Effect of allelopathic plants on Congress grass (Parthenium hysterophorus L.) in a tropical region

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Abstract: Two of the many benefits of including allelopathic plants in suppressing Parthenium hysterophorus L. are decreasing fresh weight and biomass of Parthenium weed. This study was conducted in order to examine the effect of selected plants on fresh weight and biomass in tropical Agra, India. Together with an untreated control plot, Parthenium and selected allelopathic plants were grown from January 2012- December 2012. The weeds were allowed to develop uncontrolled for 3 months until the time when selected allelopathic plants would be planted with Parthenium. In the period after the incorporation of allelopathic plants Parthenium biomass was less than in control. More than half of the biomass reduced by 15 days after the incorporation of allelopathic plants. The chemical exudates from allelopathic plants are proposed to play a major role in the allelopathy mode of action.

Key words: Parthenium, Allelopathic plants, Incorporation, Biomass

Introduction
In order to manage Parthenium weed in ecologically safe and viable manner, at present there is a trend towards searching for allelopathic plant species which have the potential to replace this weed through allelopathic mechanism. The most common effect of allelochemicals may occur through leaching, volatilization, root exudation and decay of the fallen parts either through biotic and abiotic means (Anaya et al., 1990). Positive and negative allelopathic effect of Parthenium on many agricultural crops and other plant species have been reported (Oudhia et al., 1997; Oudhia and Tripathi, 1998; Agarwal and Kohli, 1992) and it has been established that Parthenium has an inhibitory effect on surrounding herbaceous vegetation (Kanchan, 1978; Mall and Dagar 1979; Nath 1981, 1988; Srivastava et al., 1985). The weed biomass was suppressed by living hairy vetch by 62.8% during the spring fallow period (Anugroho and Kilou, 2011). However, the effect of the incorporation of allelopathic plants on weed fresh weight and biomass in tropical region has not been examined.

The objective of the present study was to determine: (i) the biomass of Parthenium in control and (ii) the biomass of Parthenium in the presence of allelopathic plants.

Materials and Methods
Experimental site and soil properties: The study was conducted at the Tropical Field, St. John’s College, Agra, Urban North Central India. The chemical properties of the soil were: pH= 8.10; electrical conductivity: 0.54 (dS m⁻¹); organic matter: 1.1%; available phosphate: 17.5 (kg ha⁻¹); available potash: 393 (kg ha⁻¹) and available nitrogen: 112.896 (kg ha⁻¹) (Knox, 2009).

Selected allelopathic plants:
Cassia occidentalis: Cassia occidentalis Linn. commonly called as coffee weed belongs to the family Caesalpiniaeae. It is an erect, annual shrub. The leaves are pubescent and are 3 to 6 cm long. The inflorescence is axillary cyme. The flowers are purplish in colour and its flowering time is July to September. Fruit is a drupe.

Azadirachta indica: Azadirachta indica (Juss.) commonly called as Neem tree belongs to the family Meliaceae. It is a perennial, erect, woody tree. Leaves are dissected at margins and its base is pulvinus and are 4 to 7 cm long. The inflorescence is axillary panicle cyme. The flower is yellowish in colour and its flowering period is from July to September. Fruit is a drupe.

Calotropis procera: Calotropis procera (Willd.) Dryand. ex W.Ait. commonly called as milk weed belongs to the family Asclepiadaceae. It is an annual, erect shrub. Milky latex is present in stem and leaves of plants. The inflorescence is polychiasal cyme. The flowers are purplish white in colour and its flowering time is July to November. Fruit is an Etaerio of follicle.

Growing of Parthenium weed and selected allelopathic plants: Four plots of 10m × 14m were plowed by rotary tiller. In the first plot only Parthenium seeds were sown at a spacing of 0.25m without physical and chemical control. In the second, third and forth plot Parthenium seeds were sown along with Cassia occidentalis, Azadirachta indica and Calotropis procera seeds, respectively in alternate rows at spacing of 0.25m. All the seeds were obtained from Hariyali, Shikohabad, India and were manually sown on 10th January, 2012 in the experimental plots.

Biomass: Mature Parthenium plants were uprooted from all the four plots at 45 days after sowing (DAS). Fresh weight was taken and then the dry weight was taken after placing the plants in oven for 24 hr at 74°C.

Statistical Analysis: The mean values of the data were compared with factorial completely randomized design at a significance level of p<0.05 and conclusion was drawn by two way ANOVA. The statistical software was carried out with the software package, SPSS 16.0 for Windows.
Table 1: Effect of allelopathic plants on fresh weight and biomass (in gm) of Parthenium hysterophorus

<table>
<thead>
<tr>
<th>Allelopathic plants</th>
<th>Fresh weight</th>
<th>Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15.60±(0.36)</td>
<td>11.35±(0.18)</td>
</tr>
<tr>
<td>Cassia occidentalis</td>
<td>6.04±(0.11)</td>
<td>3.94±(0.07)</td>
</tr>
<tr>
<td>Azadirachta indica</td>
<td>10.12±(0.10)</td>
<td>5.27±(0.19)</td>
</tr>
<tr>
<td>Calotropis procera</td>
<td>7.45±(0.12)</td>
<td>2.64±(0.16)</td>
</tr>
</tbody>
</table>

Values in parenthesis are SE of mean

Results

Fresh weight and Biomass: The fresh weight and biomass of Parthenium hysterophorus decreased significantly as shown in the table. Maximum significant inhibition in fresh weight and biomass of Parthenium was observed in Cassia occidentalis having 6.04 gms and 3.94 gms, respectively followed by Calotropis procera in which 7.45 gms of fresh weight and 2.64 gms of biomass was observed. Minimum inhibition was observed in Azadirachta indica having 10.12 gms and 5.27 gms of fresh weight and biomass, respectively. In control 15.60 gms and 11.35 gms of fresh weight and biomass was observed, respectively.

Discussion

The allelopathic properties of plants can be explained successfully as a tool for weed reduction. The chemical exudates from allelopathic plants are proposed to play a major role in the allelopathy mode of action. P. hysterophorus has strong allelopathic potential to inhibit seed germination of neighbouring plants and is becoming a serious threat to plant biodiversity in varied ecosystem (Jaggi et. al., 2012). Root leachates of 100% concentration of C. occidentalis obtained after 9 days were responsible for the maximum inhibition of nitrogen percentage and protein content of Parthenium, indicating that biomolecular interaction plays a significant role in curbing the population dynamics of this obnoxious weed with enormous seed production potential (Knox et. al., 2011). Mamatha and Mahadevappa (1988, 1992) based on their preliminary surveys have reported that Cassia sericea, C. tora, Tephrosia purpurea and Croton bonplandianum restricted, Parthenium invasion in many states in India. Aqueous extract of root, stem and leaves of Ocimum americanum were tested against seed germination and seedling growth of Parthenium. The inhibitory effects of the aqueous extract of O. americanum significantly inhibited the germination and seedling growth of Parthenium (Singh and Thaper, 2004).

Inhibition of Parthenium seed germination was absolute in aqueous foliar extracts of Cassia occidentalis, Andrographis paniculata, Abutilon indicum and Hyptis suaveolens. There was no stimulatory effect of extracts on seed germination and seedling growth to test P. hysterophorus. All the species tested, inhibited the early seedling growth and fresh weight of the seedling. Cassia sericea recorded the highest reduction in seedling length i.e. 87.66 and 87.31% by leaf and whole plants extract, respectively at 50% concentration followed by Hyptis suaveolens (83.89 & 84.55%). These plants also caused maximum reduction in the seedling fresh weight of Parthenium hysterophorus (Senthil et. al., 2004).

Weeds like Achyranthes aspera, Datura stramonium, Calotropis procera, Cassia occidentalis etc., were commonly found in close vicinity of Parthenium. Out of all these weeds at different sites, C. occidentalis was dominant cohabiting Parthenium successfully (Knox et. al., 2006).

References


