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The Residual Allelopathic Effects of two Brassicaceae Seed Powder on the Following Summer Plants and Associated Weeds

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ABSTRACT

In Egypt, faba bean can be followed by summer crops such as sesame or soybean to increase the Egyptian crops area per year. So, this work was designed to study the residual effect of different rates from watercress, or mustard seed powder and Basamid herbicide which were previously applied to faba bean pots on the following plants. Sesame and soybean plants were sown in the same pots after the harvest of faba bean plants which were treated with different rates from watercress, or mustard seed powder and Basamid herbicide. This study was carried out in two successive summer seasons of 2016 and 2017 at the greenhouse of the National Research Centre, Dokki, Giza, Egypt. Results indicated that all previous treatments minimized fresh and dry weight of weeds and significantly increased growth parameters, yield and yield components for both plants. Also, results indicated that all tested treatments had no toxic effects on the following two plants. Therefore, more attention must be paid for the possibility of using the vegetative parts of the two mentioned plants as a cover crop on weed dynamics in subsequent cultivation. Moreover, weed control should begin in the previous crop by weed monitoring, control and management

***Keywords*:** Basamid herbicide, faba bean, mustard, residual effect, sesame, soybean and watercress.

Introduction

Allelopathy is one of the approaches which can be safely used as an alternative method to control several annual, parasitic as well as some perennial weeds (Ahmed *et al*., 2012, 2018 &2020; Messiha *et al*., 2013 &2018; El-Rokiek *et al*., 2018; El-Dabaa *et al*., 2019; El-Masry *et al*., 2015, 2019 a &b and El-Wakeel *et al*., 2019). Various plant species / families have been reported to have allelopathic activity and could be used in agricultural ecological systems (Rice, 1995). Brassicaceae family had great attention since it can be a part of the interaction between crops and weeds and also could affect the growth of preceding crops as mentioned by Vilhorde *et al*. (1985).

When Brassicaceae plant tissues are disrupted in the soil, its contents are hydrolyzed by the enzyme myrosinase resulting in several degradation phytotoxic products which include isothiocyanate, nitriles, thiocyanates and epithiocyanates which are phytotoxic to some weed species (Brown and Morra, 1997 and Bones and Rossiter, 2006).

Weed control with crop residues (allopathy) first assumed by Putnam and Duke (1974). Since then, efforts have been made in different parts of the world to exploit the allelopathy potentials of different plant species to control weeds in different crop systems as mentioned by Chon et al. (2002). For example, Angus *et al*. (1991) stated that the improvement in wheat growth after mustard compared to wheat followed by canola may be due to higher levels of different types of glucosinolates in mustard leading to more effective disease suppression. Moreover, previous crop residues can have a major allelopathic effect on wheat growth. Similar results were also reported by Purvis (1990) who also recorded that the growth of wheat seedlings was affected by the remains of many crops, including Brassicaceae, and the effects were highly dependent on the type of crops and the status of wheat remnants before planting.

It is well known that Brassica residues release phytochemicals during decomposition process which inhibit the germination of seeds of many plant species (Purvis *et al*., 1985; Thorne *et al*., 1990; Cheema and Khaliqa 2000; Batish *et al.,* 2002 and Northworthy *et al.,* 2005).

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Most of the researches concerning the allelopathic potentiality of Brassicaceae species have focused on its use as a green manure and cover crops. Several important cover crops include Brassica plants as mentioned by Mirsky *et al*. (2013).

The aim of the present work is to assess the residual potentiality of using the seed powder of watercress or mustard on the growth of the preceding two summer plants sesame and soybean.

Materials and Methods

Two pot experiments were conducted in the greenhouse of the National Research Centre, Dokki, Giza, Egypt, during two summer seasons of 2016 and 2017 to study the residual effect of different rates of two Brassicaceae plants seed powder i.e. watercress or mustard as well as Basamid herbicide on the following summer seasons i.e. sesame (*Sesamum indicum*) and soybean (*Glycine max*). A randomized complete design with six replicates was used. Each experiment includes the previously used pots which were applied to faba bean as follows:

1- Faba bean plants alone (free control)
2- Faba bean + Broomrape (Infected control)
3- Faba bean + Broomrape + Watercress at 15g/kg soil
4- Faba bean + Broomrape + Watercress at 30g/kg soil
5- Faba bean + Broomrape + Watercress at 45g/kg soil
6- Faba bean + Broomrape + Mustard at 15g/kg soil
7- Faba bean + Broomrape + Mustard at 30g/kg soil
8- Faba bean + Broomrape + Mustard at 45g/kg soil
9- Faba bean + Broomrape + Basamid 0.2 g/pot
10-Faba bean + Broomrape+ Basamid 0.4 g/pot

The residual effects of different seed powder rates of two Brassicaceae plants i.e. watercress (*Eruca sativa*) or mustard (*Sinapis alba*) as well as Basamid herbicide in faba bean (*Vicia faba*) pots were studied on both sesame (*Sesamum indicum***)** and soybean (*Glycine max*) following crops.

After faba bean harvest, each pot was cleaned without distributing the soil surface, therefore the emerging weeds will be considered as the still viable and non-affected summer weeds from the previous treatments. Seeds of sesame "Giza 32" cultivar and soybean" Giza 111" cultivar were sown on 22th and 25th May of 2016 and 2017seasons, respectively. Natural cultural practices were followed to grow crops, especially fertilization and irrigation.

Data Recorded:

A-On Weeds:

Weeds were hand pulled from two pots from each crop after 60 and 90 days after sowing (DAS). Fresh and dry weight of broad-leaved, grasses and total weeds (g/pot) were recorded.

B- On Sesame Plants:

1- Plant growth

After 60 and 90 DAS, Samples of 7 plants were collected from each treatment, some morphological and growth characteristics of sesame plants were recorded for each individual plant. The recorded characteristics included: plant height (cm), number of leaves/plant, fresh and dry weight of plant (g).

2- Yield and yield components

At harvest, Samples of *sesame* plants were taken from each treatment to determine: no. of capsules / plant, weight of capsules / plant (g), weight of seeds /plant (g) and weight of 1000 seeds (g).

C- On Soybean Plants:

1-Plant growth

After 60 and 90 DAS, Samples of 7 plants were collected from each treatment, some morphological and growth characteristics of soybean plants were recorded for each individual plant.

The recorded characteristics included: plant height (cm), number of leaves/plant, number of branches/plant, fresh and dry weight of plant (g).

2- Yield and yield components

At harvest, Samples of soybean plants were taken from each treatment to determine: no. of pods/ plant, weight of pods/ plant (g), no. of seeds/pod, weight of seeds/plant (g) and weight of 100 seeds (g).

Chemical Analysis

A- Total Glucosinolates (µ mol/g DW)

Total glucosinolates were extracted from dry samples of seed powder of watercress or mustard. Glucosinolates were measured by determining the liberated glucose which released during hydrolysis by myrosinase enzyme (Rauchberger *et al*., 1979).The resulting glucose was determined colorimetrically according to the method defined by Nasirullah and Krishnamurthy (1996).

B - Total Phenolic Content (mg/g DW)

Total phenolic content of watercress or mustard seeds were determined colorimetrically using Folin and Ciocalteu phenol reagent according to the method defined by Snell and Snell (1953).

Statistical analysis

All data were statistically analyzed according to Snedecor and Cochran (1989), and the treatment means were compared by using LSD at 5% level of probability. The data obtained were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1980) using the CoStat Software Program Version 6.303 (2004), and LSD at 0.05 level of significance was used for the comparison between means.

Results

A- Residual Effect from Faba bean Treatments on the Associated Weeds in Sesame and Soybean Pots:

Results recorded in Tables (1, 2, 3 and 4) cleared that previous faba bean treatments were significantly reduced the fresh and dry weight of broad-leaved, grasses and total weeds grown in the following crops after 60 and 90 DAS than the infected control treatment (faba bean +broomrape).

1- Sesame crop:-

At 60 DAS, Broad-leaved weeds did not appear with all treatments except mixed pots (infected control). Faba bean pots treated with mustard at 45g, Basamid at 0.4 g/pot, free plants from weed, mustard at 30g, watercress at 45g and mustard at 15g/kg soil showed the highest decrease in fresh and dry weight of grasses and whole weeds in the following sesame crop compared with the mixed control pots (Table 1). While, at 90 DAS, broad-leaved weeds did not appear with all treatments except mixed pots. the highest reduction in the previous parameters were achieved from Basamid at 0.4 g/pot, watercress at 45g, Basamid at 0.2 g/pot, watercress at 30g, free plants from weed and mustard at 45g/kg soil treatments compared with other treatments. They reduced the dry weight of total weeds by about 84.11, 79.90, 70.68, 70.51, 70.48 and 69.11%, respectively when compared with the mixed control treatment (Table 2).

2- Soybean crop:-

At 60 DAS, broad-leaved weeds did not appear with all treatments except mixed pots, watercress at 15g and mustard at 15g/kg soil. Treatments of Basamid at 0.4 g/pot, free plants, Basamid 0.2 g/pot, mustard at 45g/kg soil, watercress at 45 and at 30g/kg soil showed the lowest fresh and dry weight of grasses and total weeds in soybean crop (Table 3). Whereas, at 90 DAS, the highest reduction on the fresh and dry weight of grasses and total weeds grown with soybean plants at harvest were recorded from Basamid 0.4 and 0.2 g/pot, free plants, watercress at 45g, mustard at 45 and at 30g/kg treatments which reduced the dry weight of total weeds by about 97.48, 95.10, 88.81, 84.75, 64.31 and 56.63%, of the mixed control treatment respectively (Table 4).

On the contrary, the highest values of fresh and dry weight of broad-leaved, grasses and total weeds grown in the following crops after 60 and 90 DAS were recorded with their mixed control in both seasons.

Table 1: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the fresh and dry weight of weeds grown with sesame plants at 60 days after sowing (g/pot) (Combined analysis for 2016 and 2017 experiments).

Treatments	Fresh weight of weeds			Dry weight of weeds		
	Broad-leaved	Grasses	Total	Broad-leaved	Grasses	Total
Free control	0.00	14.91	14.91	0.00	4.21	4.21
Faba bean +Broomrape (Infected control)	11.21	60.53	71.74	3.41	17.93	21.34
Faba bean +Broomrape + Watercress at 15g/kg soil	0.00	54.94	54.94	0.00	16.26	16.26
Faba bean +Broomrape + Watercress at 30g/kg soil	0.00	46.55	46.55	0.00	12.89	12.89
Faba bean +Broomrape + Watercress at 45g/kg soil	0.00	30.17	30.17	0.00	8.33	8.33
Faba bean +Broomrape + Mustard at 15g/kg soil	0.00	32.11	32.11	0.00	8.87	8.87
Faba bean +Broomrape + Mustard at 30g/kg soil	0.00	29.52	29.52	0.00	8.16	8.16
Faba bean +Broomrape + Mustard at 45g/kg soil	0.00	10.65	10.65	0.00	2.94	2.94
Faba bean +Broomrape + Basamid 0.2 g/pot	0.00	36.80	36.80	0.00	10.51	10.51
Faba bean +Broomrape + Basamid 0.4 g/pot	0.00	12.29	12.29	0.00	3.41	3.41
L.S.D.at 5%	0.25	2.15	2.21	0.23	1.79	1.60

Table 2: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the fresh and dry weight of weeds grown with sesame plants at 90 days after sowing (g/pot) (Combined analysis for 2016 and 2017 experiments).

Treatments	Fresh weight of weeds			Dry weight of weeds		
	Broad-leaved	Grasses	Total	Broad-leaved	Grasses	Total
Free control	0.0	26.50	26.50	0.00	8.62	8.62
Faba bean +Broomrape (Infected control)	6.3	80.40	86.70	1.92	27.28	29.20
Faba bean +Broomrape + Watercress at 15g/kg soil	0.0	30.98	30.98	0.00	10.53	10.53
Faba bean +Broomrape + Watercress at 30g/kg soil	0.0	25.25	25.25	0.00	8.61	8.61
Faba bean +Broomrape + Watercress at 45g/kg soil	0.0	16.40	16.40	0.00	5.87	5.87
Faba bean +Broomrape + Mustard at 15g/kg soil	0.0	53.15	53.15	0.00	18.06	18.06
Faba bean +Broomrape + Mustard at 30g/kg soil	0.0	44.88	44.88	0.00	15.35	15.35
Faba bean +Broomrape + Mustard at 45g/kg soil	0.0	26.62	26.62	0.00	9.02	9.02
Faba bean +Broomrape + Basamid 0.2 g/pot	0.00	25.03	25.03	0.00	8.56	8.56
Faba bean +Broomrape + Basamid 0.4 g/pot	0.00	13.60	13.60	0.00	4.64	4.64
L.S.D.at 5%	0.22	2.17	2.36	0.07	1.97	1.87

Table 3: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the fresh and dry weight of weeds grown with soybean plants at 60 days after sowing (g/pot) (Combined analysis for 2016 and 2017 experiments).

Treatments	Fresh weight of weeds			Dry weight of weeds		
	Broad-leaved	Grasses	Total	Broad-leaved	Grasses	Total
Free control	0.00	15.01	15.01	0.00	2.99	2.99
Faba bean +Broomrape (Infected control)	21.67	97.14	118.81	6.11	19.73	25.84
Faba bean +Broomrape + Watercress at 15g/kg soil	17.56	82.00	99.56	4.95	16.47	21.42
Faba bean +Broomrape + Watercress at 30g/kg soil	0.00	46.50	46.50	0.00	9.30	9.30
Faba bean +Broomrape + Watercress at 45g/kg soil	0.00	46.14	46.14	0.00	9.23	9.23
Faba bean +Broomrape + Mustard at 15g/kg soil	4.94	75.32	80.26	1.37	15.06	16.43
Faba bean +Broomrape + Mustard at 30g/kg soil	0.00	72.46	72.46	0.00	14.56	14.56
Faba bean +Broomrape + Mustard at 45g/kg soil	0.00	39.44	39.44	0.00	7.91	7.91
Faba bean +Broomrape + Basamid 0.2 g/pot	0.00	30.40	30.40	0.00	16.47	16.47
Faba bean +Broomrape + Basamid 0.4 g/pot	0.00	5.78	5.78	0.00	1.25	1.25
L.S.D.at 5%	0.97	2.87	2.49	0.31	1.40	1.41

Table 4: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the fresh and dry weight of weeds grown with soybean plants at 90 days after sowing (g/pot) (Combined analysis for 2016 and 2017 experiments).

Treatments	Fresh weight of weeds			Dry weight of weeds		
	Broad-leaved	Grasses	Total	Broad-leaved	Grasses	Total
Free control	0.00	8.97	8.97	0.00	2.26	2.26
Faba bean +Broomrape (Infected control)	18.93	52.68	71.61	6.01	14.19	20.20
Faba bean +Broomrape + Watercress at 15g/kg soil	17.32	40.70	58.02	5.51	10.17	15.68
Faba bean +Broomrape + Watercress at 30g/kg soil	0.61	35.45	36.06	0.19	8. 85	9.04
Faba bean +Broomrape + Watercress at 45g/kg soil	0.00	12.35	12.35	0.00	3.08	3.08
Faba bean +Broomrape + Mustard at 15g/kg soil	16.73	38.65	55.38	5.32	9.61	14.93
Faba bean +Broomrape + Mustard at 30g/kg soil	3.67	30.13	33.80	1.17	7.59	8.76
Faba bean +Broomrape + Mustard at 45g/kg soil	2.60	25.54	28.14	0.83	6.38	7.21
Faba bean +Broomrape + Basamid 0.2 g/pot	0.00	4.10	4.10	0.00	0.99	0.99
Faba bean +Broomrape + Basamid 0.4 g/pot	0.00	2.11	2.11	0.00	0.51	0.51
L.S.D.at 5%	1.51	2.01	2.13	0.52	1.25	1.03

B- Residual Effect of Faba bean Treatments on Sesame Growth, Yield and Its Components:

Results presented in Tables (5 & 6) showed that all treatments in faba bean pots significantly increased plant height (cm),number of leaves/plant, fresh weight of plant (g), dry weight of plant (g),number of capsules / plant, weight of capsules / plant (g), weight of seeds /plant (g) and weight of 1000 seeds (g) compared with mixed control.

Sesame plants grown in pots previously treated with watercress at 45 and 30g, mustard at 45g, watercress at 15g, mustard at 30 and at 15g/kg soil as well as Basamid 0.4 g/pot recorded the highest values of sesame growth parameters which exceeded than those of the free plants, respectively at 60

DAS (Table 5). Whereas treatments of watercress at 45 and 30g, Basamid at 0.4 g/pot as well as mustard at 45g/kg soil gave the highest values of growth at 90 DAS, yield and its components which exceeded than those of the free plants, respectively at harvest. These treatments increased weight of capsules/ plant by about 29.35, 21.18, 13.74 and 5.34%, respectively over the free control plants.

Table 5: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the following sesame plant growth at 60 and 90 days after sowing. (Combined analysis for 2016 and 2017 experiments).

Treatments	Growth parameters			
	At 60 days after sowing			
	Plant height (cm)	No. of leaves/plant	Fresh weight of plant (g)	Dry weight of plant (g)
Free control	91.3	29.0	52.61	10.36
Faba bean + Broomrape (Infected control)	81.0	19.9	31.26	6.12
Faba bean + Broomrape + Watercress at 15g/kg soil	99.8	40.0	71.60	14.01
Faba bean + Broomrape + Watercress at 30g/kg soil	105.5	45.5	92.95	18.04
Faba bean + Broomrape + Watercress at 45g/kg soil	110.0	52.0	97.30	18.85
Faba bean +Broomrape + Mustard at 15g/kg soil	93.8	34.0	60.27	11.83
Faba bean +Broomrape + Mustard at 30g/kg soil	96.0	37.8	64.73	12.69
Faba bean +Broomrape + Mustard at 45g/kg soil	101.8	43.0	75.05	14.62
Faba bean +Broomrape + Basamid 0.2 g/pot	88.0	26.8	46.83	9.25
Faba bean +Broomrape + Basamid 0.4 g/pot	92.5	31.3	55.25	10.84
L.S.D. at 5%	2.7	2.7	2.39	1.64

Table: 5: Continued

Treatments	Growth parameters			
	At 90 days after sowing			
	Plant height (cm)	No. of leaves/plant	Fresh weight of plant (g)	Dry weight of plant (g)
Free control	132.6	62.0	83.50	21.23
Faba bean +Broomrape (Infected control)	105.5	41.3	44.25	11.36
Faba bean +Broomrape + Watercress at 15g/kg soil	123.7	58.5	78.95	20.01
Faba bean +Broomrape + Watercress at 30g/kg soil	145.0	76.0	110.69	28.03
Faba bean +Broomrape + Watercress at 45g/kg soil	153.5	87.3	115.83	29.35
Faba bean +Broomrape + Mustard at 15g/kg soil	120.0	55.7	68.49	17.53
Faba bean +Broomrape + Mustard at 30g/kg soil	130.5	60.0	80.18	20.43
Faba bean +Broomrape + Mustard at 45g/kg soil	136.4	66.0	87.53	22.59
Faba bean +Broomrape + Basamid 0.2 g/pot	116.8	52.5	63.55	16.29
Faba bean +Broomrape + Basamid 0.4 g/pot	140.0	70.0	98.53	24.96
L.S.D. at 5%	2.72	2.74	2.65	1.93

Table 6: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the following sesame yield and yield components at harvest. (Combined analysis for 2016 and 2017 experiments).

Treatments	No. of capsules/ plant	Weight of capsules / plant (g)	Weight of seeds /plant (g)	Weight of 1000 seeds (g)
Free control	36.3	26.20	5.61	3.27
Faba bean +Broomrape (Infected control)	19.4	14.17	3.49	2.96
Faba bean +Broomrape + Watercress at 15g/kg soil	31.7	22.40	5.21	3.20
Faba bean +Broomrape + Watercress at 30g/kg soil	48.5	31.75	7.28	3.38
Faba bean +Broomrape + Watercress at 45g/kg soil	50.4	33.89	7.86	3.41
Faba bean +Broomrape + Mustard at 15g/kg soil	29.9	21.33	4.96	3.15
Faba bean +Broomrape + Mustard at 30g/kg soil	34.5	23.15	5.53	3.23
Faba bean +Broomrape + Mustard at 45g/kg soil	39.8	27.60	6.58	3.31
Faba bean +Broomrape + Basamid 0.2 g/pot	28.3	20.60	4.85	3.11
Faba bean +Broomrape + Basamid 0.4 g/pot	42.0	29.80	6.74	3.36
L.S.D. at 5%	1.92	2.10	0.93	0.08

C- Residual Effect of Faba bean Treatments on Soybean Growth, Yield and Its Components:

Treatments in the previous faba bean pots had a significant effect on soybean plants, where they significantly increased plant height (cm), number of leaves/plant, number of branches/plant, fresh weight of plant (g) and dry weight of plant (g) at 60 and 90 DAS (Table 7), also no. of pods/ plant, weight of pods/ plant (g), no. of seeds/pod, weight of seeds/plant (g) and weight of 100 seeds (g) at harvest time (Table 8).

These results indicate that treatments applied in faba bean crop had no toxic residues on the following soybean plants. Soybean plants grown in pots previously treated with mustard at 45g, Basamid at 0.4 g/pot, watercress at 45g, mustard at 30g as well as watercress at 30 and at 15g/kg soil gave the highest values of all growth parameters of soybean, where these treatments exceeded than those of the free plants, respectively at 60 and 90 DAS (Table 7).

At harvest time, faba bean pots treated with watercress at 45g, mustard at 45 and at 30g as well as watercress at 30g/kg soil gave the highest values of all parameters studied exceeded than those of the free plants, respectively. These treatments increased weight of pods/ plant by about 31.71, 16.04, 10.74 and 6.41%, respectively as compared to free plants (Table 8). On the other hand, mixed control recorded the lowest values of growth at the two ages as well as yield and yield components of soybean plants at harvest.

D- Total Glucosinolates and Total Phenolic Content in Watercress and Mustard Seed Powder

The results in Table (9) show the content of total glucosinolates and total pohenolics in both watercress and musterd seed extracts.

Table 7: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the following soybean plant growth at 60 and 90 days after sowing. (Combined analysis for 2016 and 2017 experiments).

Treatments	Growth parameters				
	At 60 days after sowing				
	Plant height (cm)	No. of leaves/plant	No. of branches /plant	Fresh weight of plant (g)	Dry weight of plant (g)
Free control	100.0	34.3	4.9	33.65	10.89
Faba bean +Broomrape (Infected control)	67.5	20.5	1.2	22.41	7.15
Faba bean +Broomrape + Watercress at 15g/kg soil	102.2	35.0	3.7	35.64	11.46
Faba bean +Broomrape + Watercress at 30g/kg soil	106.5	35.8	5.4	36.22	11.69
Faba bean +Broomrape + Watercress at 45g/kg soil	111.0	49.0	6.6	40.37	13.08
Faba bean +Broomrape + Mustard at 15g/kg soil	96.0	33.0	4.0	31.24	10.11
Faba bean +Broomrape + Mustard at 30g/kg soil	109.3	42.0	5.4	38.85	12.55
Faba bean +Broomrape + Mustard at 45g/kg soil	124.0	50.0	6.1	46.70	15.23
Faba bean +Broomrape + Basamid 0.2 g/pot	90.0	31.8	2.6	29.67	9.73
Faba bean +Broomrape + Basamid 0.4 g/pot	116.0	50.7	4.4	42.93	13.99
L.S.D.at 5%	3.19	2.65	0.86	3.09	1.75

Table 7: Continued

Treatments	Growth parameters				
	At 90 days after sowing				
	Plant height (cm)	No. of leaves/plant	No. of branches /plant	Fresh weight of plant (g)	Dry weight of plant (g)
Free control	140.6	64.0	6.8	77.36	32.98
Faba bean +Broomrape (Infected control)	82.4	31.2	2.3	30.53	13.63
Faba bean +Broomrape + Watercress at 15g/kg soil	122.6	57.8	5.3	59.43	25.56
Faba bean +Broomrape + Watercress at 30g/kg soil	144.8	67.8	7.1	80.10	34.11
Faba bean +Broomrape + Watercress at 45g/kg soil	170.4	75.0	8.5	129.50	54.32
Faba bean +Broomrape + Mustard at 15g/kg soil	135.4	60.0	5.9	67.42	28.86
Faba bean +Broomrape + Mustard at 30g/kg soil	153.2	69.0	7.5	80.60	34.32
Faba bean +Broomrape + Mustard at 45g/kg soil	162.1	70.0	8.0	109.60	46.34
Faba bean +Broomrape + Basamid 0.2 g/pot	121.9	56.9	4.5	55.10	23.77
Faba bean +Broomrape + Basamid 0.4 g/pot	136.3	63.0	6.5	74.20	30.65
L.S.D.at 5%	4.55	2.65	1.03	3.26	2.35

Table 8: The previous allelopathic effects of two Brassicaceae plants seed powder and Basamid rates on the following soybean yield and yield components at harvest. (Combined analysis for 2016 and 2017 experiments).

Treatments	No. of pods/ plant	Weight of pods/ plant (g)	No. of seeds/pod	Weight of seeds/plant (g)	Weight of 100 seeds (g)
Free control	47.0	44.34	2.99	11.32	17.94
Faba bean +Broomrape (Infected control)	25.3	20.70	2.24	5.18	14.42
Faba bean +Broomrape + Watercress at 15g/kg soil	37.5	32.60	2.69	8.91	16.53
Faba bean +Broomrape + Watercress at 30g/kg soil	50.0	47.18	3.02	11.99	18.26
Faba bean +Broomrape + Watercress at 45g/kg soil	64.0	58.40	3.27	14.95	19.58
Faba bean +Broomrape + Mustard at 15g/kg soil	40.0	35.76	2.75	9.87	16.75
Faba bean +Broomrape + Mustard at 30g/kg soil	52.0	49.10	3.12	12.52	18.69
Faba bean +Broomrape + Mustard at 45g/kg soil	59.0	51.45	3.23	13.26	19.12
Faba bean +Broomrape + Basamid 0.2 g/pot	34.6	31.46	2.59	8.49	15.60
Faba bean +Broomrape + Basamid 0.4 g/pot	44.0	40.42	2.87	10.14	17.16
L.S.D.at 5%	0.58	2.58	0.11	1.35	0.87

Table 9: Total glucosinolates (μ mol/g dry weight) and total phenolic contents (mg/g dry weight) in the seed powder of both watercress and mustard

Materials	Total glucosinolates (μ mol/g dry weight)	total phenolic contents (mg/g dry weight)
Watercress seed extract	316.03	35.62
Mustardseed extract	288.59	43.62

Discussion

There is no doubt that the length of time that the residual allelopathic effects remain active in the soil, is extremely important because it means the length of time which could be expected for weed control. This type of researches is of particular importance in Egypt, since two or three crops could be grown in one year. So this work was carried out to investigate the effect of the previous allelopathic potentiality of the residues from the seed powder of two Brassicaceae plants i.e. watercress (*Eruca sativa*) or mustard (*Sinapis alba*), on subsequent growth of sesame (*Sesamum indicum*) or soybean (*Glycine max*) as well as the growth of emerging summer weeds. Incorporation of plant residues in the soil can be both stimulatory and inhibitory and the results clearly indicate that differences in the allelopathic potentiality depend on plant species, amount and condition of residues (Oliva *et al*., 2002).

Generally, the results clearly show that the residues from the previously mentioned two Brassicaceae plants significantly decreased the fresh and dry weight of emerging both broad-leaved weeds as well as grasses at 60 and 90 days after sowing associating the growth of the two summer plants till harvest. In this connection it is worthy to mention that several authors reported that the degradation products from the previously added seed powder of the two Brassicaceae plants contains Glucosinolates hydrolysis products which could inhibit the germination of dormant and non-dormant seeds (Wolf *et al*., 1984; Teasdale and Taylorson, 1986; Bialy *et al*., 1990; Choesin and Boerner, 1990 and Peterson *et al*., 2001).

Our results showed clearly that the residues from the previously mentioned two Brassicaceae plants, significantly increase the growth parameters as well as the yield and yield components of sesame or soybean plants. This means that the residues from the two Brassicaceae plants had a stimulatory action on the preceding crop plants (Vilhorde *et al*., 1985; Angus *et al*., 1991 and Oliva *et*

al., 2002).For example, Vilhorde *et al*. (1985) showed that rapeseed had an allelopathic effects on the subsequent growth of soybean during crop rotation between the two species. Similar results were also reported by Vera *et al*. (1987) which showed that rapeseed and other Brassica species had phytotoxic effects on weeds to the subsequent crops. Therefore, the incorporation of rapeseed into the soil as green manure and cover crops is used to decrease weeds in the subsequent crops (Boydston and Hang, 1995; Al-Khatib *et al*., 1997 and Krishnan *et al*., 1998).

Conclusion

It is worth noting that the results of the previous applied treatments improved the following growth, yield and yield components of the following summer crops (sesame and soybean). This could be attributed to the efficiency of these treatments in controlling weeds and their stimulatory effects on the crop.

We predict the possibility of using the seed powder of watercress or mustard as a powerful tool in controlling weeds and definitely decrease the weed seed bank for the next crop, similar to synthetic Basamid herbicide, since the mode of action of both is the production of isothiocyanate. Therefore, more attention must be paid for the possibility of using the vegetative parts of the two mentioned plants as a cover crop on weed dynamics in subsequent cultivation. Moreover, weed control should start in the previous crop by monitoring controlling and managing the weeds. This means that Brassicaceae crops could be considered as a wise application of controlling weeds.

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