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Effect of Corps Rotation and Sequence Weed Control Treatments on Weeds and Faba Bean Productivity

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CROP rotation is thought to reduce weed density, hence preventing the domination of some weeds problem. Variance in weed population between cropping systems may be the direct result of crop rotation. Two rotation experiments in a long - term study were carried out at Shandaweel Res. St., Sohag Governorate in Upper Egypt from 2014/15, 2015/16 and 2016/17 winter seasons. The Area used for agriculture has not changed over the three seasons. Plots were not changed in every treatment in the sense that all experimental pieces received the same treatment in the three seasons of summer and winter.

Results showed that of crop rotation system (Faba bean/maize/faba bean/maize) gave the height effect in decreased on number and weight of grassy, broad-leaved and total weeds and increased weight of pods, weight of seeds/plant, 100-seed weight and seed yield (arad/fad) compared with (Faba bean/peanut/faba bean/peanut) in seasons 2014/15,2015/16 and 2016/17, respectively. Gradually increased the weight of pods and seeds/plant, 100-seed weight and seed yield (arad/fad) from season to season using of herbicide or hand hoeing compared with control.

Significant positive correlation values were detected between the number and weight of all weeds spices in both seasons. A correlation value was negative between the number and weight of weeds and seed yield (ard/fad) and 100-seed weight but a correlation value was positive between yield and it's components.

Economic evaluation of the results indicated that using crop rotation system (Faba bean/maize/faba bean/maize) gave the highest economic values in the average of three seasons for all economic evaluation.

Keywords: Crop rotation, Weed control, Faba bean, Maize, Peanut Fusilade super Basagran, Hand hoeing.

Introduction

Crop rotation is one of the oldest methods and most effective cultural control strategies. It means the planned order of specific crops planted on the same field. Legumes are great importance in rotation, in general rain fed areas in which the fallow lands are intensive. Liebman & Dyck (1993) showed that varied crop rotations tend to diminish the development of a few primary weed species by offering distinct, sowing and harvest times, different life cycles and different possibilities for weed control.

Powerful weed management demand the integration of crop sequences with other biological, physical and chemical techniques to promote crop dominance over weeds (Al-Akkad, 1994). Karlen et al. (1994) stated that crop rotation that alternate different crop species generally interrupt weed growth cycles, thus improving crop yields. Hassanein et al (1994 ;1995; 1999 and 2000) showed that faba bean/wheat/faba bean/wheat sequences decreased weeds competition and increased yield through reducing weeds infestation and decreasing seed bank in soil. Also, Using the combined herbicides under crop rotation to increase yield and decrease weeds. A rotation is "the sequence of crops grown in succession on a particular field" (Wibberley, 1996). Rotational management strategies affected the growth of the weed population (Davies et al., 1997). Reduction in weed effects through adapted crop management (prevention) involves any aspect of management that favors the crop relative to the weed, i.e., crop rotations (Wu et al., 1999). Kropff & Walter (2000) reveled that weed management has always been a key issue

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in most agricultural production systems. Zentner et al. (2002) explained that crop rotation is one of the main practices in sustainable agricultural systems, because of its effects on soil fertility and reduction weed competition. Thorup et al. (2003) stated that less diverse crop rotations, such as arable crop rotations with high proportions of cereals for grain, may offer good opportunities for problematic weeds to propagate, since the growing conditions are very similar from one year to the next. Buhler (2004) showed that crop rotation is an effective tool for weed management by changing the pattern of distribution which diversifies selection pressure. This variegation prevents the proliferation of weed species to be well suited to the practices corresponding with a single crop (Filizadeh et al., 2007). It is noteworthy that assorted rotation systems in which legumes are involved are applied in countries with advanced agriculture. Stanger & Lauer (2008) showed that crop rotation system containing different crops, especially faba bean (legumes) is thought to be more convenient which is widely used, due to their various advantages.

Herbicides are very important of the available methods for annual weeds. Ebaid (1990) found that hand weeding lowered the number of weeds in faba bean by 54.2-61.4plants/m^2, respectively, compared to untreated control 134.0-152.0plants/m^2 and increased crop seed yields by 9.5-9.8ardab/faddan, respectively, compared to untreated control 6.8-7.0ardab/faddan. Heath et al. (1991) noted that Bentazone controlled many broadleaved weeds applied post-em. at the full dose (1.44kg/ha). Nehra & Malik (1999) showed that two hand weeding at 30 and 60 DAS gave an effective level of weed control. El-Metwally & Ahmed (2001) indicated that the best control and highest seed yield of faba bean were achieved by application of Bentazon and Fluazifop-butyl. Saad El-Din (2003) noted that the best control of broad-leaved weeds and highest seed yield of faba bean were achieved by application of Bentazon. Ismail & Fakkar (2008) reported that the best treatments for faba bean seed yield, dry weight of weeds and broomrape were achieved from hand hoeing and pulling twice and Bazagran + Fusilade herbicides. Abasalt et al. (2014) showed that dry weight of weed was obtained Bentazon followed by hand weeding once accompanied with increased broad bean yield.

The objective, of this studying determine more suitable crop rotation systems for faba bean by comparing different rotation systems in which numerous crops are involved, with respect to improvement crop yield and economic profitability.

Materials and Methods

Two field experiments were conducted at Shandaweel Agricultural Research Station, Sohag Governorate, Egypt during three successive winter seasons of 2014/15, 2015/16 and 2016/17 winter seasons and two summer seasons 2015 and 2016 to study effect of two crop rotation and three weed control treatments sequence on weeds yield and yield component of faba bean crop in 2014/15, 2015/16 and 2016/17 seasons. The experimental design was split-plot with three replicates.

Main plots: crop rotation

1-Faba bean/maize/faba bean/maize/faba bean (1st system).

2-Faba bean/peanut/faba bean/peanut/faba bean (2nd system).

Sub plots: weed control treatments of sequence

1- Harness at 1.0L/fad at pre-emergence applied on weeds of maize in summer /Bazagran 48% AS at 500cc/fad + Fusilade super 12.5% EC at 1.0L/fad at 30 days after planting applied on weeds of peanut in summer and faba bean in winter.

2- Hand hoeing twice at 18 and 30 days after planting on weeds in summer and winter crops.

3- Un-weeded in summer and winter crops.

	Treatments on different crops		
Crops	**Peanut**	**Maize**	**Faba bean**
Seasons	**2015 - 2016**	**2015 - 2016**	**2014/15 - 2015/16 - 2016/17**
1	Bazagran + Fusilade super	Harness	Bazagran + Fusilade super
2	Hand hoeing twice	Hand weeding twice	Hand hoeing twice.
3	Un-weeded	Un-weeded	Un-weeded

Area used for agriculture has not changed over the three seasons. Plots were not changed in every treatment in the sense that all experimental pieces received the same treatment in the three seasons of summer and winter.

All tested herbicides were applied by knapsack sprayer equipped with a single nozzle boom was used and spray solution volume was 200L water/ fad in all cases.

Faba bean seeds Giza-843 cultivar was sown on one side of the ridge, at 20cm apart. The experimental unit area was 10.5m^2, it contains 6 ridges with 3m length and 60cm between ridges. The experimental soil was clay loam in texture with pH value of 7.8, organic mater content of 1.6%, total N 1.2%, available P and K of 7.5, 160ppm, respectively. The other normal agricultural practices, i.e. irrigation, insects and disease control, were carried out according to the officinal recommendations. Planting seasons (planting date, harvest date, seeding rate and variety data are illustrated in Table A

Data recorded

Weed control

The dominant weed species in the present study were recorded: *Avena spp.* (Wild oats) and *Phalaris* sp. (Canary grass) as annual grassy weeds; *Emex spinosus* (Spiny emex), *Chenopodium* sp. (Lambsquarters), *Brassica* sp. (Kabar, black mustard), *Rumex dentatus* (Curly dock) and *Sonchus oleraceus* (Annual sowthistle) as annual broad-leaved weeds in 2014/15, 2015/16 and 2016/17 seasons.

Weeds were hand pulled from one square meter of each plot after month from last treatment, after 60 from sowing were identified and classified into the following group: (1) Numbers (m^2) and dry weight of grassy weeds (g/m^2). (2) Numbers (m^2) and dry weight of broad-leaved weeds (g/m^2). (3) Numbers (m^2) and dry weight of total grassy and of broad-leaved weeds (g/m^2).Weeds were air dried for 2 days and then dried in an oven at 70°C for 48h then weighted.

Yield and its components

At harvest in mid April, samples of ten plants were collected at randomly from the central rows of each plot to study the following criteria: Plant height (cm), number of branches/plant, number of pods/plant, weight of pods (g/plant), seed weight (g/plant), and 100-seed weight (g). Seed yield (ard/fad) was estimated from the whole of each plot.

TABLE A. Show that planting seasons, (planting, harvest and seeding rate) and variety of crops.

Crop rotation	Sowing seasons			Sowing date			Harvest date			Seeding rate	Variety
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd		
Faba bean	2014/15	2015/16	28/11/2017	15/11/2014	20/11/2015	28/11/2016	19/4/2015	22/4/2016	15/4/2017	40kg/fad	Giza 843
Maize	2015	2016	--	11/6/2015	14/6/2016	--	2/10/2015	4/10/2016	--	10kg/fad	H.singil-10
Peanut	2015	2016	--	11/6/2015	14/6/2016	--	19/10/2015	22/10/2016	--	40kg/fad	Giza 5

Statistical analysis

Differences among the treatment means were determined by Fisher's protected LSD at a significance level of 0.05 probability level according to Steel & Torrie (1980). The weed species community by treatment was analyzed separately for each crop rotation using an analysis similar to that above. Data over seasons of seed yield was subjected to simple correlation coefficients and simple linear regression analysis according to Sendecor & Cochran (1989) to construct the prediction model for weed species community in faba bean was performed. When F was significant (P<0.05) for the levels of symptoms, a regression analysis was performed.

Results and Discussion

Influence of crop rotation on

Number of weeds (m^2)

Data in Table 1 show that the effect of crop rotation was significant on number of weeds in 2014/15, 2015/16 and 2016/17 seasons. Crop ratation faba bean/ maize/faba bean/maize/faba bean (1st system) decreased numbers of hearbal, broad-leaved and total weeds (g/m^2) among three seasons compared with faba bean/peanut/faba bean/peanut/ faba bean (2nd system). Using of crop rotation 1st system decreased numbers of grassy by 39.72, 36.26 and 33.88% and broad-leaved weeds by 19.22, 5.00 and 31.04%, while over all weeds minimize by 27.23, 17.38, and 32.18% in the first, second and third seasons, respectively compared to 2nd system.

These results may be due to the use of the first agricultural crop rotation which was more capable to reduce the number of weeds, because the maize has the effect of an inhibitor to the growth of weeds in the next winter season. Our results are harmony by Elian & El-Mashed (1994), Hassanein et al. (2000) and Kookhki et al. (2009).

Dry weight of weeds (g/m^2)

Table 2 found that, using of 1st system dropped the dry weight of grassy, total weeds and broad-leaved college years. The crop rotation and that are shown in Table 2. Crop rotation faba bean/ maize/faba bean/ maize/faba bean (1st system) decresed significantly the dry grassy, broad-leaved and total weeds in among three seasons. Grassy, broad-leaved and total weeds decrased significantly by 33.14, 31.49 and 32.013% in 2014/15 seasons, by 32.14, 31.97 and 31.42% in 2015/16 season and by 38.83, 35.3 and 36.69% in 2016/17 season, compared with faba bean/peanut/ faba bean/peanut/ faba bean (2nd system).

Mature maize plants possess a number of (nine) water soluble allelochemicals which are phytotoxic to the growth of certain weeds such as *Phalaris minor* Retz., *Chenopodium album* L, *Rumex dentatus* L and *Convolvulus arvensis* L. Incorporation of sorghum roots suppressed the weed biomass by 25-50% and increased wheat yields by 7-8% (Cheema et al., 1997). These results agreement with Thorup et al. (2003), Buhler (2004) and Filizadeh et al. (2007).

TABLE 1. Effect of crop rotation on numbers of weeds (g/m^2) in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Numbers of grassy weeds			Numbers of broad-leaved weeds			Numbers total weeds		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
Crop rotation									
1st system	65.44	67.00	62.67	136.78	152.11	97.00	202.22	219.11	159.67
2nd system	108.56	105.11	94.78	169.33	160.11	140.67	277.89	265.22	235.44
F-test	**	**	**	**	**	**	**	**	**

TABLE 2. Impact of crop rotation on dry weight of weeds (g/m^2) in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Dry weight of grassy weeds			Dry weight of broad-leaved weeds			Dry weight of total weeds		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
Crop rotation									
1st system	101.33	98.78	95.70	166.33	163.44	161.22	267.66	262.22	256.92
2nd system	156.44	151.56	145.56	252.67	242.67	233.56	409.11	394.23	379.12
F-test	**	**	**	**	**	**	**	**	**

Yield and its components

Data in Tables 3 and 4 showed significantly increase in number and weight of pods/plant (g) and seed weight/plant (g), 100-seed weight (g) and seed yield (ard/fad) by following 1st system, except for plant height in three seasons. Number of branches/plant was affected significantly in first seasons only compared to the following 2nd system. Using of crop rotation 1st system increased significantly the seed weight, 100-seed weight (g) and seed yield (ard/fad) by 15.77, 8.26 and 8.54% in first season, by 19.63, 5.78 and 17.72% in second season and by 10.82, 7.69 and 9.18% in third season, respectively compared to (2nd system). Low seed yield of faba bean grown after peanut because the direction of faba bean plants to vegetative growth and rampage plants, unlike seed growth. This is because the peanut grown in the summer season, leaving a large amount of nutrients especially nitrogen installer addition to fertilize faba bean per recommended. Since the maize crop overwrought soil, it does not leave too little nutrients. So, the faba bean planted after maize grows naturally therefore increasing seed yield output especially in light of the excellent weed control using herbicides or hoeing. Our results are harmony by Dogan et al. (2008), Mohammaddoust et al. (2009) and Demjanová (2009).

Impact of weed control treatments sequence

Number of weeds (m^2)

Table 5 revaled that the effect of weed control treatments was significante on numbers of grassy, broad-leaved and total weeds in 2014/15, 2015/16 and 2016/17 seasons. Harness at 1.0L/fad pre-emergence on weeds of maize/Fuslide super at 1.0L/fad + Basagran at 500cc/fad at 30 days after sowing on peanut and faba bean decreased significantly numbers of grassy, broad-leaved and total weeds by 40.66, 31.88 and 37.45% in first season, by 63.95, 55.45 and 58.77% in second season and by 72.91, 36.41 and 54.21% in third seasoin, respectively. Hand hoeing twice in summer and winter seasons decreased significantly numbers of grassy, broad-leaved and total weeds by 68.13, 94.60 and 55.11% in first season, by 80.76, 66.47 and 72.06% in second season and by 72.91, 65.90 and 77.41% in third seasoin, respectively, compared with unweeded treatment.

TABLE 3. Effect of crop rotation on yield and it's components in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Plant height (cm)			No. branches/plant			Weight pods/plant (g)		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
	Crop rotation								
1st system	75.37	78.06	78.10	3.21	3.66	2.89	19.08	19.46	24.67
2nd system	86.51	91.71	88.08	2.20	3.40	2.67	16.32	16.86	19.24
F-test	**	**	**	NS	NS	NS	**	**	**

TABLE 4. Influence of crop rotation on yield and yield components in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Weight seeds/plant (g)			1000-seed weight (g)			Yield (ard/fad)		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
	Crop rotation								
1st system	13.80	14.52	15.05	72.96	73.42	75.61	5.37	5.58	6.09
2nd system	11.92	12.58	13.58	67.39	69.66	70.21	4.53	4.74	5.11
F-test	**	**	**	**	**	**	**	**	**

TABLE 5. Effection of weed control treatments on dry weight of weeds (g/m2) in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Numbers of grassy weeds			Numbers of broad-leaved weeds			Numbers total weeds		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
	Weed control treatment sequence								
Herbicide	76.17	59.83	46.50	141.00	117.17	114.67	217.17	177	161.17
Hand hoeing twice	44.67	32.00	18.00	111.17	88.17	61.50	155.84	120.17	79.5
Unweeded (check)	140.17	166.33	171.67	207.00	180.33	263.00	347.17	346.66	434.67
$LSD_{0.05}$	8.17	7.39	5.92	9.06	9.18	18.59	9.38	9.67	17.63

The number of weeds decreased gradually to the growing season of the last season using weed control treatment, while the number of weeds gradually increased in the treatment control. There was a clear effect of the treatment weed control used on summer crops. As the succession of the use of the herbicide or hoeing in the summer and the winter crop yields and had a clear decline in the number and weight of weeds. These results was in agreement with the results of Elian & El-Mashed (1994), Hassanein et al. (2000) and Kookhki et al. (2009).

Dry weight of weeds (g/m²)

Table 6 revaled that effect of weed control treatments was significant on broad-leaved, total weeds and dry weight of grassy in 2014/15, 2015/16 and 2016/17 seasons.

Harness/Fuslide super+Basagran (on weeds in summer and winter seasons) decreased significantly dry weight of grassy, broad-leaved and total weeds by 42.62, 40.81 and 41.52% in first season, by 60.45, 60.68 and 41.52% in second season and by 68.90, 63.22 and 65.50% in third seasoin, respectively. Hand hoeing twice in summer/hand hoeing twice in winter season decreased significantly dry weight of grassy, broad-leaved and total weeds by 60.07, 54.23 and 54.51% in first season, by 74.83, 72.20 and 73.22% in second season and by 78.49, 74.16 and 75.90% in third seasoin, respectively, compared with unweeded treatment. Therefore, crop rotation and hand hoeing twice weed treatment strategy is mainly significant regard in evolution of sustainable and environmentally safe strategies for weed control. Elian & El-Mashed (1994), Hassanein et al. (2000) and Kookhki et al. (2009).

Yield and its components

Data in Tables 7 and 8 stated that the effect of weed control treatments was significantly on yield and yield components in 2014/15, 2015/16 and 2016/17 seasons. Weed control treatments suqunce of Harness/Fuslide super+Basagran and hand hoeing twice in summer and winter seasons, incresed siginficantly number and weight of pods/plant, weight of seeds/plant, seed weight 100-seed weight and seed yield (ard/fad) in three seasons. Harness/Fuslide super+Basagran increased the 100-seed weight and seed yield (ard/fad) by (30.75, 38.34 and 31.91%) and (57.39, 67.16 and 62.67%) in frist, second and third seasoin, respectively. Hand hoeing twice in summer/hand hoeing twice in winter increased the 100-seed weight and seed yield (ard/fad) by (39.88 and 73.04%) in frist season, by (49.27 and 92.54%), in second season and by 40.71and 121.10% in third seasoin, respectively, compared with unweeded treatment. These results was in same trend with the results of Elian & El –Mashed (1994).

TABLE 6. Crop rotation and weed control treatments affected on dry weight of weeds (g/m²) in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Dry weight of grassy weeds			Dry weight of broad-leaved weeds			Dry weight of total weeds		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
	Weed control treatments								
Herbicide	110.17	88.00	76.88	177.17	141.17	139.33	287.34	229.17	216.21
Hand hoeing twice	76.67	56.00	53.17	137.00	98.50	99.17	213.67	154.5	152.34
Unweeded (check)	192.00	222.50	247.17	299.33	354.33	383.83	491.33	576.83	631
$LSD_{0.05}$	16.80	16.72	19.11	10.94	19.91	10.08	10.75	10.11	12.29

TABLE 7. Crop rotation and weed control treatments sequence affected on yield and yield components in 2014/15, 2015/16 and 2016/17 seasons.

Treatments	Plant height (cm)			No. branches/plant			Weight pods/plant (g)		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
	Weed control treatment sequence								
Herbicide	82.73	85.27	86.67	3.58	3.75	3.00	19.90	19.73	21.03
Hand hoeing twice	85.05	87.60	90.50	3.77	3.67	3.00	20.47	21.60	27.76
Unweeded (check)	72.03	66.78	66.10	2.28	3.17	2.33	13.73	13.14	17.08
$LSD_{0.05}$	7.38	5.91	5.52	0.91	NS	3.54	9.37	3.95	6.13

TABLE 8. Effectiveness of crop rotation and weed control treatments sequence on yield and yield components in 2014/15, 2015/16 and 2016/17 seasons

Treatments	Weight seeds/plant			1000-seed weight (g)			Yield (ard/fad)		
	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
	Weed control treatment sequence								
Herbicide	14.02	14.83	16.05	74.27	76.60	77.43	5.43	5.60	6.30
Hand hoeing twice	15.37	16.88	18.27	79.45	82.65	82.60	5.97	6.45	7.23
Unweeded (check)	9.48	9.20	8.93	58.70	55.37	56.80	3.45	3.35	3.27
$LSD_{0.05}$	1.51	3.59	3.52	6.57	5.22	4.91	3.86	3.46	3.36

Impact of interactions

Crop rotation and weed control treatments affected significantly on the all studied weed population traits. Faba bean/maize/faba bean/ maize/faba bean (1st system) decreased all weed population number and weight traits. Whereas, crop rotation decrease total weed number and weed dry biomass was received in hand hoeing twice weed control treatment.

Number and dry weight of weeds (m²)

Results obtained in Tables 9 and 10 indicated that interaction between crop rotation and weed control treatments significantly affected number and dry weight of grassy as will as broad-leaved and total weeds. It noticed significantly less total weed number and dry weight of weeds was received in hand hoeing twice weed control treatment under 1st system (Faba bean/ maize/faba bean/ maize/faba bean) for grassy weeds number in 3rd season, broad-leaved weeds number in 2nd season, total weeds number in 2nd season and grassy, broad-leaved and total weeds dry weight in the 2nd season and 3rd season. These results was in harmony with the Elian & El-Mashed (1994), Hassanein et al. (2000) and Kookhki et al. (2009).

Yield and its components

Tables 11 and 12 shown the interaction between crop rotations and weed control treatments, there were significant differences for weight of seeds/plant and seed yield (ard/fad) in the 3rd season. The highest values in these traits was recorded in hand hoeing twice weed control treatment under 1st system (Faba bean/ maize/faba bean/ maize/faba bean).

Therefore, results showed the significant effect among the crop rotations and weed treatments for some yield traits. Crop rotations improve crop growth and yield traits. 1st system (Faba bean/ maize/faba bean/maize/faba bean) had the highest faba bean seed yield. Hand hoeing twice weed control treatment recorded the highest values seed yield. These results was in agreement with Elian & El-Mashed, (1994), Hassanein et al. (2000) and Kookhki et al. (2009).

TABLE 9. Interactions between crop rotation and weed control treatments sequence on dry weight of weeds (g/m²) in 2014/15,2015/16 and 2016/17 seasons.

Crop rotation	Weed control treatments	Numbers of grassy weeds			Numbers of broad-leaved weeds			Numbers of total weeds		
		2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
1st system	Herbicide	48.00	36.67	23.67	127.00	108.33	99.00	175.00	145.00	122.67
	Hand hoeing twice	26.33	20.00	12.33	88.33	68.00	50.67	114.67	88.00	63.00
	Unweeded (check)	122.00	144.33	152.00	195.00	280.00	141.33	317.00	424.33	293.33
2nd system	Herbicide	104.33	83.00	69.33	155.00	126.00	130.33	259.33	209	199.66
	Hand hoeing twice	63.00	44.00	23.67	134.00	108.33	72.33	197.00	152.33	96.00
	Unweeded (check)	158.33	188.33	191.33	19.33	220.00	246.00	177.66	408.33	437.33
L. S. D. at 0.05		10.20	9.10	7.02	9.06	11.63	24.94	11.91	12.33	23.58

TABLE 10. Effect of interactions between crop rotation and weed control treatments sequence on dry weight of weeds (g/m^2) in 2014/15, 2015/16 and 2016/17 seasons.

Crop rotation	Weed control treatment sequence	Dry weight of grassy weeds			Dry weight of broad-leaved weeds			Dry weight of total weeds		
		2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
1st system	Herbicide	86.33	69.67	58.10	124.67	102.33	85.00	211.00	172.00	143.10
	Hand hoeing twice	50.00	38.33	32.67	110.33	84.67	75.33	160.33	123.00	108.10
	Unweeded (check)	167.67	188.33	196.33	264.00	296.67	330.00	431.67	485.00	526.33
2nd system	Herbicide	134.00	106.33	95.33	229.67	176.33	197.33	363.67	282.67	293.67
	Hand hoeing twice	103.33	73.67	73.67	163.67	112.33	123.00	267.00	187.00	196.67
	Unweeded (check)	216.33	256.67	300.00	334.67	412.00	437.67	551.00	667.67	737.67
L. S. D. at $_{0.05}$		18.27	18.16	11.54	14.12	12.67	12.91	13.85	12.95	16.03

Table 11. Interactions between crop rotation and weed control treatments sequence on yield and it's components in 2014/15, 2015/16 and 2016/17 seasons.

Crop rotation	Weed control treatment sequence	Plant height (cm)			No. branches			Weight pods/plant (g)		
		2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
1st system	Herbicide	79.70	81.60	83.63	3.30	3.90	3.92	20.37	20.77	21.90
	Hand hoeing twice	82.13	85.77	82.97	3.90	3.60	3.77	22.17	23.73	34.70
	Unweeded (check)	64.27	63.80	61.70	2.43	3.47	2.33	14.70	13.87	17.43
2nd system	Herbicide	87.77	88.93	89.70	3.87	3.60	3.00	17.43	18.70	20.17
	Hand hoeing twice	88.97	89.43	93.03	3.63	3.73	2.67	18.77	19.47	20.82
	Unweeded (check)	79.80	66.77	69.50	2.13	2.87	2.33	12.77	12.40	16.73
L. S. D. at $_{0.05}$		4.35	3.28	6.46	NS	NS	3.66	13.24	4.23	7.32

TABLE 12. Impact of interactions between crop rotation and weed control treatments sequence on yield and it's components in 2014/15, 2015/16 and 2016/17 seasons.

Crop rotation	Weed control treatment sequence	Weight seeds/plant (g)			100-seed weight (g)			Yield (ard/fad)		
		2014/15	2015/16	2016/17	2014/15	2015/16	2016/17	2014/15	2015/16	2016/17
1st system	Herbicide	15.43	16.20	17.63	77.27	78.93	80.07	5.97	6.27	7.07
	Hand hoeing twice	16.43	18.20	19.27	82.90	84.70	86.30	6.40	6.77	7.60
	Unweeded (check)	9.53	9.17	9.70	58.70	56.63	60.47	3.73	3.70	3.60
2nd system	Herbicide	12.60	13.47	14.47	71.27	74.27	74.80	4.90	5.10	5.53
	Hand hoeing twice	14.30	15.77	17.27	76.00	78.90	80.60	5.53	6.13	6.87
	Unweeded (check)	9.27	8.87	8.70	54.90	54.10	56.93	3.17	3.00	2.93
L. S. D. at $_{0.05}$		2.14	3.72	6.63	9.29	6.03	5.59	2.22	3.55	3.41

Correlation analysis

The simple correlation coefficient for all comparisons among the studied traits is presented in Table 13. Significant positive correlation values were detected between seed yield (ard/fad) and each of plant height (cm) (r=0.81**), number of branches/plant (r=0.43**), pods weight (g/plant) (r=0.41**), 100-seed weight (g) (r=0.910**) and seeds weight (g/plant) (r=0.93**). These findings indicate that selection for each or both of seed yield components would be accompanied by high yielding potentiality under such conditions.

Negative and significant correlations were observed between seed yield (ard/fad) and each of dry weight of grassy weeds (g/m^2) (r= - 0.92**), dry weight of broad-leaved weeds (g/m^2) (r= - 0.92**), dry weight of total grassy and broad-leaved weeds (g/m^2) (r= - 0.93**), numbers of grassy weeds (m^2) (r= - 0.94**), numbers of broad-leaved weeds (m^2) (r= - 0.84**), numbers of total grassy and broad-leaved weeds (m^2), (r = - 0.92**). The same trend

of negative significant correlation between seed yield and weed control treatments traits was recorded in Table 5.

These findings indicate that selection for each or both of seed yield components would be accompanied by high yielding potentiality under such conditions. The same trend of negative significant correlation is recorded between seed yield and weed control treatments traits.

Economic analysis

Table 14 clears the net return of the three treatments in the first rotation of faba bean and maize which shows that the average price of the crop is estimated at 766 pounds/ardeb while the average price of hay heml about 131 pounds, and the rent cost of feddan is estimated at 1873 pounds. In the light of the results obtained, the average yield, when conducting the first, second and third treatments is estimated at 6.43, 6.92 and 3.68ardeb/faddan, respectively, while the variable costs of production is estimated at 2702, 0.3221 and 0.2819pounds/faddan for the three treatments, respectively. By estimating revenue of the yield (major and minor), it reaches about 5848, 6224 and 3707 pounds when conducting the first, second and third treatments, respectively. Deducting the total costs (variable + fixed) from the total yield revenue to estimate the net return/faddan for the three treatments. It reaches about 1273pounds for the first treatment and 1130pounds for the second treatment but the third treatment has achieved loss amounted to 985pounds/faddan. Therefore, the first treatment (Fuslide super+Basagran) is the best treatment for the first rotation and it is recommended to apply.

Table 15 shows the net return of the three treatments in the second rotation of faba bean and peanuts which indicates that the average price of the crop is estimated at 766pounds/ardeb while the average price of a heml of hay is 131pounds and the rent cost of the feddan is 1873pounds. In the light of the obtained results, the average yield is estimated at 5.18, 6.18 and 3.03ardeb/faddan when conducting the first, second and third treatments, respectively. The production variable costs is estimated at 2702, 0.3221 and 0.2819pounds/faddan for the three treatments, respectively. By estimating yield revenue (major and minor), it reaches about 4874, 5655 and 3212 pounds when carrying out the first, second and third treatments, respectively. The results cleared that the net return per feddan after deducting the total costs (variable + fixed) from the total yield revenue, for the three treatments, reaches 299 pounds/faddan for the first treatment, 56 pounds/faddan for the second treatment while the third treatment did not give any profits which made a loss of about 1479pounds/faddan. Therefore, the second treatment (Hand hoeing twice) is the best treatment for the second rotation and applying it is recommended.

The study recommends cultivating faba bean crop with maize using Fuslide super+Basagran which gives the highest return for the crop achieving a profit for the farmer while cultivating faba bean crop with peanuts with hand hoeing twice gives a net return higher for the crop.

TABLE 13. Simple correlation between weed control treatments and some yield attributes.

Trait	Plant height cm	No. of branches/ plant	Pods weight/ plant g	100-seed weight g	grassy weeds g/m²	broad-leaved weeds g/m²	Total weeds g/m²	No. of grassy weeds	No. of broad-leaved weeds	No. of total weeds	Seeds weight g
No. of branches	0.43**										
Pod weight/plant	0.26	0.04									
100-weight	0.86**	0.42**	0.34*								
Grassy weeds	-0.86**	-0.39**	-0.32*	-0.91**							
Broad-leaved	-0.87**	-0.38**	-0.32*	-0.91**	0.97**						
Total weeds	-0.87**	-0.38**	-0.32*	-0.92**	0.99**	0.99**					
No. grassy weeds	-0.87**	-0.40**	-0.39**	-0.92**	0.97**	0.97**	0.97**				
No. broad-leaved	-0.76**	-0.35**	-0.41**	-0.87**	0.82**	0.83**	0.84**	0.84**			
No. total weeds	-0.84**	-0.39**	-0.41**	-0.93**	0.93**	0.93**	0.94**	0.96**	0.96**		
Seed weight/p	0.86**	0.41**	0.42**	0.92**	-0.89**	-0.91**	-0.91**	-0.93**	-0.87**	-0.93**	
Yield (Ard.fad)	0.81**	0.43**	0.41**	0.91**	-0.92**	-0.92**	-0.93**	-0.94**	-0.84**	-0.92**	0.93**

TABLE 14. Net return of treatments of 1st system

Treatments	Yield/fad.		Average farm gate price		Main crop value	Straw crop value	Total revenue	T. variable cost	Rent	Total cost	Net return
	Main (ardeb)	Secondary Heap of Hay	Main (L.E.)	Secondary (L.E.)	L. E.	L. E.	L. E.	L. E.	L. E.	L. E.	L. E.
Herbicide	6.43	6.85	766	131	4953	894	5848	2702	1873	4575	1273
H.h twice	6.92	6.85	766	131	5329	894	6224	3221	1873	5094	1130
Unweeded	3.68	6.85	766	131	2813	894	3707	2819	1873	4692	-985

TABLE 15. Net return of treatments of 2nd system

Treatments	Yield/fad		Average farm gate price		Main crop value	Straw crop value	Total revenue	T. variable cost	Rent	Total cost	Net return
	Main ardab	Secondary heap of hay	Main (L.E.)	Secondary (L.E.)	L. E.	L. E.	L. E.	L. E.	L. E.	L. E.	L. E.
Herbicide	5.18	6.85	766	131	3980	894	4874	2702	1873	4575	299
H.H twice	6.18	6.85	766	131	4760	894	5655	3221	1873	5094	561
Unweeded	3.03	6.85	766	131	2318	894	3212	2819	1873	4692	-1479

Conclusion

Crop rotation and hand hoeing twice weed treatment play strategic role in fact significant considerations in expansion of sustainable and environmentally safe strategies for weed control and faba bean seed yield. These findings indicate that selection for each or both of seed yield components would be accompanied by high yielding potentiality under such conditions. The same trend of negative significant correlation is recorded between seed yield and weed control treatments traits.

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تأثيرالدورة الزراعية وتعاقب معاملات مكافحة الحشائش علي الحشائش وإنتاجية محصول الفول البلدي

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يعتقد أن تناوب المحاصيل تقلل من كثافة الحشائش، وبالتالي منع تفاقم بعض المشاكل الناتجة من هذه الحشائش. ويعد تغير كثافة الحشائش بين النظم الزراعية نتيجة مباشرة لتناوب المحاصيل. لذلك أجريت هذه التجربة بمحطة البحوث الزراعية بشندويل - محافظة سوهاج في المواسم الشتوي2015/2014 و 2016/2015 و 2017/2016م . أتبع في هذه الدراسة نظام القطع منشقة مرة واحدة في ثلاث مكررات حيث وضعت معاملات الدورة الزراعية في القطع الرئيسية ومعاملات مكافحة الحشائش في القطع الشقية. احتفظنا بمساحة التجربة كما هي لمدة ثلاث مواسم صيفية وشتوية وتم اجراء نفس المعاملة في كل قطعة تجريبية نفس المعاملة في الموسم الصيفي والشتوي لمعرفة قدرة المكافحة الكيماوية والميكانيكية على الحفاظ على كفائتها لمدة ثلاث سنوات متتالية. وكانت أهم النتائج المتحصل عليها كما يلي:

أثرت الدورة الزراعية معنويا على عدد ووزن الحشائش العريضة والضيقة والكلية في المواسم الثلاثة وتدرج النقص في عدد ووزن الحشائش بتوالي سنوات الدورة. كان لاستخدام الدورة بنظام (فول بلدي+ذرة شامية+فول بلدي+ذرة شامية + فول بلدي) أعلى تاثير في تقيل عدد ووزن الحشائش مقارنة بنظام الدورة (فول بلدي+فول سوداني+فول بلدي+فول سوداني+ فول بلدي). كما ادت إلى زيادة وزن القرون والبذور/نبات (جم) ووزن الـ100بذرة ومحصول البذور(اردب/ف) من موسم لاخر مقارنة باستخدام نظام الدورة الزراعية فول بلدي+فول سوداني+فول بلدي+فول سوداني+ فول بلدي) في مواسم الشتوي2015/2014 و 2016/2015 و 2017/2016 على التوالى.

أتضح أن تعاقب معاملات مكافحة الحشائش كان لة مردود قوي في تقليل عدد ووزن الحشائش العريضة والضيقة والكلية في المواسم الثلاثة. حيث قل عدد ووزن الحشائش باستخدام معاملة المبيد والعزيق بينما زاد عدد ووزن الحشائش في معاملة الكنترول تدريجيا من موسم لاخر. زاد تدريجيا وزن القرون والبذور/نبات(جم) ووزن الـ100بذرة ومحصول البذور(اردب/ف) من موسم لاخر باستخدام المبيد و معاملة العزيق مقارنة بمعاملة الكنترول في مواسم الشتوي2015/2014 و 2016/2015 و 2017/2016 على التوالى.

كان التفاعل معنويا بين نظم الدورة الزراعية وتعاقب معاملات مكافحة الحشائش وتم الحصول على أعلى نسبة لمكافحة للحشائش واكبر وزن من الـ100 بذرة ومحصول البذور/فدان باستخدام معاملة المبيد أو العزيق مرتين والدورة الزراعية بنظام (فول بلدي+ذرة شامية+فول بلدي+ذرة شامية + فول بلدي).

كان هناك ارتباطا معنويا موجبا بين عدد الحشائش الضيقة وعريضة الأوراق والكلية (م^2) ووزنها (جم/م^2) في متوسط الثلاث مواسم .أرتبط محصول البذور ووزن الـ100 بذرة ومحصول البذور(أردب/فدان) ارتباطاً سالباً بعدد ووزن الحشائش الضيقة والعريضة والكلية وارتباطاً موجباً بين معظم مكونات المحصول في متوسط الثلاث مواسم.

أشار التقييم الاقتصادي إلى أن نظام الدورة الزراعية (فول بلدي+ذرة شامية+فول بلدي+ذرة شامية + فول بلدي) أعطى أعلى عائد اقتصادي مقارنه بالطريقه الأخرى في متوسط الثلاث مواسم. وقد أعطت معاملة المبيد ومعاملة العزيق مرتين إلى الحصول على أعلى زيادة معنوية في الدخل الإجمالي والعائد الصافي وهامش الربح والفائدة/معدل التكلفة والأربحية الأقتصادية في متوسط الثلاث مواسم.

الخلاصة أن تناوب المحاصيل يعتبر مفيداً في إنتاج الفول للحد من ضرر الحشائش. ولذلك، تعتبر استراتيجية تناوب المحاصيل هامة في تطوير استراتيجيات مستدامة وآمنة بيئيا لمكافحة الحشائش الضارة.