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Phytotoxicity of Some Common Weed Species to Certain Vegetable Crops Grown in Jordan

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ABSTRACT

Thirty common weed species of 18 plant families were screened for their phytotoxic effects against certain vegetable crops grown in Jordan. Aqueous shoot extract of *Amaranthus gracilis*, *Convolvulus arvensis*, *Lactuca serriola* and *Portulaca oleracea* were highly toxic to most crops. High volume of extract in the medium inhibited seed germination or significantly reduced seedlings growth of different tested crops. The inhibitory effect depended on extract level in the medium, with low volume of some weeds extracts enhanced seedlings growth of certain crops. Roots appeared more sensitive to extracts than shoots, with cabbage; onion and tomato were most sensitive. Root exudates of *L. serriola* were most toxic to germination and growth of most crops with cucumber and onion were most reduced. Volatiles emanated from fresh shoots of certain weeds exhibited various inhibitory actions on different growth parameters of the tested crop species. *C. arvensis* and *L. serriola* volatiles were the most harmful to carrot, cucumber, pepper and squash, but cabbage was the most tolerant to all weeds.

KEYWORDS: Phytotoxicity, weeds, allelopathy, vegetable crops.

INTRODUCTION

Many noxious annual and perennial weeds have been regarded as species with allelopathic potential and can severely affect crops survival and productivity (Putnam and Duke, 1978; Rice, 1979; Qasem, 1993 and 1994a,b; Qasem and Foy, 2001). Allelochemicals produced by plants may be released into the surrounding environment in sufficient amounts with enough persistence that affect neighboring and successional species (Akram *et al*., 1990) .Different studies showed that water extracts of weeds inhibited or reduced seed germination of different crops (Weston and Putnam, 1986; Qasem and Foy, 2001) and negatively affected plant growth and development (Lovett and Lynch, 1979; Qasem, 1995; Obaid and Qasem, 2002). Some allelopathic agents are volatiles emanated from different parts (Muller *et al*., 1964; Hicks *et al*., 1989; Qasem, 1995); others are exudates released from roots to the root zone and interfere in roots growth and functions (Rice, 1979; Kumari and Kohli, 1987; Bradow and Conick, 1988) or inhibit seed germination (Achhireddy and Singh, 1984). Some allelochemicals are water soluble leached from foliage parts by rain, mist, dew, or fog drip (Retig *et al*., 1972; Putnam and Duke, 1978; Qasem, 1994b) leading to the colonies that several perennial weeds form in nature (Rice, 1974). However, the inhibitory materials may be auto- or hetero-pathy (Kumari and Kohli, 1987), some can be highly selective (Qasem and Hill, 1989; Qasem and Foy, 2001) and their effects are extract volume dependent (Weston and Putnam, 1986; Qasem, 1993).The present work was conducted to investigate the effect of aqueous shoot extracts, volatile materials, root exudates and foliage leachates of some common weed species on germination and growth of selected vegetable crops grown in Jordan.

Materials and Methods

Weeds (Table 1) were collected during the growing seasons from different locations in Jordan. Plants were selected and harvested from the above soil surface, and brought to the laboratory, cleaned then extracted. Crop seeds were brought commercially from local markets. Three hundred g of fresh shoots of each weed species was

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washed with tap water, then with distilled water, allowed to dry for 2 h, then chopped into small pieces, added to a liter of distilled water and blended and homogenized in a Waring blender for five minutes at room temperature. The mixture was allowed to stand for half an hour; the supernatant was filtrated through a Whatman No.1 filter paper. The filtrate was considered a full strength crude concentration and stored at 4°C in the refrigerator until used. The following experiments were carried out:

Experiment 1. Effect of Aqueous Extract

Twenty seeds of cabbage (*Brassica oleracea* L. var. *Capitata* cv. Pronzwik), Cucumber (*Cucumis sativus* L. cv. Beithalpha), Squash (*Cucurbita pepo* L. cv. Byrouti), Onion (*Allium cepa* L. cv Texas Early Grana), Pepper (*Capsicum annum* L. cv. Red common), Tomato (*Lycopersicon esculentum* Mill cv. Special Back) or Carrot (*Daucus carrota* L. cv. Natus) were placed on filter paper in four Petri-dishes (11 cm in diameter) per treatment. Ten ml full strength fresh crude shoot extract of one weed species was added per each of four replicate Petri-dishes. In another treatment, extracts were replaced by distilled water and considered as a control.

Petri-dishes were incubated in the dark at 24°C for 2-3 weeks, depending on germination date of crop species used, before the experiment was terminated. Data on germination and growth of different crops were recorded.

Experiment 2. Effect of Extract Volume

The most inhibitory weed extracts were further examined and twenty seeds of each crop were sown separately on a filter paper in each of four Petri-dishes. Full strength extract at 0.5, 1, 2, 3, 4 and 5 ml were added per Petri-dish. The final volume was completed to 10 ml by adding distilled water. For the control treatment, 10 ml of distilled water was added per Petri-dish. The dishes were incubated as above and data on crops germination and growth were recorded .

Experiment 3. Effect of Root Exudates

Ten cm diameter plastic pots were filled with 500 g of soil mixture (clay: sand: peat 3:1:1 of a pH 7.7) and planted with seeds or rhizomes of certain weed species. After emergence, seedlings were thinned to ten per pot, irrigated with tap water when needed and left to grow for two months before being removed. The soil was loosened and cleaned up from weed roots then mixed with equal volume of distilled water and thoroughly shaked for 2 h using a shaker. The mixture was passed through filter paper and immediately assayed for allelopathic activity. For the control treatment 500 g of weed free soil was mixed with the same volume of distilled water and similarly treated before used. The effect of soil filtrate was studied by placing twenty seeds of each of the crop species tested on a filter paper in each of four Petri-dishes at which 10 ml of the soil extract of either weeds species was added per Petri-dish. In another treatment, 10 ml extracts of the weed free soil was added per Petri-dish and considered as a check. Dishes were incubated as usual and data on germination and growth of crops were recorded.

Experiment 4. Effect of Volatile Materials

Ten seeds of each crop species were placed separately in each of four sterilized (9 cm diameter) Petri-dish lined with moistened filter paper. Thirty g of fresh, healthy and clean shoots of different weed species were placed separately in the bottom of a wide mouth 500 ml cups (11 cm diameter), using four containers per weed species . Petri dishes containing seeds were placed open over weed shoots inside the containers which then tightly closed to eliminate any air diffusion. For the control treatment, dishes sown with crop seeds were placed in similar containers, but without any weed materials were added. All containers were incubated as before for 1-2 weeks depending on crop species tested. Data on germination and growth of different crops were recorded.

Statistics and Data Analysis

Treatments in all experiments were laid out in a randomized complete block design with four replicates. In all experiments, data were taken on germination percentage, shoot and total root lengths, and root dry weights after being oven dried at 80°C for 48 h. All data were statistically analyzed by ANOVA, and treatments means were compared using the least significant differences (LSD) at p=0.05.

RESULTS

Experiment 1. Effect of Weed Extracts

Water extract of most weed species significantly reduced germination and growth the tested crops compared with the controls (Table 1). The degree of inhibition depends on crop and weed species tested with certain extracts stimulated growth of certain crops. Seed

germination of all crops was reduced by most extracts and the strength of inhibition was greatly different for different crops. Root growth of onion, squash, and tomato were more affected than for other crops. The degree of inhibition was crop and weed extract dependent. Carrot, cucumber, and pepper were less affected than cabbage, onion, squash, and tomato while extract of *A. palastina*, *C. dactylon*, *S. vernalis*, and *S. oleraceus* failed to inhibit growth of any crop tested. In contrast, higher shoot growth of cabbage, cucumber, and pepper was obtained with *A. palastina* extract compared with the controls. Roots affected more than shoots, with tomato and cabbage roots were least affected. On the other hand, extract of *A. arvensis* and *A. palastina* increased root dry weight of cabbage and squash. Shoot dry weight was severely reduced with full strength crude extract .The degree of inhibition varied between crops with cabbage, cucumber, and pepper were the least affected. In contrast, shoot extract of *A. palastina* increased shoot dry weight of pepper and squash compared with the controls, while the same extract showed no effect on other crops.

Generally, extracts of *A. gracilis*, *C. arvensis*, *L. serriola* and *P. oleracea* were the most inhibitory to different vegetable crops and therefore the follow up work was mainly concentrated on these weed species.

Experiment 2. Effect of Extract Volume

The phytotoxic effect of different volumes of fresh shoot extract on germination, total root length, and root and shoot dried weights are shown in Table (2). Response to aqueous extract of promising weed species was varied among tested crops. The harmful effect was proportional to extract volume. Roots appeared more sensitive to extracts than shoots. Shoot extract of *A. gracilis* inhibited growth of all crops, but carrot, cucumber, pepper, and squash were less affected. In contrast growth of cucumber, pepper, and squash was promoted at low (0.5 ml) extract volume.

When fresh shoot extract of *C. arvensis* was used, germination of all crops was significantly reduced compared with the control. However, high volume delayed radicle emergence. Root and shoot lengths were inhibited with extract volume and up to 5 ml/Petri-dish. In contrast, this volume stimulated stem elongation in cabbage, cucumber, and squash. As low as 1/10 extract volume of *L. serriola* added per Petri-dish was sufficient to delay germination of the tested crops (except carrot). However, higher volumes were required to reduce other growth parameters of the crops used. Less reduction in length and dry weight of shoots than for roots was found using extract of this weed species.

Shoot extract of *P. oleracea* significantly reduced germination of all crops (except squash) and tomato when 4 ml of this extract was added per Petri-dish. However, lower volumes were enough to delay germination compared with the control, except when cabbage and carrot extracts were used. Roots of cabbage, pepper, and tomato were more sensitive to extract than shoots. Shoot extract of *D. erucoides*, and *P. oleracea* were less phytotoxic to the tested crops than other extracts. Meanwhile, low extract (0.5 ml) volume of the three species increased shoot length of carrot.

Results showed that, aqueous extract of *C. draba*. *C. arvensis*, and *S. syriaca* were the most phytotoxic among tested extracts. However, carrot, cucumber, and pepper were the least inhibited crop species.

Experiment 3. Effect of Root Exudates

Effects of root exudates on germination, total root and shoot lengths and dry weights are shown in Table (3). No significant reduction in germination of cabbage was obtained with root exudates of any weed species tested. However, *L. serriola* exudates significantly reduced total root length of this crop. Root exudates of *A. gracilis* and *L. serriola* delayed seedlings emergence of carrot but did not affect germination. Total root length was reduced with *P. oleracea* exudates.

Emergence of the radicle was delayed and germination and growth of cucumber were reduced with root exudates of *L. serriola* and similar effect for the same weed species was found on onion .In contrast, pepper and squash were not affected by exudates of any weed species .

Experiment 4. Effect of Volatile Materials

Volatile materials released from *A. gracilis* inhibited seed germination of carrot, shoot growth of cabbage and tomato and root growth of carrot and pepper (Table 4). Those of *C. arvensis* inhibited germination of pepper and tomato, shoot dry weights of carrot and cucumber and root dry weights of cabbage, carrot, onion, pepper and squash. *L. serriola* inhibited Volatiles germination of carrot, shoot dry weights of cabbage, carrot, and pepper and root dry weights of carrot, pepper and squash. Volatiles of *P. oleracea* reduced seed germination of carrot and root growth of onion and pepper.

DISCUSSION

Crops were varied in their sensitivity to the phytotoxic effect of weed extracts. This variation (negative or positive) of different extracts agreed with the findings with other workers who observed that some weed extract may inhibit growth while others stimulate or had no effect (Stachon and Zimdahl, 1980; Bhowmick and Doll, 1982; Qasem, 1993; Qasem, 1995). Qasem (1995) reported differences between crops in their tolerance to the allelochemicals present in weed extract indicating that allelopathy is selective mechanism .

Weed extract containing growth inhibitors and when found in sufficient concentration they inhibit growth of the receiver species .Many workers isolated some of the allelochemicals responsible on growth suppression and were identified as alkaloids (Lehle *et al*., 1983), saponons (Agero and Baland, 1985), and terpenoides (Lovett and Lynch, 1979) or other unrelated chemicals .

Studies carried out on the effective weed extract revealed that the harmful effect is extract volume dependent. High volume severely reduced germination and seedlings growth, which may be due to the presence of high concentration of inhibitors. It has been suggested that plant extract contains allelochemicals responsible for the inhibitory action obtained (Brown *et al*., 1983; Obaid and Qasem, 2002). Low extract volume however, stimulated seedlings growth of certain crops (Table 2) which agreed with results of other workers (Patterson, 1981; Obaid and Qasem, 2002). The stimulatory effect at low volume and the inhibitory action of extracts at high volume are parallel to the effect of certain herbicides (Qasem, 1994b).

Germination was delayed with weed extracts but final germination was less affected. These results were in agreement with others' findings and indicating that the toxic effect of allelochemicals is more severe at early stages of growth (Qasem, 1993). The higher sensitivity roots to the inhibitory effects than shoots because roots were in direct contact with the extract and subsequently subjected to their allelopathy influence. Roots appeared short and thick suggesting that inhibitors may interfere with cell division and cell elongation and probably responsible for the reduction obtained in shoot height and root length (Qasem, 1994a). Duke *et al*. (1987) suggested that inhibitors may block some other processes required for cell division or elongation such as amino acid synthesis or respiration.

Phytotoxicity of weeds root exudates showed great variation in this regard and was depending on weed and crop species tested. Some showed no allelopathic activity which may be due to less toxins released from their roots to the growing medium. Stachon and Zimdahl (1980) indicated that much higher rates of root exudates were required to reduce plant growth and Patterson (1981) observed that long term release of toxic compounds of living plants into the soil caused strong harmful effect that would not otherwise appear in short term experiments.

Results of the present experiments showed that crop growth was reduced when root exudates were added to the growing medium (Table 3) and roots were more sensitive to exudates effect. Exuded chemicals from roots of different weed species may interfere with nutrient availability to plants and thus reduced growth showed up mineral deficiency symptoms. Qasem (1995) reported that root exudates of *A. retroflexus* and *C. murale* released to the soil affected growth of squash seedlings that exhibited mineral deficiency symptoms compared with the control. However, evidences are accumulating and showing that root exudates of certain plant species are toxic to the roots of neighboring plants, and inhibited germination of some other species (Rovira, 1969).

Results showed that volatiles fresh shoots of certain weeds inhibited growth of all crops except pepper, but the degree of phytotoxicity was varied between crops. Oleszek (1987) concluded that the toxicity of released compounds from crucifers dependent, and the acceptor species react in different ways to the presence of volatiles of different donor species.

Although the exact nature of released volatiles from the donor plant is unknown, so more attempts must be employed in this aspect of allelopathy.

Persistence of the rainfall for a long period may leach chemicals from fresh shoots of plants found in the fields. Allelopathic effects of the leached materials depend upon the transfer of chemicals from weed to crop foliage and may decrease growth of the tested crops depending on both donor and acceptor species. Although the effect of the leachates used and applied to the soil in the present study was less phytotoxic than when other methods were used. The concentration of leached material and the effect of microorganisms play a major role in determining the stimulatory or inhibitory action of the leached compounds (Qasem and Hill, 1989). Lower amounts of allelochemicals could be leached and used in this experiment due to the short period that weed shoots

immersed in water or to the low weight of shoots or high volume of water used. Stimulation of seedlings growth by certain treatments was in agreement with the suggestions of Tukey (1969) in that plant metabolites liberated in soil were not inhibitory to other species but rather may be quite stimulatory.

In conclusion, allelopathic effect of weed extracts was varied among weed species and crops were also varied in their responses. Extracts of different weeds inhibited germination and growth of several crops and the degree of inhibition was proportional to extract volume. However, certain extract enhanced growth of certain crops tested .Volatile materials emanated from fresh shoots of certain weed species reduced growth and development of the receiver crop species. Using closed container technique volatile materials from shoots significantly inhibited germination and growth of all crops except pepper. Root exudates of different weed species resulted in various inhibitory action which were donor and receiver dependent.

Table 1. Effect of full strength crude extracts of different common weed species on germination (G), shoot dry weight (SHDWt.), and root dry weight (RDWt.) of certain vegetable crops grown in Petri-dishes at 24°C.

Weed species	Growth stage	CABBAGE			CARROT			CUCUMBER		
		G%	SDWt (mg)	RDWt. (mg)	G%	SDWt. (mg)	RDWt. (mg)	G%	SDWt. (mg)	RDWt. (mg)
dH2O (Check)	-	80	25.4	9.6	85	13.3	3.7	86	637	387
Adonis annua L.	F	63	3.0	1.6	55	2.3	0.0	65	50	44
Amaranthus gracilis Desf.	V	39	3.0	1.1	41	2.1	0.0	53	6	5
Ammi majus L.	F	65	3.1	1.2	58	4.4	2.0	84	375	235
Anagallis arvensis L.	F	76	22.9	9.9	68	3.6	1.5	90	561	230
Anthemis palastina Reut	F	74	25.9	10.5	71	8.7	1.5	90	659	371
Capsella bursa pastoris (L.) Medik	F	68	7.0	2.0	65	6.0	0.0	75	541	265
Carthamus nitidus Bioss	V	58	0.0	0.0	51	4.1	0.0	54	211	131
Centaurea iberica Trev.ex Spreng	F	70	10.0	3.0	79	4.7	1.5	74	463	245
Chenopodium murale L.	F	45	4.0	1.3	54	4.3	0.0	64	63	52
Convolvulus arvensis L.	V	5	5.0	0.0	43	2.1	1.7	39	41	33
Cynodon dactylon (L) Pers	V	61	24.2	9.7	55	4.6	0.0	90	659	246
Eruca sativa Mill	F	69	3.7	1.2	69	5.3	0.0	74	564	362
Heliotropium europium L.	F	66	22.4	8.0	71	4.6	0.0	70	420	270
Lactuca serrioal L.	V	43	4.2	1.6	65	2.1	0.0	55	52	34
Lamium amplexicaula L.	V	70	14.0	3.4	76	8.7	0.0	81	639	271
Malva sylvestris L.	V	76	19.9	8.1	78	9.5	0.0	46	102	72
Molucella leavis L.	V	71	5.0	0.0	68	5.2	0.0	78	375	391
Notobasis syriaca (L) Cass.	V	65	22.4	5.9	76	7.7	2.0	74	349	253
Papaver rhoeas L.	V	69	4.0	1.0	74	7.7	0.0	71	351	326
Polygonum aviculare L.	PF	63	9.0	2.0	66	12.3	2.0	79	668	318
Portulaca oleracea L.	V	53	1.0	0.0	60	6.9	0.0	53	55	51
Rumex crispus L.	PF	63	1.0	0.0	73	2.0	1.5	73	273	231
Senecio vernalis Wildest and Kit	F	70	24.6	9.6	81	10.5	0.0	81	632	346
Sinapis arvensis L.	F	58	0.0	0.0	63	9.5	2.1	81	468	345
Sisymbrium irio L.	F	60	1.0	1.0	55	7.3	0.0	71	479	215
Solanum nigrum L.	V	64	1.0	1.1	59	8.9	2.0	48	247	143
Sonchus oleraceus L.	F	80	17.9	10.0	80	9.7	0.0	85	612	195
Sorghum halepense (L.) Pers	V	58	2.0	1.5	54	4.5	0.0	71	73	45
Urtica urens L.	V	55	6.0	0.0	50	5.9	0.0	56	140	46
Vicia peregrina L.	F	54	5.0	2.0	51	4.7	0.0	50	52	47
LSD (P = 0.05)		**7**	**1.3**	**0.5**	**8**	**0.5**	**0.2**	**10**	**28**	**25**

Table 1. (Continued) Effect of full strength extracts of different common weed species on germination (G), shoot dry weight (SHDWt.), and root dry weight (RDWt.) of certain vegetable crops grown in Petri-dishes at 24°C.

Weed species	Growth stage	ONION			PEPPER			SQUASH			TOMATO		
		G%	SDWt. (mg)	RDWt. (mg)	G%	SDWt. (mg)	RDWt. (mg)	G%	SDWt. (mg)	RDWt. (mg)	G%	SDWt. (mg)	RDWt. (mg)
Control	-	76	14.5	2.4	83	45.7	28.8	74	634	167	81	21.8	17.5
A. annua L.	F	71	1.5	0.0	50	4.9	0.8	50	58	16	53	3.0	2.3
A. gracilis	V	34	1.0	0.0	25	5.3	1.0	34	55	24	44	3.1	2.1
A. majus L.	F	70	1.5	0.0	68	5.0	1.1	55	126	45	71	3.0	2.0
A. arvensis L.	F	66	15.6	2.5	80	43.4	19.5	75	552	188	46	12.3	13.7
A. palastina Reut	F	70	1.0	0.0	75	51.8	18.8	79	762	243	71	20.7	16.2
C. bursa pastoris (L.) Medik	F	76	1.3	0.0	75	10.6	1.1	51	245	86	64	7.8	3.2
C. nitidus Bioss	V	45	1.4	0.0	48	3.6	1.3	35	518	45	49	0.0	0.0
C. iberica Trev.ex Spreng	F	66	1.7	0.0	66	7.6	3.2	43	171	33	74	7.6	6.2
C. murale L.	F	70	1.2	0.0	45	9.5	1.1	33	53	18	53	3.3	2.3
C. arvensis L.	V	66	0.0	0.0	43	9.9	1.0	40	95	35	48	6.0	1.0
C. dactylon (L) Pers	V	74	7.3	1.1	71	34.4	19.4	73	368	151	73	19.5	19.0
E. sativa Mill	F	53	3.4	0.0	60	12.0	1.1	47	158	33	74	6.6	2.4
H. europium L.	F	65	7.2	1.2	49	25.6	4.2	70	459	254	69	10.6	8.4
L. serrioal L.	V	64	1.0	0.0	31	9.2	1.2	26	14	8	51	6.8	3.1
L. amplexicaula L.	V	73	4.4	0.0	49	8.7	2.5	55	450	172	80	4.1	3.1
M. sylvestris L.	V	74	7.6	1.3	30	29.6	13.2	43	279	161	70	16.0	12.3
M. leavis L.	V	75	7.6	1.4	68	8.4	0.8	68	350	97	40	6.3	0.0
N. syriaca (L) Cass.	V	49	17.4	2.8	75	34.5	16.7	63	500	169	75	12.3	10.3
P. rhoeas L.	V	71	3.5	0.0	35	7.0	0.5	58	433	105	75	5.6	1.3
P. aviculare L.	PF	70	1.2	0.0	61	6.5	2.1	48	372	86	71	6.2	3.1
P. oleracea L.	V	41	1.8	0.0	50	4.3	0.0	33	182	34	48	1.2	0.0
R. crispus L.	PF	68	4.4	0.0	75	5.1	0.5	58	229	179	71	2.0	0.7
S. vernalis Wildest and Kit	F	51	7.2	1.2	54	24.1	18.4	63	517	184	78	15.8	12.2
S. arvensis L.	F	69	7.5	1.3	50	5.1	0.0	48	483	53	64	2.2	1.0
S. irio L.	F	63	3.4	0.0	40	5.8	1.2	48	443	75	60	3.5	2.0
S. nigrum L.	V	35	3.6	0.0	49	10.8	8.6	70	687	180	61	5.9	4.1
S. oleraceus L.	F	54	6.4	1.0	78	36.9	15.4	35	382	48	78	10.2	13.4
S. halepense (L.) Pers	V	45	3.3	0.0	43	1.0	1.3	39	86	22	58	1.2	2.0
U. urens L.	V	43	1.6	0.0	25	6.2	1.0	28	224	32	49	2.0	0.3
V. peregrina L.	F	44	0.0	0.0	43	7.1	1.6	38	215	33	51	2.3	3.0
LSD (P = 0.05)		**8**	**4.0**	**0.2**	**11**	**1.8**	**1.1**	**9**	**24**	**13**	**8**	**1.1**	**1.1**

F = Flowering

PF = Pre-Flowering

V = Vegetative

Table 2. Effect of extract volume of different weed species on germination (G), shoot dry weight (SHDWt.) and root dry weight (RDWt.) of different crops grown in Petri-dishes.

Effect on Cabbage

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	85	25.5	9.6	85	25.5	9.6	85	25.5	9.6	85	25.5	9.6
0.5	80	21.8	5.9	93	24.7	10.8	93	28.2	7.5	84	23.5	9.7
1.0	84	21.7	6.2	85	35.9	7.6	84	21.9	7.4	70	21.0	8.3
2.0	74	16.7	4.9	77	22.9	6.1	78	30.3	4.9	71	10.3	5.7
3.0	66	16.2	4.7	74	22.8	7.9	83	22.3	4.8	62	14.4	4.8
4.0	53	13.6	4.8	54	19.0	8.3	68	23.2	5.3	64	20.0	4.3
5.0	39	12.5	1.8	44	18.1	4.6	75	19.8	5.1	59	13.6	4.1
LSD (P=0.05)	**6**	**2.9**	**1.3**	**8**	**2.4**	**1.1**	**11**	**3.6**	**1.7**	**9**	**5.7**	**1.0**

Effect on Carrot

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	89	13.1	2.5	89	13.1	2.5	89	13.1	2.5	89	13.1	2.5
0.5	88	12.	2.5	86	14.8	3.6	36	12.1	2.7	81	12.0	2.4
1.0	78	10.7	2.3	80	9.7	1.9	35	11.5	2.1	76	12.4	2.8
2.0	84	12.8	2.3	78	9.6	1.8	33	13.0	3.0	73	11.9	3.0
3.0	79	11.6	2.2	69	11.6	2.0	29	11.1	2.0	74	12.3	2.1
4.0	73	12.9	2.4	71	10.7	1.9	30	12.2	2.0	79	10.3	1.9
5.0	74	10.6	2.2	60	9.4	1.8	19	11.8	2.1	76	14.4	2.6
LSD (P=0.05)	**10**	**1.1**	**0.4**	**9**	**1.2**	**0.6**	**12**	**1.4**	**0.8**	**9**	**1.5**	**0.9**

Effect on Cucumber

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	93	289	67	93	289	67	93	289	67	93	289	67
0.5	90	272	77	84	273	54	90	278	56	89	274	68
1.0	85	290	68	86	285	64	89	286	65	86	241	66
2.0	78	278	63	73	248	27	89	289	61	80	258	55
3.0	60	237	59	75	246	37	89	292	55	65	254	51
4.0	45	196	52	71	221	50	70	275	47	71	193	42
5.0	30	106	15	50	114	30	79	286	78	64	234	32
LSD (P=0.05)	**8**	**40**	**2**	**9**	**36**	**8**	**7**	**54**	**10**	**9**	**6**	**5**

Table 2 (Continued)

Effect on Onion

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	89	14.1	2.4	89	14.1	2.4	89	14.1	2.4	89	14.1	2.4
0.5	83	13.9	2.5	85	13.3	2.2	26	11.9	2.3	88	13.0	2.5
1.0	76	10.7	1.8	84	13.3	2.2	31	12.5	2.2	83	10.2	2.2
2.0	68	8.0	1.0	78	9.0	1.9	29	8.7	1.8	78	8.8	1.6
3.0	66	3.1	0.0	75	5.0	1.0	24	10.9	1.9	69	8.8	1.6
4.0	65	2.2	0.0	63	12.2	1.9	13	4.7	1.0	71	7.0	1.2
5.0	61	1.8	0.0	53	5.8	0.0	15	7.8	1.4	69	5.2	1.0
LSD (P=0.05)	**12**	**1.5**	**0.8**	**9**	**1.6**	**0.3**	**9**	**3**	**0.4**	**7**	**3.0**	**0.5**

Effect on Pepper

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	90	50	14	90	50	14	90	50	14	90	50	14
0.5	84	51	22	84	51	19	81	60	14	88	54	17
1.0	81	45	15	80	44	14	84	59	28	80	43	12
2.0	78	35	15	63	44	16	75	47	14	75	34	13
3.0	81	38	13	74	42	12	80	50	19	71	17	12
4.0	71	14	7	68	30	12	78	40	12	65	27	16
5.0	54	20	4	58	25	12	79	41	11	64	19	11
LSD (P=0.05)	**6**	**7**	**2**	**8**	**4**	**1**	**7**	**3**	**2**	**8**	**10**	**2**

Effect on Squash

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	92	594	167	92	594	167	92	594	167	92	594	167
0.5	89	594	180	80	570	165	83	607	166	69	584	169
1.0	84	601	171	90	695	176	89	597	170	81	580	167
2.0	78	452	117	75	434	86	83	566	143	88	494	170
3.0	81	513	104	81	495	133	88	636	176	81	532	160
4.0	83	597	164	88	494	94	90	535	187	84	575	165
5.0	61	493	91	70	386	127	90	644	134	88	530	145
LSD (P=0.05)	**9**	**20**	**6**	**9**	**28**	**11**	**10**	**15**	**6**	**12**	**89**	**13**

Table 2 (Continued)

Effect on Tomato

Weed species	***A. gracilis***			***C. arvensis***			***L. serriola***			***P. oleracea***		
Extract volume **(ml/Petri-dish)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**	**G%**	**SDWt. (mg)**	**RDWt. (mg)**
0 (Control)	90	22	12	90	22	12	90	22	12	90	22	12
0.5	90	20	11	85	21	17	83	20	17	89	20	10
1.0	85	23	9	86	20	16	88	24	10	83	20	10
2.0	80	22	8	84	22	6	81	19	11	76	20	8
3.0	83	18	8	90	16	4	78	17	9	88	18	8
4.0	88	23	11	78	18	5	78	20	6	84	13	9
5.0	71	6	6	78	19	5	78	21	7	79	14	9
LSD (P=0.05)	**6**	**3**	**3**	**6**	**2**	**2**	**9**	**3**	**2**	**9**	**2**	**2**

Table 3. Effect of root exudates of different weed species on germination (G), shoot dry weight (SDWt.) and root dry weight (RDWt.) of selected vegetable crops grown in Petri-dishes at 24^{o}C.

Crops /Weed species		**Control**	***A. gracilis***	***C. arvensis***	***L. serriola***	***P. oleracea***	**LSD (P = 0.05)**
Cabbage	G%	75	72	70	75	75	**8**
	SDWt. (mg)	23	33	26	20	20	**3**
	RDWt. (mg)	11	10	11	11	`0	**3**
Carrot	G%	85	83	83	82	81	**8**
	SDWt. (mg)	7	10	9	10	8	**2**
	RDWt. (mg)	1.4	1.9	1.4	1,8	1.3	**0.6**
Cucumber	G%	93	87	82	55	80	**7**
	SDWt. (mg)	269	262	265	178	244	**19**
	RDWt. (mg)	54	56	54	27	51	**11**
Onion	G%	78	68	70	52	73	**8**
	SDWt. (mg)	12	12	12	8	10	**2**
	RDWt. (mg)	2.0	2.1	2.0	1.9	1.9	**0.7**
Pepper	G%	72	83	75	70	70	**8**
	SDWt. (mg)	21	21	21	20	18	**2**
	RDWt. (mg)	5	6	7	6	7	**2**
Squash	G%	82	82	81	78	88	**10**
	SDWt. (mg)	569	502	601	458	491	**38**
	RDWt. (mg)	163	115	137	122	144	**25**
Tomato	G%	87	90	85	87	83	**10**
	SDWt. (mg)	21	22	21	19	18	**2**
	RDWt. (mg)	5	6	7	6	7	**1**

Table 4. Effect of volatile materials of different weed species on germination (G), shoot dry weight (SDWt.) and root dry weight (RDWt.) of selected vegetable crops grown in Petri-dishes at 24°C.

Crops /Weed species		Control	*A. gracilis*	*C. arvensis*	*L. serriola*	*P. oleracea*	LSD (P = 0.05)
Cabbage	G%	80	80	78	70	65	**16**
	SDWt. (mg)	23	21	21	21	23	**2**
	RDWt. (mg)	9	8	6	9	9	**2**
Carrot	G%	82	70	80	70	63	**12**
	SDWt. (mg)	13	13	10	11	13	**2**
	RDWt. (mg)	4.0	2.9	3.3	3.0	4.0	**0.5**
Cucumber	G%	88	88	75	83	88	**15**
	SDWt. (mg)	145	139	112	149	150	**20**
	RDWt. (mg)	23	22	22	26	23	**4**
Onion	G%	70	68	68	68	75	**12**
	SDWt. (mg)	11	10	11	10	10	**2**
	RDWt. (mg)	3.7	3.0	3.2	3.7	3.0	**0.5**
Pepper	G%	80	65	70	73	75	**10**
	SDWt. (mg)	4.8	4.3	4.0	4.0	4.5	**0.8**
	RDWt. (mg)	1.5	1.0	0.8	1.0	0.8	**0.5**
Squash	G%	85	90	78	85	88	**15**
	SDWt. (mg)	193	399	385	408	353	**34**
	RDWt. (mg)	44	38	18	39	49	**3**
Tomato	G%	80	73	65	53	78	**11**
	SDWt. (mg)	12	10	11	11	12	**2**
	RDWt. (mg)	4.0	4.0	3.5	3.9	4.0	**0.6**

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السمية النباتية من بعض الأعشاب الشائعة لأنواع محاصيل خضار معينة مزروعة في الأردن

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ملخـص

تم فحص التأثيرات السامة لثلاثين نوعا عشبيا شائعا تتبع ثماني عشرة عائلة نباتية، وذلك على أنواع معينة من محاصيل الخضار المزروعة في الأردن. أظهرت النتائج أن المستخلصات المائية للأفرع الخضرية لكل من أعشاب عرف الديك *Amaranthus gracilis* Desf. والمدادة الملونة *Convolvulus arvensis* L. والشخيص *Lactuca serriola* L. والبقلة *Portulaca oleracea* L. هي عالية السمية لمعظم محاصيل الخضار التي تمت دراستها. عملت الأحجام العالية من المستخلصات على تثبيط الإنبات أو إحداث خفض معنوي في نمو بادرات المحاصيل التي تمت دراستها. لقد اعتمد التأثير المثبط على مستوى المستخلص في بيئة النمو، حيث عملت الأحجام المنخفضة لمستخلصات بعض الأعشاب على تشجيع نمو بادرات أنواع معينة من المحاصيل المدروسة. لقد كانت الجذور أكثر حساسية للمستخلصات من الأفرع الخضرية؛ بينما كانت محاصيل الملفوف والبصل والبندورة هي الأكثر تأثرا وحساسية للمستخلصات. أظهرت الدراسة أن إفرازات جذور عشب الشخيص هي الأكثر سمية لإنبات بذور ونمو معظم المحاصيل، وكان الخيار والبصل هما الأشد تأثرا وخفضا في النمو. أظهرت الأبخرة المتطايرة من الأفرع الخضرية الطازجة لأعشاب معينة تأثيرات مثبطة مختلفة على مؤشرات نمو مختلفة للمحاصيل التي تم فحصها وكانت الأبخرة المنطلقة من عشبي المدادة الملونة والشخيص هي الأكثر ضررا لمحاصيل الجزر والخيار والفلفل والكوسا؛ بينما كان الملفوف هو الأكثر تحملا ولكافة الأعشاب التي تم فحصها.

الكلمات الدالة: سمية نباتية، أعشاب، تثبيط، محاصيل خضار.

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