Pak. J. Weed Sci. Res., 22(3): 471-480, 2016

ALLELOPATHIC EFFECT OF *Cucumis melo* SUB-SPECIES *agrestis* VARIETY *agrestis* ON WHEAT

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ABSTRACT

Cucumis melo subsp. agrestis var. agrestis (family Cucurbitaceae) is a creeping weed of cultivated fields in Pakistan. The experiment was carried in pots to assess the allelopathic potential of different concentrations (i.e. 0%, 25%, 50% and 75%) of stem, leaves, roots, fruit and seeds of Cucumis melo subsp. agrestis var. agrestis against wheat. 10g of powder material prepared from each part of the plant was separately dissolved in 100 ml of distilled water and after 48 hrs the solutions were filtered and aqueous extracts of different concentrations (i.e. 0%, 25%, 50% and 75%) were obtained for each part. These extracts were then applied to different pots separately and each pot contained 10 seeds of wheat. Results indicated that extracts of different plant parts showed non-significant results on No. of leaves plant^{-1}, No. of grains spike^{-1}, 1000 grain weight and moisture content while plant height, length of spike plant^{-1} and fresh and dry weight of test species were significantly affected. Roots extract reduced the plant height, stem extract inhibited the length of spike plant^{-1}, stem and roots extracts decreased the fresh weight and leaves extract suppressed the dry weight of test species. Increase in concentrations, increased the No. of grains spike^{-1}, fresh weight and dry weight while decreased the 1000 grains weight and moisture content of test species. It is concluded that the various assayed parts of Cucumis melo subsp. agrestis var. agrestis have strong allelopathic potential at least against the tested species. Further explanation is needed to see its allelopathic potential under field conditions against its associated grasses and forbs and to identify the toxic chemicals.

Key words: *Cucumis melo*, *agrestis*, allelopathy, aqueous extract, growth, wheat.

Citation: Hadi, F., H. Bibi, A. Razzaq, A. Iqbal and G. Ali. 2016. Allelopathic effect of *Cucumis melo* sub-species *agrestis* variety Agrestis on wheat. Pak. J. Weed Sci. Res. 22(3): 471-480.

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INTRODUCTION

Allelopathy is the combination of two Greek words *allelo* and *pathy* which means "mutual harm" or "suffering" and it is the beneficial or harmful effect of one plant on another plant (including both crop and weed species) by the release of biochemicals, known as allelochemicals. These biochemicals are secondary metabolites and are not required for metabolism (growth and development) of the allelopathic organism but their negative effects are important in plant defense against herbivory (i.e. animals eating plants as their primary food) (Fraenkel, 1959; Stamp, 2003). Allelopathic inhibition is complicated and can involve the interaction of different classes of chemicals, such as phenolic compounds, flavonoids, terpenoids, alkaloids, steroids, carbohydrates, and amino acids with mixtures of different compounds sometimes having a greater allelopathic effect than individual compounds alone. The allelochemicals may be more biodegradable than traditional herbicides but they may also have undesirable effects on non-target species (James *et al.,* 2013). The allelochemicals might be present in all plant tissue, i.e. leaves, fruit, stems and roots (Rice, 1984; Putnam, 1985).

The African melon (*Cucumis melo* subsp. *agrestis* Naudin.) belongs to family *Cucurbitaceae* is an annual and trailing-vine plant and is cultivated in many African countries for its edible fruits (Kouonon *et al.,* 2009).

MATERIALS AND METHODS

The plants of *Cucumis melo* subsp. *agrestis* var*. agrestis* were collected from Botanical Garden-Azakhel, University of Peshawar in 2014. Stem, leaves, roots, fruits and seeds were separated and kept in shade for air dry. Each plant part was crushed and the powder material was obtained from each part. 10g of powder material of each was dissolved separately in 100ml of distilled water and after 48hrs each solution was filtered by using Whatman filter paper and aqueous extracts of different concentrations (25%, 50% and 75%) were prepared from the stock extract solution of different plant parts. Distilled water was used as control (0%) treatment. All these extracts were then applied to the pots kept in Green House having ten seeds of wheat. The plant height, No. of leaves plant^{-1}, length of spike plant^{-1}, No. of grains spike^{-1}, 1000 grain weight, fresh and dry weights and moisture content were measured. The design of the experiment was randomized complete blocks with four replicates of each parameter. All the results were statistically analyzed by using MSTATC program. The difference between means of different treatments was calculated by keeping least significant difference (LSD) at 0.05 probability level.

RESULTS AND DISCUSSION

The experiment was conducted in greenhouse at the Centre of Plant Biodiversity, University of Peshawar, Pakistan, in order to study the allelopathic effect of different plant parts of *Cucumis melo* subsp. *agrestis* var*. agrestis* during 2014. The study revealed that all parts like stem, leaves, roots, seeds, and fruit of *Cucumis melo* subsp. *agrestis* var*. agrestis* showed stimulating effect at low concentrations but increase in concentration of plant materials the allelopathy also increased that inhabited/reduced or increased the plant height, No. of leaves plant^{-1}, length of spike plant^{-1}, no. of grains spike^{-1}, 1000 grain weight, fresh and dry weights and moisture content.

The Table-1 indicated that extracts of different plant parts showed significant effect on plant height while different concentrations and the interaction of extracts and concentration of different plant parts showed non-significant effect on plant height of wheat. Roots of *Cucumis* showed more allelopathy and resulted minimum mean plant height (43.637 cm) and fruit was less allelopathic by showing maximum plant height (50.624 cm). Generally, the increase in concentration of different plant parts enhanced the plant height as compare to control treatment as the mean plant height was maximum (48.126 cm) at 75% and minimum (43.595 cm) at 0% (control) of plant extracts. Our findings are agreement with those of Carmo *et al.* (2007), Pereira *et al.* (2008) and Hadi *et al.* (2013) who also suggested that roots were more allelopathic as compare to other plant parts.

Table-1. Mean table for the effect of plant part and its concentration on plant height (cm).

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	43.595	54.370	48.115	44.105	47.546 ab
Leaves	43.595	43.135	44.385	45.890	44.251 b
Roots	43.595	43.850	42.680	44.425	43.637 b
Fruit	43.595	50.645	50.045	58.210	50.624 a
Seeds	43.595	45.680	46.940	48.000	46.054 ab
Mean	43.595	47.536	46.433	48.126	

LSD value for mean of extract @ ɑ 0.05 = 4.947

The data for No. of leaves plant^{-1} revealed that different concentration, different extracts of different plant parts and the interaction of extract and concentration of different plant parts all showed non-significant effect on No. of leaves plant^{-1} of wheat (Table-2). Roots of *Cucumis* were more allelopathic that minimized the mean number of leaves plant^{-1} (7.300) as compare to leaves that showed less allopathic and hence the test species had maximum number of leaves plant^{-1} (7.575). Generally, maximum number of leaves plant^{-1} (7.500) was observed at 0 % (control) and increase in concentration of plant extracts inhabited number of leaves plant^{-1} (7.410 at 75 % of plant extract). Khan *et al.* (2006), Anjum and Bajwa (2007) and Sher *et al.* (2011) suggested minimum number of leaves plant^{-1} in test species due to root allelopathy. These findings are co-related with our result.

Table-2. Mean table for the effect of plant part and its concentration on number of leaves plant^{-1}.

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	7.500	7.050	7.400	7.700	7.412
Leaves	7.500	7.400	7.900	7.500	7.575
Roots	7.500	7.400	7.350	7.100	7.300
Fruit	7.500	7.500	7.250	7.050	7.325
Seeds	7.500	7.250	7.250	7.700	7.425
Mean	7.500	7.330	7.430	7.410	

The result showed that different extracts of different plant parts showed significant effects while both different concentrations of different plant parts and the interaction of extract and concentration of different plant parts showed non-significant effect on length of spike plant^{-1} of wheat (Table-3). Stem of *Cucumis* was more allelopathic as it minimized the number of spike plant^{-1} (9.009) as compare to fruit extracts that increased the number of spike plant^{-1} to maximum (10.324). Similarly, increase in concentration of plant extracts usually enhanced the mean number of spike plant^{-1} as maximum spikes (10.710) were observed at 75 % and minimum spikes (9.600) at 0% (control). Our findings are supported by Samreen *et al.* (2009), Barkatullah *et al.* (2010) and Hadi *et al.* (2014) that stated that different plant parts showed different allelopathic effects.

Table-3. Mean table for the effect of plant part and its concentration on number of spikes plant^{-1}.

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	9.600	9.010	9.276	8.150	9.009 c
Leaves	9.600	9.125	9.240	9.065	9.257 bc
Roots	9.600	8.760	8.715	9.635	9.177 c
Fruit	9.600	10.041	10.160	11.495	10.324 a
Seeds	9.600	10.405	9.815	10.710	10.132 ab
Mean	9.600	9.468	9.441	9.811	

LSD value for mean of extract @ α 0.05 = 0.8805

Table-4 indicates that different concentrations of different plant parts showed significant effect while different extracts and interaction of extract and concentration of different plant parts showed non-significant effect on the no. of grains spike^{-1} of wheat. Stem of *Cucumis* showed maximum allelopathy for number of grains spike^{-1} and reduced the number to 4.887 and fruit extract maximized the number 6.862 indicating less allelopathy. Generally, increase in concentrations of different extracts raised the mean no. of grains spike^{-1} i.e. lowest (4.400) was observed at 0 % (control) and maximum (7.600) number of grains spike^{-1} were observed at 75 % of plant extracts. Khan *et al. (*2006), Pereira *et al.* (2008) and Sher *et al.* (2014) are in agreement with our findings that number of grains spike^{-1} were increased with increase in concentration of plant extracts.

Table-4. Mean table for the effect of plant part and its concentration on number of grains spike^{-1}.

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	4.400	6.550	4.300	4.300	4.887
Leaves	4.400	4.150	4.900	6.150	4.900
Roots	4.400	4.900	5.250	6.750	5.325
Fruit	4.400	4.800	6.750	11.500	6.862
Seeds	4.400	5.600	3.850	9.300	5.787
Mean	4.400 b	5.200 b	5.010 b	7.600 a	

LSD value for mean of concentration @ α 0.05 = 1.671

The data revealed that different concentrations of different plant parts showed significant effect while different extract and the interaction of extract and concentration showed non-significant effect on 1000 grain weight of wheat (Table-5). Roots of *Cucumis* were more allelopathic and reduced the weight to minimum (37522 gm) while seeds were less allelopathic and resulted maximum (43749 gm) weight of 1000 grains. Similarly, increase in concentrations of different plant parts decreased the 1000 grain weight upto some extent but more concentrated extracts increased the weight i.e. maximum weight (52500 gm) of 1000 grains was observed at 0 % (control) followed by 75 % concentrated extract (36543 mg), 25 % (35996 gm) and 50 % extract resulted 33521 gm weight of 1000 grains. Hussain *et al.* (2004), Barkatullah *et al.* (2010) and Hadi *et al.* (2014) suggest that lowest 1000 grains weight was observed in treatment of root extracts in their studies. These findings are similar to our results.

Table-5. Mean table for the effect of plant part and its concentration on thousand grain weight (mg).

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	52507	52493	22496	35104	40650
Leaves	52499	27504	35008	35099	37528
Roots	52502	32488	30091	35008	37522
Fruit	52491	35002	30009	37503	38751
Seeds	52499	32494	50003	40001	43749
Mean	52500 a	35996 bc	33521 c	36543 b	

LSD value for mean of concentration @ α 0.05 = 2724

Table-6 depicted that different concentrations, different extracts and the interaction of extract and concentration of different plant parts all showed significant effect on fresh weight of wheat. Roots of *Cucumis* showed maximum allelopathy so reduced the fresh weight to minimum (4200 mg) of test species and seeds showed less allelopathy and the wheat had maximum (5050 mg) fresh weight. Generally, increase in concentrations of different plant parts enhanced the fresh weight of test species as minimum fresh weight (4410 mg) was shown at 0% (control), increased with increase in concentration of plant material and maximum fresh weight of test species was observed at 75 % of *Cucumis* parts extracts. Our findings are in agreement with those of Carmo *et al.* (2007), Samreen *et al.* (2009) and Sher *et al.* (2014) found that roots show more allelopathy than other plant parts in their experiments.

Table-6. Mean table for the effect of plant part and its concentration on fresh weight (mg) of ten wheat plants.

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	4410 def	4000 efg	4000 efg	4400 def	4210 b
Leaves	4400 def	3900 fg	4500 de	4200 defg	4250 b
Roots	4400 def	4400 def	4200 defg	3800 g	4200 b
Fruit	4400 def	5400 b	4500 de	5500 ab	4950 a
Seeds	4400 def	4700 cd	5100 bc	6000 a	5050 a
Mean	4410 b	4480 b	4460 b	4780 a	

LSD value for mean of concentration @ α 0.05 = 262.1
LSD value for mean of extract @ α 0.05 = 293.0
LSD value for interaction @ α 0.05 = 586.0

The data shows that different concentrations, different extracts and concentration of different plant parts all have significant effect on dry weight of wheat (Table-7). The roots of *Cucumis* were highly allelopathic and thus reduced the dry weight of wheat to minimum (3325 mg) as compare to fruits that showed maximum dry weight (4131 gm). Increase in different concentrations of plant parts increased the dry weight as mean dry weight was minimum (2900 mg) at 0 % (control), which increased and was maximum (4190 mg) at 75 % of concentration of plant material. Our findings are similar to those of Carmo *et al.* (2007) and Samreen *et al.* (2009) which shows that increase in contration of plant material the dry weight of test species increased.

Table-7. Mean table for the effect of plant part and its concentration on dry weight (mg) of ten wheat plants.

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	2900 h	3600 defg	3525 efg	4000 cd	3506 b
Leaves	2900 h	3425 fg	3550 efg	3600 defg	3368 b
Roots	2900 h	3850 cde	3650 def	3200 gh	3325 b
Fruit	2900 h	4500 b	4075 bc	5050 a	4131 a
Seeds	2900 h	4000 cd	4500 b	5100 a	4125 a
Mean	2900 c	3795 b	3860 b	4190 a	

LSD value for mean of concentration @ α 0.05 = 191.9
LSD value for mean of extract @ α 0.05 = 214.6
LSD value for interaction @ α 0.05 = 429.1

Table-8 indicates that different concentrations of different plant parts showed significant effect while different extracts and the interaction of extract and concentration of different plant parts showed non-significant effect on moisture content of wheat. The wheat treated with extract of stem of *Cucumis* showed reduced (16.06%) moisture contents while the seedlings treated with leaves extracts contained high (20.03%) moisture content. Generally, increase in concentrations of different plant parts caused reduction in mean moisture content of wheat as high content was observed at 0% (34.08%), which reduced to 12.33% at high concentration of 75 % of the plant material. Hussain *et al.* (2004), Samreen *et al.* (2009) and Hadi *et al.* (2013 & 2014) suggested that moisture contents of their test species reduced with increase in concentration of plant parts. These findings are in favour of our result.

The present study indicated that *Cucumis melo* subsp. *agrestis* var*. agrestis* may contains water leachable allelochemicals and has strong allelopathic nature for plants especially against the test species. Increase in concentrations of different plant parts of *Cucumis melo* subsp. *agrestis* var. *agrestis* have increased the plant height, length of spike plant^{-1}, no. of grains spike^{-1} and fresh and dry weights of the test species and reduced the no. of leaves plant^{-1}, 1000 grain weight and moisture content. Extract of different parts showed that roots were more allopathic and inhibited/reduced the fresh and dry weight, plant height, 1000 grain weight and no. of leaves plant^{-1} followed by stem caused reduction/inhibition in no. of spikes plant^{-1}, no. of grains spike^{-1} and moisture content.

Table-8. Mean table for the effect of plant part and its concentration on moisture content (%) of ten wheat plants.

Extract	Concentration of plant material				
	0%	25%	50%	75%	Mean
Stem	34.088	9.778	11.467	8.900	16.058
Leaves	34.088	11.900	20.308	13.840	20.034
Roots	34.088	9.272	12.192	15.490	17.761
Fruit	34.088	16.137	9.440	7.932	16.899
Seeds	34.088	14.820	11.705	14.993	18.901
Mean	34.088 a	12.382 b	13.022 b	12.231 b	

LSD value for mean of concentration @ α 0.05 = 4.181

Our findings are correlated with the studies of same nature carried out by different workers and they found toxicity of aqueous extracts from other plants (Hussain *et al.* 2004; Hamayun *et al.* 2005; Carmo *et al.* (2007), Pereira *et al.* (2008) and Hadi *et al.* (2013 and 2014).

CONCLUSION

It is concluded from the present study that different parts of *Cucumis melo* subsp. *agrestis* var. *agrestis* showed strong detrimental effects on growth and development and yield of wheat. *Cucumis* may contain water leachable allelochemicals having strong allelopathic nature against the test species. The roots and stem extracts showed more allelopathic effects, so the removal of the weed in vegetative stage can help in control of this weed and to obtain good production and yield of wheat.

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