التأثير التثبيطي للمستخلص المائي لبعض الأعشاب الضارة في إنبات ونمو القمح الطري *Triticum aestivum* L.

Inhibitory Effect of Some Weed Aqueous Extract on Germination and Seedling Growth of Bread Wheat *Triticum aestivum* L.

Dr. Ghassan Ibrahim[1] **Dr. Tharwat Ibrahim**[2-3]

(1) Dept. Plant Protection, Fac. Agriculture, Damascus University, Syria.
(2) Dep. for Renewable Natural Resources and Environment, Fac. Agriculture, Damascus University, Syria.
(3) The Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD).

الملخّص

نُفذ هذا البحث في عام 2014 في دائرة المكافحة الحيوية للأعشاب الضارة في مركز بحوث ودراسات المكافحة الحيوية في كلية الزراعة بجامعة دمشق (سورية)، لتقييم تأثير المستخلص المائي لبعض الأعشاب الضارة شائعة الانتشار في حقول القمح في إنبات ونمو بادرات القمح الطري *Triticum aestivum* L. الصنف شام$_{10}$. تم تجهيز المستخلص المائي لأنواع الأعشاب المختبرة: *Avena sterilis* L., *Convolvulus arvensis* L., *Diplotaxis erucoides* L., *Lolium perenne* L. and *Sonchus oleraceus* L. من الأوراق والسوق والجذور بصورة منفصلة بالتراكيز التالية: 5، 10، 15، 20 و 25 %، ووضعت التجربة وفق التصميم العشوائي الكامل بثلاثة مكررات.

أشارت النتائج إلى أن المستخلصات المائية للأعشاب المختبرة أظهرت تأثيرات تثبيطية في إنبات البذور، وطول البادرات والوزن الجاف لها، وازداد هذا التأثير مع ازدياد تركيز المستخلص. وكان التأثير الأعظمي في الصفات المدروسة لمستخلص الأوراق لكل الأعشاب المختبرة، تلاه مستخلص الساق، ثم الجذور. أظهرت النتائج بوضوح التأثير السلبي لبقايا الأعشاب الضارة في الحقل، والتي يفضل التخلص منها قبل زراعة المحصول التالي.

الكلمات المفتاحية: التأثير التثبيطي، القمح، الإنبات، الأعشاب الضارة.

Abstract

The present investigation was carried out in the Weed Biological Control Section at the Biological Control Research and Studies Centre, Faculty of Agriculture, Damascus University (Syria) to evaluate the inhibitory effects of some weed species commonly found in wheat species on germination and seedling growth of wheat (*Triticum aestivum* L.) variety Cham$_{10}$. Aqueous extracts of weeds (*Avena sterilis* L., *Convolvulus arvensis* L., *Diplotaxis erucoides* L. *Lolium perenne* L. and *Sonchus oleraceus* L.) were made from leaf, stem and roots separately at 5, 10, 15, 20, 25% concentrations and the trail was designed in (CRD) completely randomized design with three replicates.

The results showed that the aqueous extracts of all tested weeds caused inhibitory effects on seed germination, seedling length and seedling dry weight of wheat, however this effect increased with increasing the concentration of weed extracts. Leaf extracts had the highest inhibitory effect on studied traits of wheat followed by the stem and root

 ISSN:2305 - 5243 ; AIF(NSP)-316

extracts, and this clearly indicated the negative effect of weed residues in the field which should be removed before sowing the next crop.
Keywords: Inhibitory effect, Wheat (*Triticum aestivum* L.), Germination, Weeds.

Introduction

Weeds are the most severe and widespread biological constraint to crop production and cause invisible damage till the crop is harvested (Dadar et *al*.,2014). Weeds are undesirable plants which compete with main crops in the growth media for nutrients, moisture, space, light and hamper the healthy growth ultimately reducing the growth and yield both qualitatively and quantitatively. Plant releasing chemical (Allelopathic compounds) into the environment may have deleterious and beneficial effects on other plants growing in their vicinity (Ghafarbi et *al*., 2012).

Allelopathic compounds are most commonly found in plant extracts and in plant residues in soil, some are found in live plant exudates and as volatile gases liberated from leaves and rhizome (Keeley, 1988). Allelochemicals emancipated as residues, exudates and leachates by many plants from leaves, stems, roots, fruits and seeds reported to interfere with growth of other plants (Batish et *al*., 2007, Duke et al., 1999, Asgharipour and Armin, 2010). These chemical products mainly affect plants at seed emergence and seedling levels (Mohamadi and Rajaie, 2009; Naseem et *al*., 2009).

The allelopathic potential of several weeds have been studied in the laboratory (Kato-Noguchi et *al*., 2002). The residues of the plants (crops and weeds), that remain in the field at the end of the season, may adversely affected the next crops, Suleiman (2010) mentioned that the residues of leaves of Prosopis farcta affected significantly the wheat seedling height (19.01 cm) and dry weight (0.26 g) for the treatment of 100 g/1kg soil against the figures of the control, 21.36 cm and 0.65 g, therefore, the present study was undertaken in Weed Biological Control Section in Biological Control Research and Studies Centre, Fac. Agriculture, Damascus University to determine the influence of aqueous extract of some weeds on germination and growth of wheat.

Material and Methods

-Botanical material

Very common weed plants in wheat field were selected for the present study namely, wild oat (*Avena sterilis* L.), field bind weed (*Convolvulus arvensis* L.) wall- rocket (*Diplotaxis erucoides* L.), perennial ryegrass (*Lolium perenne* L.) and common sowthistle, *Sonchus oleraceus* L. Fully grown healthy plant collected from field, and were separated into three pieces, leaves, stems and roots, roots were washed thoroughly with distilled water and then all parts air dried for 15 days. The dried plant parts were ground separately in a grinder and stored in air tight colored glass bottles. Aqueous extracts were prepared by soaking 10 gm of air dried weed plant material in 100 ml of distilled water for 24 hrs at room temperature. Then the extract was filtered using filter paper (Whatman no. 2) the volume of the filtrate made to 100ml and this considered as stock solution (Dhawan and Narwal, 1994). Stock solution was diluted appropriately with distilled water to give the final concentration of 5%, 10%, 15%, 20% and 25%. The control treatment, distilled water, was used to estimate potential germination of seeds.

-Plant material

The seeds of bread wheat (*T. aestivum)* variety ($Cham_{10}$) were obtained from Department of Agronomy, Faculty of Agriculture, Damascus University (Syria). The plant seeds were sterilized with 15:1 water/bleach (commercial NaOCl, 10 to 14 % available chlorine) solution for 5 minutes and subsequently washed with distilled water, then fully dried on blotter paper.

-Seed germination

Plastic plate (30 X 15 cm) were used to study the allelopathic effect of aqueous extract, two layers of folded blotter paper placed in each Plate above a layer of 5 cm sterilized sand. Paper towels were treated with 0.1% of a fungicide, topsin 70 wp, 5 days before use. Each paper towel was moistened with 20 ml of respective extracts, while the control was moistened with 20 ml of water. Fifty grains of T. aestivum ($Cham_{10}$) were placed uniformly in each plate, and replicated in triple. Plates were kept in a germinator (25±3º C, 70% humidity and constantly dark) for 5 days. Germination considered

when radical emergence ≥ 1 mm). The plates were watered equally once in every 2 days with either concentrations of aqueous solution of leaf extract or distilled water for the control.

-Seedling growth and dry weight

After 5 days, from germination, the plates moved from the germinator and kept under green house conditions with daily watering with distilled water. After 30 days, the length of shoots (Seedling height) were measured for every seedling in each tray and then the mean was calculated for each replicate.

The dry weight of the seedlings was also recorded at same time in the same manner.

-Statistical analysis

The trial was conducted in a complete randomized design (CRD) with three replicates. Germination percentage, seedling height and seedling dry weight were subject to Statistical analysis after the calculation of the inhibition percentage using the Abbot formula (Abbot, 1925): **= (control – treatment / control) * 100**

And then subjected to analysis of variance (two ways ANOVA) at (P< 0.01) using genStat7 program.

Results and Discussion

Concerning the germination rate, seedling height and seedling dry weight of wheat affected by the different extracts, data demonstrated a significant degree of suppression and a positive response to the increasing concentration (Tables 1-5). There were significant differences between the test treatments and the control. Similar observations were found by Ballester et *al*., 1982; Rizvi and Rizvi, 1987; Bansal, 1998; Daniel, 1999; Turk *et al*., 2005.

1-Allelopathic Effect of *Avena sterilis* extracts on Grain germination, seedling height and seedling dry weight.

The data in the Table 1 indicated that the extract from various plant parts of *A. sterilis* gave a negative significant effect on germination of wheat seeds, however the leaf extract showed the highest effect on grain germination inhibition (50.34%) as compared to stem extract (26.44%) and root extract (41.53%). Similar results were noticed for the effect on seedling height as the leaf extract showed the highest significant effect, followed significantly by the stem and root extracts.

Regarding the dry weight, the leaf extract also showed significant reduction but it was non significant for stem and root extracts. Similar results were reported by Suleiman (2010) as the leaves extract of *Prosopis farcta* affected significantly on the studied traits compared to other plant parts extracts. Albarni (2012) found that the silver leaf nightshade (*Solanum elaeagnifolium*) residues play a negative significant role on wheat germination and seedling height.

The statistical interaction between plant parts extracts and extract concentrations, showed that the highest effect was for leaf extract at concentration 25% for all studied traits: grain germination, seedling height and seedling dry weight, followed by stem extracts at concentration 25%.

Table 1. Allelopathic Effect of *Avena sterilis* extracts on Grain germination, seedling height and seedling dry weight.

Conc. (%)	Germination reduction (%)			Mean
	Leaf	Stem	Root	
5	13.98	4.17	1.39	6.51^{E}
10	36.35	9.78	8.39	18.17^{D}
15	48.96	30.08	50.32	43.12^{C}
20	65.70	35.70	62.93	54.78^{B}
25	86.73	52.47	84.60	74.60^{A}
Mean	50.34^{a}	26.44^{b}	41.53^{c}	

Variable	Extract	Conc.	E x C
$L.S.D_{0.01}$	3.355	4.331	7.502
CV%	8.4		

Conc. (%)	Seedling height reduction (%)			Mean
	Leaf	Stem	Root	
5	15.08	10.71	4.80	10.20^{D}
10	18.35	12.81	9.93	13.70^{CD}
15	20.93	17.84	16.95	18.57^{BC}
20	25.05	19.29	23.23	22.52^{B}
25	69.64	23.11	67.91	53.55^{A}
Mean	29.81^{a}	16.75^{b}	24.56^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	4.738	6.117	10.594
CV%	19.8		

Conc. (%)	Dry weight reduction (%)			Mean
	Leaf	Stem	Root	
5	24.17	13.70	18.24	18.70^{D}
10	53.24	34.26	23.15	36.88^{C}
15	58.89	42.13	53.61	51.54^{B}
20	62.04	52.04	60.09	58.06^{B}
25	83.70	65	77.69	75.46^{A}
Mean	56.41^{a}	41.43^{b}	46.56^{b}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	9.32	12.03	20.83
CV%	19.2		

- Similar letters indicate non-significance in the corresponding line or column.

2-Allelopathic Effect of *Convolvulus arvensis* extracts on seed germination, seedling height and seedling dry weight.

Leaf extract of *C. arvensis* showed the highest effect on seeds germination inhibition (31.96 %) as compared to stem extract (20.84%) and root extract (14.03%) (Table 2). Similar results were noticed for the effect on seedling height as the leaf extract showed the highest significant effect, followed significantly by the stem and root extract. dry weight results showed non significant difference between leaves and roots extracts as compared to stem. Similar results of wheat growth suppression by C. *arvensis* were recorded by Alam et *al*., 1996.

Table 2. Allelopathic Effect of *Convolvulus arvens*is extracts on Grain germination, seedling height and seedling dry weight.

Conc. (%)	Germination reduction (%)			Mean
	Leaf	Stem	Root	
5	4.21	3.50	0.00	2.57^{E}
10	19.00	9.15	6.25	11.47^{D}
15	34.50	26.06	15.97	25.51^{C}
20	40.84	30.27	21.53	30.88^{B}
25	61.26	35.21	26.39	40.95^{A}
Mean	31.96^{a}	20.84^{b}	14.03^{c}	

Variable	Extract	Conc.	E ^{x} C
L.S.D $_{0.01}$	2.860	3.692	6.395
CV%	12.7		

Conc. (%)	Seedling height reduction (%)			Mean
	Leaf	Stem	Root	
5	5.28	1.59	3.41	3.43^{C}
10	8.11	3.18	5.93	5.74^{C}
15	11.21	5.69	7.83	8.24^{C}
20	19.08	8.59	13.78	13.82^{B}
25	36.53	16.10	12.51	21.71^{A}
Mean	16.04^{a}	7.03^{b}	8.69^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	3.803	4.910	8.504
CV%	14.8		

Conc. (%)	Dry weight reduction (%)			Mean
	Leaf	Stem	Root	
5	24.01	10.72	34.73	23.15^{E}
10	35.20	29.60	51.05	38.62^{D}
15	69.93	56.65	56.18	60.92^{C}
20	78.09	64.80	71.94	71.61^{B}
25	91.84	73.89	83.69	83.14^{A}
Mean	59.81^{a}	47.13^{b}	59.52^{a}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	5.211	6.727	11.652
CV%	9.3		

- Similar letters indicate non-significance in the corresponding line or column.

Interaction between plant parts extracts and extract concentrations, showed that the highest effect was for leaf extract at concentration 25% for all grain germination, seedling height only and for seedling dry weight it was for the leaf and root extracts.

3-Allelopathic Effect of *Diplotaxis erucoides* extracts on Grain germination, seedling height and seedling dry weight.

Although the effect of extracts was similar to other weeds extracts but there was no significant differences between the stem and root extracts. *D. erucoides* was highly phytotoxic and significantly reduced seed germination and inhibited seedling growth of wheat, similar findings observed with Fujii and Hiradate, 2007.

Table 3. Allelopathic Effect of *Diplotaxis erucoides extracts* on Grain germination, seedling height and seedling dry weight.

Conc. (%)	Germination reduction (%)			Mean
	Leaf	Stem	Root	
5	30.70	18.55	18.59	22.61^{E}
10	40.69	22.13	32.84	31.89^{D}
15	43.55	33.56	34.27	37.13^{C}
20	57.16	52.13	35.72	48.34^{B}
25	64.99	59.26	55.72	59.99^{A}
Mean	47.42^{a}	37.13^{b}	35.43^{b}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	2.288	2.954	5.116
CV%	5.7		

Conc. (%)	Seedling height reduction (%)			Mean
	Leaf	Stem	Root	
5	29.46	21.09	21.06	23.87^{D}
10	49.61	29.34	29.10	36.02^{C}
15	56.99	32.42	36.47	41.96^{C}
20	67.54	37.36	41.41	48.77^{B}
25	78.05	46.03	49.87	57.98^{A}
Mean	56.33^{a}	33.25^{b}	35.58^{b}	

Variable	Extract	Conc.	E x C
L.S.D. (0.01)	4.771	6.160	10.669
CV%	11.3		

Conc. (%)	Dry weight reduction (%)			Mean
	Leaf	Stem	Root	
5	21.53	9.36	9.62	13.50^{D}
10	35.12	14.45	23.07	24.21^{C}
15	44.72	32.29	36.89	37.97^{B}
20	49.31	43.06	38.50	43.62^{B}
25	62.03	53.32	53.96	56.44^{A}
Mean	42.54^{a}	30.50^{b}	32.41^{b}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	6.87	8.87	15.36
CV%	19.4		

- Similar letters indicate non-significance in the corresponding line or column

Interaction resulted cleared that the leaf extracts were superior for all studied traits.

4-Allelopathic Effect of *Lolium perenne* extracts on Grain germination, seedling height and seedling dry weight.

The leaf extract of *L. perenne* has the highest negative effects (72.61%) on the germination rate and seedling dry weight among all studied weeds, as the mean inhibition germination rate was 72.61% and seedling dry weight 64% with leaf extracts (Table 4). Lehoczky et *al*., 2011 proved the negative effect of *Lolium perenne* on wheat seedling.

Table 4. Allelopathic Effect of *Lolium perenne* extracts on Grain germination, seedling height and seedling dry weight.

Conc. (%)	Germination reduction(%)			Mean
	Leaf	Stem	Root	
5	28.73	15.58	7.66	17.32^{E}
10	68.71	53.12	14.70	45.51^{D}
15	77.32	62.41	18.65	52.79^{C}
20	93.77	73.33	25.68	64.26^{B}
25	94.51	93.77	31.95	73.41^{A}
Mean	72.61^{a}	59.64^{b}	19.73^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	2.520	3.254	5.636
CV%	4.9		

Conc. (%)	Seedling height reduction (%)			Mean
	Leaf	Stem	Root	
5	30.50	26.52	4.09	20.37^{E}
10	49.47	44.35	5.24	33.02^{D}
15	58.75	55.69	17.42	43.95^{C}
20	69.76	63.93	25.12	52.94^{C}
25	78.58	78.58	35.12	64.09^{A}
Mean	57.41^{a}	53.81^{b}	17.40^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	2.816	3.636	6.297
CV%	6.5		

Conc. (%)	Dry weight reduction (%)			Mean
	Leaf	Stem	Root	
5	27.38	14.99	5.10	15.82^{E}
10	41.35	22.72	13.65	25.91^{D}
15	64.38	43.31	23.31	43.67^{C}
20	93.44	58.08	27.38	59.63^{B}
25	93.44	93.44	38.54	75.14^{A}
Mean	64.00^{a}	46.51^{b}	21.60^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	7.35	9.49	16.43
CV%	16.5		

- Similar letters indicate non-significance in the corresponding line or column

The interaction analysis showed the superiority of leaf and stem extracts of *L. perenne* on the studied characters as compared to root extracts.

5-Allelopathic Effect of *Sonchus oleraceus* extracts on seed germination, seedling height and seedling dry weight.

Similar behavior was observed for the *S. oleraceus* inhibitory effect on wheat characters, the germination reduced significantly with leaf extracts (51%) followed by stem extracts 20.56% and then the root extract (31.36), the seedling height affected in same manner, but for the dry weight there was non significance difference between stem and root extract effect. Decomposing *Rumex obtusifolius* leaves and their extracts were most toxic for germination and root growth of several grass weeds species, *Lolium perenne* L., *Poa pratensis* L. and *Dactylis glomerata* L. (Carral et *al*., 1988).

Table 5. Allelopathic Effect of *Sonchus oleraceus* extracts on Grain germination, seedling height and seedling dry weight.

Conc. (%)	Germination reduction (%)			Mean
	Leaf	Stem	Root	
5	16.88	1.77	6.84	8.50^{E}
10	34.17	1.79	18.01	17.99^{D}
15	54.69	3.55	30.91	29.72^{C}
20	71.20	34.98	40.99	49.06^{B}
25	78.04	60.73	60.05	66.27^{A}
Mean	51.00^{a}	20.56^{b}	31.36^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	2.660	3.434	5.947
CV%	7.7		

Conc. (%)	Seedling height reduction (%)			Mean
	Leaf	Stem	Root	
5	17.73	4.80	4.21	8.91^{E}
10	21.32	22.31	7.18	16.94^{D}
15	44.83	27.37	11.36	27.85^{C}
20	54.23	34.61	27.66	38.83^{B}
25	77.66	42.46	40.96	53.69^{A}
Mean	43.15^{a}	26.31^{b}	18.27^{c}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	3.243	4.186	7.251
CV%	11.0		

Conc. (%)	Dry weight reduction (%)			Mean
	Leaf	Stem	Root	
5	37.01	28.81	19.43	28.42^{D}
10	49.92	39.80	39.73	43.15^{C}
15	56.29	51.43	47.92	51.88^{B}
20	66.08	56.29	57.80	60.06^{A}
25	70.93	60.98	64.41	65.44^{A}
Mean	56.05^{a}	47.46^{b}	45.86^{b}	

Variable	Extract	Conc.	E x C
L.S.D $_{0.01}$	5.125	6.617	11.461
CV%	10.2		

- Similar letters indicate non-significance in the corresponding line or column

The interaction analysis for the dry weight showed that the effect of the concentration of 20 % was non significant with the 25% concentration, and this indicate the worst effect of this weeds among the studied ones.

conclusion

In conclusion, plant residues remain in the field after the harvest may play an important role of inhibition of the proceeding crop seed germination and seedling growth. In addition, the allelochemicals are an important defense for certain plants against the interference of other plants of the same or different species, which can affect their growth and development (Albarni *et al*., 2012 and Uremis *et al*., 2009) and this phenomenon could be utilized to control unwanted plants. We suggest to intensify the researches for the negative and positive effect of the plant residues in soil.

References

- Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265 - 267.
- Alam, S.M., A.R. Azmi and S.S.M. Naqvi. 1996. Effect of aqueous leaf extract of field bindweed (*Convolvulus arvensis* L.) and NaCl on growth of wheat. Rachis, 15(1 - 2).
- Albarni, N., G. Ibrahim and A. Almouemar. 2012.Allelopathic Effect of Silverleaf Nightshade (*Solanum elaeagnifolium* Cav.) on Germination and Growth of Two Wheat Varieties. J. Biol. Chem. Enveron. Sci., p. 15
- Albarni, N. 2012. Allelopathic Effect of Silverleaf Nightshade *Solanum elaeagnifolium* Cav. on Germination and Growth of Wheat *Triticum* spp. Ph.D. submitted to Damascus University, p. 200.
- Asgharipour, M.R. and M. Armin.2010. Inhibitory effects of *Sorghum halepense* root and leaf extracts on germination and early seedling growth of widely used medicinal plants. Advances in Environmental Biology, 4(2): 324-316
- Ballester, A., A.M. Vieitez and E. Vieitez. 1982. Allelopathic potential of *Erica vegans*, *Callunga vulgaris* and *Daboecia cantabrica*, J. Chem. Ecol., 8: 851 - 857.

- Bansal, G.L. 1998. Allelopathic effects of *Lantana camara* on rice and associated weeds under the midhill conditions of Himachal Pradesh, India. In:F M. Olofsdotter (ed.), Proc. Workshop on Allelopathy in Rice, Manila (Philippines): International Rice Research Institute, p. 133 - 138.
- Batish, D.R., K. Lavanya, H.P. Singh and R.K. Kohli. 2007. Root-mediated allelopathic interference of nettleleaved goosefoot (*Chenopodium album*) on wheat (*Triticum aestivum*). J. Agronomy and Crop Science, 193: 37 - 44.
- Carral, E., M.J. Reigosa, and A. Carballeira. 1988. *Rumex obtusifolius* L: Release of allelochemical agents and their influence on small-scale spatial distribution of meadow species. J. Chemical Ecology. 14: 1763 - 1773.
- Dadar, A., A. Asgharzade and M. Nazari. 2014. Determination of allelopathic effect of purple nut sedge (*Cyperus rotundus* L.) On germination and initial development of tomato (*Lycopersicum esculentum*. Indian J. Fundamental and Applied Life Sciences, 4(2) :576 - 580.
- Daniel, W.G. 1999. Historical review and current models of forest succession and interference. Florida: CRC press: 237 - 251.
- Dhawan, S.R. and S.S. Narwal. 1994. Critical assessment of allelopathy bioassays in India. Proc. Int. Symp. Allelopathy in Sustainable agriculture, Forestry and environment. New Delhi: Indian society of Allelopathy, IARI. p. 25.
- Duke, S.O., F.E. Fedayan, J.G. Romagni and A.M. Rimando. 1999. Natural Products as sources of herbicides: current status and future trends. Weed Research, 40: 99 - 111
- Fujii, Y. and S. Hiradate. 2007. Allelopathy: New Concepts and Methodology. CRC Press, Edenbridge Ltd, British Isles, p. 398.
- Ghafarbi, S. P., S. Hassannejad and R. Lotfi. 2012. Allelopathic Effects of Wheat Seed Extracts on Seed and Seedling Growth of Eight Selected Weed Species. International J. Agriculture and Crop Sciences, 4(19): 1452 - 1457.
- Kato-Noguchi, H., T. Ino, N. Sata and S. Yamamura. 2002. Isolation and identification of a potent allelopathic substance in rice root exudates. Physiologia Plant, 115: 401 - 405.
- Keeley, J.E. 1988. Allelopathy. Ecology, 69: 262 - 263.
- Lehoczky, E., M. O. Nelima, R. Szabó, A. Szalai and P. Nagy. 2011. Allelopathic effect of *Bromus* spp. and *Lolium* spp. shoot extracts on some crops. Commun. Agric. Appl. Biol. Sci., 76:537 - 554.
- Mohamadi, N. and P. Rajaie. 2009. Effect of aqueous Eucalyptus (*E. camaldulensis* Labill) extracts on seed germination, seedling growth and physiological responses of *Phaseolus vulgaris* and *Sorghum bicolor*. Research J. Biological Sciences, 4(12): 1291 - 1296.
- Naseem, M., M. Aslam, M. Ansar and M. Azhar. 2009. Allelopathic effects of sunflower water extract on weed control and wheat productivity. Pakistan J. Weed Science Research, 15(1): 107 - 116.
- Rizvi, S.J.H. and V. Rizvi. 1987. Improving Crop Productivity in India: Role of Allelochemicals. *In*: Allelochemicals Role in Agriculture and Forestry, Waller, G.R. (Ed.). American Chemical Society, Washington, DC: 69 - 75.
- Suleiman, R. 2010. The seasonal increase of *Prosopis farcta* and it effect on germination and growth of wheat. M.Sc. thesis. Damascus University, p. 93.
- Turk, M.A., K.D. Lee and A.M. Tawaha. 2005. Inhibitory effects of aqueous extracts of black mustard on germination at growth of Radish. Research J. Agriculture and Biology Science, 1(3): 227 - 231.
- Uremis, I., M. Ahmet, A. Uludag and M. Sangun. 2009. Allelopathic potentials of residues of 6 Brassica species on johnson grass (*Sorghum halepense*) African J. Biotech., 8: 3497 - 3501.

Nº Ref- 537