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Allelopathic potential of *Notholirion thomsonianum* (D.Don) stapf

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Abstract

The present study was conducted to assess the allelopathic potential of *Notholirion thomsonianum* (D.Don) Stapf against *Triticum aestivum* by using extract of plant parts. The plant material was collected from swat and dried at room temperature (25˚C- 30˚C). Allelopathic potential was evaluated by conducting experiments in laboratory. The aqueous and hot water treatments were more effective than the liter and mulching experiments. The aqueous extract obtained after 48h has shown more inhibition than the extract obtained after 24h. All the experiments with increase in concentration and duration have shown that the germination declined significantly. Plumule growth, seminal roots length and radical growth inhibited significantly. The fresh and dry weights were decreased. It is suggested that the various assayed parts of *Notholirion thomsonianum* have strong allelopathic potential against the tested specie. Further investigation is required to see its allelopathic behavior under field condition against its associated species and to identify the toxic principles.

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Introduction

Allelopathy is a biochemical interaction among plants within a common habitat (Macías *et al*., 2007; Duke, 2007). Allelopathy plays a prominent role in ecology and evolution of plant communities. However, its pervasive interacting nature intrigues and challenges scientists understand its mechanism of action (Mallik, 2008). Several authors have published convincing evidence of allelopathy as ecological mechanism (Bias *et al*., 2002, 2003; Callaway & Aschehoug, 2000; Inderjit & Callaway, 2003). Many researchers have evaluated the allelopathic potential with its action of mechanism (Mallik, 2008; Vivanco *et al*., 2004; Thorpe *et al*., 2009). Allelopathic effect of plants has shown by many workers like *Sacchrum spontaneum* (Hussain *et al*., 2010), *Sacchrum officinarum* (Sampietro *et al*., 2007; Pushpa *et al*., 2009), *Cenchrus ciliaris* and *Bothriochloa pertusa* (Hussain and Illahi, 2009; Hussain *et al*., 2010, 2011), *Eucalyptus microtheca* (Gillani *et al*., 2002), *Azadirachta indica* A Juss. (Xuan *et al*, 2004), *Broussonetia papyrifera* Vent (Hussain *et al*, 2004). Allelopathy exhibited by members of family liliaceae (Marize *et al*., 2010), onion (Macías, 2000), *Chameascilla corymbosa* (Allan *et al*., 2009) and *Nothoririon bulbuliferum* (Fanqlong *et al*., 1982) has also been reported.

The review reveals that no such study was conducted on *Notholirion thomsonianum*, which is a species from the rain-shadow part of the western Himalayas. It has winter-growing foliage and flowers in late spring, then requires a dry (but not desiccating) summer dormancy. It withstands frost if covered against excessive winter rain. The flowers are lightly fragrant. The present study was conducted to assess its allelopathic potential.

Materials and methods

Shoots and foliage of *Notholirion thomsonium* were collected from Swat and shade dried at room temperature (25˚C- 30˚C). The dried material was powdered and stored in paper bags. Glassware, thoroughly washed with tap water, was sterilized at 170˚C for at least 4 hours. The detail of procedure is given in many papers for evaluating allelopathic potential (Hussain *et al*., 2010, 2011).

Effect of aqueous extracts

Five and ten gm of each powdered parts (shoot and foliage) were soaked in 100 ml distilled water at 25˚C for 24 and 48 hours and filtered to get aqueous extracts. These extracts were tested against *Triticum aestivum* on 2-folds of filter paper in Petri dishes. The filter papers were moistened with the respective extracts, while distilled water was used as a control. For each treatment, five replicates, each with 10 seeds were made. The Petri dishes were incubated at 25˚C. After 72 hours, % germination, growth of plumule and radical were noted. Twenty seedlings were randomly taken out for fresh and dry weight determination. Seedlings were dried at 65˚C for 72 hours.

Effect of hot water extracts

Five gm dried plant parts (shoot and foliage) were boiled in 100 ml of water for 5 minutes and filtered. The room cooled extracts were applied against the same test species as before.

Effect of litter

Five gm litter of powdered shoot and foliage were crushed and spread on one fold of filter paper in a Petri dish. The filter papers were moistened with 5ml distilled water. In control treatment fine pieces of filter paper were used for each treatment and five replicates each with 10 seeds were made. The Petri dishes were incubated at 25˚C. After 72 hours % germination, growth of plumule and radical were recorded. Twenty seedlings were randomly taken out for fresh and dry weight.

Effect of mulching

Five gm crushed dried parts (shoot and foliage) were placed in plastic glasses containing sterilized moist sand for test. Control consisted of sand only. For each treatment five replicates, each with 10 seeds was made. The plastic glasses were incubated at 25˚C and daily observed for germination. After germination the glasses were transferred to light at

room temperature (25-30˚C). Plumule and radical growth were measured after 15 days. Twenty seedlings were randomly taken out for determining fresh and dry weight and moisture contents.

Table 1. Effect of aqueous extract on germination, plumule and radical growth, fresh and dry weight and moisture contents of *Triticum aestivum*. Each value is a mean of 5 replicates each with 10 seedlings.

Treatment		Soaking duration and concentration			
		5g/24h	5g/48h	10g/24h	10g/48h
Germination %	Control	100	100	100	100
	Test	77.9*	74**	92	90
	% of control	77.9	74	92	90
Plumule growth(mm)	Control	7.37	51.3	7.1	52.3
	Test	20.2	8.31**	11.56	11.36*
	% of control	101.0	15.8	66.5	21.7
Radical growth(mm)	Control	4.5	43.6	4.41	43.0
	Test	28.9*	18.0***	25.0*	22.18**
	% of control	199.0	41.2	172.4	50.8
Seminal roots (mm)	Control	5.18	5.14	5.1	5.0
	Test	4.9*	5.02	4.8*	4.8
	% of control	94.6	97.6	93.4	93.3
Fresh weight (mg)	Control	4.8	5.16	4.3	5.6
	Test	4.61	5.12*	5.01	4.9*
	% of control	96.0	99.2	104.3	94.9
Dry weight (mg)	Control	4.5	5.0	4.7	5.1
	Test	4.41	4.91	4.41*	4.11*
	% of control	98	98.2	98.0	82.2
Moisture content (%)	Control	6.6	3.1	6.61	3.2
	Test	14.9	4.2	13.6	19.70
	% of control	101.2	131.0	206.6	115.6

*Significant different from control at alpha 0.050 according to one way ANOVA
(*less significant, **moderately significant, ***highly significant)

Results and discussions

Effect of aqueous extracts

The germination was inhibited in all concentrations but at lower concentration (5gm), the germination declined significantly more than the increase in concentration (10gm) even with more duration (Table ١). The plumule however had shown both inhibitory and stimulatory effects as at higher concentrations with more duration, the plumule length was decreased but at lower concentration with less duration the plumule length was stimulated (Table ١). The radical growth declined with increase in concentration and duration. However it showed stimulation at lower concentration with less duration (Table ١). The length of seminal roots decreased with increase in concentrations. Sometimes the root, stem and shoot together shows inhibition (Baber *et al.*, 2009). The fresh weight and dry weight get decreased with increase in concentration and duration. These findings were similar to the allelopathic potential of Walnut on wheat (Roohia *et al.*, 2009). The moisture contents of test specie increased as compare to the control value (Table 1).

Our results agree with the work of many researchers (Hussain *et al.*, 2004, 2010, 2011). Jabeen and ahmed, 2009 reported that the extracts of Onion, Fumeria and Euphorbia have shown inhibition on maize crop with increase in moisture contents. The extract may show inhibition in one test specie while in another test specie the extract can be stimulated the growth (Wilson & Rice, 1968).

Allelopathy involves the addition of some toxic substances into the habitat to render it unfavorable.

The present study shows that the germination and seedling growth of the tested specie was significantly inhibited more than its stimulation by the aqueous extract obtained from various parts of *Notholirion thomsonanum*.

Table 2. Effect of litter and mulching on germination, plumule and radical growth, fresh and dry weight and moisture contents of *Triticum aestivum*. Each value is a mean of five replicates each with 10 seedlings.

Treatment		Germination %	Plumule growth(mm)	Radical growth(mm)	Seminal roots (mm)	Fresh weight (mg)	Dry weight (mg)	Moisture content (%)
Litter	Control	100	33.9	43.6	3.7	3.6	2.8	28.0
	Test	69.9***	17.84**	28.2*	3.1	3.01	1.9	52.1
	% of control	69.9	52.6	64.7	83.7	83.6	67.9	186.0
Mulching	Control	100	80.7	73.4	3.9	5.01	4.11	2.4
	Test	35***	59.4**	71.5	3.2	2.01	1.09*	8.4
	% of control	35	73.6	97.4	82.0	40.1	26.5	35.0

*Significant different from control at alpha 0.050 according to one way ANOVA
(*less significant, **moderately significant, ***highly significant)

Table 3. Effect of hot water extract o n germination, plumule and radical growth, fresh and dry weight and moisture contents of test of *Triticum aestivum*. Each value is a mean of 5 replicates each with 10 seedlings

Treatment	Germination %	Plumule growth(mm)	Radical growth(mm)	Seminal roots (mm)	Fresh weight (mg	Dryweight (mg)	Moisture content (%)
Control	100	35.1	49.5	4.8	4.84	4.12	174
Test	74**	8.31***	18.0***	4.7	3.94	3.54	113*
% of control	74	23.6	36.6	97.9	81.4	85.9	64.9

*Significant different from control at alpha 0.050 according to one way ANOVA
(*less significant, **moderately significant, ***highly significant)

Effect of hot water extracts

The germination and seedling growth in hot water show more inhibition than aqueous extracts. Also the seminal roots show mark decrease in its length. Fresh and dry weights of Triticum aestivum were reduced. Moisture content of *Triticum aestivum* (test specie) was also reduced (Table ٢). Since hot water extracts inhibited the germination and seedling growth of test species, therefore it appeared that hot water extracts retained phytotoxicity and that they were inhibitorier than the cold water extracts. Other researchers (Hussain *et al.,* 2007; Elizabeth *et al.*, 2008; Kamal & Bano, 2008) investigated similar phytotoxicity for other plant species, which further strengthened our results.

Effect of litter and mulching

The germination of test specie decline significantly (Table ٢). The plumule and radical growth decline significantly. Fresh and dry weights of test specie were inhibited much more than its moisture content. The moisture content showed mark increase in its value. Same results were reportd by Hussain & Abidi (1991), Hussain *et al.*, (2004) and Startsev *et al.,* (2008).

These findings suggested that *Notholirion thomsonianum* like Sacchrum spontaneum (Hussain *et al.*, 2010) exhibited strong allelopathic potential by the release of allelochemicals from its various parts to inhibit the growth of test specie. It is suggested that the various assayed parts of

Notholirion thomsonanum have strong allelopathic potential at least against the test species.

Further investigation is required to evaluate its allelopathic potential under field cultivation against its associated species and identify the toxic principles.

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