag's fingers became swollen and painful for seven days. Reddish lesions were also observed on the palm and fingers. This severe skin reaction was treated using Savlon cream and pain killers.

3) New Research

With this background, Professor Karim recently started studying different aspects of parthenium weed with his research group (Figure 6). Two of his masters students have started their research on the allelopathic effects of the weed, one student on the nutrient exploitation capacity of the weed, one student on the effects of soil type, moisture content and depth of sowing on the growth and development of the weed, and another student on the effects of different herbicides on the control of the weed.

Figure 6: Parthenium weed research group in Bangladesh.

The researchers and research projects are as follows:

***Project No. 1*:** Allelopathic effects of aqueous extracts of parthenium weed on the seed germination and growth of rice, wheat, chickpea and mustard.

Researcher: Mr. Md. Rayhan Forzoa.

Objective: To determine the effects of aqueous extracts of different parts of parthenium weed on seed germination, length of plumule, length of radicle and dry matter weight of rice, wheat, chickpea and mustard seedlings.

Project No. 2: Allelopathic effects of decomposed plant debris of parthenium weed on the seedling emergence and development of rice, maize, jute and sesame.

Researcher: Mr. Omker Biswas.

Objective: To observe the effects of decomposed debris of parthenium plants on percentage of seedling emergence, seedling height and dry matter weight of rice, maize, jute and sesame.

Project No. 3: Nutrient exploitation capacity of parthenium weeds in competition with rice.

Researcher: Mr. Md. Aminul Islam.

Objective: To learn about the uptake of nutrients from soil by parthenium weed in comparison to rice.

Project No. 4: Effect of soil type, moisture content and depth of sowing on the seed germination and development of parthenium weed.

Researcher: Mr. Md. Zahidul Islam.

Objective: To learn the percentage of seedling emergence, plant height, leaf area and dry matter weight of the weed under different soil types, moisture contents and sowing depths.

Project No. 5: Effect of different herbicides on the control of parthenium weed.

Researcher: Mr. Md. Masud Rana.

Objective: To determine the effectiveness of different rates of five herbicides (i.e. 2,4-D, Atrazine, Glyphosate, MCPA and Paraquat) on the control of the weed.

Research Highlights - Germany

A large research team from Germany and Ethiopia (Melanie Wiesner, Taye Tessema, Andreas Hoffmann, Wilfried Pestemer, Carmen Buettner, Inga Mewis, Christian Ulrichs, Thomas Henniger, Martina Bandte, Susanne von Bargen, Ivonne Roth, Armin Blievernicht, Arunava Goswami, Christian Rupschus and Dieter Kirschke) are undertaking a number of studies on parthenium weed.

Research Projects

The team is involved with the following research topics:

1) Impact of the pan-tropical weed *Parthenium hysterophorus* L. on human health in Ethiopia.

2) Studies on transmission of the phyllody of parthenium by *Cuscuta* sp. and different insect-vectors in regard to cultivated plants.

3) Insecticidal effects of *Parthenium hysterophorus* extracts rich in terpenoids and phenolic acids.

4) Economic impacts of invasive weed species in developing countries: the case of parthenium in Ethiopia.

Upcoming Conferences on Weed Science and Invasive Species

22nd Asian Pacific Weed Science Conference.

Date: 8 to 12 March, 2010.
Theme: Judicious Weed Management: Road to Sustainability.
Website: http://www.wssp.org.pk/news.htm.
Venue: G.C. University, Lahore, Pakistan.

17th Australasian Weeds Conference.

Date: 26-30 September, 2010.
Theme: New Frontiers in New Zealand.
Website: http://www.17awc.org.
Venue: Christchurch, New Zealand.

Workshop on Management of Parthenium hysterophorus.

Date: November 3 to 5, 2010.
Venue: Nairobi, Kenya.
Contact: Costas Zachariades
E-mail: zachariadesC@arc.agric.za

International Conference on Challenges to Biodiversity and Environment for Sustainable Development

Date: 12 to 14 March, 2010
Venue: Mysore, India.
Contact: Dr Mahdevappa

IPaWN Discussion Series

A discussion series was launched on International Parthenium Weed Network (IPaWN) in 2009. The objective of this discussion series was to invite views on different matters that may aid our thinking on parthenium weed management. In this series, each month, a question was posted to the network for discussion. The questions were regarding the biology, ecology and management aspects of parthenium weed in diverse natural and agro-ecosystems around the globe. Five discussion questions have been placed to the network so far. The following is a summary of those discussion points and responses fro you

Topic I – The perennial nature of parthenium weed.

This was a discussion about whether parthenium weed acts as an annual or a perennial plant. It was concluded that the weed generally behaves as an annual plant, but in certain conditions it can survive for more than 1 year. But we probably don't know for how long. It was noted that mature plants are generally killed by winter frost, but observations in Australia (Monto and Kilcoy) and Pakistan (Mardan and Lahore) suggest that it can survive in the field for more than 1 year under certain climatic conditions and management practices. Some people believe that the lifespan of the weed could be extended by the action of biological control agents, but others have the totally opposite view saying that biological control reduces its lifespan by weakening the plant. It was suggested that, to ascertain the true lifespan of this plant, a study involving continuous tagging of plants at various locations is needed.

Topic II – What environmental factors limit the distribution of parthenium weed across different environments?

Parthenium weed has invaded a diverse range of natural and agro-ecosystems in different parts of the world and has the potential to widen its range in the future. It was noted that there are a number of environmental factors that limit its distribution, but the most important are temperature, moisture and features of the soil. The availability of soil moisture in early spring is essential to germinate the seeds and to establish seedlings. The growth of parthenium weed is also restricted in saline and waterlogged soils. Soil disturbance, due to livestock and human activities, also creates conditions that allow the plant to invade.

Topic III – Spread of parthenium weed by animals.

A question was posted on the network regarding animal spread of parthenium weed along with some photos of a plant growing over a cow's pat. If animals feed on parthenium weed, then what is the fate of seeds after passing through the gut of an animal? Could these seeds be spread to new localities with the movement of these animals? After a short discussion some people expressed doubts that parthenium weed seeds could survive movement through the gut of an animal and argued that, if this was the case, there would be a myriad of parthenium seedlings emerging from cow dung, not just one. However, it was suggested that studies should be conducted to prove if this is the case. It was also argued that goats can feed on parthenium weed and are suspected to be responsible for the spread of parthenium weed into Sri Lanka, where they were introduced along with a peace-keeping army.

Topic IV – Is there any information available on economic losses caused by parthenium weed to agriculture, the environment and/or health in your country or region?

There are a number of evaluation studies from Australia on animal production losses, but those figures are out of date and only involve one aspect of loss. In a relatively new survey undertaken in Central Queensland (2005), 77% of individuals sensitive to parthenium weed were found to spend $40 per month for medication to treat their allergy. The indirect effects of parthenium weed on crops are diverse and there is a dire need to include this aspect in any future economic evaluation studies.

In India and Australia, parthenium is the major alternate host for Tobacco streak virus (TSV) which has caused significant yield losses in several crops including sunflower, mungbean, urdbean, okra and peanuts. Although it is difficult to get accurate data, in Australia it is estimated that TSV has caused yield losses in sunflower of about 20% across large regions where parthenium is found. This equates to a loss of about $2 to 3 million (Australian) annually across the sunflower industry, partly due to direct damage from TSV but also due to a lack of confidence in planting sunflowers in certain regions which have been badly affected.

Parthenium weed is also a host of other plant disease agents such as phytoplasmas and begomoviruses. This is potentially alarming for other countries where this weed is present and invading cropping systems. Some of the begomoviruses are known to be the worst pests of cotton crops, one of the backbones of Pakistan's economy.

Topic V –What are the effects of parthenium weed on human health in the different parts of the world where this weed is found?

Parthenium weed is known to cause a range of human and livestock health problems, including skin (contact dermatitis) and respiratory complaints (asthma). It is believed that reactions can occur upon first contact with the weed or following contact with air-borne particles (plant fragments, pollen etc.), but generally prolonged contact is required before severe allergic reactions are seen. It was argued that toxic effects on skin are the results of chemicals that cause blistering, and skin damage very similar to an acid burns. This is caused by extensive handling of the leaves, as is the case of some flower sellers in Pakistan. This reaction is NOT an allergic reaction, but a toxin-induced dermatitis (inflammation of the skin). Other symptoms include reddening and watering of the eyes (irritant contact conjunctivitis). In humans, pollen allergy symptoms may only appear after many years of exposure, so there is a potential threat that this weed might become a serious health concern in developing countries where unfortunately little management in place.

Recent Parthenium Weed Publications

Agarwal, K.K. and D'Souza, M. (2009). Airborne contact dermatitis induced by parthenium: a study of 50 cases in South India. Clinical and Experimental Dermatology 34: 4-6.

Chembolli, L. and Srinivas, C.R. (2009). Montelukast does not inhibit the late phase reaction in parthenium dermatitis. *Indian Journal of Dermatology* 54: 94.

Dhileepan, K. (2009). Managing parthenium weed across diverse landscapes: prospects and limitations. In: *Management of Invasive Weeds*. Chapter 12. Springer Science, pp. 227-260.

Dhileepan, K. and Strathie, L. (2009). *Parthenium hysterophorus* L. (Asteraceae). In: Biological Control of Tropical Weeds Using Arthropods (eds.: R. Muniappan, G.V.P. Reddy and A. Raman). Cambridge University Press, Cambridge, pp. 272-316.

Dhileepan, K. and Wilmot Senaratne, K.A.D. (2009). How widespread is *Parthenium hysterophorus* and its biological control agent *Zygogramma bicolorata* in South Asia? *Weed Research* 49: 557-562.

Javaid, A. and Adrees, H. (2009). Parthenium management by cultural filtrates of phytopathogenic fungi. *Natural Product Research* 23: 1541-1551.

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