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Impact of *Parthenium hysterophorus* L. (Asteraceae) On Natural Ecosystem of Nagpur (Maharashtra)

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Abstract
The present study was carried out in the open space of Shree Mathuradas Mohots College of Science campus, Nagpur, Maharashtra, during June 2013 to Dec 2014, aimed at determining the impact of *Parthenium* weed on natural ecosystem of Nagpur. Quadrates method was used and 30 quadrates of 1x1 meter size were laid out. Quadrates were divided into infested and non infested group. Species diversity was recorded in each quadrate. Impact of biological control agent *Z. Bicolorata* on *Parthenium* and native biodiversity was also recorded in same quadrates after three months. The species richness in the non infested quadrates is higher than the infested quadrates. *Parthenium* weed comprised 28% of the infested field, while the non-parthenium component declined by 23% from non-infested quadrates. Some species are highly endangered because of *Parthenium* weed infestation while, some species were found better associated with *Parthenium* weed. The abundance of *Parthenium* in the infested area is declined after three months of application of *Z. bicolorata*. This decline in the biodiversity of natural ecosystem in *Parthenium* infested area is due to the allolopathic effect of *Parthenium* on other plants. In addition to its aggressiveness and allelopatic effect removal of top soil creates a good opportunity for *Parthenium* weed by minimizing the competition from native species and enhancing the chance of survival for the invading plants.
Keywords: *Parthenium hysterophorus, biodiversity, Z. bicolorata,* infestation

Introduction:

Parthenium hysterophorus locally known as gajar ghans or carrot weed is an obnoxious weed which has spread throughout India after its first occurance in Pune in 1956. Now it has achieved the status of "worst weed" owing to its allelopathic effects on agricultural lands and forestry crops. *Parthenium* is largely a weed of the fallow and wastelands but now spreading on any open pockets of rural and urban areas causing substantial harmful impacts on man and animal.

Infestation of *Parthenium* weed can degrade natural ecosystem because it has a very high invasive capacity and allelopathic properties which has the potential to disrupt any type of natural ecosystem. There was a sharp decline in the native biodiversity index, evenness and species richness over the time, clearly indicating the threat of *Parthenium* on native biodiversity of other weeds. According to McFadyen (1992), Chippendale and Panetta (1994), *Parthenium* has been reported to cause a total habitat change in native Australian grassland, open woodlands, river banks and food plains. Its allelopathic effect coupled with absence of natural enemies like insects and diseases are the two important factors responsible for its spread in India. According to Picman and Picman (1984), two sesquiterpene lactones such as parthenin and coronopilin present in large quantities. Phytotoxins (allelochemicals) of *Parthenium* plant are released from the decomposing biomass and root exudates in the soil. Bioassay, pot culture and field studies have revealed that all plant parts, namely shoot, root, inflorescence and seeds are toxic to crop plants. According to Kanchan S.D. (1975), the concentration of allelochemicals viz. parthenin, caffeic acid and pcoumaric acid which are present

in *Parthenium* have serious allelopathic effects. Thus, antifeedant property in the plant system and its wide adaptability to varying soil and agroclimatic conditions have enabled this plant to adjust itself to a variety of growing environmental conditions.

Material and Method:

The present study was carried out in the open space of shree mathuradas Mohota College of science campus, Nagpur, Maharashtra, India. A reconnaissance survey was carried out to see the pattern of *Parthenium* weed distribution and to design appropriate sampling method. A quadrat method (Smith, 1983 and Mishra, R. 1968) was adopted to study the phytosociological structure in study site. The sampling plots were arranged on the transect line laid on all sides of the campus. 30 quadrates of 1 X1 m size were laid out in each site and analytical characteristic viz., frequency and density of plant species, encountered in each quadrat were recorded from study site. Each species available in the quadrat was counted and recorded. Visual cover estimation of each species was taken.

After the completion of benchmark survey the *Parthenium* weed was controlled by the biological control agents. For this Mexicam beetle *Zygogramma bicolorata* a biological control agent of *Parthenium* weed was released in the field. The feeding of *Z. bicolorata* was recorded and the effect of *Z. bicolorata* on the species diversity was determined by same preferential method.

Observation and Result:

The species richness in the non infested quadrates is higher than the infested quadrates. *Parthenium* weed comprised 28% of the infested field, while the non-parthenium component declined by 23% from non-infested quadrates. From comparison made in the same way in mean difference percent, more species were frequently found in non infested quadrats than in infested quadrats. Conversely, some species were found frequently in infested quadrats than non infested quadrats. Some species are highly endangered because of *Parthenium* weed infestation while, some species were found better associated with *Parthenium* weed. From the comparison of species abundance made among the components, the infested quadrats were more abundant when compared to the non-infested quadrates. The value showed that the non infested component is more diverse in species composition even though lesser in abundance value than infested.

After the impact of Mexican beetle *Z. bicolorata* on the *Parthenium* weed the plant diversity of the infested and non infested quadrats were differ. The abundance of *Parthenium* in the infested area is declined after application of *Z. bicolorata*. In infested quadrates the number of species was increased after the defoliation of *Parthenium* by *Z. bicolorata*. In non infested quadrats the species richness was also increased.

Discussion:

Observations revealed that *Parthenium* has completely captured the habitat of indigenous plant species with few struggling indigenous species in *Parthenium* infested sites by providing non-congenial habitat conditions for indigenous diversity of the area. The conversion of native biotic communities to invasive dominated communities has negative aesthetic and cultural impacts because of its direct

threat to the habitat of species (Raghubanshi *et al.* 2005). This is in agreement with what Evans (1997) stated that *Parthenium* weed has the potential to replace dominant flora and suppresses natural vegetation in a wide range of habitats and disrupt natural ecosystems. Investigators realized that *Parthenium* weed releases allelopathic chemicals that inhibit the germination and growth of pasture grasses, legumes, cereals, vegetables, other weeds and even trees. Displacement by direct competition reduced structural diversity, increased biomass production and disruption of the prevailing vegetation dynamics (Van Wilgen & Van Wyk 1999). The same situation was observed in present study that some patches of *Parthenium* weed monoculture with little under growths were observed.

Kumar and Rohatki (1999) have also feared the role of invasive *Parthenium* in changing floristic diversity of natural forests with little or no growth of any other indigenous species lead to cause total loss of biodiversity of the area. It was in line with a total habitat change due to *Parthenium* weed reported in Australia grass lands, open wood lands, river banks and flood plains (Kohli et al., 1992; Chippendale and Panetta, 1994). Similar investigation in Ethiopia showed that about 93.6%, 90.8% and 77.7% variation in density of broad leaved, grass and sedges respectively were accounted for the density of *Parthenium* (Mulisa Urga *et al.* 2008). In addition to its aggressiveness and allelopatic effect removal of top soil creates a good opportunity for *Parthenium* weed by minimizing the competition from native species and enhancing the chance of survival for the invading plants (Shabbir and Bajwa 2006; Kohli et al., 1985). According to Picman and Picman (1984), two sesquiterpene lactones such as parthenin and coronopilin present in large quantities. These are autotoxic to seed germination and seedling growth. It exerts strong allelopathic effect and suppresses the growth and productivity of surrounding crops.

Some species positively associated with *Parthenium* weed showed difference in stand density from the infested. The result is in consistent to that of a survey made in Pakistan which reported that P. *hysterophorus* and Desmostachya bipinnata, Lantana camara and Senna uniflora had a high degree of sociability and these formed large stands under different habitats (Shabbir and Bajwa, 2007). Those threatened species ecceeding 2-3 times higher than those better associated with *Parthenium* weed showed that as time goes many species leave the ecosystem and only a few competent species remain in the near future. This leads to the domination of a few species in the system.

Zygogramma *bicolorata* was considered effective biocontrol agent for *Parthenium* suppression (Sangamitra and Monica Basu 2008). Sushilkumar (2009) discussed and reviewed the impact of bioagent *Z. bicolorata* in detail. It is a monophagus insect. Adults and grubs of *Z. bicolorata* damaged *Parthenium* and reduced plant height, shoot length, root length, stem diameter and plant biomass. After its application it reduces the density of *Parthenium* and allolopathic effect of *Parthenium* on other plant species is declined.

Conclusion:

Infestation of *Parthenium* weed increases the total stand density and total stand biomass, while species diversity and evenness decreases. *Partheium* weed invades disturbed road sides and overgrazed pastures but, it has less potential to

invade dense pasture. In addition *Parthenium* weed has the ability to utilize the opportunity of drought prone period in the area to use the chance where the indigenous plants deteriorate and leave much bare ground cover. Parthenium weed establishes its weed monoculture on the bare grounds and gradually weakens even the survival of herbaceous plants in the vicinity. Based on these strategic ways of its expansion, parthenium weed can create a great challenge on herbaceous plant diversity.

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