

Allelopathic Interaction Studies on
***Parthenium hysterophorus* L.**

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ABSTRACT

The increase in concentration of allelochemicals, both from plant and seeds of *Parthenium*, caused decrease in the germination of *Raphanus* seeds. The seed germination was inhibited up to 100% in the presence of Plant diffusates (PD) and up to 86.66% in the presence of seed diffusates (SD). These allelochemicals also reduced the glucose level in germinating seeds of *Raphanus sativus*. The glucose level reduced up to 55% in 100 % PD grown seeds and up to 37% in 100% SD grown seeds.

Extracts (essential oils) from *Eucalyptus citriodora*, *Cymbopogon citratus* and *Cinnamomum camphora* were used to analyze their effects in germination and seedling development of the weed. *Cymbopogon* oil at 8 ml l⁻¹, *Eucalyptus* and *Cinnamomum* oils at 12 ml l⁻¹ and all above concentrations of all extracts arrested the seed germination of the weed completely. The oil extracts irrespective from their sources were found significantly effective ($P < 0.05$) in arresting the seed germination and seedling length of *Parthenium hysterophorus* in laboratory conditions.

EXECUTIVE SUMMARY

Parthenium hysterophorus L., a noxious weed infesting both fallow and cultivated fields in many places of Asia, is now of common occurrence in Kathmandu valley too. The weed is reported problematic due to its fast spreading ability, rapidly infesting nature, and allelopathic behavior. Studies revealed the presence of an active chemical called Parthenin in the different parts of the weed is responsible for allergic reactions to cattle and human beings. The chemical is also reported to have high degree of negative allelopathic impacts on neighboring flora including many agriculturally important plants specially legumes and crucifers. Many researches were carried out and others are in progress in different aspects of the weed mostly in its allelopathic nature. Lots of attempts are being made to control its infestation and to dispose of from its problems but little success is achieved. The use of many chemical herbicides is mostly practiced however the use of bio herbicides as an alternative is very rare. This research mainly focuses on the allelopathic influence of the weed *Parthenium* in *Raphanus* seed germination as well as in the use of essential oils as bio-herbicide to control the seed germination of the weed. However, the overall work was carried out in laboratory and its practical implementation is not tested.

The plant diffusates (PD) obtained from rhizospheric soil and germinating seed diffusates (SD) released in plain agar medium were used at different concentrations to analyze possible impacts of the weed in *Raphanus* seed germination in *in vitro* condition. The *Raphanus* seeds (30) were soaked in respective concentrations of plant as well as seed diffusates for about 24 h. These seeds were plated in different petriplates provided with three layers of water soaked filter papers. The system was left in dark for about 10-12 h. and the data was taken then after.

These allelochemicals were found strictly inhibitory in *Raphanus* seed germination. The water imbibed (24 h.) seeds were viable up to 91.66% (at $25 \pm 1^\circ\text{C}$) whose germination was decreased to 0% by 100% solution of plant diffusates and to 13.33% by 100% seed diffusates. Accordingly the inhibition by plant diffusates was up to 100% and that of seed diffusates was up to 86.66%.

Again 15 *Raphanus* seeds were soaked separately in 0% (D/W), 100% PD solution and 100% SD solution. The system was left up to 12 h. in dark. The germinating seeds were boiled and homogenized in water separately and the extract was prepared. The level of glucose on each extract was then estimated by Somogyi's and Nelson (1951) colorimetric method.

The allelochemicals used were found effective to minimize the glucose level in those germinating seeds. Plant diffusates (100%) minimized the glucose level by 55% (0.151×10^{-9} gm /seed) while seed diffusates (100%) minimized by 37% (0.211×10^{-9} gm /seed) in comparison to that of the control (0.355×10^{-9} gm /seed).

The possible effects of plant essential oils from eucalyptus, camphor, and lemongrass in *Parthenium* seed germination was also analyzed using their different concentrations (0 to 20 ml l⁻¹). Water imbibed (36 h.) seeds (20) were germinated at 25 °C ± 1 in petriplate containing 3 layers of distilled water soaked filter papers providing 1.5 ml of particular concentration of a given essential oil. Experiment was carried out with three replicas and an average value was derived for results. Observations were made at an interval of 24 hrs from the 4th day of incubation till 20th day.

The entire 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 oil at 8 ml l⁻¹, Cinnamomum and Eucalyptus oil each at 12 ml l⁻¹ inhibited the germination of *Parthenium* seeds completely. None of the seeds 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). The seedling lengths in 4 ml l⁻¹ of Lemon grass, 8 ml l⁻¹ of Cinnamomum and 8 ml l⁻¹ of Eucalyptus oil showed similar values. Similar trends in concentration response was found for seedling growth also (LSD= 0.94).

Hence the use of essential oils as bio herbicide to control the seed germination of the noxious weeds *Parthenium* could be one of the alternative ways to check their rapid infestation.

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ACRONYMS

μl	-	Micro litre.
L	-	Litre
H	-	Hours
ml	-	Millilitre
gm.	-	Gram
cm.	-	Centimetre
MS	-	Mass Spectroscopy
GC	-	Gas Chromatography
ml L^{-1} (ml /L)	-	Millilitre per Litre.
$^{\circ}\text{C}$	-	Degree Celcius
rpm	-	Revolutions per minute
PSG	-	Percent seed germination
Conc.	-	Concentration
Sol. ⁿ	-	Solution
Std.	-	Standard
dil.	-	Dilute
prod.	-	Production
Glu.	-	Glucose
D/W (d/w)	-	Distilled water
PD	-	Plant diffusates
SD	-	Seed diffusates
ASL	-	Average seedling length
PSG	-	Parthenium seed germination.
Eu	-	Eucalyptus
Lg	-	Lemon grass
Cn	-	Cinnamomum