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Effect of some Weed Control Practices on Coriander (*Coriandrum sativum* L.) Productivity and their Associated Weeds

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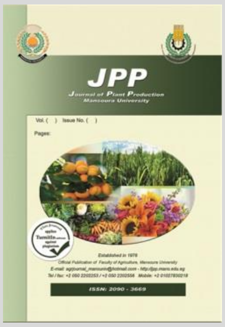

ABSTRACT

Two field experiments were carried out during 2016/2017 and 2017/2018 winter seasons at Sids Horticultural Research Farm, Egypt, to evaluate the efficacy of eleven weed control treatments on weeds and coriander productivity with monitoring chemically herbicidal residues by HPLC in both soil and coriander seeds in randomized complete block design with four replicates. The results show that coriander seed yield losses due to weed competition varied from 56.6-55.5 percent through the course of this study. Hand hoeing thrice, black polyethylene mulch, rice straw mulch and Stomp extra at 1.7 l/feddan treatments gave 91-96 percent of weed control accompanied with coriander increases seed yield varied from 200.9-230.5 percent than unweeded check. Such increases in seed yield per feddan are positively correlated with various studied yield components and negatively with various studied weed categories emphasizing the need of good weed control program in coriander crop production with less herbicide residues, which determined by HPLC in both soil and seed coriander were below than the maximum residue allowable level expect with Ultra afalon at 1.0 l/fed. in the soil. Economic evaluation, showed that seed yield of coriander is a profitable enterprise for coriander growers by using hand hoeing thrice or Stomp extra or black polyethylene mulch and rice straw mulch treatments which can be recommended as good and clean alternatives for weed control in coriander crop.

Keywords*:* Coriander (*Coriandrum sativum* L.), weed control, mulching, herbicides of residues.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) family Apiaceae is one of the oldest known seed spices used by package as coriander production condiment throughout the world. According to Elsoguar and Abdel-Hafiz (2013) the cultivated area by coriander in Egypt was 8079 feddan with 7292 ton which used as green leaves in salad as a source of vitamin A& C and add stronger antioxidant and oil seed contain linalool as aromatic characters, Bairwa *et al.* (2017). Coriander production face weed problem which cause yield loss varied from 20-50% according to Kushwaha *et al.* (2002) and by 82% according to Savaliya *et al.* (2017) who attributed this that coriander is a short stature crop seed takes longer time for germination and also having slow early vegetative growth where the crop is very sensitive to early weed competition. On another hand, the traditional method of growing of coriander by broadcast sowing method further makes manual weeding very difficult. Hence, identification and use of a selective and less cost effective herbicide alone or in combination with hand weeding in an integrated manner can be a good economic alternatives for effective weed management. Singh *et al.*(1988) reported that soil temperature increased with the use of plastic mulch\. Mulching stimulates the microbial activity in soil through improvement of soil agro-physical properties. Many researchers as Kothari *et al.* (1989) found that application of pendimethalin and fluchloralin at 0.75 and 1.00 kg a.i./ha, respectively causing 76.5 and 71.9% weed control, were most promising treatments, and gave seed and oil yields comparable to weed-free check. None of these treatments impaired the quality of coriander seed oil, measured in terms of d-linalool content, Zheljazkov and Zhalnov (1995) reported that the best weed control in coriander field was achieved with a combination of pendimethalin (1320 cc/ha) and metribuzin (500 g/ha) and the highest seed yields were obtained with trifluralin (840 cc/ha) + linuron (1000 g/ha), pendimethalin (320 cc/ha) or metribuzin (500 g/ha). GC analysis of oils obtained from coriander seed produced from a variety of herbicide treatments did not appear to affect the chemical composition greatly although the oil produced from plants treated with metribuzin (500 g/ha) was richest in linalool (44.47%). Nagar *et al.* (2009) and Meena and Mehta (2009) revealed that weeding twice at 20 and 40 days after sowing and pre-emergence application of pendimethalin at 1.0 kg/ha+ hand weeding at 40 days after sowing were significantly reduced the density and dry weight of weeds and increased significant yield attributes of coriander resulting in higher seed yield and net return, Yadav *et al.* (2013) and Yadav *et al* (2015) reported that two hand-weeding done 20 and 40 days after sowing and pendimethalin at1.0 kg ha^{-1} alone or followed hand-weeding at 40 days after sowing were the most effective in reducing the density and dry weight of weeds and controlled the weeds to the extent of 94.9% and recorded the highest plant height, number of branches/plant, umbels/plant and test weight. It also provided the

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maximum seed and straw yields of coriander more than unweeded control. Pickett and Zheljazkov (2016) reported that the herbicides linuron, trifluralin and pendimethalin pre-emergence application could be used for weed control in coriander crop. Savaliya *et al.* (2017) reported that the highest weed control efficiency were registered under treatments two hand weeding at 20 and 40 days after sowing and pendimethalin at 1.0 kg/ha as pre-emergence + quizalofop ethyl 0.04 kg/ha at 20 days after sowing 85.3 and 79.3%, respectively. It were also recorded the higher seed yield 747 and 723 kg/ha, respectively. Nagar (2017) revealed that two hand weeding at 30 and 45 days after sowing was found the most effective in controlling all weeds. Pendimethalin at 1.0 kg / ha + hand weeding at 45 days after sowing found equally effective in controlling weeds as that of two hand weeding. Both of these treatments gave significantly higher seed yield, over rest of the treatments and increased the seed yield by 200.57 and 198.67 per cent, respectively compared to weedy check. Application of metribuzin at 0.30 kg/ ha as pre-emergence was found least effective in the control of various weeds. Ocharo *et al.* (2018) found that black plastic mulch was the superior treatment in controlling weeds, then metribuzin herbicide came in the second rank in controlling broadleaved weeds. pendimethalin is very good efficacy on weeds. Gasti and Chakravorty (2019) found that pre-emergence application of pendimeathalin at 1.5 a.i kg / ha alone, supplemented with one hand weeding after 45 days after sowing or two hand weeding after 45 and 60 days after sowing exhibited the highest weed control efficiency and gave plant height, number of branches per plant, yield per ha., net returns and B:C ratio in coriander. Singh and Kulshrestha (1991) reported that pendimethalin and butralin were dinitroanline herbicides show that pendimethalin was degraded to two metabolites N-(1-ethyl propyl)-3,4-dimethyl-2-dinitro benzene 1,6- diamine and 3,4-dimethyl 2,6- dinitroaniline due to nitro reduction and dealkylation, respectively. Jerome (1990) and Kearney *et al.* (1976) found one metabolite of butralin was determined from parent compound by loss of one nitro substituent, these metabolites were characterized by low solubility and basicity, volatization from surface soil than parent. Walker (1987) found that linuron (phenyl urea) is very low volalitily, slow biodegradation because of its high tendency to absorb with soil particles and organic compounds. Chen *et al.* (2017) showed that prometryn (S- triazne) decay in soil through hydroxylation, dealkylation and dethiomethylation pathway. Allan (2008) found that the photo degradation of metribuzin (triazine) to deamino metribuzin (DA) by deamination (NH_2) and diketometribuzin (DK) by sulfoxidation and dealklation (SCH_3). Both of these metabolites were evaporated from soil. Duke and Powls (2008) mentioned the main degradation of glyphosate was amino methyl phosphonic acid (AmPA) is strongly adsorbed to soil. For these reasons glyphosate generally has been regarded as an environmentally safe herbicide. Sancho *et al.* (1996) reported that degradation and adsorption of glyphosate and AmPA depend on soil properties and climatic conditions. Thus, the main goals of this work were to study the effect of different weed control methods in coriander field with monitoring chemically herbicidal residues by HPLC analysis in soil and seed coriander at harvest with economic feasibility study.

MATERIALS AND METHODS

Two field experiments were carried out at Sids Horticultural Research Station, Beni-Suef Governorate, Horticultural Research Institute, Agricultural Research Center, Egypt, in clay soil during two successive winter seasons 2016/2017 and 2017/2018 (Table 1) to study the effect of various weed control method treatments on weeds and yield component of coriander yield and herbicides residues by HPLC in both soil and seed yield of coriander at harvest. The cultivated variety was medium maturity variety ballady. The experimental design was a randomized complete block design with four replicates.

Table 1. Mechanical and chemical analysis of the experimental soil.

Mechanical analysis				Chemical analysis			Available nutrients					
Sand %	Silt %	Clay %	Texture	OM	PH	E.C mmhos/cm	N %	P (ppm)	K (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)
17.6	31.2	51.2	Clay loam	1.55	7.8	1.1	0.1	29.1	371.1	32.0	19.0	5.6

The treatments were as follow:

1-Roundup 48% WSC (glyphosate)(N-(phosphonomethyl) glycine), was applied at 1.0 l/fed. sprayed after 21 days from false irrigation on germinated weeds and then sowing coriander after two weeks from herbicide application.

2 - Stomp extra 45.5% CS (pendimethalin) was applied at 1.7 l /fed. pre- emergence.

3 - Amex 48% EC (butralin) was applied at 2.5 l/fed. pre-emergence.

4 - Sencor 70% WP (metribuzin) was applied at 300 g/fed. pre- emergence.

5 - Gesagard 50% SC (prometryn) was applied at 1.0 l/fed. pre- emergence.

6 - Ultra afalon 45% SC (linuron) was applied at 1.0 l/fed. pre- emergence.

7 - Black polyethylene mulch by plastic sheets thick 0.15 mm covering soil surface and sowing coriander in plastic holes by using mineral tubes with sharped edge at 30 cm distance between holes.

8 - Rice straw mulch at 10 ton/fed., or equal 25 kg/plot and covered homogenously in the furrow beneath plants and ridges.

9 - Hand hoeing twice at 20 and 40 days after sowing.

10 - Hand hoeing thrice at 20 , 40 and 60 days after sowing (weed free for the whole season).

11 - Unweeded check (control).

The used herbicides characteristic were mentioned in Table (2).

Table 2. Trade, common and chemical names, family group and site of action of the herbicides according to the pesticide manual (2012) and number of group according to (WSSA, 2011) classification.

Trade name	Common name	Chemical name	Family group	Site of Action	WSSA Group
Roundup 48% WSC (Water soluble concentrate)	Glyphosate Isopropyl Ammonium	N-(phosphonomethyl)glycine Other names sulfosate* (for discontinued dimethylsulfonium salt)	Glycine derivative	Inhibits enzyme **(EPSPS)	9
Stomp Extra 45.5% CS (Capsule suspension)	Pendimethalin	[N - (1-ethylpropyl) -3, 4-dimethyl-2, 6-dinitro benzenamine]	Dinitroanilines	Inhibits cell division and cell elongation. It is listed in the K1-group according to the HRAC classification.	3
Amex 48 % EC (Emulsifiable concentrate)	Butraline	[[4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitro benzenamine	Dinitroanilines	Inhibits microtubule formation and disrupting cell division.	
Sencor 70% WP (Wettable powder)	Metribuzin	(4-amino-6-(1,1-dimethylethyl) -3-(methylthio) 1,2,4-triazin-5 (4H)-one)	Triazinone	Photosynthetic electron transport inhibitor at the photosystem II receptor site. Selectivity is due to metabolism (mostly conjugation) within the plant. *Inh. photosystem II	5
Gesagard 50% SC (Suspension concentrate)	Prometryn	(N2,N4-di-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine)	(s.triazine)	Photosynthetic electron transport inhibitor at the photosystem II receptor site. Selective systemic herbicide, absorbed by the leaves and roots, with translocation acropetally through the xylem from the roots and foliage, and accumulation in the apical meristems.	5
Ultra afalon 45% SC (Suspension concentrate)	linuron	*N′*-(3,4-dichlorophenyl)-*N*-methoxy-*N*-methylurea	Urea	Inh. photosystem II	7

***Inhibits** ****5-enolpyruvylshikimate-3-phosphate synthase (EPSPS).**

Herbicides were applied by CP3 knapsack sprayer with 200 l/fed. on soil surface. Seeds were planted in five rows the growing seedlings were thinned to two plants per hill, after three weeks from sowing. The experimental unit area was 10.5 m^2 each row was 3 m long and 0.7 m wide, planting dates were 1st October in both seasons. The other agricultural practices were done as recommended.

Data recorded

a: Weeds characters:

Table (3) weeds were assessed by handpulling from one square meter at 60 days from coriander sowing where these weeds were chosen at random from each plot and identified to species according to Tackholm (1974) and their fresh weight as gram per square were divided into the following groups:

1- Annual grassy weeds (g/m^2).
2- Annual broad-leaved weeds (g/m^2).
3-Total of annual weeds (g/m^2).

Table 3. Scientific and english names of weed species which existed in experimental plots at 60 days from sowing coriander in 2016/2017 and 2017/2018 seasons.

Scientific name	English name
Annual broad- leaved weeds	
Beta vulgaris L.	Sea beta
Capsella bursa-pastoris (L.) Medik	Shepherds purse
Coronopus niloticus (Del.) Spreng	Watercress
Euphorbia helioscopia L.	Sun spurge
Malva parviflora L.	Cheese – weed, mallow
Rumex dentatus L.	Dentated Dock
Sonchus oleraceus L.	Sow thistle
Annual grassy weeds	
Avena sterilis L.	Sterile oat
Phalaris minor L.	Shaeer –al- faar
Echinochloa colonum (L.) Link.	Jungle rice

b:Coriander yield and yield components:

At harvest, ten plants were taken at random from each plot and the following measurements were recorded:

1 - Plant height (cm). 2 - Stem diameter (cm).
3 - Number of branches/plant. 4 - Dry weight / plant (g).
5 - Number of umbels /plant. 6 - Seed yield / plant (g).
7 - 1000 – seed weight (g). 8- Seed yield (kg / fed.).
9- Oil %. 10- Oil yield L/ fed.

To determine the percentage and total yield of essential oil, the plants were harvested and, they were dried by air and weighed 100 g of seeds were used to oil extraction for three hour by utilized to a 3 h hydro distillation apparatus according to British Pharmacopoeia, (1963). The essential oil ratio of the plants was reported by a volumetric method (ml /100 g) then oil yield per plant as well as per feddan was calculated.

- Weed competition index (%) was worked by the following formula according to Kushwaha *et al.* (2002).

Weed competition index (%) = (Seed yield of thrice hand hoeing plot - Seed yield of treated plot) / Seed yield thrice hand hoeing plot × 100

c: Herbicides residues determination in soil and coriander seed yield:

Reagents: All the solvents and reagents used in this study were of high analytical and HPLC grade include acetonitrile, methanol.

Materials: glyphosate, pendimathaline, butralin, metribuzin, prometryn and linuron, sampling (seed coriander and soil).

Preparation of standard solution: Weight 10 mg (related to purity of 100%) from all above herbicides standard into a10 ml volumetric flask (you can take another weight in different volume but with the same equivalence) and dilute to the mark with methanol LC grade and mixing well. This is the standard solution.

Calibration: Calibration for the HPLC is usually carried out at concentrations related to that of sample found in formulation sample. Inject all above herbicides standard solution individual into HPLC column. Ensure reproducibility of injections to obtain retention time for each herbicide. Ensure linearity of pendimathaline, butralin, metribuzin, prometryn, linuron and glyphosate.

Determination of herbicides residue: Samples were determined by high performance liquid chromatography apparatens. All samples were measured three times in experiment period and take the mean to eradicate any discrepancies. Chromatographic conditions: the mobile phase: acetonitrile / methanol = 95:5(v/v), reagent with ultrasonic degassing filter, flow rate:1ml / min, column: Luna C18 reversed-phase column. The amount of active ingredient was determined for all samples by comparison to external standard solution. All regents were HPLC grade.

HPLC Analysis: The type of chromatographic HPLC system model (Agilent ,series 1100) with Quaternary pump, UV-detector was employed. The chromatographic C18 stainless steel column (2.4×250mn).

Extraction and clean up of seeds and soil samples: The extraction technique mentioned by (Mollhoff 1975) was adopted for the extraction of pesticides under study as follows : 20 g of plant or soil was mixed with 60 ml of methanol. The mixture was shaked mechanically using an electrical shaker for one hour for separation of water from methanol extract. The extract was partitioned successively with methylene chloride in separatory funnel. The combined methylene chloride phase was dried by filtration through filter paper and anhydrous sodium sulphate, then evaporated just to dryness on rotary evaporator at 40 ^{0}C The residue was quantitatively transferred into small vials with 5ml methanol. The solvent was then evaporated till dryness and vials were stored at – 15^{0}C until the clean up the extracts of samples were cleaned by reversed phase C18 (SPE) Cartridge according to FAO/ WHO (1993). Residues were dissolved in 1ml methanol and then determined by HPLC and conditions for determination are given in Table 4. Mean recoveries obtained from tested samples fortified with known quantities of the above tested herbicides ranged from 82 to 100 %.

Table 4. The conditions for the determination of Roundup (glyphosate), Stomp extra (pendimethalin), Amex (butralin), Sencor (metribuzin), Gesagard (prometryn) and Ultra afalon (linuron) in seed yield and soil by HPLC.

Herbicides and its chemical group	Mobile phase	Wave Length (nm)	Flow Rate ml/min	Retention Time (min)	Detection Limit µg/kg (ng)
Glyphosate (Glycine derivative)	Acetonitrile/ methanol 95/5	235	1mil / min.	3.0 70	5
Pendimethahin(Dinitroaniline)	Acetonitrile/ methanol 95/5	235	1mil / min.	2.242	4
Butraline (Dinitroaniline)	Acetonitrile/ methanol 95/5	235	1mil / min.	2.282	3
Metibuzin (Triazinone)	Acetonitrile/ methanol 95/5	235	1mil / min.	2.34	5
Prometryn (S.triazine)	Acetonitrile/ methanol 95/5	235	1mil / min.	3.9	2
Linuron (Phenylurea)	Acetonitrile/ methanol 95/5	235	1mil / min.	3.157	4

Economic feasibility study:

Variable and fixed costs and total economic returns of the (LE) are shown in table (11) the budget various were estimated. Cost of coriander yield per feddan was estimated and compared among the treatments. The price for seed yield was 20000 LE /ton. Price of black polyethylene for mulch was 30 LE/ kilogram (4 x10 m^2), Rice straw for mulch was 200 LE/ton, Roundup was 230 LE/liter, Stomp extra = 230 LE/ liter, Amex = 250 LE/liter, Sencor (300 g) = 150 LE, Gessagard (1 liter) = 200 LE, Ultra afalon (1 liter) = 260 LE, two hoeing = 1200 LE and for three hoeings 1800 LE respectively. Economic analyses were performed to estimate returns and profitability using the following formula used by according to Heady and Dillon (1961) and Dunan *et al.* (1995) with some modification :

Gross income = total yield x price(LE)of unit (Ton = 20000 LE).

Total cost of increased = increased yield per fed./all of yield x cost of all yield

Net income = gross income – total costs (LE).

Net income of increased = gross income of increased – cost of increased yield.

Benefit/ costs ratio (B/C) = gross income / total costs.

Statisticale analysis:

The collected data were statistically analyzed according to the method described Snedecor and Cochran (1981). Means were compared using Duncan's multiple range test as published by Duncan (1955). All statistical analyses were performed using analysis of variance technique by means of MSTATC computer software package (Freed *et al*., 1991). The simple correlation coefficients were calculated following Singh and Chaudhary (1985).

RESULTS AND DISCUSSION

a: Effect of weed control treatments:

Weeds characteristics

Tables (3&5) show that weedy check plots of coriander were heavily infested by annual predominated weed species in both seasons which were *Beta vulgaris* L., *Rumex dentatus* L., *Sonchus oleraceus* L., *Malva parviflora* L., *Capsella bursa-pastoris* L, *Euphorbia helioscopia* L. and *Coronopus niloticus* L. as annual broad-leaved weeds and *Phalaris minor* L., *Avena sterilis* L. and *Echinochloa colonum* L. as annual grassy weeds which were the most important weeds of coriander crop. The level of weed infestation in both season show that the rate of infestation in unweeded check reached to 9.43 and 10.30 ton fresh weight per fed. after 60 days from sowing where the mixture of weed species was represented by 88.59 and 11.41% broad -leaved and grassy weeds, respectively. This mean that the experimental field had heavy weed infestation which help in determining weed control efficiently. Results showed that weedy check plots recorded the highest fresh weight of weeds (Table 5). All weed control treatments gave significant effect on controlling weeds in 2016/2017and 2017/2018. Black polyethylene mulch, hand hoeing thrice, rice straw mulch and Stomp extra at 1.7 l /fed. resulted the highest reduction % in fresh weight of annual broad-leaved, grassy and total weeds by (97.1, 93.2, 96.6, 95.0, 94.4, 94.9, 93.0, 92.0, 92.9 and 91.4, 91.5, 91.5 %), respectively, followed by Amex at 2.5 l/fed., Round up 1.0 l /fed., Sencor at 300 g. /fed. and twice hand hoeing by (85.5, 87.5, 85.7, 82.4, 81.9, 82.4, 81.7, 78.5, 81.4 and 81.2, 81.3, 81.2 %), respectively. Whilst the Gesagard at 1.0 l/fed. and Ultra afalon at 1.0 l /fed. gave controlling % by (78.2, 74.4, 77.8 and 70.7, 70.4, 70.7 %), respectively, comparison to weedy check in season 2016/2017. However, in the second season 2017/2018 black polyethylene mulch, hand hoeing thrice, rice straw mulch and Stomp extra at 1.7 l/fed. gave weed control efficiency % of the fresh weight of the annual broad-leaved, grassy and total weeds by (96.7, 92.3, 96.2; 94.5, 95.8, 94.7; 92.8, 91.8, 92.6 and 92.3, 90.6, 92.1%), respectively. followed by Amex at 2.5 l /fed., Roundup 1.0 l /fed., Sencor at 300 g /fed. and hand hoeing twice by (84.7, 86.8, 84.9, 81.0, 82.8, 81.2 , 80.4, 78.4, 80.2 and 80.7, 82.4, 80.9 %), respectively. Whilst the Gesagard at 1.0 l /fed. and Ultra afalon at 1.0 l /fed. gave weed control efficiency % by (79.1, 72.2, 78.3 and 71.2, 71.1,71.2%), respectively, comparison to weedy check. Generally, black polyethylene mulch, hand hoeing thrice, rice straw mulch, Stomp extra at 1.7 l/fed. and Amex at 2.5 l /fed. were the superior treatments comparing with the other treatments in both seasons.

Table 5. Effect of weed control treatments on fresh weight of weeds (g/m^2) of coriander experimental field in 2016/2017 and 2017/2018 seasons.

Treatments & Herbicidal rate / fed.	Broad leaved weeds (g/m^2)	Weed control efficiency %	Grassy weeds (g/m^2)	Weed control efficiency %	Total weeds (g/m^2)	Weed control efficiency %
			2016/2017 season			
Roundup at 1.0 L	351.0 cd	82.4	45.0 cde	81.9	396. cd	82.4
Stomp extra at 1.7 L	170.0 ef	91.4	21.0 ef	91.5	191.0 e	91.5
Amex at 2.5 L	290.0 de	85.5	31.0 def	87.5	321.0 d	85.7
Sencor at 300 g	365.0 cd	81.7	53.0 bcd	78.5	418.0 cd	81.4
Gesagard at 1.0 L	435.0 c	78.2	63.5 bc	74.4	498.5 c	77.8
Ultra afalon at 1.0 L	585.0 b	70.7	73.5 b	70.4	658.5 b	70.7
Rice straw mulch	140.0 f	93.0	20.0 ef	92.0	160.0 e	92.9
Black polyethylene mulch	58.8 f	97.1	17.5 f	93.2	76.3 e	96.6
Hand hoeing twice	375.8 cd	81.2	46.3 cde	81.3	422.0 cd	81.2
Hand hoeing thrice	99.5 f	95.0	14.0 f	94.4	113.5 e	94.9
Unweeded check	1997.3 a	0.0	248.5 a	0.0	2245.8 a	0.0
			2017/2018 season			
Roundup at 1.0 L	410.8 c	81.0	49.5 bcd	82.8	460.3 cd	81.2
Stomp extra at 1.7 L	167.0 d	92.3	27.0 cd	90.6	194.0 e	92.1
Amex at 2.5 L	331.8 c	84.7	38.0 cd	86.8	369.8 d	84.9
Sencor at 300 g	424.8 c	80.4	62.0 bc	78.4	486.8 c	80.2
Gesagard at 1.0 L	452.8 c	79.1	80.0 b	72.2	532.8 c	78.3
Ultra afalon at 1.0 L	624.0 b	71.2	83.0 b	71.1	707.0 b	71.2
Rice straw mulch	156.5 d	92.8	24.0 cd	91.8	180.5 e	92.6
Black polyethylene mulch	72.3 d	96.7	22.0 d	92.3	94.3 e	96.2
Hand hoeing twice	417.5 c	80.7	51.0 bcd	82.4	468.5 cd	80.9
Hand hoeing thrice	118.5 d	94.5	12.0 d	95.8	130.5 e	94.7
Unweeded check	2166.0 a	0.0	287.5 a	0.0	2453.3 a	0.0

Means followed by the same letters within each column do not differ significantly according to Duncan's multiple range test at the 5% level.

These results may be due to the inhibition and deleterious effect of weed control treatments on growth of weeds. Black polyethylene mulch and rice straw mulch were effective on controlling weeds which may be due to reducing penetration of light necessary for weed photosynthesis. Stomp extra and Aemx being dinitroaniline, are known to be absorbed by germinating weed seedlings and inhibits cell division in meristematic tissue so that most of weeds die within few days of their emergence. These results are in agreement with obtained by Nagar *et al.* (2009) Yadav *et a.l* (2015), Galal *et al.* (2019) and Galal *et al.* (2020). Savaliya *et al.* (2017) reported that the highest weed control efficiency were registered under treatments of two hand weeding at 20 and 40 days after sowing and pendimethalin at 1.0 kg/ha as pre-emergence + quizalofop ethyl 0.04 kg/ha at 20 days after sowing 85.3 and 79.3%, respectively. Gasti and Chakravorty (2019) found that pre-emergence application of pendimeathalin at 1.5 a.i kg / ha alone, supplemented with one hand weeding after 45 days after sowing or two hand weeding after 45 and 60 days after sowing exhibited the highest weed control efficiency.

b: Coriander yield and yield components

The results in Table (6) show clearly that the application of some mulching, mechanical weeding and herbicide treatments for controlling weeds significantly increased yield and yield components of coriander yield as compared with the unweeded check. Weed control treatments significantly affected on plant height, number of branches/plant, stem diameter, dry weight per plant and number of umbels per plant in both seasons (Table 6). Black polyethylene mulch, thrice hand hoeing, rice straw mulch and Stomp extra at 1.7 l/fed. treatments gave the highest value of plant height, dry weight per plant and number of umbels per plant, by increasing statistically value than unweeded check treatment.

Hand hoeing thrice gave the highest mean values in the number of branches/plant and stem diameter in the both seasons followed by black polyethylene mulch, rice straw mulch and Stomp extra at 1.7 l/fed. Seed index seed yield per plant, weight of 1000 seed and seed yield/fed. of coriander was significant differences between treatments (Table 6). The treatment of thrice hand hoeing gave the highest values in both seasons followed by black polyethylene mulch, rice straw mulch and Stomp extra at

1.7 l/fed. treatments. The lowest weed competition index was recorded in black polyethylene mulch, rice straw mulch and Stomp extra at 1.7 l/fed. (3.5, 12.0 and 12.8 %), (3.8, 7.6 and 8.3 %) followed by twice hand hoeing (13.2 and 13.1%) comparison to weedy check which record highest weed competition index (56.6 and 55.5%) in both seasons respectively. These treatments resulted in effective and timely control of weeds and did not allow weeds to regenerate and therefore lower weed competition index was recorded.

Table 6. Effect of weed control treatments on characters of coriander yield and its components in 2016/2017 and 2017/2018 winter seasons.

Treatments & Herbicidal rate / fed.	Plant height (cm)	Number of branches / plant	Stem diameter (cm)	Dry weight / plant (g)	Number of umbels /plant	Seed yield / plant (g)	1000 - seed Weight (g)	Seed yield (kg/fed.)	Weed competition index (%)
2016/2017 season									
Roundup at 1.0 L	117.7 bcd	7.08 abc	0.78 abc	175.0 bc	49.8 abc	20.1 c	12.1 abcd	802.5 c	23.1
Stomp extra at 1.7 L	122.7 abc	7.16 abc	0.88 ab	185.0 ab	53.5 ab	22.7 b	12.3 abc	909.0 b	12.8
Amex at 2.5 L	116.3 bcde	6.75 abc	0.73 bc	170.0 bc	49.1 abc	19.5 c	12.1 abcd	780.0 c	25.2
Sencor at 300 g	116.1 bcde	6.99 abc	0.70 bc	168.8 bc	48.8 abc	19.5 c	11.9 abcd	777.5 c	25.5
Gesagard at 1.0 L	112.0 cde	6.33 bc	0.70 bc	157.5 bcd	47.1 bcd	18.4 c	11.7 bcd	735.0 c	29.5
Ultra afalon at 1.0 L	109.9 de	6.08 bc	0.65 c	145.0 cd	43.8 cd	18.2 c	11.7 cd	727.5 c	30.2
Rice straw mulch	123.8 ab	7.25 abc	0.88 ab	192.5 ab	50.7 abc	23.0 b	12.6 abc	917.5 b	12.0
Black polyethylene mulch	129.0 a	8.00 ab	0.93 a	217.5 a	55.0 a	25.2 a	12.9 ab	1007.0 a	3.5
Hand hoeing twice	120.4 abcd	7.17 abc	0.78 abc	175.0 bc	48.8 abc	22.6 b	12.2 abc	905.0 b	13.2
Hand hoeing thrice	128.6 a	8.67 a	0.95 a	210.0 a	53.9 ab	26.1 a	12.9 a	1043.0 a	0.0
Unweeded check	106.6 e	5.67 c	0.60 c	135.0 d	41.7 d	11.3 d	10.9 d	452.5 d	56.6
2017/2018 season									
Roundup at 1.0 L	115.3 c	6.75 abc	0.70 cd	165.0 ab	48.6 bc	21.4 d	12.4 abc	855.0 d	20.1
Stomp extra at 1.7 L	122.1 abc	7.00 ab	0.85 ab	177.5 a	51.0 ab	24.5 bc	12.5 abc	981.3 bc	8.3
Amex at 2.5 L	116.0 c	6.17 abc	0.68 cde	167.5 a	47.5 cd	19.8 e	12.5 abc	790.0 e	26.2
Sencor at 300 g	116.8 bc	6.34 abc	0.63 de	147.5 bc	44.5 de	18.7 ef	11.8 bc	745.0 ef	30.4
Gesagard at 1.0 L	114.3 cd	6.25 abc	0.63 de	142.5 c	42.8 ef	18.1 f	11.8 bc	722.5 f	32.5
Ultra afalon at 1.0 L	106.5 de	5.92 bc	0.60 de	135.0 c	40.8 fg	17.9 f	11.6 bc	715.0 f	33.2
Rice straw mulch	121.8 abc	6.83 ab	0.80 bc	180.0 a	51.3 ab	24.8 b	13.0 ab	988.8 bc	7.6
Black polyethylene mulch	126.8 a	7.33 a	0.88 ab	185.0 a	54.3 a	25.7 ab	13.1 ab	1028.0 ab	3.9
Hand hoeing twice	120.8 abc	6.92 ab	0.70 cd	175.0 a	49.5 bc	23.3 c	12.0 bc	930.0 c	13.1
Hand hoeing thrice	125.0 ab	7.50 a	0.95 a	183.8 a	53.3 a	26.8 a	13.5 a	1070.0 a	0.0
Unweeded check	104.3 e	5.50 c	0.55 e	130.0 c	38.0 g	11.9 g	11.3 c	475.8 g	55.5

Means followed by the same letters within each column do not differ significantly according to Duncan's multiple range test at the 5% level.

Generally, hand hoeing thrice, black polyethylene mulch, rice straw mulch and Stomp extra at 1.7 l/fed. treatments, were the best for the most traits in both seasons followed by Amex at 2.5 l/fed. and hand hoeing twice treatments. These results mean that coriander production is highly affected by weed existence and coriander growers should plan weed management strategies using weed control tactics for increasing production of coriander yield. These results are in agreement with obtained by Nagar et al. (2009), Meena and Mehta (2009), Yadav et al (2015), Pickett and Zheljazkov (2016) reported that the herbicides of linuron, trifluralin and pendimethalin pre-emergence application could be used for weed control in crop coriander. Nagar (2017) revealed that two hand weeding at 30 and 45 days after sowing and pendimethalin at 1.0 kg / ha + hand weeding at 45 days after sowing gave significantly higher of seed yield, over rest of the treatments and increased the seed yield by 200.57 and 198.67 percent, respectively compared to weedy check. Application of metribuzin at 0.30 kg/ ha as pre-emergence was the least effective in the control of various weeds. Ocharo et al. (2018) found that black plastic mulch was the highest effective of weed control then metribuzin herbicide came in the second rank. Gasti and Chakravorty (2019) found that pre-emergence application of pendimeathalin at 1.5 a.i kg / ha alone, supplemented with one hand weeding after 45 days after sowing or two hand weeding after 45 and 60 days after sowing gave the greatest plant height, number of branches per plant, yield per ha., net returns and B:C ratio in coriander. Savaliya et al. (2017), Gasti and Chakravorty (2019), Galal et al. (2019) and Galal et al. (2020).

c:Oil percentage and oil yield (l/fed.)

Table (7) show clearly that the effects of weed control treatments on either oil % or oil yield of coriander were statistically significant differences in both 2016/2017 and 2017/2018 winter seasons. Both oil % and oil yields as l/fed. were increased by all weed control treatments where hand hoeing thrice, black polyethylene and rice straw mulches gave the highest values of oil % of coriander followed by Stomp extra at 1.7 l/fed. and hand hoeing twice while the other treatments did not significant differ between in the first season. In the second season hand hoeing thrice, black polyethylene, rice straw mulches, Stomp extra at 1.7 l/fed. and hand hoeing twice gave the highest values and did not significant differ between while the other treatments did not statistically significant differences between. Concerning the effect on oil yield per feddan hand hoeing thrice and black polyethylene mulch gave the highest values followed by rice straw mulch, Stomp extra at 1.7 l/fed. and hand hoeing twice in both season.

The highest oil % was achieved by hand hoeing three times and increased by 21.3&19.7 percent followed by black polyethylene, rice straw mulches, Stomp extra at 1.7 l/fed. and hand hoeing twice by 14.8,13.1, 9.8 and 9.8 percent & 19.7, 18.0,18.0, 14.8 and 14.8 percent in 1st & 2nd season respectively. Concerning the effect of treatments on oil yield per feddan all weed control treatments exceeded unweeded check by more than two times these increases are attributed to role of these treatments in elimination of weed competition to coriander plants and consequently improved coriander growth and seed production accompanied with improving plant and growth and yield. These results are in agreement with Kothari *et al.* (1989) found that application of pendimethalin at 0.75 kg a. i./ha gave seed and oil yields comparable to weed-free check.

Table 7. Effect of weed control treatments on oil % and oil yield (L./fed.) of coriander yield in 2016/2017 and 2017/2018 seasons.

Treatments & Herbicidal rate / fed.	2016/2017 season		2017/2018 season	
	Oil%	Oil yield L / fed.	Oil%	Oil yield L / fed.
Roundup at 1.0 L	0.63 cd	5.06 c	0.64 c	5.47 e
Stomp extra at 1.7L	0.67 bc	6.12 b	0.70 a	6.92 c
Amex at 2.5 L	0.64 cd	4.99 c	0.65 bc	5.13 ef
Sencor at 300 g	0.64 cd	4.92 c	0.65 bc	4.83 fg
Gesagard at 1.0 L	0.63 cd	4.70 c	0.64 c	4.63 g
Ultra afalon at 1.0 L	0.62 cd	4.52 c	0.63 c	4.50 g
Rice straw mulch	0.69 ab	6.19 b	0.72 a	7.00 bc
Black polyethylene mulch	0.70 ab	7.06 a	0.72 a	7.40 ab
Hand hoeing twice	0.67 bc	6.07 b	0.70 ab	6.45 d
Hand hoeing thrice	0.74 a	7.67 a	0.73 a	7.81 a
Unweeded check	0.61 d	2.78 d	0.61 c	2.91 h

Means followed by the same letters within each column do not differ significantly according to Duncan's multiple range test at the 5% level.

d:Correlation coefficients between weed categories and coriander traits

Table (8) show that the correlation coefficients between broad leaved weeds, grassy weeds and total weeds with coriander yield, yield components during winter 2017 and 2018 seasons. Correlation coefficients between broad leaved, grassy and total weeds with plant height, number of branches/plant, stem diameter, dry weight/plant, number of umbels/plant, 1000-seed weight, seed yield/feddan, oil % and oil yield were negative and highly significant in both seasons except 1000 seed weight with grassy weeds and oil % with grassy weeds and total weeds were negative and significant in the first season, showing that coriander crop productivity severely affected by weed competition. These results are agreement with those Galal *et al.* (2019) for pea and Galal *et al.* (2020) for pepper.

Table 8. Correlation between fresh weight of broad leaved, grassy weeds and total weeds with yield and yield components in coriander during 2016/2017and 2017/2018 winter seasons.

Seasons	2016 / 2017			2017/ 2018		
Traits	Broad leaved weeds(g/m^2)	Grassy weeds (g/m^2)	Total weeds (g/m^2)	Broad leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total weeds (g/m^2)
Plant height (cm)	-0.553**	-0.513**	-0.550**	-0.649**	-0.573**	-0.647**
Number of branches/plant	-0.384**	-0.428**	-0.390**	-0.475**	-0.499**	-0.469**
Stem diameter (cm)	-0.571**	-0.517**	-0.567**	-0.555**	-0.534**	-0.555**
Dry weight / plant (g)	-0.346**	-0.318**	-0.344**	-0.593**	-0.653**	-0.602**
Number of umbels /plant	-0.582**	-0.574**	-0.583**	-0.704**	-0.678**	-0.696**
1000 - seed weight (g)	-0.363**	-0.420*	-0.371**	-0.417**	-0.384**	-0.408**
Seed yield / fed.	-0.816**	-0.799**	-0.817**	-0.816**	-0.817**	-0.816**
Oil %	-0.314**	-0.364*	-0.321*	-0.556**	-0.534**	-0.556**
Oil yield (L./fed.)	-0.726**	-0.765**	-0.767**	-0.775**	-0.769**	-0.775**

***, ** significant and highly significant correlation coefficients, respectively.**

e: Correlation coefficients among the coriander studied traits

The correlation coefficients for all comparisons among the studied traits are presented in table (9) show that coriander seed yield per feddan was positively and highly significant correlated with all studied traits in the both seasons except dry weight/plant was significant for the first season only.

Table 9. Correlation coefficients (r^2) among different pairs of characters in coriander during 2016 / 2017 and 2017/ 2018 winter seasons.

Traits	Number of branches/plant	Stem diameter (cm)	Dry weight / plant (g)	Number of umbels /plant	1000 - seed weight (g)	Seed yield / fed.	Oil %	Oil yield (L./fed.)
2016 / 2017 season								
Plant height (cm)	0.325*	0.545**	0.479**	0.526**	0.371*	0.649**	0.457**	0.767**
Number of branches/plant		0.466**	0.476**	0.342*	0.060ns	0.448**	0.350**	0.615**
Stem diameter (cm)			0.410**	0.509**	0.313*	0.685**	0.207ns	0.721**
Dry weight / plant (g)				0.197ns	0.161ns	0.332*	0.292*	0.728**
Number of umbels /plant					0.401**	0.640**	0.232*	0.815**
1000 - seed weight (g)						0.423**	0..179ns	0.500**
Seed yield / fed.							0.344**	0.967**
Oil %								0.767**
2017/ 2018 season								
Plant height (cm)	0.378**	0.653**	0.626**	0.699**	0.404**	0.731**	0.465**	0.707**
Number of branches/plant		0.656**	0.368*	0.692*	0.371*	0.593**	0.494**	0.600**
Stem diameter (cm)			0.668**	0.787**	0.579**	0.743**	0.592**	0.758**
Dry weight / plant (g)				0.749**	0.511**	0.812**	0.664**	0.804**
Number of umbels /plant					0.591**	0.858**	0.666**	0.849**
1000 - seed weight (g)						0.504**	0.362**	0.502**
Seed yield / fed.							0.712**	0.978**
Oil %								0.787**

ns, *, ** nonsignificant, significant and highly significant correlation coefficients, respectively.

Plant height was positively and highly significant correlated with all traits. Number of branches/plant was positively and highly significant correlated with all traits except 1000-seed weight was no significant different in the first season. Dry weight / plant was positively and highly significant correlated with all traits except 1000-seed weight and number of umbel per plant were no significant for the first season. Oil % was positively and highly significant correlated with all traits except 1000-seed weight and stem diameter for the first season. These results are agreement with those Chauhan *et al.* (2019), Jain and Singh (2003), Singh *et al.*(2008), Dutta (2006) and Bhandari and Gupta (1991).

f:Herbicide residues determination in coriander seed and soil

Results in (Table 10 and Fig. 1) showed that the residues of applied herbicides in seeds yield of coriander and soil at harvest. Maximum residual level (MRL) which were allowed by as set by EU 0.05 ppm for Amex 48% (butralin) at 2.5 l/fed. and 0.1 ppm for Gesagard 50% (prometryn) at 1.0 l/fed. were not detectable in seeds of coriander while other herbicides were lower than their maximum residual level (MRL) which were allowed by as set by EU 0.1 ppm for Round up 48% (glyphosate) at 1.0 l/fed. 0.014 ppm, 0.05 ppm for Stomp extra 45.5% (pendimethalin) at 1.7 l/fed. 0.0025 ppm, 0.1 ppm for Sencor 70% (metribuzin) at 300g\fed. 0.0025 ppm and 0.05 ppm for Ultra afalon 45% (linuron) at 1.0 l/fed.0.045 ppm. Ultra afalon residues in seeds of coriander was higher than these of Stomp extra, Sencor and Round up had lower residues. These herbicides can be degraded by microbial soil population, soil constituents e.g. organic matter and clay, factors soil are pH, temperature and other environmental conditions, which play as an important role in pesticide degradation.

Table 10. Residues of studied herbicides in seed coriander and soil as detected by HPLC (ppm) at harvest.

Herbicides	Mean concentration (PPM)		Acceptable daily intake (ADI) (PPM)	MRL** (PPM)
	Seed coriander	Soil		
Glyphosate	0.014	UND*	1	0.1
Pendimethahin	0.0025	0.0399	0.12	0.0 5
Butralin	UND	0.0024	UND	0.0 5
Metribuzin	0.0025	0.0195	0.013	0.1
Prometryn	UND	0.075	0.04	0.1
Linuron	0.0 45	0.148	0.003	0.0 5

***UND : non detectable. **MRL :Maximum residue level.**

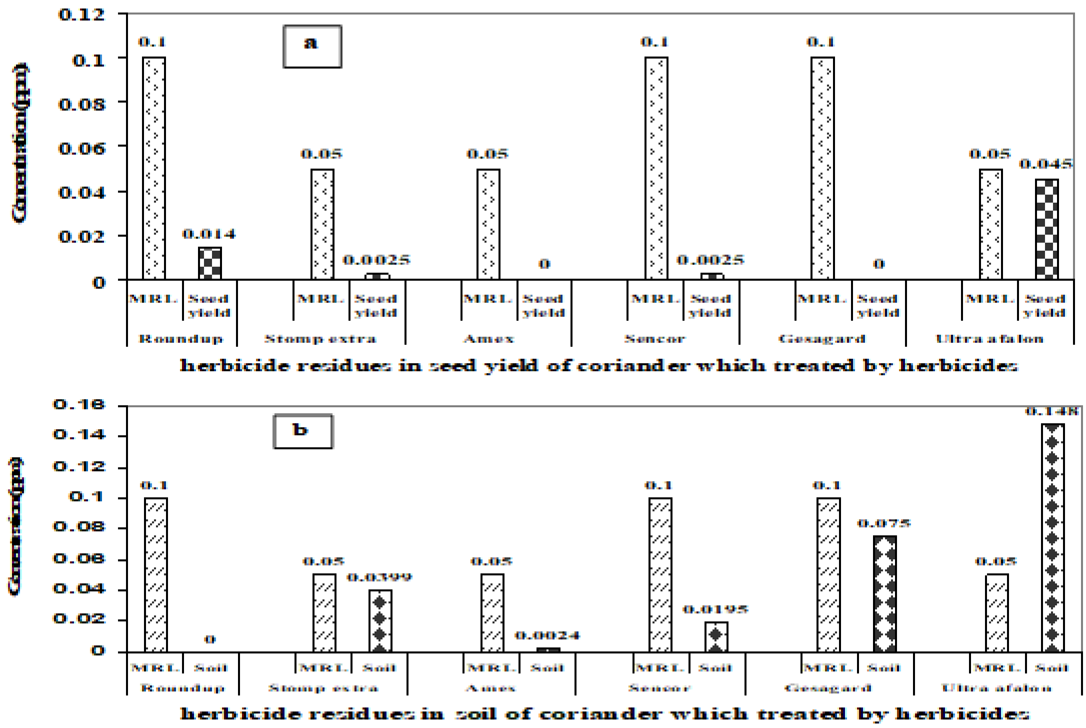

Fig. 1. Herbicide residues (ppm) (a) seed yield and (b) in soil of coriander and maximum residue level (MRL) for Roundup 1.0 l/fed., Stomp extra at 1.7l/fed., Amex at 2.5 l/fed.,Sencor at 300 g/fed., Gesagard at 1.0 l/fed. and Ultra afalon at 1.0 l/fed.

On another hand the maximum residual limit in soil at harvest, which were allowed by as set by EU 0.1 ppm for Roundup 48% (glyphosate) at 1.0 l/fed. was not detected while the other four herbicides used, were lower than their maximum allowable residual levels, which were allowed by as set by EU 0.05 ppm for Stomp extra 0.0399, 0.05 ppm for Amex 0.0024, 0.1 ppm for Sencor 0.0195 and 0.1 ppm for Prometryn 0.075 ppm, respectively. Meanwhile Ultra afalon recorded higher residual level in soil 0.148 ppm than maximum residue level 0.05 ppm. These results, may be attributed to that Ultra afalon is very low volatile, slow in bio-degradation because of its high tendency to absorb with soil particles and organic compounds. These results mean that such used herbicides can be degraded in soil to level lower than permissible level and can be used safety for weed control on coriander without any toxic effects in seeds or soil except with linuron which exceed permissible level and was banded. These results are in agreement with those obtained by Zahnow and Riggleman (1983) mentioned that half life of linuron in the field conditions is 2 to 5 month. Hassanein *et al.* (2014) found that there was no herbicide residues were detected for pendimethalin, butralin and metribuzin herbicides in tomato fruits and Galal *et al.* (2019) herbicides of Stomp extra, Amex, Gesagard and Ultra afalon, in green pea seeds which were found to be below the maximum residual level.

g:Economic feasibility study :

Table (11) showed that the economic analysis of coriander seed yield under various weed control treatments had been done. Studied economic criteria namely total variable cost as hand labor wages and herbicide prices were estimated under each treatment in addition to all fixed costs of land rents, fertilizers, irrigation, plowing land, soil leveling, planting and other costs of pest control and harvest …etc were estimated as Egyptian pounds. The gross and net incomes and benefit/costs ratio estimates are involved. Total costs tended to deincrease with various weed control treatments than unweeded ckeck especially covering treatments by plastic sheets, rice straw and hand hoeing three times, meanwhile the cost of various herbicide application were cheaper especially with the use of Roundup. Results show that weed infestation in unweeded check treatment tables (5&6) caused seed yield losses per feddan estimated by 56.6 & 55.5 % than weed free treatments (thrice hand hoeing) which caused monetary by losses about (LE11800 & LE 11885) in 2016/2017 and 2017/2018 seasons respectively, meanwhile among the best weed control treatments from economic view were hand hoeing thrice, followed by black polyethylene, rice straw mulches and Stomp extra application at 1.7 l/fed. which recorded increase in seed yield which determined by 230.2, 222.3, 202.6 and 200.9% & 224.8, 216.0, 207.8 and 206.1 % , and increases in net income LE per feddan by 7050, 5130, 4350 and 5630, & 7600, 6560, 5775 and 7075, and highest gross income by 20850, 20130, 18350 and 18180, & 21400, 20560, 19775 and 19625, and increases in benefit/costs ratio to 1.51, 1.34, 1.31 and 1.45 & 1.55, 1.47, 1.41 and 1.56 in 2016/2017 and 2017/2018 than unweeded check respectively, meanwhile the benefit / costs ratio in unweeded check were minus than one in both seasons. These results are in agreement, Kushwaha *et al.* (2002) Savaliya *et al.* (2017) Yadav *et al.* (2013), Gasti and Chakravorty (2019), Galal *et al.* (2019) and Galal *et al.* (2020).

Table 11. Economic evaluation of the effect of some mulching and herbicide treatmentsfor coriander yield (t/feddan) during 2016/2017 and 2017/2018 seasons.

No.	Treatments & Herbicidal rate / fed.	Seed yield (ton/fed.)	Relative yield of unweeded check	Total costs (L.E/fed.)	Gross income L.E/fed.)(	Net income (L.E/fed.)	Benefit / costs ratio
			2016 / 2017 season				
1	Roundup 1 L	0.803	177.3	12400	16050	3650	1.29
2	Stomp extra 1.7 L	0.909	200.9	12550	18180	5630	1.45
3	Amex 2.5 L	0.780	172.2	12800	15600	2800	1.22
4	Sencor 300 g	0.778	171.7	12300	15550	3250	1.26
5	Gesagard 1 L	0.735	162.3	12350	14700	2350	1.19
6	Ultra afalon 1 L	0.728	160.7	12550	14550	2000	1.16
7	Rice straw mulch	0.918	202.6	14000	18350	4350	1.31
8	Black polyethylene mulch	1.007	222.3	15000	20130	5130	1.34
9	Hand hoeing twice	0.905	199.8	13200	18100	4900	1.37
10	Hand hoeing thrice	1.043	230.2	13800	20850	7050	1.51
11	Unweeded check	0.453	100.0	12000	9050	-2950	0.75
			2017/ 2018 season				
1	Roundup 1 L	0.855	179.6	12400	17100	4700	1.38
2	Stomp extra 1.7 L	0.981	206.1	12550	19625	7075	1.56
3	Amex 2.5 L	0.790	166.0	12800	15800	3000	1.23
4	Sencor 300 g	0.745	156.5	12300	14900	2600	1.21
5	Gesagard 1 L	0.723	151.9	12350	14450	2100	1.17
6	Ultra afalon 1 L	0.715	150.2	12550	14300	1750	1.14
7	Rice straw mulch	0.989	207.8	14000	19775	5775	1.41
8	Black polyethylene mulch	1.028	216.0	14000	20560	6560	1.47
9	Hand hoeing twice	0.930	195.4	13200	18600	5400	1.41
10	Hand hoeing thrice	1.070	224.8	13800	21400	7600	1.55
11	Unweeded check	0.476	100.0	12000	9515	-2485	0.79

Note that the prices are approximate in the two seasons for costs and gross.

Discussion

The level of weed infestation in unweeded check of coriander fields were 9.43 & 10.30 ton fresh weight per feddan during first and second seasons, respectively which compete with coriander plants causing yield reduction in seed yield per feddan than hand hoeing three times (weed-free condition) estimated by 56.6 & 55.5 percent and monetary losses estimated by 11800 & 11885 Egyptian pounds and exceeded extremely the economic threshold accepted yield losses levels which are normally (5-10% yield loss). These results are in agreement with those obtained by Kushwaha *et al*. (2002) who mentiond that coriander production face weed problem which cause yield loss varied from 20-50% and by 82% according to Savaliya *et al.* (2017) who attributed this that coriander is a short stature crop seed takes longer time for germination and also having slow early vegetative growth where the crop is very sensitive to early weed competition. The best treatments from view point of weed control and relative seed yield per feddan increases than unweeded check in 1st, 2nd seasons were obtained from hand weeding three times, mulching with plastic sheet or rice straw mulches and Stomp extra application which were 230.2, 222.3, 202.6 and 200.9 percent and 224.8, 216.0, 207.8 and 206.1 percent increases in seed yield of coriander per feddan, in 2016/2017 and 2017/2018 winter seasons respectively and were more profitable concerning in increasing net economic return by LE 7050, 5130 ,4350 and 5630 in 1st season, 7600, 6560, 5775 and 7075 in 2nd season respectively. The mode of action of controlling weeds by plastic sheet or rice straw covering may be attributed to soil heating in upper 5 cm layer and or preventing light penetration which kill seeds of annual weeds or shedding seedling growth and prevent photosynthesis Singh *et al.*(1988) reported that soil temperature increased with the use of plastic mulch. Mulching stimulates the microbial activity in soil through improvement of soil agro-physical properties or allelopathic effects of rice straw and the mode of action of pendimethalin by stopping mitotic cell division of apical meristems in both shoot or radicle of annual herbaceous seedlings which located in the upper 5 cm of soil layer Ocharo *et al.* (2018) found that black plastic mulch was the superior treatment in controlling weeds, then metribuzin herbicide came in the second rank in controlling broadleaved weeds. pendimethalin is very good efficacy on weeds. Thus, such promising treatments can be a used for planning weed control strategies in coriander seed production without any injurious effects and can be used in organic agriculture.

CONCLUSION

Results show that coriander crop is very sensitive to weed competition in the early half of growing season so need to control weeds through this critical period of weed competition under the high infestation by weeds which presented early with beginning growing season. The results show that some safe economic alternatives to mechanical weed control by hand hoeing thrice or twice or the use black polyethylene or rice straw mulches, or the use Stomp extra at 1.7 l/fed. and Amex at 2.5 l/fed. for weed control during the coriander crop life to produce good seed yield free from herbicidal residues and can be used fairly in organic farming conditions in Egypt.

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تأثير بعض طرق مكافحة الحشائش على إنتاجية الكسبرة والحشائش المصاحبة.

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نظرا للاستخدامات المتعددة لمحصول الكسبرة كمحصول توابل أخضر أو كزيت طبي وكأحد المحاصيل التصديرية الطبية والعطرية الهامة مما يكون هناك حاجة ملحة لمكافحة الحشائش بطرق طبيعية أو ميكانيكية أو مبيدات حشائش بدون تواجد متبقيات من المبيدات في البذور أو التربة، لذا أجريت تجربتان حقليتان بمزرعة محطة بحوث البساتين بسدس التابعة لمركز البحوث الزراعية بمحافظة بني سويف بمصر خلال الموسمين الشتويين لعامي 2017/2016 ، 2018/2017 بهدف تقييم فاعلية إحدى عشر معاملة لمكافحة الحشائش علي محصول الكسبرة ومكوناته والحشائش المصاحبة له مع اقتفاء متبقيات مبيدات الحشائش في التربة وبذور الكسبرة باستخدام جهاز التحليل الكروماتوجرافى السائل عالي الأداء HPLC وذلك في تصميم قطاعات كاملة العشوائية في أربع مكررات. أوضحت النتائج أن منافسة الحشائش تؤدى إلى فقد في محصول الكسبرة من 56.6 – 55.5 % فى هذه الدراسة. معاملات العزيق ثلاث مرات والتغطية بالبلاستيك الأسود وقش الأرز ومبيد ستومب اكسترا أعطت من 91-96% في مكافحة الحشائش مع زيادة في محصول الكسبرة من 200.9- 230.5 % مقارنة بدون معاملة (الكنترول) حيث ارتبطت هذه المعاملات ارتباطا سالبا مع كمية الحشائش وموجبا مع المحصول ومكوناته. وكانت متبقيات المبيدات اقل من الحد المسموح به دوليا في بذور الكسبرة والتربة عند الحصاد ماعدا مبيد الترا أفالون بمعدل واحد لتر كان أعلى من الحد المسموح دوليا في التربة. أوضح التقييم الاقتصادي أن المعاملات السابقة أدت إلى زيادة محصول الكسبرة وكذلك أعلى عائد إقتصادى لذا توصى هذه الدراسة بإمكانية إدارة الحشائش باستخدام الطرق السابقة لمكافحة الحشائش في حقول محصول الكسبرة مما يتيح استخدام استراتيجيات نظيفة للتخلص من منافسة الحشائش لمحصول الكسبرة سواء باستخدام المبيدات أو التغطية بالبلاستيك الأسود أو قش الأرز أو العزيق في مكافحة الحشائش مما يتيح إنتاج الكسبرة كمحصول تصديري عالي الجودة وخالي من متبقيات مبيدات الحشائش.