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## Weapons of War

**Dr. Ghazala Nasim**

A perfect storm is brewing in the agriculture fields of Pakistan. Perfect in the sense that if you are a weed scientist you would have to get your head down to search for Parthenium management options. For producers, its going to become a headache that some can ill afford. In this challenge to hamper rapidly marching Parthenium weed from wastelands to crop fields of Punjab, one important front is to combat with the onslaught of this enemy. Research teams in Australia and Pakistan have joined hands to fight with this menace. All possible options like chemical, biological and phytochemical controls are being tried separately and in integration to find a solution to stop this weed from spreading. The weed has its own weapons for the war against all odds. The weapons most of which are visible but there are some which are concealed and are extremely lethal. One of these hidden weapons are its remarkable reproductive success. The year round flower/fruit setting has enabled this cross pollinated weed to generate populations which are much more successful, resistant and nasty than ever before. The indication of prevalence of biotypes is a proof that that there is a rapid gene flow in this weed to achieve sets of biotypes/ecotypes suitable in gradient of environmental and climatic conditions. A country wide large scale eradication and management program along with awareness campaigns is urgently needed to curtail the spread of this weed.

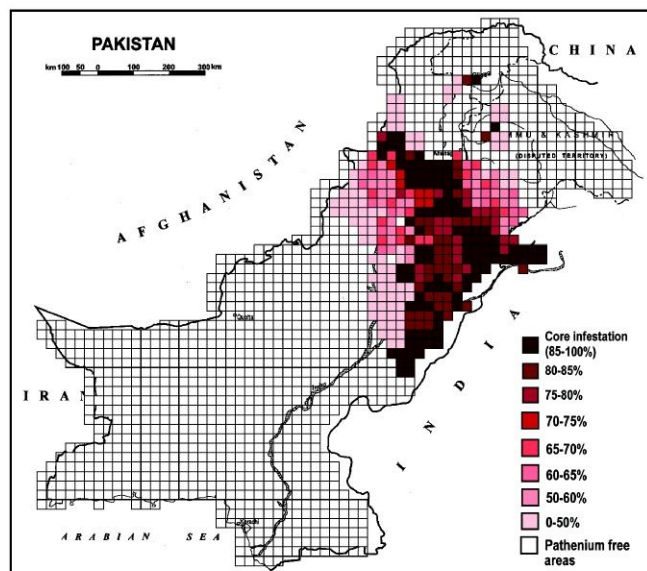
## Research on Parthenium in Pakistan

**Rukhsana Bajwa, Arshad Javaid, Asad Shabbir (P. U.)**

Studies on various aspects of Parthenium weed including its biology, ecology, distribution and management have been conducted in recent past in Institute of Mycology & Plant Pathology, University of the Punjab Lahore, Pakistan.

## Current Distribution of Parthenium weed in Pakistan

Surveys of various parts of the province Punjab and NWFP, Independent State Kashmir revealed that Parthenium weed has become most frequently occurring or the second most frequently occurring weeds in majority of the surveyed



areas. Studies regarding its germination ecology revealed that seeds produced during the winter months have higher germination percentage and rate as compared to the seeds produced during warmer months of the year. Prevailing temperature and light intensity during the seed formation period showed negative correlation with germination percentage of the fresh collected seeds.

A map of current distribution of Parthenium weed in Pakistan is developed by University of the Punjab. This is a preliminary map based on published reports, and personal observations & communications from 2005 to 2008. Presently, the weed is reported to be distributed North Western Frontier Province, Kashmir and various districts of Punjab including Sialkot, Gujranwala, Lahore, Qasur, Okara, Shekupura, Gujrat, Jehlem and Rawalpindi. A more detailed and comprehensive map will be developed after assessment of the present problem of Parthenium weed in various districts of Punjab and NWFP. Mapping of Parthenium weed infestation from various zones of the country is in progress under an HEC funded international linkages project.

## Parthenium Management Studies

Ample data has been collected regarding management of Parthenium employing all viable strategies through biological, chemical as well as natural products.

- *Zygogramma bicolorata*, was found feeding on Parthenium weed, however, its population is not practically sufficient to effectively manage the weed.
- In chemical control, Chwastox, Buctril Super, Bromoxynil +MCPA, Ametryn, Atrazine and

Glyphosate were found very effective herbicides for the control of Parthenium. However, since synthetic agrochemicals generally pollute the environment, alternatives to these herbicides were searched in the plant world.

- Field surveys revealed that Parthenium couldn't invade the areas already colonized by allelopathic grasses like *Imperata cylindrica* and *Desmostachya bipinnata*. Further studies led to the conclusion that extracts of these and other allelopathic grasses contain herbicidal constituents against Parthenium.
- Similar studies were also conducted using extracts and residues of allelopathic trees, weeds and crops and promising results regarding the management of Parthenium were obtained.
- Many studies regarding the screening of plants such as garlic, ginger, onion and others for their herbicidal activity against Parthenium are in progress. Studies were also extended to investigate the herbicidal activity of metabolites of 18 fungal species for management of Parthenium. Results revealed that culture filtrates of *Alternaria alternata*, *Fusarium solani*, *F. oxysporum*, *F. equiseti* and *Macrophomina phaseolina* contain potent herbicidal constituents for the management of Parthenium. Several other such studies are in progress. More than 25 research papers have been published on Parthenium research both in reputed international journals such as Allelopathy Journal, South African Journal of Botany, Natural Products Research, Philippine Agricultural Scientist, Weed Biology and Management, Pakistan Journal of Botany, as well as in a number of reputed national journals.
- Practice of burning Parthenium around cultivated crops observed at various sites has led to the observation that under burning stress, partially burnt stems sprout quickly producing mainly copious inflorescence shoots. New growth at these sites revealed excessive vegetative rosette formation. Apparently, this management practice could only be useful if the weed is burnt to ashes.



## Interview with a Local Farmer

During visit to a local farm in Lahore, a farmer was interviewed about the spread of Parthenium in cultivated land and fodder crops. Following are the excerpts:

- Removing or burning of Parthenium weed growing at the edges of the cultivated fields is necessary as it causes hindrance in the use of agriculture implements.
- It is a very bitter plant. The buffaloes don't like to take it unless they find nothing else. Crop as its now invading the fodder croplands very quickly or it gets mixed up with fodder, the cattle take it but it makes their milk bitter for the next couple of days. This complaint has been conveyed by the customers and

we take care that Parthenium does not get mixed with fodder.



## Cotton Faces Cascading Troubles Dr. Ghazala Nasim

Cotton is a major cash crop of the Country. It not only has a tremendous impact on the economy of the country but is also involved with the household of women worker associated with this crop. Besides facing a lot of threats in terms of a number of insect pests and CLCV, it is in danger of facing mealy bug disaster. The epidemic destroys large patches of the crop resulting into zero productivity. The nasty weed Parthenium stays in close proximity offering the bug to pass over cotton free period on it. As soon as the cotton is sown, the bug finds its way out on to cotton. This is going to be an important cross cutting issue for future research.



## Research Progress at NWFP AU, Peshawar Prof. Dr. Gul Hassan and Mr. Anees Amin

The issue of Parthenium needs to be tackled at war footings. It requires active collaboration and continuous input from different corners of the country. The extensive survey work conducted in major parthenium infested districts of NWFP like Charsadda, Swabi and Mardan by NWFP research team has yielded valuable information. Some heavily infested sectors of Islamabad have also been studied for reference. It has been highlighted by the research team that all the districts visited during the survey are densely invaded by the nasty weed. However, its thick and matty growth has been observed along roadsides and canal banks. The invasion of this weed into fields of Sorghum, Potato and Colocasia (Arvi) has also been noticed during the field visits. Its scanty but dense patches have been observed in some localities of Dera Ismail Khan district. The infestation was also observed in the southern districts of NWFP viz., Bannu and Kohat.

## Parthenium weed and TSV in Queensland: implications for Pakistani cotton industry

In recent years, Tobacco Streak Virus (TSV) has been reported from central Queensland, Australia as the cause of dieback in sunflower and cotton crops. TSV is present at high incidence in the Parthenium population throughout its range in Queensland poses a threat to cotton industry. Pakistan is the fifth largest producer of cotton in the world, it accounts for 8.2 percent of the value added in agriculture and about 2 percent to GDP and said to be the backbone of the economy of Pakistan. TSV reports on cotton in Australia and presence of Parthenium weed near the cotton belt of Punjab is a warning to scientists and various

stakeholders. Parthenium plants showing symptoms of viral infection have also been seen in some parts of Lahore.

## Phytoplasma on Parthenium weed from Monto

Asad Shabbir

In a survey to central Queensland the author found some strange looking Parthenium weed plants. These were later found to be infected with phytoplasma. It was observed that phytoplasma has significant impact on reproductive biology of Parthenium weed, infected plants were observed to be devoid of any seed. These phytoplasma are supposed to be spread through white flies but this still needs to be established. Phytoplasma incidence from Ethiopia has already been reported and its potential as a biocontrol agent discussed.



Abnormal growth & colour of Parthenium weed: green rose shaped disc & abnormally long ray florets (L) due to phytoplasma infection; Normal flowers (R).

## Sustainable management of Parthenium weed and the prevention of weed seed spread in Australia

(An informal report of the second project meeting held on September 1<sup>st</sup> 2008)

This project on sustainable management of invasive weeds has a focus on Parthenium weed and consists of three components.

The advisors include Dr Chris O'Donnell, Steve Adkins, Sheldon Navie, Doug George from the University of Queensland and Dr. K. Dhileepan from Alan Fletcher Research Station, Brisbane.

### Project report:

On September 1<sup>st</sup> 2008 the second meeting of the research team, sponsors and associates took place at the University of Queensland. This meeting was approximately 6 months after the start of the project and was held to report on progress to that date and to discuss the research program for the next 6 months. The next project meeting is planned for some time in the New Year 2009.

The following are brief reports from each of the Ph.D. students who were present at the meeting

### 1) The Invasive Potential of Parthenium weed

Name: Thi Nguyen (MSc) Plant Ecology, Vietnam

#### Aims of the project

This study aims to investigate aspects of the seed biology of Parthenium weed, including reproductive capacity under different present/future climatic conditions (climate change), seed dispersal, soil persistence (seed banks) and its effects on community biodiversity. This study will address the important issue of invasive potential in Australia and Vietnam.

### Results to date

Seed production under two temperature regimes (28-35 or 18-25°C) and two soil moisture levels (field capacity or 0.5 FC) showed that the warm/wet condition produced the highest number of seed (26,628) while the cool/wet condition produced the lowest number of seed (15,508). The immediate germination percentage of all collections from the warm conditions was c. 90% while it was c. 98% from the cool conditions. The viability of all collections was greater than 98%. Thus, a significant number of dormant seeds were produced in the warm conditions c. 8% or about 2,000 seeds per plant. The species composition and dynamics of the soil seed bank during periods of active management has been followed at two sites (Moolayember Creek and Clermont), over two seasons (March and October) and will continue for the next 2 years. Samples collected in April from Moolayember Creek and Clermont revealed 3,626, and 7,255 Parthenium weed seeds per m<sup>2</sup>, respectively. This represents a significant decline at both sites since they were first analyzed in 1996 but still represents a very large weed seed bank at both sites. The question is raised as to whether the present management practices, built around biological control, need to be supplemented with addition approaches. The spread of weed seeds (including Parthenium weed) on vehicles has also be studied. Sludge samples were taken from five wash-down facilities in central Queensland (Clermont, Injune, Monto, Springsure and Rolleston) at four times per year (March, June, September, December) and this will continue at for the next 3 years. The sludge samples from Clermont in May and August 2007, and Injune in December 2007 had 80, 120, and 76 germinable seeds/kg of sludge, respectively. This included grasses, sedges and broadleaf plant seeds. The total number of Parthenium weed seeds from Clermont in May and August 2007 were 3 and 21/kg of sludge, respectively. The sludge samples from the other wash-down facilities (Injune in March 2008, Monto in March 2008, Rolleston in March 2008, and Clermont in April 2008) all showed no germinable Parthenium weed seeds in the sludge samples.

### 2) Sustainable Management of Parthenium weed

Name: Naeem Khan (MSc) Agriculture, Pakistan

#### Aims of the project

This study aims (1) to screen 20 beneficial competitive plants in the glasshouse for their ability to displace Parthenium weed and then to select the best 5 for further testing under field conditions, (2) to evaluate the effect of the best 5 competitive plants on Parthenium displacement under field then livestock grazing conditions, (3) to predict the performance of the competitive plants under future climate change conditions and (4) to undertake comparative economic evaluations of the newly proposed management methods with the presently used methods.

#### Brief results to date

At this point in time 20 plant species have been tested at two densities (four and six plants per pot), in the glasshouse for their competitive ability against Parthenium weed. 10 of these species were undertaken prior to this present study and 10 have been screened during this study. In the first trial of this present study, four plant species were tested

on a black cracking soil from Gatton while in the second six plant species were tested on a cracking clay soil from Injune.

| Test Species         | Scientific Name                             | Origin     |
|----------------------|---|------------|
| Buffel grass         | <i>Cenchrus ciliaris</i> L.                 | Introduced |
| Lablab               | <i>Lablab purpureus</i> L.                  | Introduced |
| Curly windmill grass | <i>Enteropogon acicularis</i> (Lindl)       | Native     |
| Forest bluegrass     | <i>Bothriochloa bladhii</i> cv. Swann       | Native     |
| Guinea grass         | <i>Panicum maximum</i> Jacq. v. maximum     | Introduced |
| Buffel grass         | <i>Cenchrus ciliaris</i> L.                 | Introduced |
| Kangaroo grass       | <i>Themeda triandra</i> Forssk.             | Native     |
| Red grass            | <i>Bothriochloa macra</i> Steud. S.T. Blake | Native     |
| Cotton panic grass   | <i>Digitaria browni</i> Roem. & Schult.     | Introduced |
| Weeping grass        | <i>Microlaena stipoides</i> (Labill.) R.Br. | Native     |

In each case the plants were grown together with Parthenium weed plants for 40 days in plastic pots filled with soil. The above ground biomass was harvested, the dry biomass determined and using the Spitters (1983) reciprocal yield model (1983) competitive index values was determined. In both studies the introduced pasture grass, Buffel grass was used as a control (see table below). For details of the results please contact QMDC.

### 3) Reducing Viable Weed Seed Spread

**Name:** Ikramullah Khan (MPhil) (MSc) invasive plants, Pakistan

#### Aims of the project

This study aims to 1) assess the effectiveness of vehicle wash down facilities and to develop improvements, 2) screen innovative methods to kill weed seeds that may be present on vehicles, agricultural machinery and other field equipment, 3) assess the dispersal of certain kinds of weed seed by water and 4) develop long term approaches to the protection of land from invasive weeds that spread by seed.

#### Brief results to date

Seed of wild oat (*Avena fatua* L.) were collected from Lockyer Valley in November, 2007 and Parthenium weed

seed (*Parthenium hysterophorus* L.) from Central Queensland in May, 2008. The effect of temperature on seed kill was tested (see below). Briefly, air dry wild oat seeds were killed by 100°C when applied for 5 hours while imbibed or partially imbibed seeds were killed by 75°C when applied for only 1 hour.

Air dry Parthenium seeds were killed by 125°C when applied for 1 hour. Studies on a more complete series of temperatures and times, and for a total of six species are planned or underway.

### 4) Biological Control of Parthenium Weed

**Name:** Asad Shabbir, (MPhil) (MSc) invasive plants, Pakistan

#### Aims of the project

Early aims developed for this project include 1) to understand how it might be possible to promote the efficacy of biological control through 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. 3) Understanding the role of host & agent's genetic variability in biological control. Further aims are to be developed in the next 6 months.

#### Brief results to date

Field and glass house studies on biological control agents and competitive displacement are underway. Earlier work undertaken on Parthenium weed by this scientist included studies on Parthenium weed in Pakistan for his MPhil and MSc.

### Forthcoming Events

#### HEC Approved International Linkages Project on Parthenium Weed

This project involves joint research & faculty visits and split PhDs. Two Pakistani institutions University of The Punjab and NWFP Agricultural University Peshawar are collaborating with university of Queensland, Australia and Alan Fletcher Research Station. The physical work of mapping of Parthenium weed in Punjab and NWFP under said project has already been started.

First meeting of collaborators has been scheduled from 16<sup>th</sup> to 20<sup>th</sup> February, 2009 at Brisbane, Australia.

#### Conferences on Weed Science & Invasive Species

22nd Asia Pacific Weed Science Conference of Asia Pacific Weed Science Society will be held at G.C. University, Lahore, Pakistan from October 19-23, 2009. The theme of the conference is "judicious weed management- road to sustainability".

#### 3<sup>rd</sup> International Parthenium Weed Conference

The conference will be held on 18 and 19 September, 2009 at Mysore, Karnataka, India.

#### 10<sup>th</sup> Queensland weeds symposium

Symposium will be held from 26-29 July at Yeppoon Qld, Australia.

