Research Article

Allelopathic effect of *Callistemon lanceolatus* DC. against two cultivars of *Triticum aestivum* L.

Nazia Shah, Imtiaz Ahmad, Muhammad Imran*, Hina Gul,
Muhammad Jamal Babar, Waqar Ali Shah and Sakina Anwar

Department of Botany, Bacha Khan University, Charsadda-Pakistan

*Corresponding author's email: imranbotany12345@gmail.com

Citation

Nazia Shah, Imtiaz Ahmad, Muhammad Imran, Hina Gul, Muhammad Jamal Babar, Waqar Ali Shah and Sakina Anwar. Allelopathic effect of *Callistemon lanceolatus* DC. against two cultivars of *Triticum aestivum* L. Pure and Applied Biology. Vol. 7, Issue 2, pp783-790. <http://dx.doi.org/10.19045/bspab.2018.70097>

Received: 17/03/2018

Revised: 05/06/2018

Accepted: 21/06/2018

Online First: 28/06/2018

Abstract

Generally, the plants have effects on the other plants growing in their vicinity. The plants may have both positive and negative effects on each other. The purposes of the current study were to assess the allelopathic capability of *Callistemon lanceolatus* against the two cultivars of *Triticum aestivum*, under laboratory condition. Allelopathic potential of the plant was determined using aqueous extracts of various parts of the plant. Aqueous extract of leaves and bark were acquired by independently soaking 5gm and 10gm powder in 100 ml distilled water for 24, 48 and 72 hours. The results revealed that allelopathic potential of the plant was both dose and soaking duration dependent. Generally, extract of higher concentration i.e. 10gm/100 ml soaked for higher duration (72 hours) were more inhibitory than lower concentrations (5gm/100 and shorter soaking duration 24 and 48 hours). Hot water extracts, Litter and mulches of the plant also significantly repressed seed germination and the general development of both the test crops. Seminal roots numbers were also suppressed by all the treatments used in the study. It was concluded that the plant has strong allelopathic potential. Further investigation is required to isolate the chemicals that triggered inhibition which may provide base to for the development of novel synthetic pesticides. The study further suggests that cultivation of the plant should be avoided in the vicinity of the crop fields.

Keywords: Allelopathy; Aqueous extract; *Callistemon lanceolatus*; Phytotoxicity; *Triticum aestivum*

Introduction

Allelopathy is a mechanism in which chemicals produced by the plants may increase or decrease the growth of associated plants. Plants live in associations relying on the biological necessities. In nature whenever two or more than two species live in the same place, they are dependent on each other for numerous requirements for their growth [1]. Allelopathy is a complex characteristic process that activates along with rivalry to

suppress lastly eliminate susceptible related species from the common environment [2, 3]. Allelopathy can likewise be a valuable natural as well as biological control agent. [4, 5]. Recent research work identified a number of allelopathic plant species including *Imperata Clindrica* [6], *Anagallis arvensis* [7], *Accacia nilotica* and *Eucalyptus rostrate* [8], *Parthenium hysterophorus* [9], *Ficus infectoria*, *Prosopis juliflora*, *Emblca officinalis* and *Acacia leucophloea* [10] and *Jatropha*

curcas [11]. Similarly, the allelopathy of *Vitex negundo* [12], *Sorghum vulgar*, *Nerium oleander*, *Datura inoxia*, *Nicotiana tabacum*, *Ricinus communis* and *Crocus sativus* [13], *Celtis australis* [14] and *Leucaena leucocephala* [15] has also been worked out. [16] investigated *Cassia angustifolia* for its allelopathic potential. [17] tested the phytotoxicity of *Brachiaria decumbens*. [18] reported that *Cenchrus ciliaris* and *Bothriochloa pertusa* exhibit allelopathy.

Callistemon lanceolatus DC. commonly called Bottle brushes tree belong to the family Myrtaceae. *C. lanceolatus* is a small tree native to east and south-east of Australia and New Zealand, tropical Asia (Pakistan, Sarilanka and Nepal) temperate Asia (Japan, China, Russia), they frequently grow in soggy or wet environments, for example, along stream beds or in territories which are inclined to surges. They also cultivated as ornamentally in the gardens and also along with the fields in Charsadda. Therefore, the current investigations were made to evaluate the potential of *C. lanceolatus* against two different varieties of wheat.

Materials and methods

The freshly bark and leaves of the *C. lanceolatus* were collected and kept in shade at room temperature (25-30 °C) for drying. The dried material was then grinded into fine powder. The grinded powder of the plant parts was kept in small plastic bags for further research activities. Certified seed of two wheat cultivars viz., Millat and Faiz Abad were obtained from authorized dealer.

Aqueous extract bioassay

The powder of the plant in the amount of 5gm and 10gm were separately soaked in 100 ml distilled water, for shorter (24), medium (48) and longer (72) hours' durations. For the aqueous extract bioassays, the Petri dishes were used. The two folds' filter paper moistened with the respective extract were kept in the test petri plates while the same fold filter paper moistened with distilled water used as

control. Each petri plate contained uniformly placed 10 seeds of test crops. The percent germination, radicle, plumule growth, fresh, dry weight, moisture contents and number of seminal roots were recorded after 72 hours. Similarly, in hot aqueous extract bioassay the same procedure was followed but extract acquired through temperature.

Mulching bioassay

The sterilized sand was mixed with 5gm and 10gm of powder. The small plastic pots were filled with the mixture of powder and sand. Ten seeds of both the varieties of test crop species were sown in each pot separately, 5 replicates were made for each treatment. Fine pieces of filter paper were used instead of powder to retain moisture contents in the control treatments. The same data were recorded as for aqueous extract bioassay after 7 days of sowing the seeds.

Litter bioassay: The grinded powder of both the parts of plant were mixed and placed in the petri plates, topped with a single filter paper which was moistened with water. Double sheet of filter paper was used without powder material in the control treatments. Ten seeds of both test species were placed above the filter paper at uniform distance. Five replicates were made for each treatment. The data were recorded after 7 days [14]. All the collected data were recorded and analysed through one-way ANOVA using SPSS 17 version.

Results and discussion

Effect of cold aqueous extracts

The recorded and analyzed data of the aqueous extracts showed significant inhibition in germination, radicle and plumule growth, fresh and dry weight, moisture contents and seminal roots number of both the test crop species. It was observed that higher concentration (10gm/100 ml) with longer soaking duration 72 hours showed maximum inhibition as compared to low concentrations (5gm/100 ml) and shorter (24 hours) and medium (48 hours) soaking

duration respectively. The most susceptible test variety of wheat to all the extracts was found to be F. Abad. The hot water extract was also proven to be inhibitory to the test species. It was also recorded that the cold

extract showed more reduction as compared to hot water extract. Maximum inhibition was recorded for leaves extract as compared to bark (Table 1-4).

Table 1. Effect of aqueous extract of *C. Lanceolatus* on germination of wheat varieties

Treatments/ extracts	Test species	
	<i>T. aestivum</i> (Cultivar Millat)	<i>T. aestivum</i> (Cultivar F. Abad)
	% Germination	% Germination
Control	100.00±0.00	100.00±0.00
5gm/ 100 ml leaf 24 hrs.	73.33±0.43*	66.70±0.53*
5gm/ 100 ml leaf 48 hrs.	70.10±0.18*	60.00±0.08*
5gm/ 100 ml leaf 72 hrs.	69.00±0.43*	53.70±0.01*
10gm/ 100 ml leaf 24 hrs.	66.06±0.11*	56.70±0.03*
10gm/ 100 ml leaf 48 hrs.	60.30±0.01*	50.00±0.00*
10gm/ 100 ml leaf 72 hrs.	50.70±0.00*	45.00±0.00*
5gm/ 100 ml bark 24 hrs.	83.05±1.00*	83.30±1.00*
5gm/ 100 ml bark 48 hrs.	81.10±1.00*	80.50±0.73*
5gm/ 100 ml bark 72 hrs.	78.53±1.00*	80.30±0.94*
10gm/ 100 ml bark 24 hrs.	77.40±1.00*	79.30±1.00*
10gm/ 100 ml bark 48 hrs.	75.02±1.00*	76.70±0.46*
10gm/ 100 ml bark 72 hrs.	75.08±1.00*	66.70±0.22*
5g/100 ml hot water leaf extract	78.00±0.92*	87.00±0.70*
10g/100 ml hot water leaf extract	76.00±0.11*	50.00±0.02*
5g/100 ml hot water bark extract	80.00±1.00*	70.00±0.92*
10g/100 ml hot water bark extract	74.00±1.00*	67.00±0.99*

Each value is the grand mean of five replicates each having ten seeds. Ns= Non significant, * = Significant at $\alpha < 0.05$

The results are in agreement with those of [19-22] who also reported reduction in wheat seed germination after extracts application. Our results also agree with those of [2, 3, 23-25], in this aspects who also reported similar allelopathic behaviour of some plants. Our finding also agrees with those of [9] who's reported aqueous extracts of *Parthenium hysterophorus*, *Eucalyptus camaldulensis* [26] and *Dodonaea viscosa* [27] had significantly inhibitory effects on plumule and radical length. In the present study the seminal roots number also significantly reduced by both hot and cold extract in same manner as that higher concentration extract soaked for longer duration triggered maximum reduction (Table 4). Hot water extracts also showed inhibitory effects on both test

species. [14] also reported hot water extracts to be inhibitory in contradiction of test species. Fresh, dry weight and moisture contents of both wheat cultivars were significantly affected by both leaves and bark aqueous extracts (Table 3). Our findings were agreed with those of [18, 24, 28, 29] who's reported similar reduction in fresh and dry weight due to the allelopathic effects of the plants used in the experiments. Similar results were also obtained by [30] after the treatment of rice plant with allelopathic phenolic compounds. [31] reported reduction in fresh weight of pearl millet and cowpea due to extracts application. Other researcher also reported the same manner of inhibition in case of moisture contents of

the test species which include the work of [2, 11, 18, 27, 32].

Table 2. Effect of aqueous extracts of *C. lanceolatus* on Radicle and plumule length of wheat varieties

Treatments/ extracts	Test species			
	<i>T. aestivum</i> (Cultivar Millat) in mm		<i>T. aestivum</i> (Cultivar F. Abad) in mm	
	Radical	Plumule	Radical	Plumule
Control	75.03±0.01	79.30±0.05	65.33±0.03	68.83±0.07
5gm/ 100 ml leaf 24 hrs.	12.50±0.00*	15.90±0.00*	09.50±0.00*	06.23±0.00*
5gm/ 100 ml leaf 48 hrs.	11.50±0.00*	13.90±0.00*	08.80±0.00*	05.80±0.00*
5gm/ 100 ml leaf 72 hrs.	11.20±0.00*	11.77±0.00*	07.83±0.00*	03.53±0.00*
10gm/ 100 ml leaf 24 hrs.	09.50±0.00*	06.33±0.00*	07.05±0.00*	03.33±0.00*
10gm/ 100 ml leaf 48 hrs.	08.57±0.00*	05.60±0.00*	06.17±0.00*	02.27±0.00*
10gm/ 100 ml leaf 72 hrs.	07.33±0.00*	04.87±0.00*	04.50±0.00*	02.10±0.00*
5gm/ 100 ml bark 24 hrs.	32.87±0.43*	36.10±1.00*	36.80±0.00*	24.10±0.00*
5gm/ 100 ml bark 48 hrs.	29.17±0.07*	35.67±1.00*	27.83±0.00*	24.00±0.00*
5gm/ 100 ml bark 72 hrs.	24.43±0.01*	32.67±0.03*	26.17±0.00*	17.40±0.00*
10gm/ 100 ml bark 24 hrs.	29.43±0.02*	33.57±0.05*	26.83±0.00*	22.40±0.00*
10gm/ 100 ml bark 48 hrs.	21.33±0.01*	26.50±0.04*	25.80±0.00*	20.87±0.00*
10gm/ 100 ml bark 72 hrs.	19.70±0.01*	23.60±0.03*	23.23±0.00*	17.03±0.00*
5g/100 ml hot water leaf extract	06.67±0.00*	09.63±0.01*	14.30±0.00*	07.67±0.00*
10g/100 ml hot water leaf extract	06.47±0.00*	07.20±0.01*	03.23±0.00*	01.77±0.00*
5g/100 ml hot water bark extract	27.67±0.01*	35.90±0.04*	36.83±0.00*	16.80±0.00*
10g/100 ml hot water bark extract	21.00±0.01*	26.47±0.01*	21.93±0.00*	14.00±0.00*

Each value is the grand mean of five replicates each having ten seeds.

Ns= Non-significant, * = Significant at $\alpha < 0.05$

Mulching and litter effect

Added much and litter also showed significant inhibition in both cultivars. It was stated earlier that plant litter usually increases soil fertility during decay but allelopathic plants release phytotoxic substances before decay that cause soil phytotoxicity in natural ecosystems [18]. Plants release phytochemicals in litter and mulch processes, and their assimilation to the soil might support their harmful effect in the field [33]. This feature when verified by using *C. lanceolatus* litter in trials indicated that there was significant

inhibition in the growth of the test species. Leaves and bark's mulch inhibited germination of both cultivars of *T. aestivum*. All other parameters including germination, plumule and radical growth, number of seminal root, fresh, dry weight, and moisture contents of both test species also reduced by added litter and mulch (Table 5). Our findings were agreed in case of mulch and litter with those of [14, 34] who's presented the similar differential behaviour of *Celtis australis* L. and *Polypogon monspeliensis* L.

Table 3. Effect of aqueous extracts of *C. lanceolatus* on fresh, dry weight and moisture contents of wheat varieties

Treatments/ extracts	Test species					
	<i>T. aestivum</i> (Cultivar Millat)			<i>T. aestivum</i> (Cultivar F. Abad)		
	Percent of control values					
	Fresh weight (in mg)	Dry weight (in mg)	Moisture contents	Fresh weight (in mg)	Dry weight (in mg)	Moisture contents
5gm/ 100 ml leaf 24 hrs.	60.37*	51.95*	41.10*	62.76*	46.07*	54.95*
5gm/ 100 ml leaf 48 hrs.	56.72*	49.35*	33.97*	61.38*	46.07*	51.34*
5gm/ 100 ml leaf 72 hrs.	55.97*	41.56*	42.24*	60.00*	44.94*	49.06*
10gm/ 100 ml leaf 24 hrs.	52.99*	42.86*	32.04*	58.62*	42.70*	48.18*
10gm/ 100 ml leaf 48 hrs.	50.00*	38.96*	29.03*	56.55*	39.33*	47.02*
10gm/ 100 ml leaf 72 hrs.	48.51*	32.47*	34.67*	55.86*	35.96*	49.62*
5gm/ 100 ml bark 24 hrs.	66.42*	72.73*	34.07*	67.59*	51.69*	61.06*
5gm/ 100 ml bark 48 hrs.	63.43*	70.13*	28.05*	66.90*	51.69*	59.29*
5gm/ 100 ml bark 72 hrs.	61.94*	66.23*	28.16*	65.52*	50.56*	56.96*
10gm/ 100 ml bark 24 hrs.	61.94*	66.23*	28.16*	63.45*	48.31*	54.13*
10gm/ 100 ml bark 48 hrs.	60.45*	63.64*	26.80*	62.76*	46.07*	54.95*
10gm/ 100 ml bark 72 hrs.	56.72*	58.44*	21.94*	62.76*	43.82*	57.57*
5g/100 ml hot water leaf extract	55.22*	41.56*	40.19*	55.86*	42.70*	40.77*
10g/100 ml hot water leaf extract	52.24*	38.96*	35.46*	55.17*	40.45*	41.86*
5g/100 ml hot water bark extract	61.19*	64.94*	27.46*	57.93*	47.19*	40.66*
10g/100 ml hot water bark extract	59.70*	62.34*	26.13*	57.24*	44.94*	41.63*

Each value is the grand mean of five replicates each having ten seeds. Ns= Non-significant, * = Significant at $\alpha < 0.05$

Table 4. Effect of aqueous extracts of *C. lanceolatus* on the number of seminal roots of wheat varieties

Treatments/ extracts	Test species	
	<i>T. aestivum</i> (Cultivar Millat)	<i>T. aestivum</i> (Cultivar F. Abad)
Control	6.63±1.00	6.33±1.00
5gm/ 100 ml leaf 24 hrs.	4.20±1.00*	2.63±0.97*
5gm/ 100 ml leaf 48 hrs.	3.70±0.99*	2.20±0.23*
5gm/ 100 ml leaf 72 hrs.	2.23±0.03*	1.93±0.29*
10gm/ 100 ml leaf 24 hrs.	3.03±1.00*	2.53±0.32*
10gm/ 100 ml leaf 48 hrs.	3.03±0.79*	2.15±0.65*
10gm/ 100 ml leaf 72 hrs.	2.04±0.08*	1.19±0.10*
5gm/ 100 ml bark 24 hrs.	4.80±0.89*	2.73±0.51*
5gm/ 100 ml bark 48 hrs.	3.75±0.21*	2.63±0.51*
5gm/ 100 ml bark 72 hrs.	3.02±0.21*	2.50±0.51*
10gm/ 100 ml bark 24 hrs.	3.15±0.99*	2.20±1.00*
10gm/ 100 ml bark 48 hrs.	3.12±1.00*	2.03±0.04*
10gm/ 100 ml bark 72 hrs.	2.20±0.64*	1.97±0.01*
5g/100 ml hot water leaf extract	2.83±0.02*	2.37±0.79*
10g/100 ml hot water leaf extract	2.50±0.02*	0.87±0.03*

5g/100 ml hot water bark extract	3.70±0.80*	2.47±0.79*
10g/100 ml hot water bark extract	3.20±0.13*	1.47±0.52*

Each value is the grand mean of five replicates each having ten seeds. Ns= Non-significant, * = Significant at $\alpha < 0.05$

Table 5. Effect of mulching and litter of *C. lanceolatus* on the germination and overall growth of wheat varieties

Treatments	Added Mulch					Added litter	
Wheat verities	Control	5gm leaf	10gm leaf	5gm bark	10gm bark	Control	5gm litter
Germination (%)							
<i>T. aestivum</i> (Cultivar Millat)	100.00	90.00*	52.50*	90.00*	97.50 ^{Ns}	100.00	85.00*
<i>T. aestivum</i> (Cultivar F. Abad)	100.00	57.50*	50.00*	87.50*	90.00*	100.00	87.00*
Plumule length (in mm)							
<i>T. aestivum</i> (Cultivar Millat)	123.00	33.60*	06.45*	85.50*	90.15*	40.13	19.03*
<i>T. aestivum</i> (Cultivar F. Abad)	81.25	17.75*	06.73*	73.13*	72.88*	45.58	09.38*
Radicle length (in mm)							
<i>T. aestivum</i> (Cultivar Millat)	63.63	18.73*	3.85*	45.50*	40.70*	40.40	20.65*
<i>T. aestivum</i> (Cultivar F. Abad)	51.35	11.25*	3.55*	47.50*	36.35*	37.83	9.38*
Seminal root number							
<i>T. aestivum</i> (Cultivar Millat)	04.06	02.88*	01.35*	03.83*	04.23 ^{ns}	04.43	03.68*
<i>T. aestivum</i> (Cultivar F. Abad)	03.50	02.10*	00.95*	03.43 ^{ns}	02.98*	04.33	02.98*
Fresh weight in mg (% of control)							
<i>T. aestivum</i> (Cultivar Millat)		81.22*	74.5*	49.01*	83.21*	93.43*	
<i>T. aestivum</i> (Cultivar F. Abad)		80.33*	72.63*	49.41*	82.25*	97.34*	
Dry weight in mg (% of control)							
<i>T. aestivum</i> (Cultivar Millat)		66.04*	75.08*	32.09*	68.54*	49.75*	
<i>T. aestivum</i> (Cultivar F. Abad)		67.47*	75.60*	32.83*	68.98*	51.24*	
Moisture content (% of control)							
<i>T. aestivum</i> (Cultivar Millat)		81.21*	72.38*	47.68*	83.27*	97.07*	
<i>T. aestivum</i> (Cultivar F. Abad)		80.04*	70.17*	48.07*	82.12*	98.44*	

Each value is the grand mean of five replicates each having ten seeds. Ns= Non-significant, * = Significant at $\alpha < 0.05$

Conclusion

The present study suggested that *Callistemon lanceolatus* DC. has robust allelopathic potential in contradiction of the test crops. Allelopathic stress

significantly affected the germination and overall growth of the test crops. In fields, it is relatively probable that the *C. lanceolatus* might be one of the thinkable reasons of decrease of wheat yields due to

its allelopathy. Therefore, its plantation should be prudently assessed along the crop field. Furthermore, field experiments are required to confirm these results.

Authors' contributions

Conceived and designed the experiments: N Shah, I Ahmad & M Imran, Performed the experiments: N Shah & M Imran, Analyzed the data: H Gul & MJ Babar, Contributed materials/ analysis/ tools: S Anwar & H Gul, Wrote the paper: N Shah, M Imran, WA Shah & S Anwar.

References

1. Caton BP, Mortimer AM, Hill TC, Gibson JE & Fisher AJ (1999). Weed morphology effects on competitiveness for light in direct-seeded rice. *Proc 17th Asian-Pacific, weed Science Society Conference Bangkok* 1: 116-120.
2. Hussain F, Ahmad B & Ilahi I (2010). Allelopathic effects of *Cenchrus ciliaris* L., and *Bothriochloa pertusa* (L.) A. Camus. *Pak J Bot* 42(5): 3587-3604.
3. Hussain F, Ilahi I, Malik SA, Dasti AA & Ahmad B (2011). Allelopathic effects of rain leachates and roots exudates of *Cenchrus ciliaris* L., and *Bothriochloa pertusa* (L.) A. Camus. *Pak J Bot* 43(1): 341-350.
4. Tabaglio V, Gavazzi C, Schulz M & Marocco A (2008). Alternative weed control using the allelopathic effect of natural benzoxazinoids from rye mulch. *Agron Sustain Dev* 28(3): 397-401.
5. Uremis I, Arslan M, Uludag A & Sangun MK (2009). Allelopathic potentials of residues of 6 Brassica species on Johnson grass *Sorghum halepense* (L.) Pers. *African J Biotech* 8(15): 3497-3501.
6. Hussain F & Abidi N (1991). Allelopathy exhibited by *Imperata cylindrical* (L.) P. beauv. *Pak J Bot* 23(1): 15-25.
7. Rebaz Z, Shaukat SS & Siddiqui IA (2001). Allelopathic potential of *anagallis arvensis* L. A cosmopolitan weed. *Pak J Biol Sci* 4(4): 446-450.
8. Sahar A, Khawas E & Shehata M (2005). Allelopathic potentialities of *acacia nilotica* and *eucalyptus rostrata* on monocot (*Zea mays* L.) and dicot (*Phaseolus vulgaris* L.) *Biotechnology* 4(1): 23-34.
9. Maharjan S, Shrestha BB & Jha PK (2007). Allelopathic effects of aqueous extract of leaves of *Parthenium hysterophorus* on seed germination and seedling growth of some cultivated and wild herbaceous species. *Scientific World* 5(5): 33-39.
10. Siddiqui S, Yadav R, Yadav K, Wani FA, Meghvansi MK, Sharma S & Jabeen F (2009). Allelopathic potentialities of different concentration of aqueous leaf extracts of some Arable trees on germination and radicle growth of *Cicer arietinum* Var. C-235. *Global J Molecular Science* 4(2): 91-95.
11. Abugre S, & Sam QSJ (2010). Evaluating the Allelopathic Effect of *Jatropha curcas* aqueous extract on Germination, Radicle and Plumule length of Crops. *Inter J Agri Biol* 12: 769-772.
12. Kavitha D, Prabhakaran J & Arumugam K (2012). Allelopathic influence of *Vitex negundo* L., on germination and growth of Green gram *Vigna radiate* (L.) R. Wilczek. and Black gram *Vigna mungo* (L.) Hepper. *Int J Ayur Herb Med* 2(1): 163-170.
13. Nekonam MS, Razmjoo J, Sharifnabi B & Karimmojeni H (2013). Assessment of allelopathic plants for their herbicidal potential against field bindweed (*Convolvulus arvensis*). *A J C S* 7(11): 1654-1660.
14. Ahmad I, Hussain F, Barkatullah & Ahmad B (2014). Phytotoxic potential of *celtis australis* L. against four crop species. *Pak J Bot* 46(6): 2063-2067.
15. Kalpana P & Navin MK (2015). Assessment of Allelopathic Potential of *Leucaena leucocephala* (Lam) De Vit on *Raphanus sativus* L. *Inter J Scienti Res Pub* 5(1): 1-3.
16. Hussain S, Siddiqui S, Khalid S, Jamal A, Qayyum A & Ahmad Z (2007). Allelopathic potential of *Senna Cassia angustifolia* Vahl., on germination and seedling characters of some major cereal crops and their associated grassy weeds. *Pak J Bot* 39(4): 1145-1153.

16. Elizabeth GB, Pivello VR & Meirelles ST (2008). Allelopathic evidence in *Brachiaria decumbens* and its potential to invade the Brazilian Cerrados. *Braz Arch Biol Techn* 51(4): 825-831.
17. Hussain F & Ilahi I (2009). Allelopathic potential of *Cenchrus ciliaris* L., and *Bothriochloa pertusa* (L.) A. Camus. *J Sci Techn* 33(2): 47-55.
18. Patel B, Achariya B & Bupripata NP (2002). Allelopathic effects of eucalyptus leaves on seed germination and seedling growth of winter wheat. *Proc Ind Soc Allelopathy* Pp. 115-119.
19. Nadal DPS, Birta SS & Narwal SS (2005). Allelopathic influence of eucalyptus litter on germination, yield and yield components of live wheat varieties. *Proc 1st Nat Symp on Allelopathy in Agric Systems*.
20. Khan MA, Hussain I & Khan EA (2007). Effect of aqueous extract of *Eucalyptus camaldulensis* L., on germination and growth of maize (*Zea mays* L.). *Pak J Weed Sci Res* 13(3-4): 177-182.
21. Kumar M & Siangshai S (2009). Effect of leaf and bark aqueous extracts on germination and radicle length of crops in Mizoram. *Pak J Weed Sci Res* 15(4): 275-281.
22. Todaria NP, Singh B & Dhanai CS (2005). Allelopathic effects of tree extract, on germination and seedling growth of field crops. *Allelopathy J* 15(2): 285-294.
23. Hussain F, Niaz F, Jabeen M & Burni T (2004). Allelopathic potential of *Broussonetia papyrifera* Vent. *Pak J Pl Sci* 10(2): 69-78.
24. Sher Z, Hussain F, Ahmad B & Wahab M (2011). Allelopathic potential of *Populus euphratica* Oliver. *Pak J Bot* 43(4): 1899-1903.
25. Khan MA, Hussain I & Khan EA (2008). Allelopathic effects of *Eucalyptus camaldulensis* L.) on germination and seedling growth of wheat (*Triticum aestivum* L.). *Pak J Weed Sci Res* 14(1-2): 9-18.
26. Barkatullah, Hussain F & Ibrar M (2010). Allelopathic potential of *Dodonaea viscosa* (L.) Jacq *Pak J Bot* 42(4): 2383-2390.
27. Pervez SS, Pervez MM, Nishihara E, German H & Fujii Y (2003). *Tamarindus indica* L., leaf is a source of allelopathic substance. *Plant Growth Regulator* 40(2):107-115.
28. Samreen U, Hussain F & Sher Z (2009). Allelopathic potential of *Calotropis procera* (Ait.) Ait. *Pak J Pl Sci* 15(1): 7-14.
29. Yang CM, Chang IF, Lin SJ & Chou CH (2002). Effects of three allelopathic phenolics on chlorophyll accumulation of rice (*Oryza sativa* L.) seedlings inhibition of supply orientation. *Bot Bull Acad Sinica* 43: 299-304.
30. Alagesaboopthi C (2010). Allelopathic effects of *Centella asiatica* aqueous extracts on pearl millet (*Pennisetum typhoides* L.) and cowpea (*Vigna unguiculata* Walp.) *Pak J Weed Sci Res* 16(1): 67-71.
31. Uniyal AK & Chhetri S (2010). An assessment of phytotoxic potential of promising agroforestry treason germination and growth pattern of traditional field crops of Sikkim Himalaya, India. *American-Eurasian J Agri Envi Sci* 9: 70-78.
32. Inderjit S & Duke O (2003). Eco physiological aspects of allelopathy. *Planta* 217(4): 529-539.
33. Sarah S, Hussain F, Ehsan M & Burni T (2011). Allelopathic potential of *Polypogon monspeliensis* L., against two cultivars of wheat. *African J Biotech* 10(85): 19723-1972.
34. Sarah S, Hussain F, Ehsan M & Burni T (2011). Allelopathic potential of *Polypogon monspeliensis* L., against two cultivars of wheat. *Afr J Biotch* 10(85): 19723-1972.