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Possible Role of Cucumber (*Cucumis sativus* l. cv. Iba') in Management of Certain Common Weed Species

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ABSTRACT

Different experiments were conducted to investigate whether cucumber (*Cucumis sativus* L. cv. Iba') possess any toxicity to certain common weed species and thus may be incorporated in weed management programs. Experiments were carried out under laboratory and glasshouse conditions. Results showed that full strength aqueous shoot extract of cucumber reduced germination and growth of *Amaranthus retroflexus* L., *Chenopodium murale* L., *Eruca sativa* Mill, *Malva sylvestris* L., *Portulaca oleracea* L. and *Solanum nigrum* L. grown in Petri-dishes. Differences in weed sensitivity to extract were evident; with *C. murale* and *P. oleracea* were least susceptible. As low as 1 ml extract added to the Petri-dish was sufficient to reduce germination and growth of all weed species tested, and the effect increased with extract concentration. Water leached from cucumber foliage parts was phytotoxic to all weeds and significantly reduced their germination (except *C. murale* and *P. oleracea*) and growth, with more harmful effects on roots than on shoots. Volatiles from cucumber shoot extracts were also phytotoxic and the effect was more pronounced on all weeds with stem and root lengths were disintegrated. Soil-incorporated dried shoot residues enhanced weeds shoot growth but only root growth of *C. murale, E. sativa, and M. sylvestris* were affected, indicating that most allelochemicals are volatiles in nature. Decayed residues inhibited shoot growth of *A. retroflexus* and *S. nigrum* and root growth of all weeds except *E. sativa*. foliage-applied extract showed no significant effects on weed growth, but soil-applied extract was phytotoxic and reduced germination and growth of all weeds with *P. oleracea* was the least affected.

Keywords: Allelopathy, Cucumber, Weeds, Management.

1. INTRODUCTION

The concept of allelopathic crops or cultivars to certain weed species receives more attention recently as an alternative weed control method that could be incorporated in more general weed management programs. However, research on allelopathic crops is still relatively limited and its application in weed management strategies is not widely practiced. Crops may yield allelochemicals and release them to the surrounding environment in different ways and sufficient concentration that harm other plant species (Batish et al., 2001). Rice (1984) reported a number of crop species whose presence or leachates have been shown to have inhibitory actions on a number of weeds. The list includes beets (*Beta vulgaris*), lupine (*Lupinus* sp.), corn, wheat, oats, peas, buckwheat (*Fagopyrum esculentum*), hairy vetch (*Vicia villosa* Roth.), millet (*Panicum* sp.), barley (*Hordeum vulgare* L.), rye, and cucumber. In some cases, up to 70% population of rice weeds, such as duck-salad [*Heteranthera limosa* (Sw.) Willd.], purple ammania (*Ammania coccinea* Rottb.), and broadleaf signalgrass [*Brachiaria platyphylla* (Griseb.) Nash], were controlled by accessions with strong allelopathic potential (Dilday et al., 1992).

Different studies showed some degree of weed suppression resulted from various monocot crops including *Zea mays* , *Sorghum bicolor*, *Secale cereale* and *Avena sativa* (Guenzi and MaCalla, 1966; Fay and Duke, 1977; Barnes and Putnam, 1983 and Alsaadawi et al., 1986) and dicots such as *Helianthus annuus* (Leather, 1983) and *Glycine max* (Maun, 1977 and Huber and Abney, 1986). Different lines of *Triticum aestivum*, *Oryza sativa*, *Hordeum vulgare*, *Beta vulgaris*, *Lupinus*

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spp., *Pisum sativum*, and *Cucumis sativus* have been reported to inhibit different weed species, and differences between these lines have been also detected biologically and at the molecular level (Kong, 2005; Wu, 2005). More studies reported that rye root residues delayed emergence and greatly reduced barnyardgrass growth (Prezepiorkowski and Gorski, 1994; Hoffman et al., 1996) and its aqueous shoot extracts inhibited germination of *Conyza canadensis* (L.) Cronq. and *Epilobium ciliatum* Rafin. Teasdale (1993) reported that hairy vetch (*Vicia villosa* Roth.) residue in the soil reduced velvetleaf (*Abutilon theophrasti* Medicus), green foxtail [*Setaria viridis* (L.) Beauv] and common lambsquarters establishment. Spiny amaranth (*Amaranthus spinosus* L.) was the most sensitive weed to celery (*Apium graveolens* L.) root residue and common purslane (*Portulaca oleracea* L.) was the least (Bewick et al., 1994).

Certain cucurbit crops have been also implicated in this regard (Putnam and Duke, 1974; Anaya et al., 1987 and Batish et al., 2001). Research on cucumber germplasm revealed large differences in allelopathic potential among accessions. Certain accessions strongly inhibited weed germination and growth (Olofsdotter and Navarez, 1996, Putnam and Duke, 1974). Putnam and Duke (1974) also found differences in toxicity among 500 cucumber accessions, and one allelopathic accession reduced total weed fresh weight to about 1/3 of the weed biomass found with pioneer, commonly grown cultivar. Fruit extract of cucumber accession PI 169391 suppressed growth of *Punicum miliaceum* (Lockerman and Putnam, 1981) and foliage leachates of three cucumber accessions inhibited emergence and growth of the same weed species (Lockerman and Putnam, 1979). Leaf extract of squash (*Cucurbita pepo*) was reported to strongly inhibit growth of several vegetable crops (Liebman and Dyck, 1993). However, other members of the cucurbitaceae (e.g. *Citrullus vulgaris*, *Cucumis sativus* and *Cucumis melo*) exhibit an autotoxicity effect (Yu and Matsui, 1997, Yu et al., 2000 and Yu, 2001).

The objectives of this study were to:

1. Detect any possible allelopathic potential of one of the commonly grown cucumber cultivar in Jordan against certain common weed species in vegetable fields, using different experimental techniques.
2. Investigate the importance of such an effect on weed germination, growth and development under glasshouse conditions.

2. MATERIALS AND METHODS

Source of Weed Seeds and Cucumber Materials

Cucumber plants were grown in the field at the University of Jordan Research Station located in the Jordan Valley for 2 months. Healthy plants were selected and harvested from the above soil surface. The vegetative parts were placed in plastic bags and brought to the laboratory for use in different experiments. For extract and leachates preparation cucumber plants were immediately used, but for glasshouse experiments dried residues were stored at room temperature. Seeds of *Amaranthus gracilis, Chenopodium murale, Eruca sativa, Malva sylvestris, Portulaca oleracea and Solanum nigrum* were collected from cultivated fields in the Jordan Valley and used in different experiments. All weed seeds were cleaned, subjected to a preliminary germination test and then stored in glass vials at room temperature until used. Cucumber seeds were brought commercially from local companies.

Preparation of Plant Materials

Aqueous Extracts. Fresh shoots (300 g) of cucumber plants were first washed with running tap water and distilled water, and allowed to dry for 2 h then chopped and mixed with 1 L of distilled water. The mixture was blended in a Waring blender until a homogenized mixture was obtained, then allowed to stand for half an hour, filtered through Whatman no.1 filter paper, and considered a full strength concentration. The filtrate was immediately used in the required experiments and the remained was poured into dark plastic bottles and stored in a deep freezer at -20°C.

Foliage Leachates. Shoots of of cucumber plants were immersed in distilled water at a rate of 1:1 (W:V) for 20 minutes. Leached water was filtered through a Whatman no.1 filter paper and immediately tested for phytotoxicity against the tested weed species.

Dried Residues. Shoots of cucumber plants were harvested at flowering stage, oven dried at 75°C for 48 hours, ground to a fine powder using an electrical Moulinex grinder and stored in a plastic bag at room temperature until used.

The following experiments were carried out:

2.1. Laboratory Experiments

2.1.1. and 2.1. 2. Effects of cucumber aqueous shoot extract

Fifty seeds of each weed species studied were placed on a filter paper in each of four Petri-dishes (11 cm in diameter) per treatment. Five ml of full strength fresh shoot extract of cucumber was added per each of four replicate Petri-dishes. In another treatment, extracts were replaced by distilled water and considered as a control.

The inhibitory effect of cucumber shoot extract was further examined using the same methodology except that full strength extract was added at 1, 2, 3 and 4 ml per Petri-dish. The final volume was completed to 5 ml by adding distilled water. For the control treatment, 5 ml of distilled water was added per Petri-dish .

Petri-dishes in both experiments were incubated in the darkness at 25^{o}C. Germination percentage was recorded at 2 and 14 days of incubation after which the experiments were terminated, and shoot and root lengths were determined.

2.1. 3. Effect of Cucumber Foliage Leachates

Fifty seeds of each weed species were placed in Petri-dishes as previously described. Five ml of foliage leachates of cucumber was added to each of four Petri-dishes. Dishes to which 5 ml of distilled water added per Petri-dish were included and considered as a control. Petri-dishes were incubated as usual for two weeks and similar data as in the above experiments were recorded.

2.1. 3. 4. Effect of Volatile Materials

Twenty seeds of each weed species were placed separately in each of four sterilized (5.5 cm diameter) Petri-dish lined with moistened filter paper. Two ml of distilled water was added to each Petri-dish. Dishes were left uncovered (to allow volatile diffusion) and each was placed in a larger Petri-dish of 11 cm diameter at which 10 ml of full strength aqueous fresh shoot extract or distilled water (control) was added. Large dishes were closed immediately with a tight cover leaving contact between weed seeds and crop extracts only through air. Petri-dishes with seeds were incubated at 25^{o}C for one week. Germination percentage and shoot and root lengths of weeds were recorded.

2.2. Glasshouse Experiments

2.2.1. Effect of Cucumber Dried Residues

Shoot residues of cucumber were added and thoroughly mixed in the soil (clay: sand: peat of 3:1:1 w/w) at a rate of 16 gkg^{-1} of soil mixture Twenty seeds of each weed species were sown per each of four 10 cm diameter (500 g soil capacity) plastic pots filled with the residue/soil mixture and considered as replicates. Pots containing only pure soil mixture, without any residue added were included, sown with weed seeds and considered as a control. Pots were irrigated with tap water when needed. Emergence percentage was recorded at weekly intervals. Six weeks after emergence, percentage of emerged seedlings, average shoot length, shoot fresh and dry weights and root dry weight were determined.

2.2.2. Effect of Foliage Applied Shoot Extract

Twenty seeds of each weed species were sown into each of four (10 cm diameter) plastic pots used per treatment. One month after emergence plants of each weed species were sprayed each with 25 ml of fresh shoot extract of cucumber mixed with 3 ml of Tween 20 as a surfactant, using a small hand-held spryer. Spraying was repeated at 12 and 15 days after first application with a total number of 3 sprays per pot.

Pots planted with weeds but kept without being sprayed were included as control. Irrigation with tap water was done as required and plants were harvested at 20 days after the third spry of extract. Data on shoot length and shoot fresh and dry weights were recorded.

2.2.3. Effect of Soil-Applied Extracts

Twenty seeds of each weed species were sown per each of four plastic pots per treatment. To each pot 75 ml of cucumber extract was added at once. In another treatment the same volume of water was added and considered as a control.

Pots were irrigated with tap water when needed. The experiment was harvested at 5 weeks after emergence, and germination percentage, shoot length, shoot fresh and dry weights and root dry weights of weeds were determined.

2.2.4. Effect of Cucumber Root Exudates

One cucumber plant was grown until flowering in each plastic pot (10 cm diameter) before completely removed. The soil was then loosened and sown by 20 seeds of each weed species using four pots per treatment. Pots filled with version fresh soil mixture, sown with similar number of weed seeds were included and considered as control. Hoagland full nutrient solution (Hewitt, 1966) was used to compensate for the amount of nutrients removed by crop plants, added at 100 ml per pot at 3-4 days after emergence and continued until harvest.

At 6 weeks after emergence, plants were harvested and data on germination percentage, shoot length, fresh and dry weights and root dry weight were taken.

2.2.5. Effect of Decayed Cucumber Residues

Ground oven-dried shoots of cucumber plants were added and mixed thoroughly with the soil mixture at a rate of $16gkg^{-1}$. The soil shoot residue mixture was placed in plastic pots of 10 cm diameter, and regularly irrigated with tap water 3 times a week. Pots were left for 40 days to allow residue natural decay, the soil was then loosened and each pot was sown with 20 seeds of a single weed species. There were four pots per weed species. Pots filled with the same soil mixture, containing no residues and sown with seeds of the same weed species were included as a control.

All pots were irrigated with tap water when required. The experiment was continued for five weeks, then plants were harvested from the above soil surface and data on germination percentage, shoot length, fresh and dry weights and root dry weight were recorded.

2.3. Statistics

Treatments in all laboratory and glasshouse experiments were laid out in a randomized complete block design with four replicates. All data were statistically analyzed by ANOVA, and treatments means were compared using the least significant differences (LSD) at P = 0.05.

Table 1. Effect of full strength aqueous shoot extracts of cucumber on germination (G%), stem length and root length per seedling of different weed species grown for two weeks in Petri-dishes at 25°C.

Treatments	*A. retroflexus*			*C. murale*			*E. sativa*		
	G%	Stem length (mm)	Root length (mm)	G%	Stem length (mm)	Root length (mm)	G%	Stem length (mm)	Root length (mm)
Control	82	44	20.3	89	36.9	21.6	74	41.1	14.9
Cucumber	37	14	3.4	84	21.3	4.7	39	13.3	1.4
LSD (P = 0.05)	3	0.6	0.3	5	1.1	0.5	3	0.9	0.6
	M. sylvestris			*P. oleracea*			*S. nigrum*		
	G%	Stem length (mm)	Root length (mm)	G%	Stem length (mm)	Root length (mm)	G%	Stem length (mm)	Root length (mm)
Control	81	44	20.3	89	36.9	21.6	74	41.1	14.9
Cucumber	37	14	3.4	84	21.3	4.7	39	13.3	1.4
LSD (P = 0.05)	2	0.5	0.3	3.8	1.5	0.9	3	0.5	0.1

Table 2. Effect of foliage applied full strength extracts of cucumber on growth of different weed species grown in pots under glasshouse conditions

Treatments	*A. retroflexus*			*C. murale*			*E. sativa*		
	Plant height (mm)	Shoot dry weight (mg/pot)	Root dry weight (mg/pot)	Plant height (mm)	Shoot dry weight (mg/pot)	Root dry weight (mg/pot)	Plant height (mm)	Shoot dry weight (mg/pot)	Root dry weight (mg/pot)
Control	85	321	329	78	493	140	89	881	826
Cucumber	82	358	330	72	444	138	83	831	733
LSD (P = 0.05)	11	45	42	7	78	21	7	98	157
Treatments	*M. sylvestris*			*P. oleracea*			*S. nigrum*		
	Plant height (mm)	Shoot dry weight (mg/pot)	Root dry weight (mg/pot)	Plant height (mm)	Shoot dry weight (mg/pot)	Root dry weight (mg/pot)	Plant height (mm)	Shoot dry weight (mg/pot)	Root dry weight (mg/pot)
Control	98	507	770	96	383	171	80	423	546
Cucumber	96	450	755	95	371	172	79	395	562
LSD (P = 0.05)	10	61	190	9	23	21	8	52	106

3. RESULTS

3.1. Laboratory Experiments

3.1.1 and 3.1.2. Effect of Shoot Extract

The effect of cucumber fresh shoot extract on germination and growth of different weed species is shown in Table (1). Full strength aqueous shoot extract of cucumber plants significantly delayed germination of all treated weeds at 48 h after incubation (data not presented). Reduction in germination and growth of all weeds was obtained at 2 weeks after incubation. Stem and root lengths were both inhibited with cucumber extract compared with the control.

The effect of extract concentration showed that as concentration increased germination and growth of all weeds was decreased compared with untreated control and for all weeds tested (Fig. 1). However, variations in the effect of extracts between weeds were detected with *P. oleracea* was least affected. Roots appeared more sensitive to shoot extract than shoots and for all weed species.

3.1.3. Effect of Foliage Leachates

Foliage leachates at a relatively low concentration applied to weed seeds sown in Petri-dishes reduced germination, stem length (except *P. oleracea*) and root length of all weed species tested (Figure 2 a,b,c). Variations in responses of different weeds to foliage leachates of cucumber plants were evident. *E. sativa* and *S. nigrum* were the most affected species, while *P. oleracea* was the least.

3.1.4. Effect of Volatile Materials

Germination, stem length and root length of seedlings of all weed species were severely reduced with volatiles of cucumber fresh shoot extract (Fig. 3 a, b, c). While stem and root lengths of all weed species were almost similarly affected, germination of *P. oleracea* was least affected. Differences in the effect of volatiles on stem and root lengths of each weed species were small.

3.2. Glasshouse Experiments

3.2.1. Effect of Cucumber Dried Residues

Incorporation of 16 gkg^{-1} of dried cucumber residues to the potted soil mixture delayed seedling emergence of *A. retroflexus* and *M. sylvestris* compared with their respective controls (data not presented). However, at harvest no differences were detected between treatments on the number of emerged seedlings and for all weed species (Fig. 4). With the exception of *C. murale* and *M. sylvestris* root dry weights showed significant reduction in pots treated with cucumber residues, differences in plant height, shoot dry weight and root dry weight of all weeds were not significant between residue treated pots and their respective controls. In contrast, certain weed species showed better growth with cucumber residue compared with the control and this was clearly demonstrated on shoot dry weight of *E. sativa* and *S. nigrum* plants.

3.2.2. Effect of Foliage Applied Shoot Extract

Cucumber shoot extract applied to the foliage parts of different weed species reduced plant height and shoot dry weight of *C. murale*, and shoot and root dry weights of *E. sativa* and *M. sylvestris* compared with the controls, although differences were not significant (Table 2). Among all treated weeds, *A. retroflexus* was the least harmed and instead a significant increase in its shoot dry weight was obtained.

3.2.3. Effect of Soil-Applied Extracts

Application of cucumber shoot extract to the soil generally reduced germination and growth of all weeds (except *P. oleracea*) (Fig.5). However, weeds were different in their responses. *S. nigrum* and *M. sylvestris* were most reduced in terms of shoot and root growth while *P. oleracea* and *C. murale* were least affected. Generally roots appeared more effected than shoots and in most weed species.

3.2.4. Effect of Cucumber Root Exudates

The effect of cucumber root exudates released into the soil on emergence and growth of different weed species is shown in Fig. (6). Emergence of *S. nigrum* was significantly reduced compared with its control. Shoot and root dry weights of *C. murale* and root dry weights of *E. sativa* and *M. sylvestris* were significantly reduced with root exudates of cucumber plants compared with the controls. In contrast, shoot and root growth of *S. nigrum* and shoot growth of *A. retroflexus* and *E. sativa* were increased. Results showed that *A. retroflexus* and *S. nigrum* plants were the least effected by cucumber root exudates.

3.2.5. Effect of Decayed Residues

Effect of soil incorporated dried residues of cucumber plants on germination and different growth parameters of the tested weed species is shown in Fig (7). Emergence of *A. retroflexus* was significantly reduced and shoot dry weight of *A. retroflexus*, and *S. nigrum* were reduced compared with their respective controls. shoot dry weight, *A. retroflexus* appeared most reduced by 30% in comparison to the control. Roots of *A. retroflexus*, *C. murale*, *M. sylvestris* and *P. oleracea* were all effected with up to 45 % reduction in *A. retroflexus* root dry weight compared with the control. The increase in root growth of *E. sativa* and the reduction in that of *M. sylvestris* were not consistent with similar responses in their shoot growth.

4. DISCUSSION

Severe reduction in different growth parameters of the studied weed species was obtained with full strength aqueous extracts of cucumber plants (Table 1), which was in agreement with reports of different workers on the effect of full strength extract concentration of different plant species (Lockerman and Putnam, 1979; Bondev et al., 1983; Rose et al., 1984; Tsuzuki and Kawagoe, 1984; Sedun et al., 1986; Kim and Kil, 1987) and suggested that some inhibitory materials are water soluble and highly effective against the examined weed species. The degree of inhibition was concentration dependent and varied between tested weed species (Fig. 1). However, roots were most effected plant parts and at all extract concentrations. This may be due to direct exposure of roots to extract and subsequently to their inhibitory effects. Roots appeared short with burned tips as a result of extract effect. Other workers reported similar symptoms in their work with different plant species (Hussain and Gadoon, 1981; Leather, 1983; Tsuzuki and Kawagoe, 1984; Alsaadawi et al., 1986). Chemical inhibitors were reported to influence different biochemical and physiological processes in plants (Rice, 1984).

The inhibitory action of leachates indicates that some toxic materials present and affected weeds germination and growth and could be leached out to the surrounding environment. Mineral nutrients, carbohydrates and phytohormones are among substances been collected and identified in leachates of different plant species (Rice, 1984). Other workers have reported allelopathic activity of leachates of different crop species (Lockerman and Putnam, 1979; Leather, 1983; Kim and Kil, 1987). In nature, the activity of these leachates may depend on the amount of rainfall beside the other environmental factors. In the present study, the strength of inhibitory action may be greatly influenced by the duration of exposure period. However, more studies are needed on this aspect in order to define crop species with this method of action either against weeds or other crop species under field conditions.

Results clearly demonstrated that volatile inhibitors exist in cucumber extract and affected germination and growth of the tested weeds in a closed system (Fig.3). Inhibitory chemicals may be volatile material absorbed directly from the atmosphere by neighboring plants (Tukey, 1969). Different plant species are believed to impose their allelopathic effects at least in part, through this mechanism (Putnam, 1984). Other workers also reported allelopathic activity of volatile materials of some plants including tomato, crucifers and cover legumes (Kim and Kil, 1987; Oleszek, 1987; Bradow and Connick, 1990). Cucumber has been reported as a crop of allelopathic activity through other mechanisms (Putnam and Duke, 1974; Lockerman and Putnam, 1979, 1981), and showed a strong allelopathic activity against all weed species tested through volatile materials produced from its shoot extract. Higher plants are well known to produce a variety of terpenoids and monoterpenoides as a major components of essential oils of plants (Tukey, 1969), and may be involved in such a mechanism.

In summary, laboratory experiments revealed that cucumber plants had potentially a strong inhibitory effect against the tested weed species, although laboratory work should be confirmed under field conditions, and thus further glasshouse experiments were felt necessary and carried out.

Plant responses to chemical agents released from dried residues and added to the medium has been reported to range between stimulation to inhibition, and was found depending on the type of plant materials added and the receiver species (Putnam and Duke, 1974; Putnam and Defrank, 1979; Leather, 1983, Purvis et al., 1985). However, microbial action may be important in the complex physical factors in nature to produce beneficial or harmful chemical compounds that affect other plant species (Patrick et al., 1964). In the present study, it is to be expected that volatile inhibitory substances could be easily dissipated during drying process and thus their inhibitory action was greatly reduced or even completely lost. Volatile of cucumber extract was found highly toxic to all weed species tested but not so when dried residues were used.

Residue rate, plant part used, placement method of plant materials, decomposition duration, growth stage of the donor and receiver species, and environmental factors are all critical in determining the effects of allelochemicals (Purvis et al., 1985).

Decayed residues of cucumber also showed some toxicity with *M. sylvestris* was the least effected and *P. oleracea* the most (Figs. 7). These results may indicate physiological and probably morphological differences between weed species which provide some of them a tolerance advantage. However, decay process allowed more liberation of toxic substances from plant tissues or better interaction with soil microorganisms that might enhance their release to the soil or modify these to a more toxic form. This however, is just a speculation and investigation of this possibility that may be worth considering in the future research.

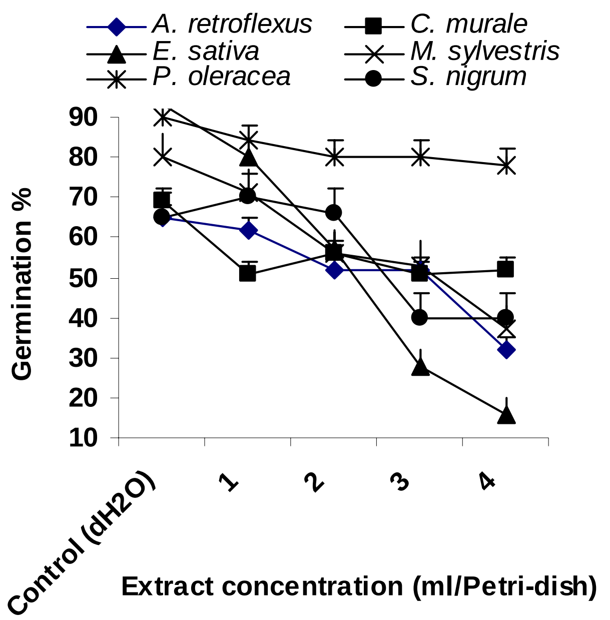
Results obtained indicated that decayed cucumber residues reduced germination and growth of certain annual weeds and may be used either through incorporation in the soil or by direct application to the soil surface as a straw mulch for weed management in the field.

Toxins from allelopathic plants have been reported to be used as natural herbicides applied to the foliage plant parts or on the soil. They could remove unwanted vegetation without danger of harmful soil residue or potential toxicity to man or animals (Putnam, 1984). In the present study, an experiment was designed to test this possibility, and results obtained were not encouraging (Table 2). Failure to obtain any positive reaction using this method may be due to that natural compounds exist in extracts are of short life, easily attacked by microorganisms on plant surface, and/or degraded rapidly by environmental factors (Doll, 1980). However, other factors may be also involved and responsible on the results obtained; of these the volume of extract used that might not be high enough to give a significant effect, in addition to some other expected physiological or morphological factors of the weeds.

Application of cucumber extract to the potted soil containing weeds resulted severe inhibition in growth of many weed species tested (Fig. 5). Both germination and growth of *A. retroflexus* were significantly reduced. *M. sylvestris* showed relatively better tolerance to the effect of extract compared with other weed species. In contrast, *C. murale* and *S. nigrum* were highly sensitive and their growth was reduced. The effect of extract under glasshouse conditions was different from its effect in the laboratory which may be due to the nature of volatile materials produced. Direct application of aqueous crude extracts in the field were found effective to certain limits against weeds or other agricultural pests, but negative effects such as partial weed control has been also reported (Heisey and Heisey, 2003).

Root exudates effect was promising, although full nutrient solution was added to the growing medium mainly to compensate for the amount of nutrients removed by previously grown crop species and to eliminate any possible interference of competition for nutrients in inhibitory effects. Many of the tested weed species grown in the same medium after crop plants removed were greatly inhibited by cucumber root exudates already released into the soil (Fig. 6), while weeds failed to recover from the alleloapthic effect by adding more nutrients. Different workers reported strong effect of root exudates of different crop species against weeds (Leather, 1983; Rose et al., 1984; Tsuzuki and Kawagoe, 1984; Alsaadawi et al. 1986; Akram and Hussain, 1987; Kim and Kil, 1987; Qasem and Issa, 2005). However, root exudates may be affected by plant species, age, temperature, light, plant nutrition, and microorganisms in the root zone (Purvis et al., 1985). Results of the present work indicated that inhibitory effect of cucumber root exudates may be regarded as a factor in crop rotation system or integrated weed control program providing that being verified under field conditions.

In conclusion, aqueous shoot extract, foliage leachates and volatiles of cucumber shoot extract reduced germination and growth of all weed species tested. Toxicity was concentration dependent. Shoot and root growth of all weed species and their stem and root lengths were disintegrated, while differences in weed responses were evident. Roots were more sensitive than shoots. Under glasshouse conditions soil-incorporated dried shoot residues enhanced growth of all weeds indicating that inhibitory chemicals are in part volatiles. However, decayed residues of cucumber plants inhibited growth of many weeds tested since allowed more release of the toxic chemicals. Although foliage-applied extract resulted no significant harmful effects on weed growth, extract applied to the soil was phytotoxic and reduced germination and growth of all tested weeds with *M. sylvestris* and *S. nigrum* were the most. Results generally showed that cucumber allelopathy could be effectively exploited for controlling some noxious annual weed species and may offer an effective alternative tool for some of the synthetic herbicides used.



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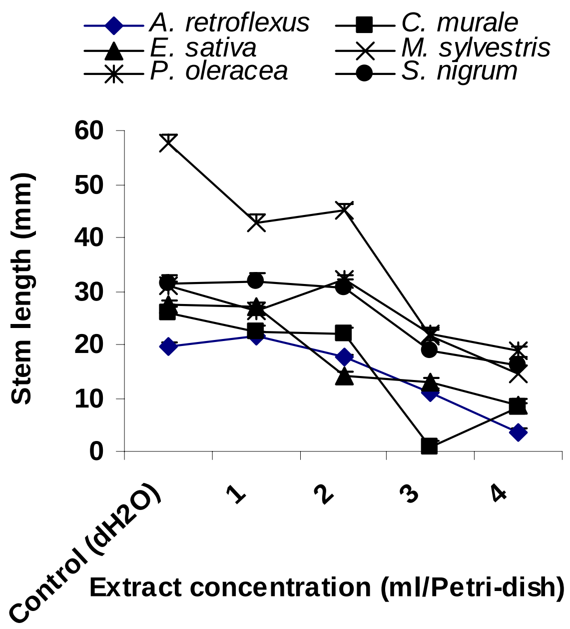

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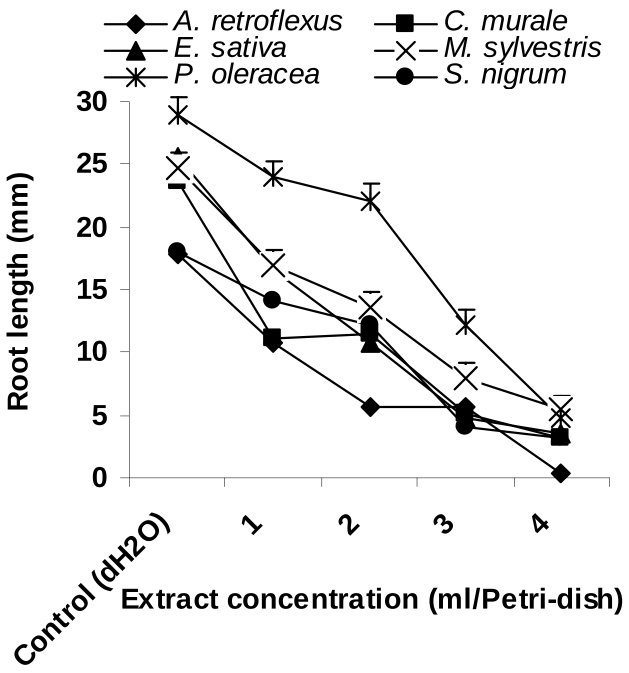
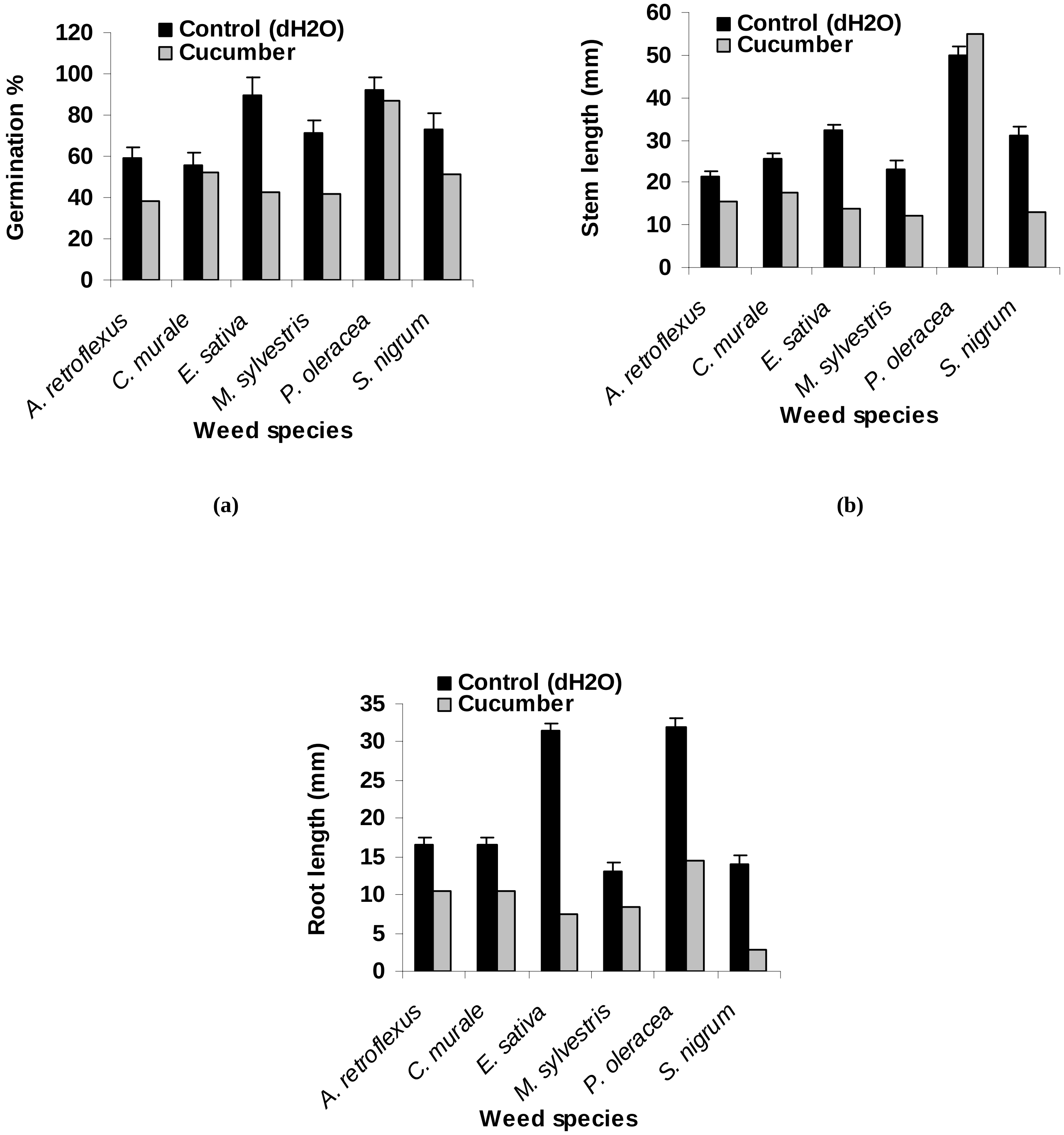


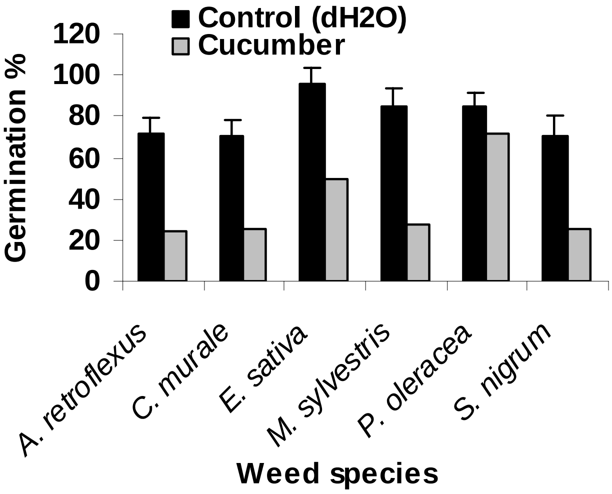
(c)

Fig. 1. Effect of aqueous extract concentration of cucumber on (a) germination, (b) stem length and (c) root length of different weed species grown for two weeks in Petri-dishes at 25°C under laboratory conditions.

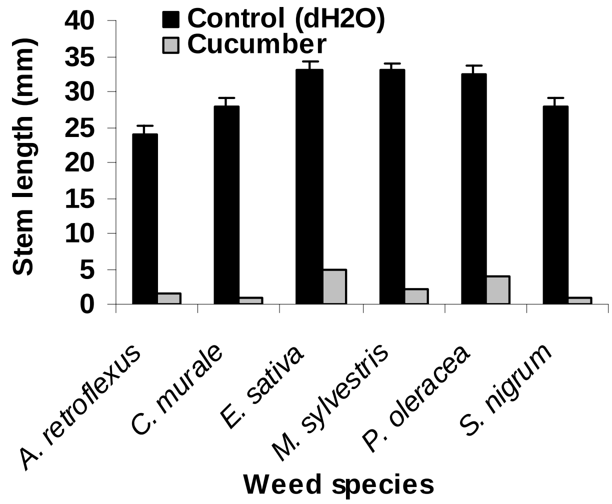


(c)

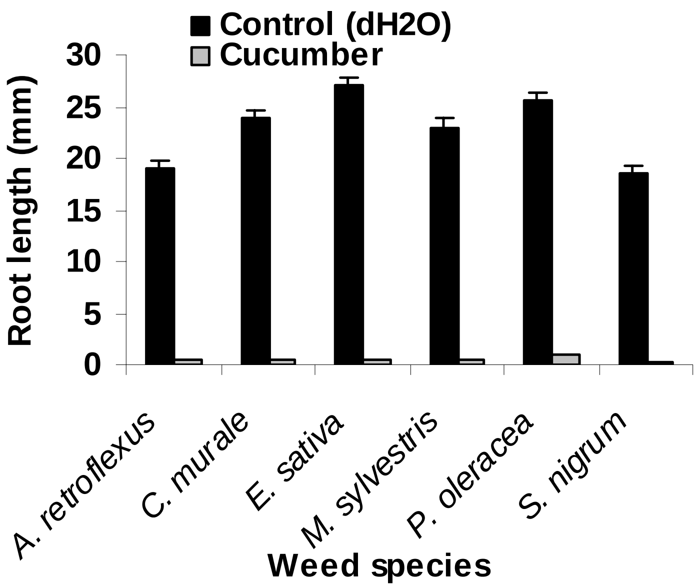
Fig.2. Effect of foliage leachates from cucumber shoots on (a) germination, (b) stem length and (c) root length of different weed species grown in Petri-dishes under laboratory conditions at 25°C.



(a)

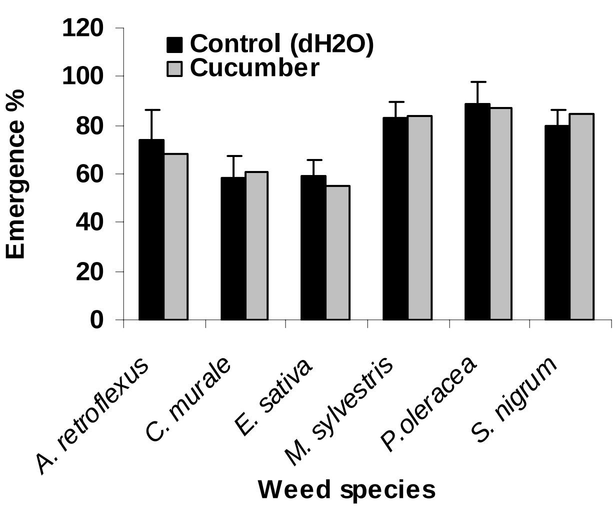


(b)

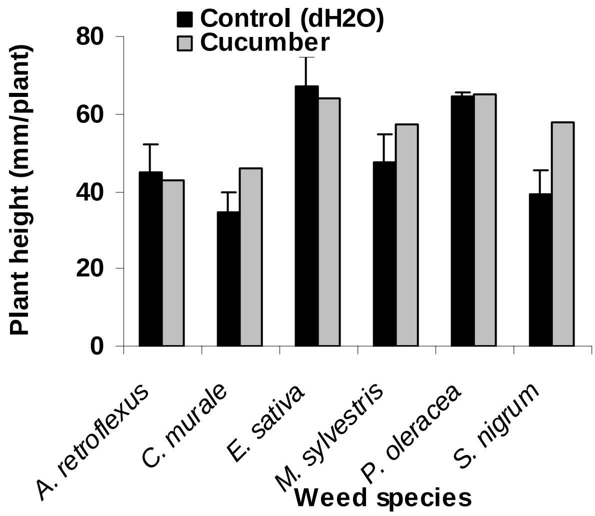


(c)

Fig. 3. Effect of volatiles from cucumber shoots on (a) germination, (b) stem length and (c) root length of different weed species grown in Petri-dishes under laboratory conditions at 25°C.



(a)



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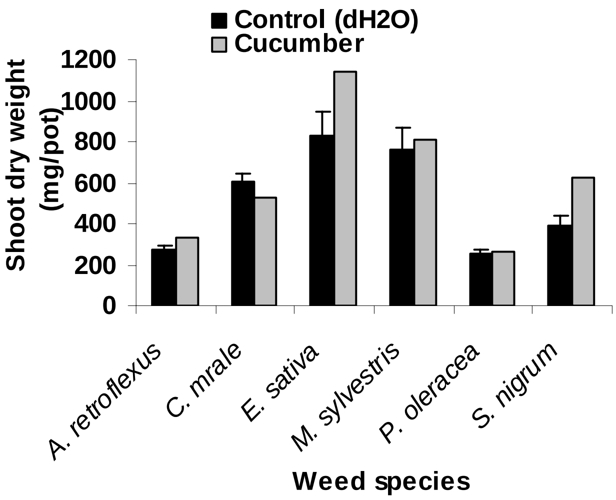
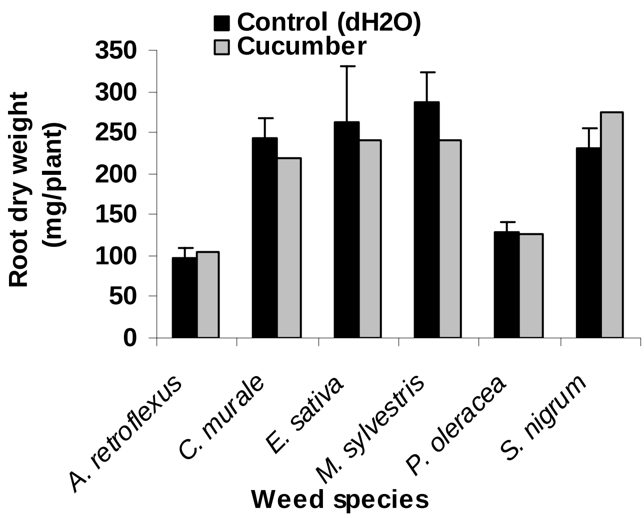


(c)



(d)

Fig. 4. Effect of incorporated dried shoot residues of cucumber on (a) emergence, (b) plant height, (c) shoot dry weight and (d) root dry weight of different weed species grown in pots under glasshouse conditions.

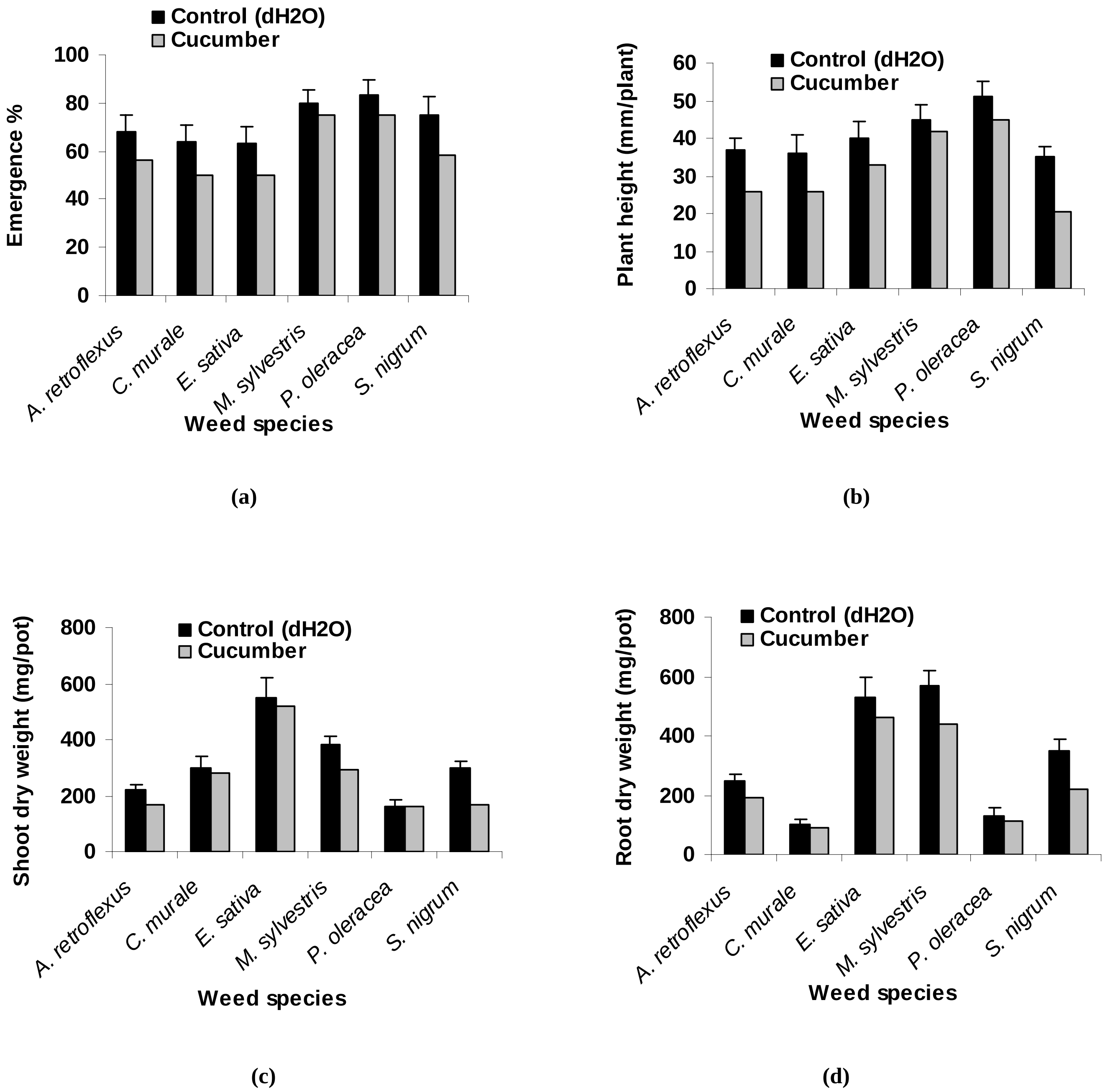


Fig. 5. Effect of soil applied extract of cucumber on (a) emergence, (b) plant height, (c) shoot dry weight and (d) root dry weight of different weed species grown in pots under glasshouse conditions.

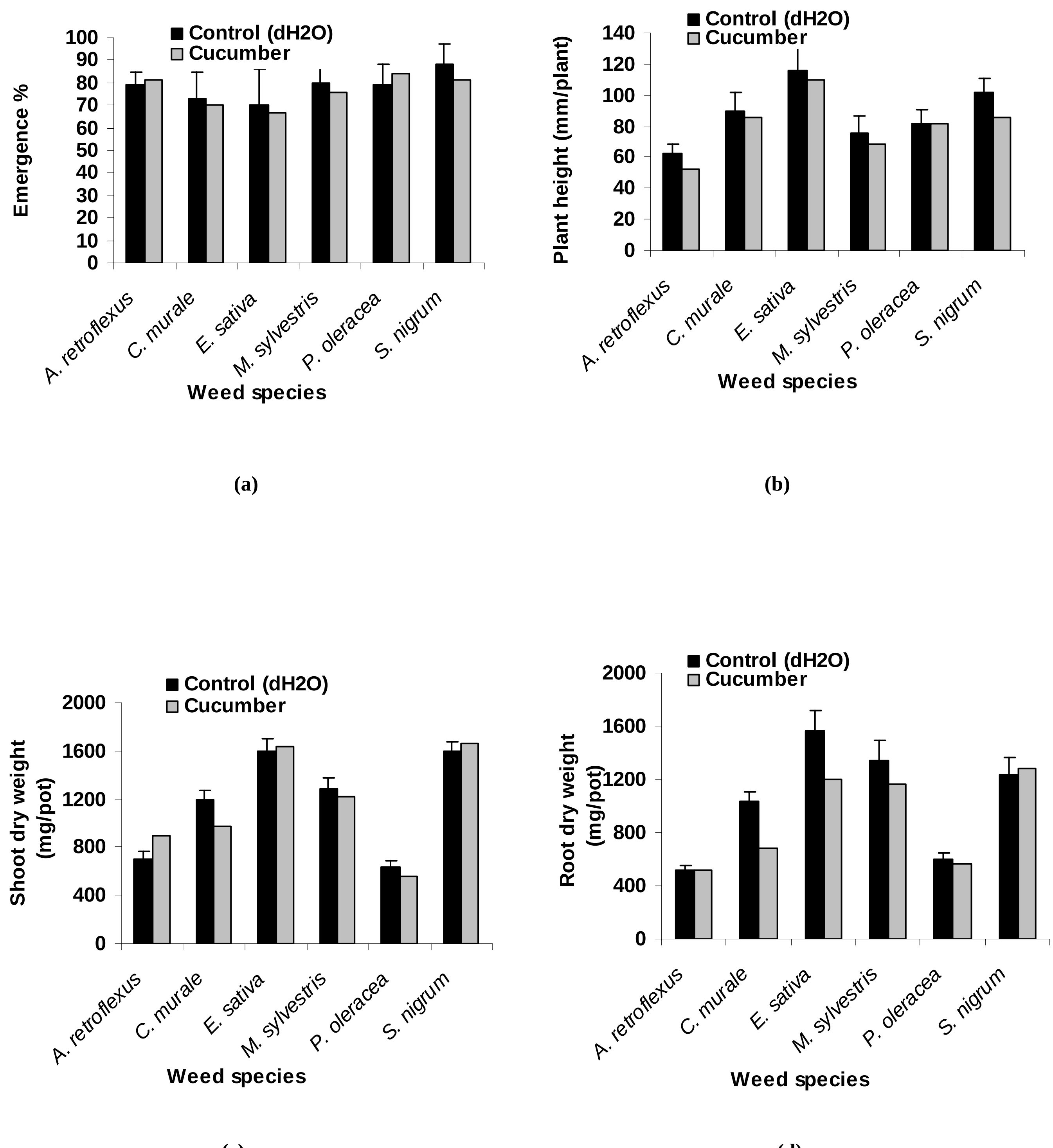
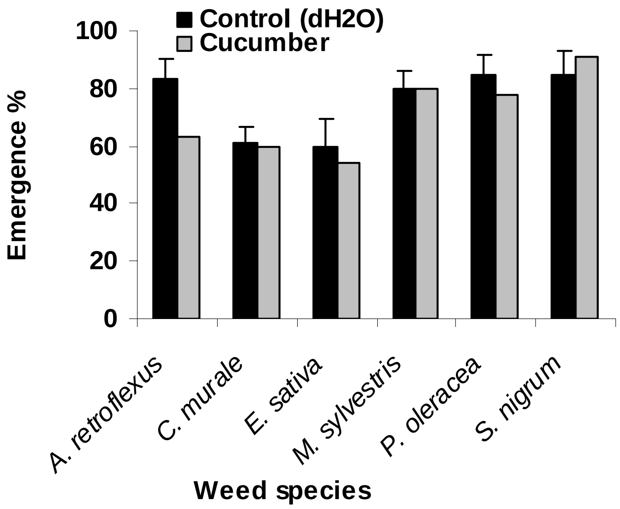
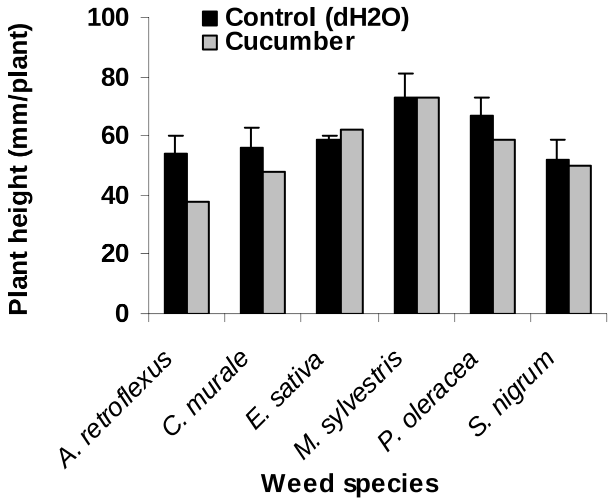


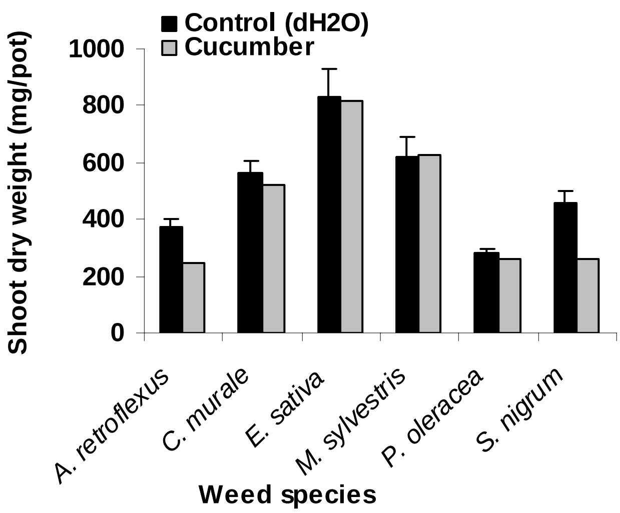
Fig. 6. Effect of root exudates of cucumber on (a) germination, (b) plant height, (c) shoot dry weight and (d) root dry weight of different weed species grown in pots under glasshouse conditions.



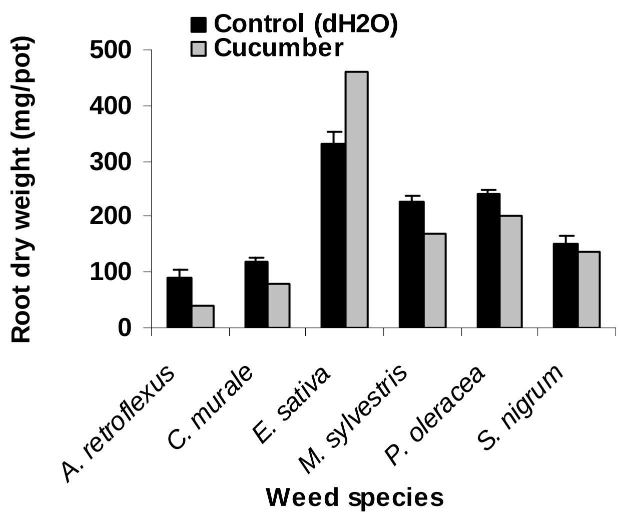
(a)



(b)



(c)



(d)

Fig. 7. Effect of soil decayed cucumber residues on (a) emergence, (b) plant height, (c) shoot dry weight and (d) root dry weight of different weed species grown in pots under glasshouse conditions.

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الدور المحتمل للخيار (*Cucumis sativus* **l. cv. Iba'**) في إدارة مكافحة أنواع عشبية شائعة

جمال راغب قاسم ونبيل نوح عيسى *

ملخـص

تم اجراء عدد من التجارب لدراسة امكانية حدوث تأثيرات مثبطة للخيار من الصنف اباء (*Cucumis sativus* l. cv. Iba') على عدد من الأنواع العشبية الشائعة وذلك تحت ظروف المختبر والبيوت الزجاجية. أظهرت النتائج أن المستخلصات المائية للأفرع الخضرية للخيار قد خفضت نسبة الأنبات والنمو لأعشاب عرف الديك القائم *Amaranthus retroflexus* L. والرمرام *Chenopodium murale* L. والجرجير *Eruca sativa* Mill والخبيزة *Malva sylvestris* L., والبقلة *Portulaca oleracea* L. وعنب الديب *Solanum nigrum* L. المزروعة في اطباق زجاجية. أظهرت الأعشاب اختلافات واضحة في درجة حساسيتها للمستخلص المائي لنباتات الخيار وكانت عشبتا الرمرام والبقلة هما الأقل تأثرا. أدت اضافة (1) مل من المستخلص الى الأطباق الزجاجية الى خفض انبات ونمو جميع الأنواع العشبية التي تمت دراستها وازداد التأثير الضار بزيادة تركيز المستخلص. أظهر الماء الراشح من المجموع الخضري للخيار سمية لكافة الأنواع وخفض بصورة احصائية انبات (ما عدا الرمرام والبقلة) ونمو الأعشاب التي تمت دراستها وكان التأثير اكثر ضررا للمجموع الجذري منه للمجموع الخضري. لقد كان تأثير الأبخرة المتطايرة من مستخلص الأفرع الخضرية للخيار واضحا على كافة الأنواع العشبية المدروسة حيث ادت الى قصر في نمو الأفرع والجذور. وبالمقابل ادى خلط مخلفات الأفرع الجافة للخيار في التربة الى تشجيع نمو المجموع الخضري للأعشاب ولكن نمو جذور الرمرام والجرجير والخبيزة فقط قد تأثر، مما يدل على أن المواد المثبطة الكيميائية هي ابخرة متطايرة في طبيعتها. من ناحية اخرى عملت المخلفات المتحللة لأفرع نباتات الخيار على تثبيط نمو المجموع الخضري لعشبي عرف الديك القائم وعنب الديب وكذلك نمو جذور كافة الأنواع العشبية باستثناء عشب الجرجير. اظهرت النتائج انه في حين أن رش المستخلص المائي لنباتات الخيار على المجموع الخضري للأعشاب لم يعط أية نتيجة ذات دلالة احصائية فان المستخلص المضاف للتربة كان ساما وخفض انبات ونمو كافة الأنواع العشبية الا ان نباتات البقلة كانت هي الأقل تأثرا بهذه المعاملة.

الكلمات الدالة: تثبيط، خيار، أعشاب ضارة، إدارة.

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