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Inhibitory effect of fruit hull and leaves of pistachio on weed growth in pots

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Abstract: Inhibitory effects of the residues of pistachio fruit hulls at maturity stage was investigated during 2013-2014 at the section of biological control of weeds, Biological Control Research and Studies Center, Department of Plant Protection, Faculty of Agriculture, Damascus University. Residues of pistachio fruit hull powder were tested for growth of some weeds grown in pots. Results showed significant effect on the germination and the growth of the weeds, the treatment 100 g powder of both fruit hull and leaf powder was with the highest effect and the superiority was for the fruit hull powder in all studies traits. These results clearly indicated the possibility of using pistachio residues to overcome the growth of the weeds in field.

Key words: pistachio, fruit hull, weeds, pots.

Introduction

The application of herbicides has been a major factor enabling the intensification of agriculture in past decades. Indeed, three million tones of herbicides per year are used in most agricultural systems and this caused increasing in weeds resistance and adverse environmental effects[1]. For this reason, the use of allelopathic plants may provide an alternative to minimize the risk towards agroecosystems by serving in a complementary way with herbicides. Various parts of same weed have different allelopathic effects on germination and growth of crop[2]. Allelopathic compound not only reduced germination, but also delayed germination that was affecting seedling greater[3]. Allelochemicals may inhibit shoot/root growth and nutrient uptake[4], and soluble protein contents[5]. Chemicals that impose allelopathic influences are called allelochemicals or allelochemics. In a review of the potential use of allelochemicals as herbicides, Putnam (1988) listed 6 classes of allelochemicals namely alkaloids, benzoxazinones, cinnamic acid derivatives, cyanogenic compounds, ethylene and other seed germination stimulants, and flavonoids which had been isolated from over 30 families of terrestrial and aquatic plants. All these chemicals possess actual or potential phytotoxicity[7]. Rainfall causes the leaching of allelopathic substances from leaves which fall to the ground during period of stress; leading to inhibition of growth and germination of crop plants[5,8]. Biodegradable natural plant products rarely contain halogenated atoms and possess structural diversity and complexity, constituting one such class of chemicals and these can act directly as herbicides or may provide lead structures for herbicidal discovery[9]. The pistachio fruit hull, gathered outside the pistachio factories, and it was noticed there were no any growth of weeds and other plants in circle of about 50 cm around the pile of the hulls, therefore this investigation was carried out to ascertain this phenomenon, and explore its possibility to use in weed control.

Experimental

Botanical powder material

Fully matured fruits of pistachio were harvested from the Farm of Faculty of Agriculture, the fresh hull (reddish colour) of the fruits were separated from other fruit parts and kept for fully air dried in shade and then

were ground into fine powder and stored in air tight colored glass bottles. Fallen and dried leaves of pistachio were also collected from the ground of the field, and proceeded in same mater as the fruit hulls.

Plant material:

Seeds of weed species (*Medicago sativa* L., *Diplotaxis erucoides* (L.)DC., *Sonchus arvensis* L. and *Papaver hybridum* L were obtained from the weed seed bank at the Biological Control Research and Studies Center, Faculty of Agriculture, Damascus University, Damascus, Syria.

Pot preparation:

Equal quantities of soil, manure, sand were mixed thoroughly and sterilized in oven at 65° centigrade for 48 hours, two days before the starting of the trial and then filled in plastic pots (15 cm diameter, 25 cm height). NPK fertilizer was added (60, 40, 40 kg, respectively). Fruit hull and leaf powder were added to pots in quantities (doses), 25, 50, 75 and 100 g per pot and replicated four times, and the control pots were filled with soil only. Pots were distributed in complete randomized design RCD design on tables in the net house. Weed seeds were sown in pots separately, 10 seeds from each weed species per pot. The total no. of pots was 80 pots. Pots were kept on tales in the net house and watered regularly and equally.

Statistical analysis

The trial was conducted in a complete randomized design (CRD) with three replicates. The following reading were recorded: Germination, delay in germination as compared to control, plant no. /pot, plant height after 3 months, ratio of dry matter (calculated as the formula: dry weight/ fresh weight *100).

Data were subjected to analysis of variance (one ways ANOVA) at ($P< 0.05$) using genStat 12 program.

Results and Discussion:

Concerning the germination delay, plant no. and height and dry weight ratio of studied weeds affected by the different treatment of fruit hull and leaf powder, data demonstrated a significant degree of suppression and a positive response to the increasing doses (Tables 1-4). There were significant differences between the test treatments and the control. Similar observations were reported by Bansal, 1998; Daniel, 1999 and Turk *et al*., 2005.

1- Effects of fruit hull and leaf powders of pistachio on *Medicago sativa*:

The residues of fruit hull and leaf of pistachio mixed with soil had significant effect to in delaying the germinating of *M. sativa* in pots and this effect increased with the increasing of the powder quantities added to soil. Fruit hull powder, at doses, 25, 50 and 75 g/ kg soil the germination delayed for 1.25, 2.25 and 2.75 days while the dose 100 g/kg prevent the germination totally (Table 1). While the leaf powder delayed the germination significantly (1.51 and 1.75 days) at doses 75 and 100 g/kg soil, respectively. This delay in germination possibly due to the toxic compounds present in the pistachio powder as mentioned by Escudero *et al.*, 2000. This result was in compatibility with the finding of Mohamadi and Rajaie, 2009 as they said that the chemical products mainly affect plants at seed emergence and seedling levels.

Plant no. /pot was also affected significantly by adding powder of fruit hulls (2.75, 2.75 and 1.25 plants/pot at doses 25, 50 and 75 g/ kg soil, respectively and the leaf powder also affected the plant no. (3.3, 3, 2.3 and 2.3 plants/pot) significantly at the doses 25, 50, 75 and 100 g/ kg soil, respectively There was significant reduction in plant height at all doses of fruit hull and leaf powder, specially with the higher doses. The lowest plant heights (4.7 and 9.9 cm) were recorded with the doses, 75 and 100 g/kg of fruit hull and leaf powder respectively which was statistically different from others. Similarly, the dry matter ratio was at lower values (17.31 and 22.45) with the doses, 75 and 100 g/kg of fruit hull and leaf powder respectively

Table 1. Effect of fruit hull and leaf powder of pistachio on *Medicago sativa.*

Treatment powder g / kg soil	Germination delay (day)		Plant no. /pot		Plant height cm		Dry matter ratio (%)	
	hull	leaf	hull	leaf	hull	leaf	hull	leaf
0	-	-	5.5^{a}	4.3^{a}	17.8^{a}	17.8^{a}	28.18^{a}	28.18^{a}
25	1.25^{a}	0.5^{a}	2.75^{b}	3.3^{b}	14.5^{b}	16.6^{a}	23.05^{b}	25.75^{b}
50	2.25^{b}	0.75^{a}	2.75^{b}	3.0^{b}	12.1^{c}	15.2^{b}	17.61^{c}	25.11^{b}
75	2.75^{b}	1.5^{b}	1.25^{c}	2.3^{c}	4.7^{d}	12.1^{c}	17.31^{c}	24.90^{b}
100	-	1.75^{b}	-	2.3^{c}	-	9.9^{d}	-	22.45^{c}
L.S.D	0.58	0.73	0.70	0.67	1.46	1.3	2.76	1.98
C.V%	8.7	9.9	19	14.9	9.4	6	10.6	5.2

- Similar letters indicate non-significance in the corresponding column

The data in Table 1 indicated very clearly the great effect of the pistachio fruit hull powders for all studied traits as compared to leaf powder, the dose 100 g/kg soil of fruit hull powder prevent the germination totally, while the dose 75 g/kg soil of fruit hull showed more effective values for seed germination, plant no. and height and also dry matter ratio. 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/ 1 kg soil against the figures of the control, 21.36 cm and 0.65 g.

2- Effects of fruit hull and leaf powders of pistachio on *Diplotaxis erucoides.*

The higher doses of fruit hull powder (75 and 100 g/kg soil) prevent the germination of *D. erucoides* totally, while the doses (25 and 50 g/kg soil) caused 1.5 and 2.5 days delay in germination, resp. (Table 2). While the leaf powder prevent the germination at only 100 g/kg soil, the other doses (50 and 75 g/kg soil) caused 1and 1.5 days delay in germination, resp. (Table 2) at the time the dose (25 g/kg soil had insignificant effect in germination delay.

Table 2. Effect of fruit hull and leaf powder of pistachio on *Diplotaxis erucoides.*

Treatment powder g / kg soil	Germination delay (day)		Plant no. /pot		Plant height cm		Dry matter ratio (%)	
	hull	leaf	hull	leaf	hull	leaf	hull	leaf
0	-	-	2.0^{a}	2.0^{a}	16.3^{a}	16.3^{a}	26.17^{a}	24.29^{a}
25	1.5^{a}	0.5^{a}	2.0^{a}	1.8^{a}	9.8^{b}	14.6^{b}	17.01^{b}	22.40^{ab}
50	2.5^{b}	1^{ab}	0.8^{b}	1.3^{b}	4.1^{c}	12.4^{c}	15.60^{b}	21.76^{b}
75	-	1.5^{bc}	-	1.0^{b}	-	7.7^{d}	-	20.94^{b}
100	-	-	0	0	-	-	-	-
L.S.D	0.55	0.55	0.34	0.48	0.82	0.89	1.82	2.41
C.V%	11.4	9.6	23.5	26.4	9	5.8	10.3	8.9

- Similar letters indicate non-significance in the corresponding column

The plant no. affected significantly with the dose 50 g/kg of fruit hull powder (0.8 plants/pot) and with the doses (50 and 75 g/kg soil) of leaf powder. The lowest plant height (4.1 cm) were recorded in pot with the fruit hull dose (50 g/kg soil) and 7.7 cm in pot of leaf powder (75 g/kg soil) and this was in agreement with Suleiman, 2010.

3- Effect of fruit hull and leaf powders of pistachio on *Papaver hybridum.*

The germination of *P. hybridum* was delay due to presence of pistachio powder, and the delay increased with the increasing of the powder doses. However the dose 100 g/kg soil of both fruit hull and leaf powder prevent the germination totally, the other doses (25, 50 and 75 g/kg soil) showed the following delay in germination, 1.5, 2 and 2.5 days for fruit hull powder and 0.5, 1.25 and 1.5 days for leaf powder, respectively (Table 3).

Table 3. Effect of fruit hull and leaf powder of pistachio on *Papaver hybridum*.

Treatment powder g / kg soil	Germination delay (day)		Plant no. /pot		Plant height cm		Dry matter ratio (%)	
	hull	leaf	hull	leaf	hull	leaf	hull	leaf
0	-	-	5.0^{a}	5.5^{a}	3.3^{a}	3.3^{a}	29.58^{a}	29.58^{a}
25	1.5^{a}	0.5^{a}	2.8^{b}	3.5^{b}	3.0^{b}	2.9^{b}	29.00^{a}	28.83^{a}
50	2^{ab}	1.25^{b}	1.8^{c}	3.5^{b}	2.0^{c}	2.3^{c}	26.50^{b}	24.32^{b}
75	2.5^{b}	1.5^{b}	1.3^{c}	1.5^{c}	1.3^{d}	2.0^{d}	25.68^{b}	22.03^{b}
100	-	-	-	-	-	-	-	-
L.S.D	0.55	0.65	0.80	0.78	0.27	0.169	1.18	1.83
C.V%	8.3	11.1	24.8	18.4	9.5	5.3	3.5	5.8

- Similar letters indicate non-significance in the corresponding column

The plant no./pot and plant height also affected significantly at all doses and lowest plant no. and height was recorded in the treatment with 75 g/kg soil. The significant effect on dry matter ratio started at the dose 50 g/kg soil for both fruit hull and leaf powders.

4- Effect of fruit hull and leaf powders of pistachio on *Sonchus arvensis.*

Same behavior was noticed with the germination of *S. arvensis*, as it get delay and the dose 100 g of fruit hull powder prevent the germination totally, the other doses (25, 50 and 75 g/kg soil) showed the following delay in germination; 1.5, 2.25 and 2.75 days for fruit hull powder respectively (Table 4). While the leaf powder caused the highest delay in germination at the dose of 100g/kg soil and the other doses (25, 50 and 75 g/kg soil) caused delay by 0.5, 1.5 and 1.75 days (Table 4).

Table 4. Effect of fruit hull and leaf powder of pistachio on *Sonchus arvensis*.

Treatment powder g / kg soil	Germination delay (day)		Plant no. /pot		Plant height cm		Dry matter ratio (%)	
	hull	leaf	hull	leaf	hull	leaf	hull	leaf
0	-	-	2.8^{a}	2.5^{a}	8.6^{a}	8.6^{a}	8.84^{a}	8.84^{a}
25	1.5^{a}	0.5^{a}	2.0^{b}	2.3^{ab}	8.2^{a}	7.7^{b}	7.61^{b}	8.30^{ab}
50	2.25^{b}	1.5^{b}	1.3^{c}	1.8^{abc}	4.7^{b}	7.7^{b}	6.82^{bc}	7.79^{abc}
75	2.75^{b}	1.75^{bc}	1.0^{c}	1.5^{bc}	2.2^{c}	3.5^{c}	6.52^{c}	7.22^{bc}
100	-	2.5^{c}	-	1.0^{c}	-	2.5^{d}	-	6.96^{c}
L.S.D	0.62	0.8	0.48	0.78	0.47	0.42	0.93	1.05
C.V%	9.1	3.6	22.6	9.1	6.6	5.3	10.3	8.9

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

The plant no./pot and plant height also affected significantly by adding the powder to the soil, the plant height reduced from 8.6 cm to 2.2 at dose 75 g of fruit hull and from 8.84 to 2.5 cm with the dose 100 g of leaf powder. Also, the dry matter ratio affected significantly.

In conclusion, the studied traits were affected significantly by adding the powder to the soil, and the great effect was noticed with adding the fruit hull powder and this clearly indicated the possibility of using pistachio residues to overcome the growth of the weeds in field. Albarni *et al.,* 2012 and Duke *et al.,* 2000 mentioned that the allelochemicals can act directly as herbicides or may provide lead structures for herbicides discovery.

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