https://doi.org/10.56815/IJMRR.V2.I1.2023/75-78
International Journal of Multidisciplinary Research & Reviews
ISSN:2945-3135
Vol 2, No. 01, 2023

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH & REVIEWS
journal homepage: www.ijmrr.online/index.php/home

Allelopathic Impact of *Parthenium hysterophorus* L. Leachate on Seed Germination, Seedling Growth, Plant Height and Node Number of Pea Plant

Awanish Kumar Singh

Department of Botany, Government Girls Degree College, Saiyadraja, Chandauli, U.P, India-232110

How to Cite the Article: Awanish Kumar Singh, Allelopathic Impact Of Parthenium Hysterophorus L. Leachate On Seed Germination, Seedling Growth, Plant Height And Node Number Of Pea Plant. *International Journal of Multidisciplinary Research & Reviews , 2(1).*

Keyword

Allelochemicals;
Allelopathic;
Leaf extract;
Parthenium;
Pisum sativum: Seedling growth.

Abstract

The present study was carried out to investigate the allelopathic effect of leaf and stem leachates of Parthenium hysterophorus on seed germination, seedling growth, plant height, and number of nodes of Pisum sativum. Different concentrations of leachates (0%, 20%, 40%, 60%, and 80%) were applied under controlled conditions. The results indicated that the control showed 100% seed germination, while increasing concentrations of leachates caused inhibitory effects. Maximum inhibition in germination was observed at 60% concentration, whereas slight variation was noted at 80%. Radicle and plumule length decreased progressively with increasing concentration, with maximum reduction recorded at 80%. Similarly, the number of nodes and plant height also declined significantly with higher concentrations, showing the strongest inhibitory effect at 60% and 80%. The study clearly demonstrates a concentration-dependent allelopathic effect of Parthenium hysterophorus, which may be attributed to the presence of phytotoxic chemicals. These findings suggest that this weed can adversely affect crop growth and productivity, highlighting its ecological and agricultural significance.

1. Introduction

Allelopathy is a biological phenomenon in which one plant releases certain chemicals (allelochemicals) that influence the growth, germination, and development of other plants. These chemicals may have inhibitory or stimulatory effects.

Parthenium hysterophorus is a highly invasive weed known for its strong allelopathic properties. It releases toxic compounds such as parthenin, phenolics, and flavonoids into the soil, which adversely affect neighboring plants. Weeds can cause up to Rs.28 billion losses in wheat crop in Pakistan and 2 billion in KPK Province (Hassan and Marat, 2001).

Allelopathy has been considered to play a key role in the success of parthenium weed (*Parthenium hysterophorus* L.), an invasive weed native to the tropical and subtropical Americas (Navie,1996) and now present in more than 50 countries worldwide.

The allelopathic nature of adult *Parthenium hysterophorus* L. (parthenium weed) plants, suppressing the growth and development of its near neighbors, has been implicated in its success as an important invader around the world (BELGERI1 and ADKINS, 2015)

Parthenium is an annual invasive broadleaf herbaceous plant of family Asteraceae. Its life cycle can range from 4 to 8 months under sufficient moisture conditions (Navie *et al.*, 1998; Doley, 1977). T. Tefera (2002) of *Parthenium hysterophorus* extracts on seed germination and seedling growth of *Eragrostis tef* and observed

https://doi.org/10.56815/IJMRR.V2.I1.2023/75-78
International Journal of Multidisciplinary Research & Reviews
ISSN:2945-3135
Vol 2, No. 01, 2023

that increasing concentrations of aqueous extracts of Parthenium from leaf and flower inhibited seed germination and complete failure of seed germination was recorded when the extract concentration from the leaf part was 10 %.

Pea (*Pisum sativum*) is an important leguminous crop used as a model plant in experimental studies. The present study aims to evaluate the allelopathic effect of leaf and stem leachates of *Parthenium hysterophorus* on: Seed germination, Radicle and plumule growth, Number of nodes and Plant height.

Sazada *et al* (2018) determine the allelopathy effects of aqueous extracts of leaves of two medicinal plants of *Sapindus mukorossi* Gaertn and Leucaena leucocephala (Lam.) de Wit. on seed germination, radicle length, mitotic index and chromosomal aberrations in two verities of vegetable crop pea.

2. Materials and Methods

Materials required for test are fresh leaves and stems of *Parthenium hysterophorus*, Healthy seeds of Pisum sativum, distilled water, petri dishes, filter paper and measuring cylinder scale (for measuring length)

Leaves and stems of Parthenium were collected, washed, and soaked separately in distilled water to prepare different concentrations (20%, 40%, 60%, 80%). Control was maintained using distilled water only.

Ten pea seeds were placed in petri dishes lined with filter paper. Different concentrations of leaf and stem leachates were applied. Control seeds were treated with distilled water. The experiment was conducted under suitable laboratory conditions. Parameters Studied are percentage of seed germination, radicle length (cm), plumule length (cm), number of nodes and plant height (cm).

3. Result and Discussion

The results clearly indicate that *Parthenium hysterophorus* exhibits strong allelopathic effects on *Pisum sativum*. The observations of the present study clearly show that the control exhibited 100% seed germination. However, with the increase in concentration of *Parthenium hysterophorus* leachate, the percentage of seed germination gradually decreased, indicating inhibitory effects. The maximum inhibition in seed germination was observed at 60% concentration. Radicle growth was more affected than plumule growth, indicating higher sensitivity of roots to allelochemicals

Similarly, the radicle and plumule length of Pisum sativum seedlings showed a decreasing trend with increasing concentration of the leachate. The highest reduction in both radicle and plumule length was recorded at 80% concentration. (Table1-2 and Figure 1).

Table 1. Allelopathic effects of leaf and stem leachate of Parthenium *hysterophorus* on percentage seed germination of *Pisum sativum*

S.N.	Concentration (%)	The percentage of seed germination (% Inhibition)	
		LEAF LEACHATE	STEM LEACHATE
1.	Control	100	100
2.	20%	86.70 (-13.30)	90.35 (-09.65)
3.	40%	93.33 (-06.67)	94.00 (-06.00)
4.	60%	60.00 (-40.00)	67.70 (-32.30)
5.	80%	86.70 (-13.30)	80.50 (-19.50)

The number of nodes also decreased progressively with the increase in concentration of the leachate. The maximum reduction in node number was observed at 60% concentration. Plant height and number of nodes showed a significant decline, suggesting overall suppression of plant development. Maximum inhibition was generally observed at higher concentrations (60%–80%).

https://doi.org/10.56815/IJMRR.V2.I1.2023/75-78
International Journal of Multidisciplinary Research & Reviews
ISSN:2945-3135
Vol 2, No. 01, 2023

Table 2. Allelopathic effects of leaf leachate of *Parthenium hysterophorus* on radicle and plumule length of *Pisum sativum.*

S.N.	Concentration (%)	RADICLE LENGTH (in cm)	PLUMULE LENGTH (in cm)
1.	Control	6.66	5.50
2.	20%	5.16 (-22.52)	5.10 (-7.27)
3.	40%	4.64 (-30.78)	4.16 (-24.36)
4.	60%	4.40 (-33.93)	3.50 (-36.36)
5.	80%	3.37 (-49.33)	2.88 (-47.63)

Plant height and number of nodes showed a significant decline, suggesting overall suppression of plant development. Maximum inhibition was generally observed at higher concentrations (60%–80%). Maximum inhibition (82.1%) in 60% concentration of *Parthenium* leaf and minimum inhibition (16.7%) in 20% concertation of *Parthenium* leaf leachates. (Table 3, Figure 2).

These inhibitory effects may be due to the presence of allelochemicals such as parthenin, which interfere with: cell division, enzyme activity and nutrient uptake. Thus, *Parthenium* acts as a harmful weed affecting crop productivity.

Table 3. Allelopathic effects of leaf leachate of *Parthenium hysterophorus* on Number of nodes and height of plant of *Pisum sativum.*

S.N.	Concentration (%)	Number of nodes	Height of plant in cm
1.	Control	4.88	12.91
2.	20%	4.26 (-12.70)	10.75 (-16.73)
3.	40%	3.50 (-28.27)	5.48 (-57.55)
4.	60%	2.40 (-50.81)	2.30 (-82.18)
5.	80%	3.37 (-30.94)	4.78 (-62.97)

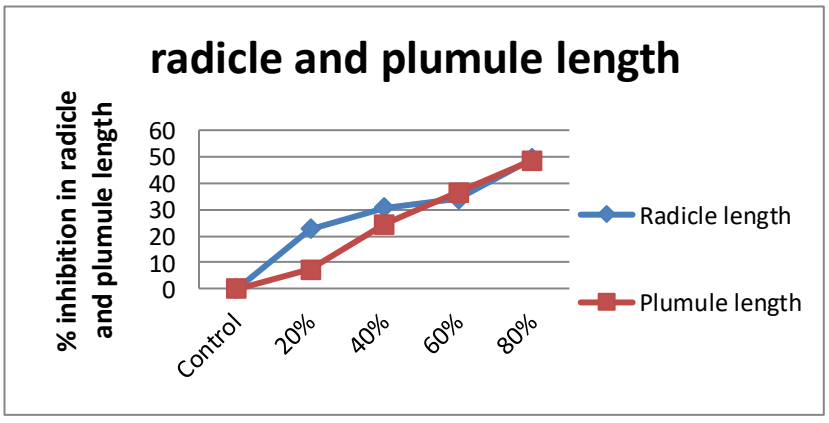

Fig 1. Allelopathic effects of leaf leachate of *Parthenium hysterophorus* on percentage inhibition in radicle and plumule length of *Pisum sativum.*

https://doi.org/10.56815/IJMRR.V2.I1.2023/75-78
International Journal of Multidisciplinary Research & Reviews
ISSN:2945-3135
Vol 2, No. 01, 2023

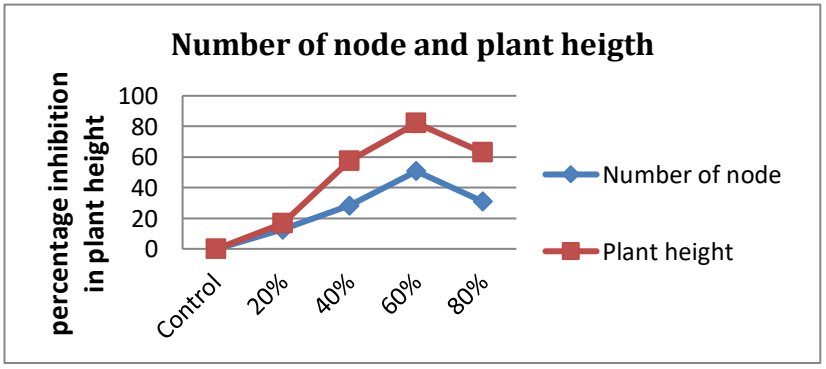

Fig 2. Allelopathic effects of leaf leachate of *Parthenium hysterophorus* on percentage inhibition in number of node and plant height of *Pisum sativum.*

4. Conclusion

The study concludes that *Parthenium hysterophorus* has strong allelopathic potential. Its leaf and stem leachates significantly inhibit germination and growth of pea plants. Higher concentrations show greater inhibitory effects. This highlights the need for proper management of Parthenium to protect agricultural crops.

Reference

1. A Belgiri A. and ADKINS S. W. (2015), Allelopathic potential of invasive parthenium weed (*Parthenium hysterophorus* L.) seedlings on grassland species in Australia, Allelopathy Journal 36 (1): 1-14 0971-4693/94
2. Doley, D. 1977. Parthenium weed (*Parthenium hysterophorus* L.): gas exchange characteristics as a basis for prediction of its geographical distribution. Aus. J. Agric. Res. 28:449-460.
3. Duke, S.O. (2010). Allelopathy: Current status and future goals.
4. Hassan, G. and K. B. Marwat. 2001. Integrated weed management in agricultural crops. In: National Workshop on Technologies for Sustainable Agriculture, Sep. 24-26, 2001, NIAB, Faisalabad Pakistan.
5. Inderjit & Dakshini, K.M.M. (1995). On laboratory bioassays in allelopathy. The Botanical Review.
6. Narwal, S.S. (2000). Allelopathy in ecological agriculture. Scientific Publishers.
7. Navie, S.C., Mc. Panetta, R.E. Fadyen, and S.W. Adkins. 1998. Behaviour of buried and surface-sown seeds of *Parthenium hysterophorus*. Weed Res. 38:335-341.
8. Navie, S.C., McFadyen, R.E., Panetta, F.D. and Adkins, S.W. (1996). The biology of Australian weeds. 27. *Parthenium hysterophorus* L. Plant Protection Quarterly 11(2): 76-88.
9. Rice, E.L. (1984). Allelopathy. Academic Press.
10. Singh A.K. (2021). Allelopathic effect of *Ageratum conyzoides* L. on seed germination and growth of pea varieties. International Journal of Biological Innovations. 3 (1): 194-198. E-ISSN: 2582-1032.https://doi.org/10.46505/IJBI.2021.3120
11. Siddiqui et al (2018) Allelopathic and Cytotoxic Effects of Medicinal Plants on Vegetable Crop Pea (*Pisum sativum*), The Japan Mendel Society Cytologia 83(3): 277–282
12. Singh, H.P., Batish, D.R., & Kohli, R.K. (2003). Allelopathic interactions and their implications.
13. Tefera, T. 2002. Allelopathic effects of *Parthenium hysterophorus* L. extracts on seed germination and seedling growth of *Eragrostis tef*. J. Agron. Crop. Sci. 188(5):306-310.