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EFFECT OF SOME ESSENTIAL OILS ON SEED GERMINATION AND SEEDLING LENGTH OF *Parthenium hysterophorous* L.

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ABSTRACT

Effect of plant essential oils on seed germination and seedling growth of *Parthenium hysterophorus* was examined. Essential oils of Eucalyptus, Camphor, and Lemongrass were used in the experiments at different concentrations (0 to 20 $ml.l^{-1}$). Water imbibed (36 h) seeds were germinated at 25°C ± 1 in petriplates containing 3 layers of filter papers soaked in distilled water and added with 1.5 ml of a given essential oil of particular concentration. Experiments were carried out taking three replicas. Observations were made at an interval of 24 h from the 4^{th} day of incubation till 20^{th}. All essential oils significantly ($P<0.05$) reduced seed germination irrespective of their sources. Effects of plant sources were, however, not significant ($P>0.05$).

Key words: Noxious weed, terpenes, sesquiterpenes, essential oil.

INTRODUCTION

Parthenium hysterophorus L., family *Asteraceae,* a noxious weed has infested both fallow and cultivated lands in tropical Asia, North America, etc. Its occurrence was first reported in Nepal in 1982 by Hara *et al.* (Tiwari *et al.* 2005). The weed is now widely distributed in a number of tropical and subtropical countries like, Australia, India, China, and Kenya (Navie *et al.* 1996, Anonymous 2004). This weed has prolific seed production (Haseler 1976), allelopathic effect on neighbouring plants (Adkins and Sowrby 1996), and strong competitiveness with crop plants (Tamado *et al.* 2002). It has been found toxic to human as well as cattle. Some of the reports revealed that regular contact with the plant or its pollen may cause dermatitis, hay fever and asthma to human beings (Anonymous 2004). It is also reported to have adverse effects to livestock and cattle and even can cause death if consumed in significant amount (Anonymous 2003). A comprehensive account on its phenology has been reported in the pest series publication of Queensland government and the Natural heritage trust, Australia (Anonymous 2003; 2004). The plant contains '*Parthenin*', an active chemical which is a terpenoid (sesquiterpene). This group of chemicals are reported to affect the early growth and physiology of *Ageratum conizoides* (Singh *et al.* 2005). An allelopathic influence of *Parthenium hysterophorus* on the early growth of *Brassica* species by releasing water soluble phenolics into the soil (Batish *et al.* 2005) and seed germination and seedling growth of *Eragrostis tef* (Tefera

2002) have been reported. So far the control of this weed is concerned; an effective control is yet to be achieved through various chemical, biological, or physical methods. Although environment unfriendly and hazardous, the chemical methods involving the use of synthetic herbicides have been tried with limited success elsewhere (Anonymous 2004). As alternative the use of bio-herbicides is considered potential.

Essential oils of aromatic plants are being explored to find out possible herbicides since they do not persist in soil or contaminate ground water and causes little or no mammalian toxicity (Isman 2000). The essential oils can also be used as viable weed control technology under organic farming systems (Tworkoski 2002). The present work addresses the seed germination and early seedling growth of *Parthenium hysterophorus* in relation to the effects of plant essential oils obtained from common plant species like Lemon grass (*Cymbopogon citratus*), Eucalyptus (*Eucalyptus citrodora*), and Camphor (*Cinnamomum camphora*).

MATERIALS AND METHODS

Harvesting of seeds: Seeds of *Parthenium hysterophorus* L. were collected from Kirtipur during August and dried in shade for about a week. Air dried seeds with moisture content below 12%, as managed through repeated weighing and drying, was taken for use in the experiments.

Essential Oils: Extraction of essential oils from *Cymbopogon citratus, Eucalyptus citrodora* and *Cinnamomum camphora* leaves was carried out by Clevenger Apparatus. Fresh leaves were shade dried for two days. For a given species of plant, 50 g of leaves was steam extracted using 500 ml flask. Three to five hours were allowed for the extraction of oil in one run. Thus, obtained oils were placed in plastic vials and stored at low temperature (10°C) until used. Acetone (80%) was used for each oil to prepare stock solutions and their dilutions to appropriate concentrations ranging from 0 to 20 ml l^{-1}.

Treatments: Seeds were imbibed in distilled water for a period of 36 h. Three layers of filter paper were stacked in all petriplates and moistened by 3 ml distilled water. Then 1.5 ml oil of desirable concentration was poured on the filter paper and allowed to diffuse by covering the plates. Each of the treatment combination had three replications. Twenty seeds were kept in each plate maintaining equidistance. Plates were incubated at 25 ± 1°C. The petriplates were examined for germination regularly.

Statistical analysis: A factorial design was adopted and *f*- distribution (ANOVA) analysis was carried out to find out the level of significance. The degree of probability ($P < 0.05$ or $P > 0.05$) has been incorporated into figures.

RESULTS AND DISCUSSION

The overall study suggests that the essential oils from aromatic plants at their different concentrations have adverse effects on the seed germination and seedling length of *Parthenium* weed at varying degree. These oils are found perfect to arrest the seed germination of the weed in laboratory condition. Possible effects of plant essential oils on the seed germination and seedling growth of this weed is shown in Fig. 2a and 2b. Herbicidal activities of volatile oils of *Eucalyptus citriodora* against *Parthenium hysterophorus* L. has been reported recently by Singh *et al.* (2005).

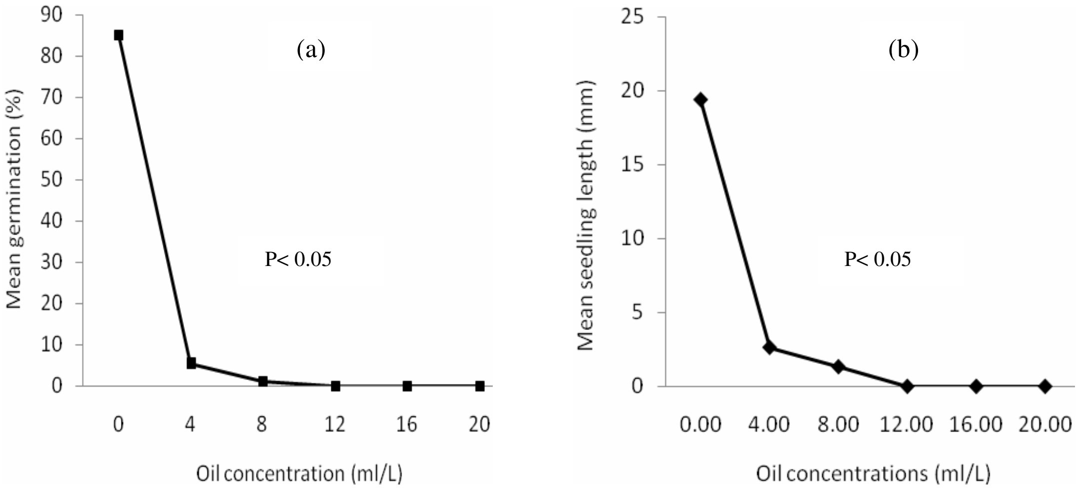

Fig. 1. Effect of essential oils on seed germination (a) and seedling length (b).

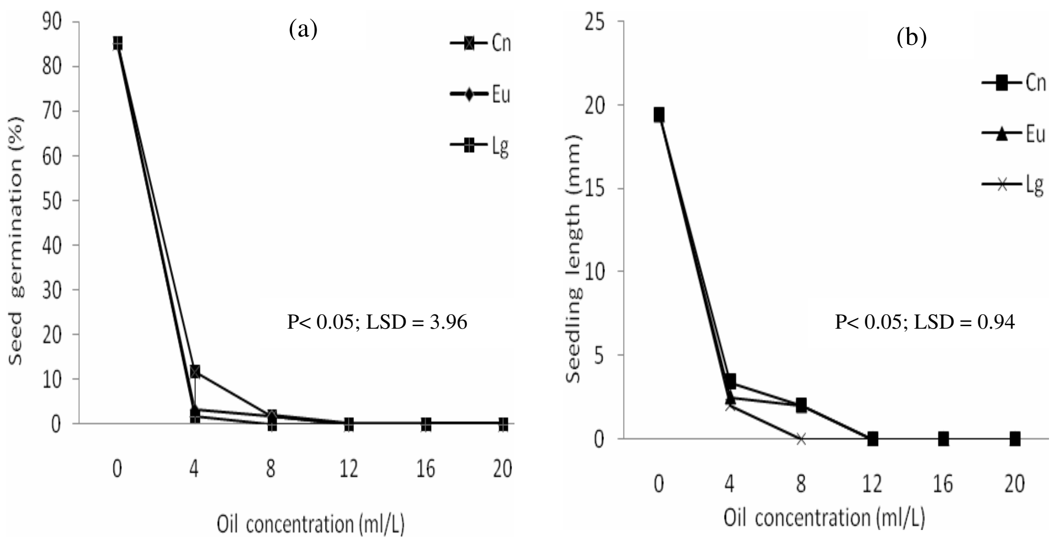

Fig. 2. Individual effects of various concentrations of essential oils on seed germination (a) and seedling length (b) (Cn = Camphor, Eu = Eucalyptus, Lg = Lemongrass).

Table 1. *f*- distribution (ANOVA) table for *Parthenium* seed germination.

Source of variation	Sum of square	Degree of freedom	Mean square	Variance ratio
Total	17628.96	17	-	-*
Treatment	17569.66	5	3513.93	742.9**
Plants	12.05	2	6.025	1.27#
Error (Residual) Mean square	47.25	10	4.73	-

** = Significant at $p < 0.05$, # = Not significant at $p = 0.05$.

Table 2. ***f*- distribution (ANOVA) table for *Parthenium* seedling length.**

Source of variation	Sum of square	Degree of freedom	Mean square	Variance ratio
Total	884.93	17	-	-
Treatment	881.21	5	176.24	660.07**
Plants	1.05	2	0.525	1.966#
Error (Residual) Mean square	2.67	10	0.267	-

** = Significant at p < 0.05, #= Not significant at p = 0.05.

All essential oils significantly ($P<0.05$) affected seed germination irrespective to differences in their sources. Effects of plant sources were, however, not significant ($P>0.05$). Lemon grass at 8 ml l^{-1}, Cinnamomum and Eucalyptus oil, each at 12 ml l^{-1} inhibited the germination of *Parthenium* seeds completely (Fig. 2a). In the case of Cinnamomum oil, only 11.67% and 1.67% seeds germinated at 4 ml l^{-1} and 8 ml l^{-1} concentrations, respectively. None of the seeds, however, germinated at and above 12 ml l^{-1} concentrations of any of the oils. Concentration responses were found as 20 ml l^{-1} = 16 ml l^{-1} = 12 ml l^{-1} > 8 ml l^{-1} > 4 ml l^{-1} ($P< 0.05$; LSD= 3.96).

Similarly all essential oils significantly ($P<0.05$) affected seedling lengths of *Parthenium hysterophorus.* Oil concentrations at 4 ml l^{-1} of Lemon grass, 8 ml l^{-1} of Cinnamomum and 8 ml l^{-1} of Eucalyptus showed similar values for seedling length. The Concentration responses were found as 20 ml l^{-1} = 16 ml l^{-1} = 12 ml l^{-1} > 8 ml l^{-1} > 4 ml l^{-1} ($P< 0.05$; LSD= 0.94) as shown in Fig. 2b.

Our results may be interpreted in terms of different kinds of terpenoids present in plant essential oils and their probable effects on seed germination process. It is reported that these terpenoids, particularly the sesquiterpene, is a group of compounds with variable biological activities. Active at low concentrations these compounds exhibit specific structure-activity relationship (Beekman *et al.* 1997). Among several biologically active compounds, the phytotoxic potential of sesquiterpene lactones has long been established (Dalvi *et al.* 1971, Dayan *et al.* 1999). Possible roles of these terpenes in regulating hydrolytic enzymes including amylases, *de novo* synthesized in germinating seeds, can not be overruled. Works in the line of further chemical characterization of the used essential oils are speculated to justify the finding of the present investigation.

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