Feature Article

Integrated approaches to manage the invasive alien weed Parthenium in Nothern Sri Lanka

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Family Asteraceae member *Parthenium hysterophorus* is one of the noxious alien weeds to Sri Lanka, invaded from India and spread from Vavuniya to all over the country within a short period of time using its own biological power. *Parthenium* weed is a resilient plant; therefore it can grow in wide range of soils and climatic conditions. It can grow in wastelands, agricultural areas, shrub lands, urban areas, overgrazed pastures and along roadsides, industrial areas, playgrounds, railway tracks and residential developments.

Individual plants can produce up to 100,000 seeds each in their lifetime and seeds germinate anytime moisture is available. Seeds can disperse over long distance through wind, machinery, livestock, livestock feed, vehicles movement and water currents. This noxious weed has the potential to cause serious economic loss in crop production and environmental human health hazards issues such as, dermatitis, asthma and bronchitis.

In Northern Sri Lanka, It has been reported that *Parthenium* invaded nearly 137,225 ha in Jaffna peninsula alone (Fig. 1). Due its problem, post-risk assessment recommended that this weed should be considered as "Weed of National Significance" by Sri Lanka Council for Agricultural Research Policy (SLCARP) and research priorities to control this weed have been implemented through Faculties of Agriculture and Department of Agriculture in Sri Lanka since 2009.

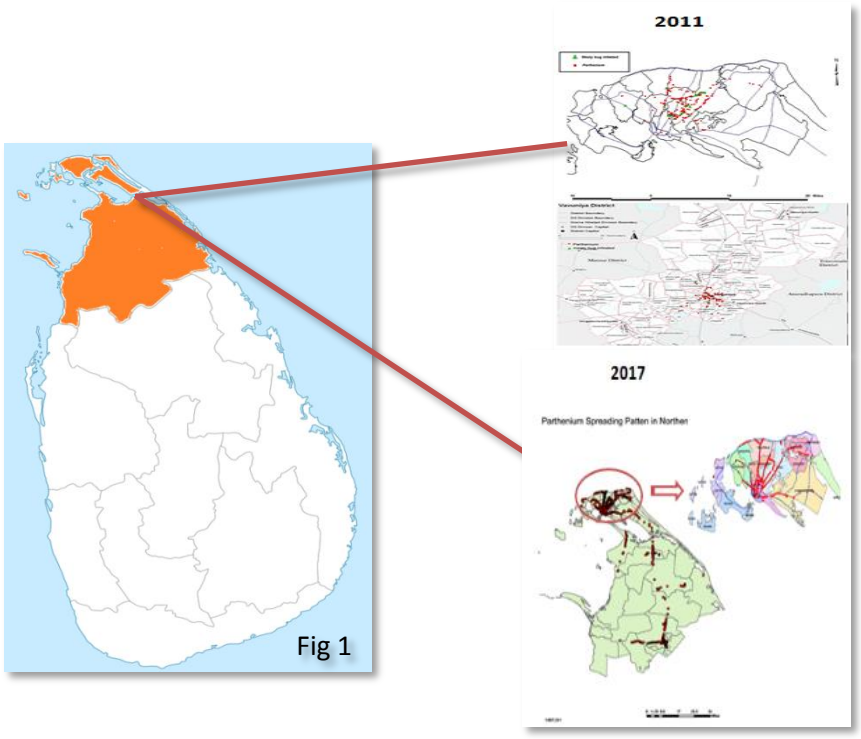

Figure 1: Spread of Parthenium weed by 2011 and 2017

Spread of *Parthenium* weed by 2011 and 2017

Parthenium weed was initially only found in Northern part of Sri Lanka (Fig. 1). In 2011, this weed was found in Jaffna and Vavuniya Districts. But by 2017, *Parthenium* weed has spread into Killinochchi, Mullaithevu and Mannar Districts in the Northern Province of Sri Lanka. The weed was perhaps in its initial stages of invasion in 2011, and little attention was paid to its existence. *Parthenium* weed has now spread across the Northern Province.

There is an urgent need for controlling this weed from further invasion. Many weed management techniques implemented were not successful to control this weed fully because of lack of awareness among the farmers and citizens of Sri Lanka as well of its resistance to herbicide, high regeneration capacity, production of huge amount of seeds, high seed germinability and extreme adaptability to a wide range of ecosystems.

Biological control has many advantages and in India this weed was satisfactorily biocontrolled by the Chrysomelid beetle *Zygograma bicolorata*. *Z. bicolorata* alone may not be sufficient to manage this weed in Sri Lanka. In the past, several biocontrol agents (insects and pathogens) including *Z. bicolorata* (leaf feeding beetle), *Epiblema strenuana (*stem galling moth), *Listronotus setosipennis* (stem boring weevil), *Semicronyx lutulentus* (seed feeding weevil), *Bucculatrix parthenica* (leaf mining moth), *Platphalonidia mystica* (stem boring moth), *Conotrachelus albocinereus* (stem galling weevil) and *Carmenta ithacae* (root boring moth) have been used in other countries to manage *parthenium* weed without success. In the Northern Province of Sri Lanka, there are reports of a mealybug infestation and mycoplasma-like infection on the inflorescence of the *Parthenium* plants.

In initiatives taken by the Ministry of Agriculture, Northern Provience, manpower is being used to eradicate this noxious weed. Utilising manpower for the *Parthinium* eradication programme has proved to be effective and efficient in comparison to usage of other biological organism because of following reasons:

1. **No environmental influence:** Failure of many biological control programme due to poor adaptability of bio-control agents to the targeted regions. But human force from targeted area are well adapted
2. **Availability of cheap labour force:** Sri Lanka as developing small country has lots of labourforce without employment or with seasonal employment. If we use this cheap labour, we can create short-term employment for jobless people or can create regular income for seasonal workers.
3. **Very quick:** If we can use human labour to abolish the weed within shorter period and any time of the year as well as any stage of the weed
4. **Easy monitoring and creating awareness:** When we use local labourers it will create awareness among the residents as well as can get more benefit from citizens as well. Data regarding distribution can be generated by agricultural extension workers and researchers to map the distribution pattern for future purposes
5. **No non-target effect:** Human labourers with protective equipment can target only particular weed while still enabling use of chemical spray for other pests in the crop field, while use of other biological agents limits the use of chemicals for other pest control if needed.

There is also a research study aimed to identify and select plants-derived products to suppress the growth and spread of *P. hysterophorus* in the northern region of Sri Lanka. The use of botanicals should possibly replace the environmentally harmful synthetic herbicides and is fast becoming important to control noxious weeds. Among the natural plant products, volatile essential oils and their constituents have attracted much attention due to their phytotoxicity (allelopathic properties) and relatively quick degradation in the environment. The volatile substances present in the leaves, released as vapours into the surroundings. Their partial vapour pressure is higher than air pressure; hence, they get adsorbed into soil particles and affect the germinating seeds and seedlings growth.

Twenty plant species were selected for this study and their phytotoxicity was measured at different concentrations (5g/ml, 15g/ml, 25g/ml, 35g/ml and 50g/ml). Fresh, mature healthy leaves were collected. Finely-ground plant leaves were then immersed in cow urine (195 ml) supplemented with soap solution (5 ml) and allowed ferment for one week. Soap solution was used as a surfactant. To evaluate the bio control effect of each plant species, a preliminary pot experiment was done to study the herbicidal activity of plant extracts, against 4-wks-old plants of *P. hysterophorus* under controlled conditions. The extracts were applied on the *P. hysterophorus* plants as foliar application. In this study, *Eucalyptus camaldulensis*, *Allium sativum, Piper betle*, *Cassia tora*, *Ricinus communis* and *Tephrosia purpurea* were identified as the most efficient growth suppressing plants at 35 to 50 mg/l concentrations. Using this concentration, weeds were dead in one day from application.

According to the experiment the extracts from tested plant species reduced the growth of *P. hysterophorous*. However, response was varied with plant species and concentrations. *Cassia tora, Ricinus communis* had significant inhibitory effect on *P. hysterophorous* than others. As the concentrations of extract increased, more dead *P. hysterophorous* plants were found as compared to control. In the case of six allelopathic plants, complete death of the *Parthenium* (100% of plants) was observed at 35 to 50 mg/L concentration.

The 35 mg/l and 50 mg/l doses of *Eucalyptus camaldulensis*, *Allium sativum, Piper betle*, *cassia tora*, *Ricinus communis* and *Tephrosia purpurea* were again formulated (195 ml cow urine + plant extract + 5ml surfactant to enhance dispersion, penetration of the plant extract, and to promote residual effects) as above and were tested in a field experiment. The formulated doses were applied on *P. hysterophorus* plants using a hand sprayer early in the morning on a clear day. The plants were carefully observed. Wilting and necrosis of leaves started two days after application but mortality was only seen after 4 days. 50mg/l doses has 90% mortality of *P. hysterophorus*, thus these selective bio-herbicides, are effective in killing of *P.hysterophorus* but *Cassia tora* and *Ricinus communis* are comparatively more effective as compared to other plant extracts.

Recent observation on integrated control of *P. hysterophorus* as in Northern Sri Lanka could become an effective, cost-effective and compatible practice, applicable to any other similar country(s).

Parthenium
Photo by Ethel Aardvark

Zygogramma bicolorata
Source: International Association for the Plant Protection Sciences