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Inhibitory effects of *Pluchea lanceolata* leachate on seed germination and seedling growth of two varieties of Wheat

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Keyword

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Triticum aestivum.

Abstract

The present study was conducted to evaluate the allelopathic effects of stem and root leachates of Pluchea lanceolata on seed germination and seedling growth of two wheat varieties (UP 2338 and HUW 234). Different concentrations (5%, 10%, 15%, and 20%) of leachates Pluchea lanceolata were applied under laboratory conditions. Results revealed that increasing concentration of leachates significantly reduced germination percentage, shoot length, and root length. Root growth was found to be more sensitive than shoot growth. Root leachate exhibited stronger inhibitory effects compared to stem leachate. Among the two varieties, HUW 234 showed relatively higher tolerance than UP 2338. The study highlights the importance of allelopathy in crop–weed interactions.

1. Introduction

Allelopathy is a biological phenomenon in which plants release chemical substances (allelochemicals) that influence the growth and development of other plants. These effects can be either inhibitory or stimulatory depending on the concentration and nature of the compounds.

Weeds like *Pluchea lanceolata* are known to produce allelochemicals that interfere with crop growth. These chemicals affect seed germination, root elongation, and shoot development. Wheat (*Triticum aestivum*) is an important cereal crop, and understanding weed–crop interaction is essential for improving productivity. The present study was conducted to evaluate the allelopathic effects of stem and root leachates of *Pluchea lanceolata* on seed germination and seedling growth of wheat varieties UP 2338 and HUW 234. Invasion by the alien plant species is responsible for the homogenization of floras and is a substantial threat to biodiversity and ecological integrity of native habitats and ecosystems (Booth 2003).

P. lanceolata amended soils reduced seed germination, number of nodes, internodes length, shoot and root length, nodule number and weight, and chlorophyll a and b of asparagus bean (Indrajeet 1992, Dongre *et al* 2010).

Several researchers have reported the inhibitory effects of weeds on crop plants. Rice (1984) defined allelopathy as the direct or indirect harmful or beneficial effect of one plant on another through chemical compounds released into the environment. These compounds include phenolics, alkaloids, flavonoids, and terpenoids.

Narwal (1996) reported that allelopathic interactions play a significant role in agroecosystems and can reduce crop yield by interfering with germination and seedling growth. Similarly, Inderjit and Dakshini (1995) observed that aqueous extracts of many weeds significantly reduced germination and growth of crop plants. Studies by Chou (1999) demonstrated that allelochemicals inhibit physiological processes such as cell division, nutrient uptake, and enzyme activity, ultimately reducing plant growth. Root growth is often more sensitive to allelopathic stress because roots are directly exposed to toxic substances in the soil.

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Batish *et al*. (2001) and Dongre and Singh (2007) reported that weed extracts caused significant inhibition in wheat seed germination and seedling growth, and the degree of inhibition increased with concentration. This supports the dose-dependent response observed in the present study. Singh *et al*. (2003) found that allelopathic effects vary among crop varieties, indicating genetic variability in tolerance. This is consistent with the present findings where wheat varieties UP 2338 and HUW 234 showed differential responses.

2. Materials And Methods

I use healthy seeds of wheat varieties UP 2338 and HUW 234 for experiment. Fresh stem and root parts of Pluchea lanceolata were collected, washed, and soaked in distilled water to prepare aqueous extracts. Different concentrations (5%, 10%, 15%, and 20%) were prepared using water and stock solution. Seeds were placed in sterilized Petri dishes lined with filter paper. Each treatment received a specific concentration of leachate. Control was maintained with distilled water. The experiment was conducted under laboratory conditions. I studied in this experiment percentage seed germination, shoot length (in cm) and root length (in cm). Data were analyzed, and Critical Difference (CD) at 5% level was calculated.

3. Results And Discussion

Seed germination percentage decreased progressively with increasing concentrations of leachates. Similarly, shoot length showed a gradual reduction with higher concentrations, indicating an inhibitory effect on plant growth. Root length was more severely affected compared to shoot length, suggesting that roots are more sensitive to allelochemicals. Furthermore, root leachate exhibited stronger inhibitory effects than stem leachate at corresponding concentrations. Among the two wheat varieties, HUW 234 showed comparatively less reduction in growth parameters, indicating greater tolerance, whereas UP 2338 was found to be more sensitive to the allelopathic effects. (Dongre and Singh 2011).

Maximum seed germination was observed in the control treatment (approximately 93%), while a significant decrease was recorded at higher concentrations (15% and 20%). (Table 1-2)

Table 1. Allelopathic Effects of stem and root leachate of *Pluchea lanceolata* on % seed germination of wheat

S.N.	CONCENTRATION (%)	% seed germination			
		Stem leachate		Root leachate	
		UP 2338	HUW 234	UP 2338	HUW 234
1.	Control	93.2	92.0	93.2	92.0
2.	5	93.2(0.0)	90.8(-1.3)	92.4(-0.8)	92.0(0.0)
3.	10	84.0(-9.8)	88.8(-3.4)	86.0(-7.7)	92.4(0.4)
4.	15	82.4(-11.58)	89.2(-3.0)	72.4(-22.3)	91.8(-0.2)
5.	20	90.0(-3.4)	89.2(-3.0)	64.0(-31.3)	91.0(-1.0)
CD at 5%		4.4	1.95	3.5	1.92

The root leachate at 20% concentration caused the maximum inhibition, showing about 31% reduction in variety UP 2338. Similarly, shoot length decreased gradually with increasing concentration, where in UP 2338 it declined from 8.3 cm in control to 7.7 cm at 20%, while HUW 234 also showed a reduction compared to control.

Root length was found to be the most sensitive parameter under allelopathic stress, as in UP 2338 it decreased from 5.9 cm in control to 4.0 cm at 20% concentration. However, HUW 234 exhibited comparatively less reduction in root length, indicating better tolerance.

The results clearly indicate that allelopathic compounds present in Pluchea lanceolata inhibit seed germination and seedling growth in wheat. The inhibitory effect increased with concentration, confirming a dose-dependent relationship. (Singh et al 2003, Singh 2012)

Root growth was more affected than shoot growth, which is consistent with the fact that roots are directly exposed to allelochemicals. The stronger inhibitory effect of root leachate suggests higher concentration of toxic

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compounds in roots. (Batish et al 2001 Dongre et al 2004).

Table 2. Allelopathic Effects of stem leachate of *Pluchea lanceolata* on shoot length and root length of wheat.

S.N.	concentration (%)	Shoot length (cm)		Root length (cm)	
		Stem leachate		Stem leachate	
		UP 2338	HUW 234	UP 2338	HUW 234
1.	**Control**	8.3	7.74	5.9	7.22
2.	**5**	8.1 (-2.4)	7.2(-6.9)	5.7(-3.3)	7.18(-0.2)
3.	**10**	7.8(-6.0)	7.10(-8.2)	5.5(-6.7)	7.18(-0.5)
4.	**15**	7.8(-6.0)	6.88(-11.1)	5.0(-1.52)	7.18(-0.5)
5.	**20**	7.7(-7.2)	7.08(-8.3)	4.0(-32.2)	7.15(-0.9)
CD at 5%		0.33	0.41	0.21	0.23

Differences between wheat varieties indicate genetic variability in tolerance. HUW 234 appeared more tolerant, while UP 2338 was more sensitive to allelopathic stress. These findings are in agreement with earlier studies on weed allelopathy affecting crop growth.

4. Conclusion

The present study clearly demonstrates that Pluchea lanceolata possesses strong allelopathic potential, significantly influencing seed germination and seedling growth of wheat. The inhibitory effects were found to be concentration-dependent, with increasing concentrations of leachates causing a marked reduction in germination percentage as well as growth parameters. Among the different parameters studied, root growth was the most sensitive to allelopathic stress, showing greater inhibition compared to shoot growth, which may be due to the direct exposure of roots to allelochemicals. Furthermore, root leachate exhibited comparatively stronger inhibitory effects than stem leachate, indicating a higher concentration or activity of toxic compounds in root tissues. A clear varietal difference was also observed, where wheat variety HUW 234 showed relatively higher tolerance, while UP 2338 was more susceptible to the allelopathic effects. Overall, the findings highlight the significant role of allelopathy in crop–weed interactions and emphasize the need for effective management of such weeds to minimize their adverse impact on crop productivity.

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