

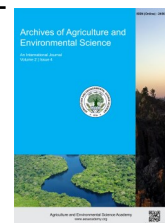


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ORIGINAL RESEARCH ARTICLE



## Allelopathic effects of *Juglans regia* leaf extract on seed germination and seedling growth of wheat (*Triticum aestivum*) and rye (*Secale cereale*)

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### ABSTRACT

This investigation was conducted to study the allelopathic effects of *Juglans regia* (Walnut) leaf extract on seed germination and seedling growth of wheat (*Triticum aestivum*) and rye (*Secale cereale*). For this *J. regia* leaves extract was selected to analyze its allelopathic effects on seed germination and seedling growth of wheat and rye seeds. Applied seeds was treated with *J. regia* leaves extract using 2%, 4% and 6% concentrations. Different parameters i.e., seed germination, seedling growth, mortality percentage, fresh and dry weight of plumule and radicle was observed after the experiments. The higher seed germination percentage (50%) was recorded at 2% level, in both the applied seeds, which is followed by 4% in comparison to control. Almost higher concentration showed deleterious effects than the lower doses on germination percentage and seedling growth. The highest mortality percentage (70%) has been recorded at 4% level in wheat and 6% level in both wheat and rye seeds. Therefore, the results indicated that the growing weeds in high quantity between crops can affect the productivity rate of crops due to its allelopathic effects. The allelopathic compounds can be used as natural herbicides and other pesticides; they are less disruptive of the global ecosystem than are synthetic agrochemicals.

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### INTRODUCTION

Allelopathy is a natural ecological phenomenon by which one organism produces biochemicals that influence the growth, survival, development, and reproduction of other organisms and it has been known and used in agriculture since ancient times (Zeng, 2014). It can stimulate or inhibit plant germination and growth, and permit the development of crops with low phytotoxic residue amounts in water and soil, thus facilitating wastewater treatment and recycling (Macias *et al.*, 2003). It have also great potential to minimize the introduction of refractory chemicals and effectively control weeds in farmland ecosystems, represent the most promising application of allelopathy (Mahmoud and Croteau, 2002; Weston and Duke, 2003; Fragasso *et al.*, 2013). Allelopathy is concerned with the

effects of chemicals produced by plants or microorganisms on the growth, development and distribution of other plants and microorganisms in natural communities or agricultural systems (Einhellig, 1995). It is any positive or negative effect of one plant on another through the production of chemicals that are released into the environment (Thi *et al.*, 2015). Allelochemicals are also a suitable substitute for synthetic herbicides because allelochemicals do not have residual or toxic effects, although the efficacy and specificity of many allelochemicals are limited (Bhadoria, 2011; Li *et al.*, 2010; Jabran *et al.*, 2015). The main objectives of research on allelopathy include the application of the observed allelopathic effects to agricultural production and provision of effective methods for the sustainable development of agricultural production and ecological systems.

## MATERIALS AND METHODS

The leaves of *J. regia* were collected from Rajouri (J&K), India and were separately cut using a pair of shears and dried under shade for 20 days until all the moisture present in leaves. The completely dried leaves then grinded using a pestle mortar into fine power. Then different amount of *Juglan* leaves powder were separately soaked at room temperature 25°C in 100 ml of distilled water dissolved and left for 24 hours. Then filter it through two layers of filters paper to use their aqueous. The experiment was carried out with seven Petri dishes that was arranged inside the laboratory and lined with single layer of filter papers. Seeds of wheat and rye were thoroughly cleaned manually and 10 seeds of each crop were carefully placed into each Petri dish using a forceps. Out of seven Petri dishes, one was treated with distilled water as control set for both applied crops wheat and rye, and six Petri dishes with different concentration of *Juglan* leaf extract.

The aqueous obtained previously from the leaves of *Juglan* was applied on each Petri dishes marked as 2%,4% and 6% and distilled water was applied for the control Petri dishes using dropper.

All Petri dishes were kept at room temperature 25°C and continuously treated with water and respective *J. regia* concentration. This action was continued throughout the course of the experiment. After noting seed germination, seedling was allowed to grow up. The experiment was looked after regularly for its entire duration of 10 days. Those seeds inside all Petri dishes were considered germination whose appeared and counted visually. This activity was undertaken for 2 weeks until all the seeds either germinated and or expired. The root and shoot length of all the seedlings were measured using a scale while fresh and dry weight was measured using electric balance on the 10 days of experimentation. The seed germination, mortality percentage, seedlings growth, fresh and dry weight of plumule and radicle were observed during the present investigation. Statistical software was used for the analysis of variance (ANOVA).

## RESULTS AND DISCUSSION

The allelopathic effects of aqueous leaf extracts from *J. regia* at different 2%, 4% and 6% level have examined on the seed germination and seedling growth of wheat (*T. aestivum*) and rye (*S. cereale*) seeds. Germination percentage of treated seed (Wheat and Rye) shown in Figures 1 and 2. The germination was not seen at any dose including control for 3 days in the primary stage. On the fourth day of experiment, germination was observed for the first time in the control, 2% and 4% level. In all the applied treatments, the highest 50% germination was recorded at 4% level after 7 days, which was 10% less than in control. No intermediate germination was observed for 4 days even in Rye seeds. Germination started on the fifth day in Rye seeds and compared to control, only 2% level recorded 20% and 4% level recorded 10% germination. Whereas in these 5 days there was no seed germinated was in 6% level. Seeds germinated in all levels on sixth day as compared to control and highest 50% germination has noticed in 2% level and 40% germination in 4% level. The poor seedling growth rate has observed in all treated seeds at different level in comparison to control (Table 1). Only 2% concentration was found effective for all parameters in wheat and rye seeds. The maximum 4.4 cm. plumule and 2.7 cm. radicle length was recorded at this level in wheat seed. Compared to the control, the treated seeds with higher concentration were seen to have a bad effect of *J. regia*. Mortality percentage of the treated seeds has also been observed (Figure 3). Highest 70% mortality recorded at 4% and 6% level in both wheat and rye seeds in comparison to control. ANOVA (Table 2) shows that the calculated values of F are greater than the table value of F at 5% level of significance for  $V_1$  3 and  $V_2$  27, hence, both the null-hypothesis are rejected. Therefore, it is concluded that the difference arisen due to the treatment of *J. regia* leaf extract at 2%, 4% and 6% level and the difference in seedling growth (plumule and radicle length) of wheat and rye seed output due to the allelopathic effects of *J. regia*. The average fresh and dry weight of plumule and radicle of both applied crops have been observed (Table 3). It is analyzed statistically for the accuracy of a sample mean by measuring the sample-to-sample variability.

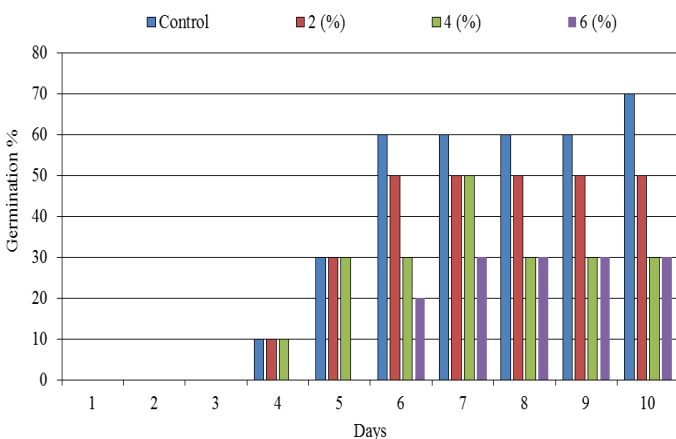


Figure 1. Effects of different concentrations of *J. regia* leaf extract on germination percentage of wheat.

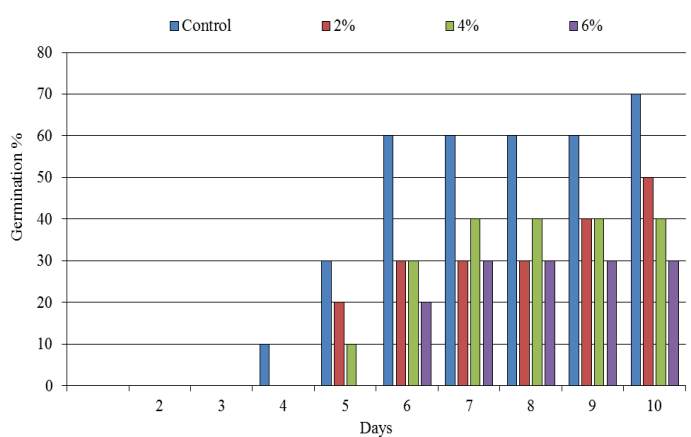
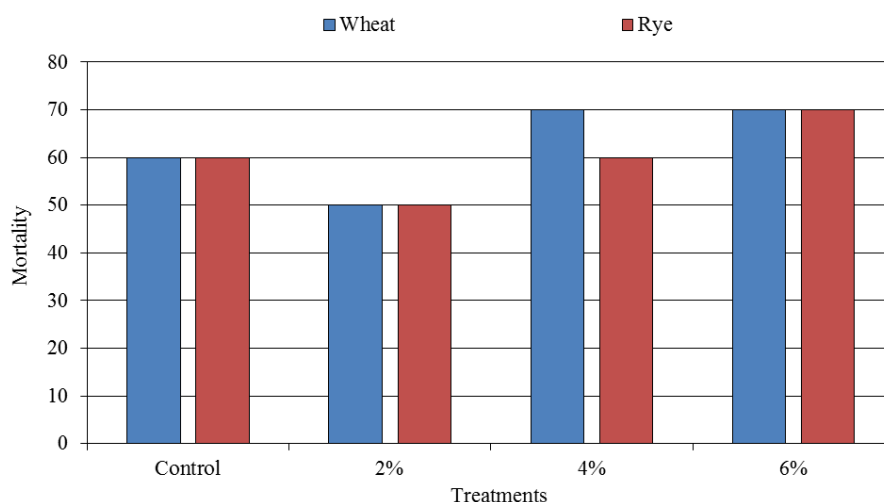


Figure 2. Effects of different concentrations of *J. regia* leaf extract on germination percentage of rye.



**Figure 3.** Effects of different concentrations of *J. regia* leaf extract on mortality percentage of wheat and rye after 10 days.

**Table 1.** Effects of different concentration of *J. regia* leaf extract on average plumule length (PL) and radicle length (RL) (cm.) of wheat and rye.

Wheat ( <i>T. aestivum</i> )											
Treatments	Parameters	Days									
		1	2	3	4	5	6	7	8	9	10
Control	PL	-	.7	1.7	2.0	3.8	4.7	5.4	7.6	8.4	10.6
	RL	-	.4	.8	1.8	2.3	3.8	4.0	5.5	6.5	7.0
2%	PL	-	-	-	.3	.8	1.1	1.6	2.1	3.5	4.4
	RL	-	-	-	.2	.3	.5	.8	1.5	2.3	2.7
4%	PL	-	-	-	-	.5	1.0	1.5	2.1	2.8	3.7
	RL	-	-	-	.2	.4	.9	1.1	1.8	2.3	3.3
6%	PL	-	-	-	-	-	.4	.7	.8	1.4	1.7
	RL	-	-	-	-	-	.3	.6	.9	1.8	2.1
Rye ( <i>S. cereale</i> )											
2%	PL	-	-	-	.2	.5	1.0	1.4	2.5	3.0	3.5
	RL	-	-	-	-	.2	.4	1.0	1.3	2.0	2.8
4%	PL	-	-	-	-	.3	.6	.8	1.2	1.8	2.7
	RL	-	-	-	-	.4	.8	1.2	1.5	1.8	2.2
6%	PL	-	-	-	-	-	.2	.4	.7	1.0	1.5
	RL	-	-	-	-	-	.2	.6	1.1	1.5	1.8

**Table 2.** ANOVA for plumule (PL) and radicle length (RL) of wheat and rye.

Wheat	SS		DF	MS		F-ratio		TVR (f)
	PL	RL		PL/RL	PL	RL	PL	
Dose	94.8	44.5	3	31.6	14.8	19.7	18.7	2.92
Days	109.5	65.3	9	12.1	7.2	7.5	9.1	2.21
Error	43.4	21.5	27	1.6	.79	-	-	-
Rye								
Dose	106.9	47.95	3	35.6	15.9	30.4	19.3	2.92
Days	171.5	55.96	9	19.0	6.2	16.2	7.5	2.21
Error	31.66	22.49	27	1.17	0.82	-	-	-

**Table 3.** Effects of different concentration of *J. regia* leaf extract on average fresh and dry weight (mg.) of plumule and radicle of wheat and rye.

Wheat ( <i>T. aestivum</i> )				
Treatments	Plumule		Radicle	
	Fresh weight (mg)	Dry weight (mg)	Fresh weight (mg)	Dry weight (mg)
Control	1.90±0.04	0.44±0.02	1.05±0.23	0.32±0.03
2%	0.63±0.02	0.22±0.01	0.54±0.01	0.24±0.01
4%	0.91±0.03	0.13±0.01	0.85±0.02	0.33±0.02
6%	0.15±0.01	0.025±0.01	0.49±0.01	0.20±0.01
Rye ( <i>S. cereale</i> )				
2%	0.54±0.02	0.22±0.01	0.47±0.01	0.21±0.01
4%	0.52±0.01	0.17±0.01	0.23±0.02	0.10±0.00
6%	0.17±0.00	0.043±0.00	0.13±0.01	0.012±0.00

Mean±SE of means

inhibited the radicle length and growth of wheat seedlings (Abu-Romman et al., 2010). Growth hormones played a significant role to promote seed germination and seedling growth of plants, but due to the interference of allelochemicals, it suppresses the activation of hormones. The reduction in seedling roots length may be attributed to the reduced rate of cell division due to the presence of allelochemicals, which might inhibit gibberellin and indoleacetic acid function (Tomaszewski and Thimann, 1966). The allelochemicals mixed with water in soil and all plants intake through absorption process. Therefore, the inhibitory effect may be due to the entry of water soluble allelochemicals into the seed. In this study, *J. regia* leaves extract inhibited radicle and plumule lengths of the wheat and rye seeds. Higher concentration showed negative results in the growth of seedling in comparison of control. Kayode and Adanlawo (1997) also reported similar results; they revealed that the extracts from leaves of *Gliricidia sepium* had inhibitory effects on the growth of radicle and plumule of cowpea (*Vigna unguiculata*). This can be attributed to the fact that low dose of phenolic compounds stimulates protein synthesis and activation of antioxidant enzymes which are effective in plant protection (Kleiner et al., 1999), while high levels of phenolic application result in plant damage (Dabgar and Kumbhar, 2010).

### Conclusion

Weeds are mainly harmful to the growth and production of crops. Various types of chemical substances are used to protect crops from their side effects. Commonly it absorbs the nutrition received by the crops. However, at the same time, they also secrete such harmful chemical substances by which insect, moths and other living organisms do not harm the crops. It is known from this study that growing weeds in high quantity between crops can affect the productivity rate of crops due to its allelopathic effects. The allelopathic compounds can be used as natural herbicides and other pesticides; they are less disruptive of the global ecosystem than are synthetic agrochemicals.

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