

Effect of Water Stress and Weed Control on Weeds, Broomrape and Yield in Some Faba Bean Varieties

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ABSTRACT

Broomrape and weeds are determining factors for faba bean cultivation in Egypt. In split split plot design for this reason two field experiments in clouded fifty treatments were conducted in naturally infested fields with weeds and broomrape (*Orobancha crenata* Forsk.) at Shandaweel Research Station, Sohag governorate during 2012/13 and 2013/14 winter seasons to study the effect of two water stress treatments (The irrigations regimes was 60% and 100% FC), five faba bean varieties namely (Giza843, Misr3, Nubaria1, Nubaria3 and Sakha4) and five weed control treatments Select-super at 500 cc/fed+ Basagran at 500 cc/fed+ Roundup twice at 75 cc/fed, Topik at 140 g/fed + Basagran at 500 cc/fed + Roundup twice at 75 cc/fed, Hand hoeing twice at 18, 30 DAS+ Hand pulling twice, Hand hoeing twice + Roundup twice at 75 cc/fed and untreated check on weeds, broomrape, faba bean seed yield and its components and water use efficiency. Results revealed that irrigation depletion at 60% FC decreased the dry weight of total weeds by 35.85 and 28.22% in first and second seasons as respectively compared with irrigation depletion at 100% FC. Irrigation at 100% FC decreased both number and dry weight of broomrape spikes/m² by 31.90 and 30.44% in 2012/13 season and by 23.13 and 24.35% in 2013/14 season, respectively, delayed broomrape emergence above soil surface and increase faba bean seed yield /fed and its components compared with depletion at 60% FC in both seasons. Water consumptive use (CU) values were (992.5 and 737.1 m³/fed.) for 100 and 60% FC treatment, respectively, in both seasons. The highest value of water use efficiency (WUE) recorded 1046.6 and 758.0 kg/m³ by using of irrigation at 60% FC in both seasons. The highest CU (882.5 and 935.6 m³/fed.) and WUE (1.008 and 0.980 kg/m³) were recorded 1.008 and by sown Sakka4 cultivar in both seasons, respectively. Excelled varieties of Nubaria1, Nubaria3 and Giza843 than other varieties and increase yield and its components by reducing the grassy and broad-leaved and total weeds in the both seasons. This due to the increased height of the plants, as well as increase the number of branches/plant compared other varieties. Varieties of Giza843 and Misr3 were brief and partially resistant to infection and Sakha4 was tolerant injured broomrape contrast while, Nubaria1 and 3, which were highly susceptible in both seasons. Weed control treatments decreased significantly the dry weight of grassy, broad-leaved and total weeds, numbers and weight of broomrape spikes and delayed broomrape emergence above soil surface of broomrape and gave the highest values of yield and yield components in both seasons. The best treatments were (Select-super +Basagran+ Roundup twice) and hand hoeing twice at 18, 30 DAS+ Hand pulling twice in both seasons. The interactions between irrigation regimes X varieties, irrigation regimes X weed control treatments, varieties X weed control treatments and irrigation regimes X varieties X weed control treatments decreased significantly the dry weight of weeds, number and dry weight of broomrape spikes in both seasons than unweeded check. So, the best seed yield was obtained from the interaction between growing faba bean variety (Giza843 and Misr3) combined with hand hoeing twice+ Roundup twice) or (Select-super +Basagran+ Roundup twice) under irrigation at 100% FC in both seasons. From this study it can be recommended for the cultivation of Giza 843 and Misr3 because it relatively resistant to infection broomrape or agriculture product was Sakha4 because it broomrape tolerant of injury. Irrigation can also be at 60% FC to minimize water consumption and getting to making seed yield of faba bean relatively reasonable. You can also use herbicide (Select-super at 500 cc/fed + Basagran at 500 cc/fed + Roundup twice at 75 cc/fed) to get the highest percentage control of weeds and broomrape and the highest seed yield of faba bean.

Keywords: Hand hoeing, Hand pulling, Select-super., Basagran, Roundup, broomrape and faba bean.

INTRODUCTION

Broomrape and other weed species are determining factors for the cultivation of faba bean in Upper Egypt. These pests cause significant losses in the yield of faba bean up to 80% and in some cases and make farmers stop to grow faba bean. Until now limited success has been obtained by using chemical control, plant breeding and agronomical practices to control broomrape (Moreno 1999), but none of them provides total control of the parasite. Because using a single method does not give complete control, a strategy can be followed by using a combination of different techniques is necessary.

A biotic stress as drought which has become as a major limiting factor on plant growth and yield. Abdel-Hameed (1996) reported that reduced irrigation decreased numbers of *Orobancha crenata* attacking the crop, but resulted in more significant damaging effect. Nassar and Mekky (2002) that irrigation after two weeks interval followed by four weeks intervals caused decreasing on number and dry weight of broomrape by 57.9 & 35.7% and 28.1 & 14.2% in 2000/01 season and

24.2 & 11.5% and 17.9 & 5.9% percent in 2001/02 season, respectively, as compared with six weeks intervals. Khan *et al.* (2010) showed that faba bean is reported to be more sensitive to water deficit than some other grain legumes. Ouda *et al.* (2010) noted that sensitivity is a result of its maximum depth of rooting being relatively shallow, approximately 0.9 m and its disability to adjust osmotic ally to water stress. The early podding stage of development was the most sensitive to water stress, causing a reduction in faba bean yield by 50%. Emam *et al.* (2010) found that drought stress reduces dry matter production, yield and yield components through decreasing leaf area and accelerating leaf senescence. Ibrahim and Al-Bassyuni (2012) showed that increasing period between irrigations from 10 to 20 days caused irrigation intervals significantly decreased plant height at harvest, number of branches/plant, number of pods/plant, yield of pods/plant, yield of seeds/plant and yield of seeds/fad and straw yield. Girma and Haile (2014) showed that supplemental irrigation significantly improved yield components. Irrigation at anthesis whereas irrigation did not affect photosynthetic rate, water use efficiency and

chlorophyll fluorescence ratio. Hegab *et al.* (2014) indicated that the 100 % irrigation treatments gave the highest seed yield. Irrigation level at 60% gave the highest water use efficiency (WUE). Increasing irrigation water above 60% lead to decrease in values of water use efficiency.

Faba bean varieties vary in their response to broomrape infestation. Nassib (1982) In Egypt, reported that percentage of *Orobanche* infested faba bean plants and the number as well as the total dry weight of *Orobanche* spikes/plant were lower in variety namely Giza 402 than those of other varieties (Rebaya40, Giza2 and Giza4). Khalil (1983) in Egypt, found that Giza402 plants were tolerant to *Orobanche* infestation and produce more than one metric ton of seed/ha. Gadalla *et al.* (2010) proved that Giza3 was the susceptible cultivar and Giza843 was tolerant, which had the lowest *Orobanche* tubercles/plant. Amer *et al.* (2012) found that differences for the varieties effect significant on growth, plant height, number branches plant⁻¹, pod length and number of seed pod⁻¹, respectively. Ismail (2013) revealed that faba bean variety (Misr1) decreased number and dry weight of *Orobanche* spikes by 17.3, 17.0 and 13.1%, respectively, as compared with variety (Giza40). Ibrahim *et al.* (2014) showed that cultivars decreased dry weight of weeds and increased seed yield. Cultivar of Barakat controlled of weeds than cultivar Mahalli.

In terms of broomrape control methods, Kharrat and Halila (1996) indicated that hand weeding of broomrape is one of the most used techniques by farmers to control *Orobanche*; this method is inefficient especially in highly infested faba bean fields. Indeed, continuous hand pulling of broomrape had slightly increased faba bean yield. Hassanein and Kholosy (1997) stated that the use of glyphosate at the rate of 178.7 cc/ha which applied twice controlled more than 96% of broomrape and increased faba bean seeds and straw yields by 103 and 68%, respectively. Al-Marsafy *et al.* (1998) found that weed infestation was estimated by 19.7 t/ha of annual weeds and 0.95 t/ha of *Orobanche*. Hassanein *et al.* (1998-a) indicated that one *Orobanche* spike/plant can decrease faba bean seed yield by 15 % and four spikes/plants can decrease seed yield by 55 %. Al-Marsafy *et al.* (2001) revealed that faba bean seed yield increased by 416, 372 and 312% obtained by the application of glyphosate twice and/or *Orobanche* hand pulling twice 30 and 110 days after sowing as compared to the untreated check. 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 and 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 + Oroban herbicides. EL-Metwally *et al.* (2013) found that application of glyphosate two or three times at rate of 75 cm³/fed gave 99.1 and 97.8% reduction of broomrape and increased seed yield by 149.5 and 141.5% as compared with the untreated plots in both of the seasons under investigation successively. Ismail (2013) stated that seed yield/fed increased by

application glyphosate by (111.1% and 140.0%), respectively, in both seasons and decreased number and dry weight of *Orobanche* compared to untreated. Abasalt *et al.* (2014) showed that lowest both density and dry weight of weed were obtained Bentazon followed by hand weeding once accompanied with increased broad bean yield.

The aim of this work was to estimate effect of water stress, varieties and weed control treatments on weeds, broomrape growth, faba bean yield and their interaction.

MATERIALS AND METHODS

Two field experiments were conducted at Shandaweel Agricultural Research Station Sohag Governorate during 2012/13 and 2013/14 winter seasons to study the effect of fifty treatments which were the combinations of two water stress, five faba bean varieties and five weed control treatments on weeds ,broomrape and faba bean productivity. The experiments were conducted in naturally infested fields with broomrape. Experimental design was split split-plot experiment with three replications. Each sub sub plot area was 10.5 m² which contains five ridges 3.5 m length and 0.6 m apart as follow:

A- Main plots (water stress): Two irrigations regimes 1-100% field capacity (FC): (6 irrigations). 2-60% field capacity (FC): (4 irrigations).

Applying irrigation water as m³/fed was 100% which of field capacity (FC) calculated from 60% of 1524 and 914 m³/fed in the first season and 1660 and 996 m³/fed in the second season respectively. Regime of irrigation systems had been started after first post planting irrigation (Mohaya).

B-Sub plots: Faba bean varieties: Five faba bean varieties were: 1-Giza843, 2- Misr3, 3-Nubaria1, 4- Nubaria3 and 5- Sakha4.

C- Sub-sub plots (weed control treatments): Five weed control treatments which were:

- 1- Topik 15 % WP (clodinafop-propargyl) applied at the rate of 140 g/fed +Basagran 48% AS (bentazon) applied at the rate of 500 cc/fed after 30 days after sowing +Roundup twice 48% WSC (glyphosate) applied at the rate of 75 cc/fed at the beginning of the flowering stage and at 21 days interval between applications
- 2- Select-super 12.5% EC (clethodim) applied at the rate of 500 cc/fed+ Basagran applied at the rate of 500 cc/fed after 30 days after sowing+ Roundup twice applied at the rate of 75 cc/fed at beginning of the flowering stage and at 21 days interval between applications.
- 3- Hand hoeing twice at 18, 30 days after sowing followed by hand pulling at the beginning broomrape emergence above soil surface.
- 4- Hand hoeing twice at 18 and 30 days after sowing +Roundup twice at the rate of 75 cc/fed at the beginning of the flowering stage and at 21 days interval between applications.
- 5- Unweeded check (control).

The herbicidal treatments were sprayed with a knapsack sprayer equipped with one nozzle boom with 200 liters of water/fed. Nitrogen fertilization and other cultural practices except weed control and varieties were carried out as recommended. Faba bean were planted in 20th and 24th November in both seasons with a rate of 35 kg seeds/fed in the first and second seasons, respectively. The preceding summer crop was maize in both seasons. Two field experiments were conducted in the same site. Physical properties of the experimental soil are presented in Table A.

Data recorded

1- Weeds

Weeds were hand pulled from one square meter of each plot after month from last treatment, after 60 days from sowing and identified and classified into the following group: dry weight of grassy, broad-leaved and

total weeds (g/m²). Weeds were air dried for 2 days and then dried in an oven at 70° C for 48 h then weighed.

Table A: Physical properties of soil at the experimental site.

Soil depth (cm)	Soil characteristics				Soil texture
	Coarse sand %	Fine sand %	Silt %	Clay %	
0 – 15	7.8	16.2	38.2	37.8	Clay loam
15 – 30	6.9	15.5	39.5	38.1	Clay loam
30 – 45	10.0	35.5	45.2	9.3	Clay
45 – 60	15.5	33.9	42.1	8.5	Clay

2- Broomrape

Before faba bean harvest immediately directly were number of broomrape spike/m² was counted and dry weight of broomrape/m² and number of days for broomrape emergence above soil surface were recorded season (Table B).

Table B: The suggested scale of Orobanche infestation in host plants to Orobanche (adopted from Hassanein et al., 1998-b).

Host susceptibility to Orobanche infection	Orobanche Incidence (%)	Score	Yield losses %
		Orobanche severity no of spikes/host plant	
Highly susceptible (HS)	100	10	100
Moderately susceptible (MS)	60 - 90	7- 9	60- 90
Moderately tolerant (MT)	40 - 60	4-7	40- 60
Tolerant (T)	0 - 30	1- 3	10- 30
Resistant (R)	>10	1> 2	No effect
Immune (I)	0	0	No effect

3- Faba bean yield and its components

At harvest, samples of ten plants were collected at random from the central ridges of each plot to study the following criteria: plant height (cm), number of branches/plant, number of pods/plant, weight of pods/plant (g), weight of seeds/plant (g), flowering% 100-seed weight/plant (g) and seed yield (ardab/fed).

4- Water relations

A- Water consumptive use (CU)

It was estimated by using the soil sampling method and calculated according to the technique used and according to the equation of Israelsen and Hansen (1962). According to the following equaling:

$$CU = D \times B_d \times (Q_2 - Q_1) / 100$$

Where:

CU = in the effective root zone (60 cm).

D = Soil layer depth.

B_d = Soil bulk density (g/cm³).

Q₁ = Soil moisture%, before irrigation.

Q₂ = Soil moisture%, 48 hours after irrigation.

For soil moisture determination, soil samples were taken from each 15 cm depth up to 60 cm from the soil surface by a regular augur. The samples were weighed immediately and then oven dried to a constant weight at 105°C. Percentage of soil moisture at the four soil depths was calculated on oven dry weight basis. The amount of water consumed in each irrigation interval was obtained from the difference between soil

content before the following irrigation and field capacity.

Actual irrigation water requirement

The amounts of actual applied irrigation water requirement under irrigation treatments were determined according to James (1988) using the following equation:

$$I = \left[\frac{(f_c - f_m)}{100} \right] \times D_r \times LF$$

I = total actual irrigation water applied mm/ interval.

f_c = soil moisture content at field capacity on volume basis.

f_m = Volumetric soil moisture content before next irrigation

dr = depth of soil layer.

Lf = leaching factor 10 %.

IE = irrigation system efficiency.

B- Water use efficiency (WUE)

Water use efficiency (WUE) values for the examined treatments were calculated according to the relation given by Jensen (1983).

$$WUE = \frac{\text{Total seed yield (kg/fed)}}{\text{Total water consumed (cubic meter)}}$$

The values of the field capacity, wetting point, available soil moisture, and bulk density for experimental were conducted in the same site are shown in Table D.

Table D: Values of the field capacity, wetting point, available soil moisture and bulk density for the experimental site in 2012/13 and 2013/14 seasons (Average two seasons).

Soil depth (cm)	Field capacity (%)	Wetting point (%)	Available soil moisture (%)	Bulk density (g/cm ³)
0 – 15	27.6	15.5	12.1	1.3
15 – 30	28.0	14.1	13.9	1.4
30 – 45	12.2	7.2	5.0	1.6
45 – 60	15.1	6.4	8.7	1.6

Statistical analysis

Statistical analysis was carried out following the procedure described by Gomez and Gomez (1984). All data were subjected to proper statistical analysis of split split plot design according to procedure outlined by Snedecor and Cochran (1967). Means were compared at 5% level of significance by the least significant different L.S.D test.

RESULTS AND DISCUSSION

Existed weed flora in experimental fields

The dominant weed species in the two seasons were: *Avena fatua* and *A. sterilis* (wild oats) and *Phalaris sp.* (canary grass) as annual grassy weeds; *Brassica nigra* (Kabar, black mustard), *Emex spinosus* (spiny emex), *Chenopodium album* (lambsquarters), *Ammi majus* (common bishop) and *Rumex dentatus* (curly dock) as annual broad-leaved weeds. The other weed species were rare infestation rates as *Lolium sp.* (ryegrass) as annual grassy weed and *Anagallis arvensis* (preinpernel), *Beta vulgaris* (wild beet, sea beet), *Medicago polymorpha* (medic, toothed medik), *Melilotus indica* (sweet clover, indica melilotus), and *Sonchus oleraceus* (annual sowthistle) as annual broad-leaved weeds and broomrape (*Orobanche crenata* Forsk.) as a parasitic weed spiced .

1- Effect of water regimes

- On weeds

Data in Table 1 revealed that water deficit irrigation at 60% of field capacity (FC) significantly decreased the dry weight of grassy, broad-leaved, and

total weeds (g/m²) in both seasons compared to full irrigation at 100% FC. Deficit irrigation at 60% FC which decreased the dry weight of grassy, broad-leaved and total weeds by 41.11, 33.21 and 35.85% in 2012/13 season and by 32.87, 25.73 and 28.22.% in 2013/14 season, respectively, as compared with full irrigation treatment at 100% FC.

- On broomrape

In contrary both number and dry weight of broomrape spikes that were significantly higher with 60% FC than with 100% FC in both seasons. Irrigation at 100% FC decreased both number and dry weight of broomrape spikes/m² by 31.90 and 30.44% in 2012/13 season and by 23.13 and 24.35% in 2013/14 season, respectively compared to deficits irrigation at 60% FC. This caused increase this may be due to water depletion which cause decrease cell division of plants of weeds in number of days required for of broomrape emergence indicating the reason of increasing both number and dry weight of broomrape spikes/m². Irrigation at 100% FC increased number of days of broomrape emergence by 10.66 and 19.75% in first and second seasons respectively compared to irrigation at 60% FC. Full water this may be attributed to the early broomrape emergence by about 12 days owing to soil aeration and consequently earlier emergence of broomrape. The obtained results are in agreement with those of Abdel-Hameed (1996) who damaging to these decreases may be due to lightening stimulant with secreted by plants the roots of faba bean by excessive water application. Reduced irrigation increased *Orobanche crenata* the crop.

Table 1: Effect of water regimes on dry weight of weeds and broomrape in 2012/13 and 2013/14 seasons.

Water regime as % of field capacity (A)	Grassy weeds g/m ²	Broad leaved weeds g/m ²	Total weeds g/m ²	No. of spikes broomrape/ m ²	Weight of spikes broomrape g/m ²	days of broomrape emergence
2012/2013						
100	56.72	111.24	167.95	7.68	31.90	126.34
60	33.40	74.30	107.74	10.13	41.61	114.17
F.test	**	**	**	**	**	**
2013/2014						
100	51.29	96.29	147.58	9.51	38.65	126.23
60	34.43	71.51	105.94	11.71	48.06	105.41
F.test	**	**	**	**	**	**

- On faba bean seed yield and yield components

Table 2 shows that full irrigation significantly increased both growth and yield characters of faba bean plants number of branches/plant, number and weight of pods/plant, weight of seeds/plant, flowering%, 100-seed weight and yield (ardab/feddan) except with plant height in both seasons as compared to deficit irrigation. Irrigation at 100% FC increased flowering%, 100-seed weight and faba bean seed yield (ard/fed) by 10.16, 11.75 and 17.45% in 2012/13 season and by 13.61, 8.07 and 18.75% in 2013/14 season, respectively, compared to irrigation at 60 % FC. These results are in agreement with those obtained by Abdel-Hameed (1996) and Hegab et al. (2014) which found that the 100 % irrigation treatments gave the highest seed yield. - On water use efficiency

Full water irrigation significantly increased actual water consumption (CU m³/fed) while water use

efficiency significantly increased with deficit irrigation in both seasons (Table 2). Water consumptive use values were (992.5 and 737.1 m³/fed) and (1046.6 and 758.0 m³/fed) for 100 and 60% FC treatment, respectively, in both seasons. This may be attributed to the early broomrape emergence by about 12 days owing to soil aeration and consequently earlier emergence of broomrape. Water use efficiency (Kg/m³) of faba bean seeds/m² of water increased under deficient irrigation by 10.65 and 9.72% than under full irrigation treatment in 2012/13 and 2013/14 seasons, respectively. These explain that faba bean can tolerate to some that water depletion. The obtained results are in agreement with those of Hegab et al. (2014) which found that irrigation level at 60% gave the highest water use efficiency (WUE). Increasing irrigation water above 60% lead to decrease in values of water use efficiency

Table 2: Effect of water regimes on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

Water regime as % of field capacity	Plant height (cm)	No. branches/Plant	No. pod/plant	Weight pods/plant (g)	Weight seeds/Plant (g)	Flowering %	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)
2012/2013										
100	123.19	3.73	25.8	68.9	56.4	43.3	69.8	5.96	992.5	0.923
60	118.82	3.04	23.5	60.0	47.5	38.9	61.6	4.92	737.1	1.033
F.test	NS	**	**	**	**	**	**	**	**	**
2013/2014										
100	126.34	3.15	27.4	68.1	59.7	44.1	73.1	6.08	1046.6	0.910
60	121.10	2.88	25.8	55.1	45.9	38.1	67.2	4.94	758.0	1.008
F.test	NS	**	**	**	**	**	**	**	**	**

2- Effect of faba bean varieties

- On weeds

Results in Table 3 indicated that decreased significant faba bean varieties of weeds in 2012/13 and 2013/14 seasons. Nubaria1, Nubaria3 and Giza843 varieties decreased the dry weight of grassy weeds by 50.5, 33.7 and 32.6% in 2012/13 seasons and by 44.3, 31.7 and 30.7% in 2013/14 seasons, respectively as compared with faba bean variety Sakha4. Faba bean varieties Giza843, Nubaria1, Nubaria3 reduced dry weight of broad-leaved weeds in the first season by (43.6, 40.4 and 19.6%) and by (37.8, 38.1 and 12.0%) in second season, respectively, as compared with variety of Sakha4. Faba bean variety Nubaria1, Giza843 and Nubaria3 decreased significantly the dry weight of total weeds by 43.8, 40.0 and 24.2% and by 40.3, 35.2 and 19.0% in the first and second seasons, respectively as compared with variety of Sakha4. Varieties of Nubaria1, Giza843 and Nubaria3 gave the good efficiency in weed control of dry weight of weeds in both seasons. These results may suggest their Nubaria1, Giza843 and Nubaria3 varieties were more competitors to weeds due to its vigorous growth because they are tallest and increase number of branches/plant than Misr3 and Sakha4 and can overcome partially weed competitions. Ibrahim *et al.* (2014) which showed that cultivars decreased dry weight of weeds and increased seed yield. Cultivar of Barakat controlled of weeds than cultivars Saraziri and Mahalli.

- On broomrape

Data in Table 3 showed that both faba bean

varieties Giza843 and Misr3 recorded the highest reduction parentages of numbers and dry weight of broomrape spikes/m² owing to the delay of broomrape attachment and late its emergence above soil surface and consequently escape partially from broomrape injury with these varieties in both seasons as compared with Nubaria1, Nubaria3 and Sakha4 varieties, respectively. Giza843 and Misr3 decreased the number and dry weight of broomrape spikes by 50.04 and 47.54% & 29.04 and 29.33 % in 2012/13 winter season and by 38.00 and 41.67% & 21.58 and 23.02 % in 2013/14 winter season, respectively as compared with variety Nubaria3.

From the pervious results depending on *Orobanche* severity no of spikes/host plant scale maximizing varieties have to tolerant to *Orobanche* infestation except with Nubaria3 which considered as highly susceptible cultivar to *Orobanche* infection. Concerning *Orobanche* severity considered as susceptible, resistant or tolerant varieties (high than 10 spikes broomrape was highly susceptible, 7-9 spikes broomrape was moderately susceptible, 4-7 was moderately tolerant, 2-3 was tolerant, less than >3 spike/faba bean was Resistant). These results proved that Giza843 and Misr3 were resistant, Sakha4 was the tolerant cultivar and Nubaria1 and Nubaria3 were highly susceptible (Table b) which showed that the suggested scale of *Orobanche* infestation. These finding are in harmony with those reported by Hassanein *et al.* (1998) and Gadalla *et al.* (2010).

Table 3: Effect of faba bean varieties on dry weight of weeds and broomrape in 2012/13 and 2013/14 seasons.

Varieties (B)	Grassy weeds g/m ²	Broad leaved g/m ²	Total weeds g/m ²	No. of spikes broomrape/m ²	Weight of spikes broomrape g/m ²	Days for broomrape emergence
2012/2013						
Giza 843	42.3	69.2	111.5	5.6	24.6	130.7
Misr3	47.4	99.9	147.2	8.0	33.2	125.7
Nubaria1	31.1	73.2	104.3	10.1	41.0	115.7
Nubaria3	41.7	98.9	140.7	11.3	46.9	122.6
Sakha4	62.8	122.7	185.5	9.6	38.6	106.5
L.S.D at 0.05	18.75	12.47	13.87	1.32	5.30	1.47
2013/2014						
Giza 843	39.8	64.2	104.0	7.7	30.4	127.3
Misr3	45.7	97.5	143.2	9.7	40.2	126.2
Nubaria1	32.0	63.8	95.85	12.3	48.1	112.7
Nubaria3	39.3	90.8	130.1	12.4	52.2	107.1
Sakha4	57.5	103.2	160.7	11.2	45.9	105.9
L.S.D at 0.05	15.26	17.97	19.28	1.25	5.53	1.66

- On faba bean yield and yield components

Results in Table 4 show that all faba bean varieties differed significantly on faba bean seed yield

and its components in both 2012/2013 and 2013/2014 winter seasons. Concerning faba bean plant height tallest plants of faba bean were belonged to varieties

Nubaria3 and Nubaria1 with height of 124.82 and 129.23 (cm) compared to the shortest plants belonged to varieties Sakha4 and Giza843 with height of 115.50 and 119.28 (cm) in both seasons, respectively. The highest numbers of branches/plant of faba bean were obtained from the variety Nubaria3 with values of 3.91 and 3.74 branches/plant compare to the smallest numbers of branches/plant from the variety Misr3 with values of 2.70 and 2.63 branches/plant in both seasons, respectively.

The highest numbers of pods/plant of faba bean were belonged to varieties Nubaria3 and Nubaria1 with the same value of 28.6 and 30.6 pods compared to the smallest number of pods/plant belonged to the variety Sakha4 of 21.2 and 23.6 pods in both seasons, respectively. The heaviest seeds/plant of faba bean were belonged to the variety Nubaria1 with values of 58.3 and 57.8 (g) in both seasons compared to the lowest weight of seeds/plant belonged to the variety Sakha4 with values of 47.3 and 47.7(g) in both seasons,

respectively. The earliest flowered variety of faba bean was Sakha4 with values of 34.6 and 35.4 days as compared to the latest variety Nubaria3 with values of 44.9 and 45.6 days in both seasons, respectively. The heaviest 100-seed weight (g) varieties of faba bean were Nubaria1 in the first season and Nubaria3 in the second season with values of 68.8 and 73.1 (g) as compared to the lowest weight of 100-seed that resulted from the variety Sakha4 with values of 61.5 and 65.4 (g) in both seasons, respectively. The highest seeds yield of faba bean were resulted from the variety Nubaria3 with values of 6.00 and 5.87 (ardab/fed) as compared to the lowest yield of seeds (ardab/fed) belonged to the varieties Sakha4 in the first season and Nubaria1 in the second season with values of 5.18 and 5.44 (ardab/fed), respectively. These results obtained were in agreement with those obtained by Gadalla *et al.* (2010), Amer *et al.* (2012), Ismail (2013) and Ibrahim *et al.* (2014) which showed that cultivar Saraziri increased seed yield than other cultivars.

Table 4: Effect of varieties on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

Varieties (B)	Plant height (cm)	No. branches /plant	No. pod/ plant	Weight pods/plant (g)	Weight seeds/plant (g)	Flowering %	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)
2012/2013										
Giza 843	122.2	2.73	25.6	61.7	47.4	42.1	62.5	5.47	875.0	0.974
Misr 3	119.1	2.70	22.7	61.9	52.4	41.3	66.1	5.46	853.6	0.993
Nubaria 1	123.5	3.78	25.3	69.1	58.3	42.8	68.8	5.34	845.8	0.991
Nubaria 3	124.8	3.91	28.6	69.1	54.2	44.9	68.2	6.00	882.5	1.008
Sakha 4	115.5	2.80	21.2	60.4	47.3	34.6	61.5	5.18	867.1	0.923
L.S.D at 0.05	5.66	0.03	1.49	3.91	2.54	1.23	3.15	2.05	25.90	0.05
2013/2014										
Giza 843	119.2	2.73	25.2	59.2	50.1	40.2	68.8	5.57	889.7	0.951
Misr 3	123.1	2.63	24.8	61.1	53.4	40.1	71.0	5.50	872.8	0.980
Nubaria 1	129.2	3.39	28.8	66.1	57.8	44.1	72.8	5.44	882.8	0.979
Nubaria 3	127.2	3.74	30.6	64.9	54.8	45.6	73.1	5.87	930.7	0.978
Sakha 4	119.8-	2.58	23.6	57.1	47.7	35.4	65.4	5.75	935.6	0.906
L.S.D at 0.05	3.91	0.08	1.06	3.73	2.28	8.94	2.84	2.03	24.28	0.03

- On water use efficiency

Results in Table 4 cleared that actual water consumptions (CU m³/fed) were significantly affected by faba bean varieties where the highest values were obtained from the variety Nubaria3 which consumed 882.5 and 930.7 m³ of water in both seasons, respectively, compared to the lowest amounts of water were consumed by the varieties Nubaria1 in the first season and Misr3 in the second season with values of 845.8 and 872.8 m³ of water, respectively. The highest values of water use efficiency were attained by faba bean variety Nubaria3 in the first season and Misr3 in the second season with values of 1.008 and 0.980 of faba bean seed (Kg/m³) as compared to the lowest values resulted from faba bean variety Sakha4 with values of 0.923 and 0.906 (Kg/m³) in both seasons, respectively. These results obtained were in agreement with those obtained by Khalil (1983), Gadalla *et al.* (2010) and Amer *et al.* (2012).

3-Effect of weed control treatments

- On weeds

Results in Table 5 indicated that weed control treatments decreased significantly dry weight of grassy,

broad-leaved and total weeds (g/m²) in both seasons. Hand hoeing twice + Hand pulling, Select-super+ Basagran + Roundup and Topik + Basagran+ Roundup recorded decrease in the dry weight of grassy weeds by (87.29, 84.6 and 79.03 %) and by (85.42, 84.02 and 78.75%), broad-leaved by (85.78, 83.52 and 79.78%) and by (86.54, 84.22 and 77.32%) and total weeds by (86.28, 83.88 and 80.33%) and by (86.60, 84.15 and 77.81%) in 2012/13 and 2013/14 seasons, respectively, as compared to unweeded check. Weeds could be attributed to the destroying effect of hand hoeing on annual weeds since these weeds are not capable to regrowth from the underground parts. The results obtained were in agreement with those obtained by Saad El-Din (2003), Ismail and Fakkar (2008) and Abasalt *et al.* (2014) showed that lowest density and dry weight of weed obtained at night cultivation and application of Bentazon+once hand weeding treatments. Also, broad bean yield and some of its components was significantly higher in application of Bentazon+once hand weeding treatments.

Table 5: Effect of weed control treatments on dry weight of weeds and broomrape in 2012/13 and 2013/14 seasons.

Weed control treatments (C)	Grassy weeds g/m ²	Broad leaved g/m ²	Total weeds g/m ²	No. of spikes broomrape/m ²	Weight of spikes broomrape g/m ²	Days for broomrape emergence
2012/2013						
Select-super+ Basagran+ Roundup	28.79	58.39	87.18	4.20	19.65	118.63
Topik + Basagran+ Roundup	27.64	54.32	81.96	6.03	25.16	117.93
Hand hoeing twice+ Hand pulling	20.29	44.28	64.57	11.50	46.73	117.97
Hand hoeing twice+ Roundup	16.75	38.21	54.96	6.47	26.51	118.73
Unweeded (control).	131.82	268.65	400.47	16.33	66.20	128.03
L.S.D at 0.05	15.20	19.96	10.35	1.09	4.52	1.62
2013/2014						
Select-super+ Basagran+ Roundup	26.30	56.19	82.49	5.60	23.29	114.83
Topik + Basagran+ Roundup	26.32	54.23	80.55	7.43	29.40	113.53
Hand hoeing twice+ Hand pulling	19.79	37.73	57.52	12.27	50.95	111.27
Hand hoeing twice+ Roundup	18.05	32.20	50.25	7.90	33.58	114.97
Unweeded (control).	123.84	239.16	363.00	19.83	79.58	124.5
L.S.D at 0.05	15.07	17.42	19.30	1.31	5.32	1.19

- On broomrape

Data in Table 5 revealed that (Select-super + Basagran + Roundup), (Topik + Basagran+ Roundup) and (Hand hoeing twice + Roundup) decreased the number and dry weight of broomrape spikes by (74.28, 63.07 and 60.38%) and (28.08, 24.69 and 23.88%) in the first seasons and by (71.76, 62.53 and 60.18%) and (70.73, 63.06 and 57.80%) in the second season, respectively, as compared with unweeded check. Weed control treatments (Hand hoeing twice + Roundup), (Select-super+ Basagran+ Roundup) and (Topik + Basagran+ Roundup) treatments and lead to number of days of broomrape emergence by (118.73, 118.63 and 117.97 days) in the first season and by (114.97,114.38 and 113.35 days) in the second season, respectively, as compared with unweeded. This effect is due to Roundup treatment with broomrape underground stage, so it makes early effects, while, the effect of hand pulling is usually after broomrape emergence above ground. These results are in agreement with those obtained by Kharrat and Halila (1996) and Hassanein and Kholosy (1997) reported that the action of glyphosate on *O. crenata* is attributable to its selective accumulation in the young parasite plant up to a level four times as high as that in faba bean host root three days after spraying.

- On faba bean yield and yield components

Data in Table 6 revealed that the tallest plants of faba bean were resulted from (Select-super+Basagran+Roundup) in the first season and (Hand hoeing twice+Hand pulling) in the second season with height of 127.34 and 128.20 cm as compared to the shortest plants resulted from unweeded control treatment with height of 111.79 and 111.35 cm in both seasons, respectively. The biggest number of branches/plant of faba bean were obtained from (Hand hoeing twice+Roundup) with values of 3.44 and 3.21 branches compare to the smallest number of branches from unweeded control treatment with values of 2.39 and 2.52 branches in both seasons, respectively. Hand hoeing twice + Roundup and Select-super + Basagran +Roundup increased number of pods/plant of faba bean by (28.38 and 27.94%) and by (31.63 and 34.88%) in the second season, respectively, as compared with unweeded. Hand hoeing twice +Roundup, Select-super+Basagran+Roundup and (Topik+ Basagran + Roundup) increased weight of pods/plant and weight of seeds/plant (g) by (32.82, 31.30 and 30.15%) and (48.84, 48.33 and 45.24%) in 2012/13 season and by (39.67, 37.79 and 38.20%) and (40.68, 34.87 and 38.98%) in the second season, respectively, as compared with unweeded.

Table 6: Effect of weed control treatments on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

Weed control treatments (C)	Plant height (cm)	No. branches/plant	No. pod/plant	Weight pods/plant (g)	Weight seeds/plant (g)	Flowering %	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)
2012/2013										
Select-super+ Basagran+ Roundup	122.16	3.37	26.2	68.8	57.7	40.1	71.6	6.02	922.0	1.025
Topik + Basagran+ Roundup	121.79	3.44	25.3	68.2	56.5	40.5	70.0	5.72	914.1	0.979
Hand hoeing twice+ Hand pulling	122.03	3.34	25.3	63.3	48.6	39.7	64.6	5.79	907.7	0.995
Hand hoeing twice+ Roundup	127.34	3.37	26.1	69.6	57.9	39.7	71.8	6.17	941.7	1.041
Unweeded (control).	111.79	2.39	20.4	52.4	38.9	45.7	49.5	3.47	639.2	0.848
L.S.D at 0.05	5.68	0.07	1.21	2.76	2.44	0.99	2.07	2.08	24.81	0.05
2013/2014										
Select-super+ Basagran+ Roundup	128.20	3.20	28.3	66.0	55.7	40.9	73.9	6.10	945.4	1.029
Topik + Basagran+ Roundup	126.56	3.21	28.3	66.2	57.4	41.0	73.8	5.85	946.9	0.985
Hand hoeing twice+ Hand pulling	125.81	3.09	25.9	61.3	51.3	39.9	72.5	5.92	934.2	1.004
Hand hoeing twice+ Roundup	126.67	3.07	29.0	66.9	58.1	39.6	75.0	6.74	987.8	1.008
Unweeded (control).	111.35	2.52	21.5	47.9	41.3	44.0	55.7	3.48	697.3	0.768
L.S.D at 0.05	2.74	0.07	1.42	2.61	2.75	1.33	2.52	2.04	34.02	0.04

The earliest flowered varieties of faba bean were resulted from both (Topik + Basagran+ Roundup) and (Select-super + Basagran + Roundup) with the same value of 39.7 days in the first season and just from

(Select-super + Basagran + Roundup) in the second season with a value of 39.6 days as compared to unweeded (45.7 and 44.0 days) in both seasons, respectively. Hand hoeing twice + Roundup and Select-

super + Basagran + Roundup increased 100-seed weight and seeds yield (ardab/fed) by (45.05, 44.65 and 41.41%) and (77.81, 73.49 and 66.86%) in the first season and by (32.50, 34.65 and 32.68%) and (93.68, 75.29 and 68.10%) in the second season, respectively, as compared with unweeded. This increase of seed yield may be due to the increase number of branches/plant, number of pods/plant, weight of pods/plant, seed weight/plant and due to the decrease to the number and dry weight of broomrape spikes. The above results are in agreement with those Al-Marsafy *et al.* (1998), Hassanein *et al.* (1998) and Al-Marsafy *et al.* (2001), Ismail (2013) and Hegab *et al.* (2014).

- On water use efficiency

Results in Table 6 cleared that actual water consumptions (CU m³/fed) were significantly affected by weed control treatments where the highest values were obtained from (Select-super + Basagran + Roundup) which lead to consume 941.7 and 987.8 m³ of water compared to the lowest amounts of water were consumed under the effect of unweeded (639.2 and 697.3 m³/fed) of water in both seasons, respectively. The highest values of water use efficiency were attained by faba bean varieties under effect of (Select-super + Basagran + Roundup) in the first season and (Topik + Basagran+ Roundup) in the second season with values of 1.041 and 1.029 Kg/m³ as compared to the lowest values resulted from unweeded (0.848 and 0.768

Kg/m³) in both seasons, respectively. The obtained results were in agreement with those obtained by Hassanein *et al.* (1990), Hassanein and Kholosy (1997), Al-Marsafy *et al.* (1998), Hassanein *et al.* (1998) and Al-Marsafy *et al.* (2001).

4-Effect of interactions

A- Interaction between water regimes and faba bean varieties

- On weeds and broomrape

The results shown in Tables 7 representing the interaction between irrigation treatments and faba bean varieties. Under effect of 60% FC faba bean variety Nubaria1 resulted in the lowest dry weight of total weeds with values of 80.1 and 75.0 (g) compared to the highest values of 239.1 and 186.3 (g) resulted from faba bean variety Sakha4 under effect of 100% FC in both seasons, respectively.

The shortest periods to the days of broomrape emergence were resulted from faba bean variety Sakha4 under effect of 60% FC with values of 95.6 and 91.6 days compared to the longest period resulted from faba bean variety Nubaria3 under effect of 100% FC with values 134.5 and 132.9 days in both seasons, respectively, indicating that of broomrape pressure appear clearly with susceptible varieties under water stress condition. The results obtained were in agreement with those obtained by Ismail and Fakkar (2008)

Table 7: Effect of the interaction between water regimes and varieties on dry weights of weeds and broomrape in 2012/13 and 2013/14 seasons.

Water regime	Varieties	Grassy weeds g/m ²	Broad leaved g/m ²	Total weeds g/m ²	days of broomrape emergence	2012/13		2013/14	
						Grassy weeds g/m ²	Broad leaved g/m ²	Total weeds g/m ²	days of broomrape emergence
100% FC	Giza843	50.8	76.5	127.3	126.3	47.4	73.1	120.5	133.6
	Misr3	63.3	114.4	177.6	122.9	57.8	105.6	163.4	117.1
	Nubaria1	40.8	87.6	128.4	130.6	39.0	77.7	116.7	130.8
	Nubaria3	51.6	115.9	167.4	134.5	48.0	103.5	151.5	132.9
	Sakha4	77.1	161.9	239.1	117.4	64.3	122.0	186.3	116.7
	Giza843	33.9	61.9	95.8	119.0	32.3	55.3	87.6	121.5
60% FC	Misr3	31.5	85.4	116.9	108.5	33.7	89.2	122.9	97.4
	Nubaria1	21.4	58.7	80.1	120.9	25.0	50.0	75.0	91.7
	Nubaria3	31.8	82.1	113.9	126.9	30.5	78.2	108.7	121.7
	Sakha4	48.5	83.4	131.9	95.6	123.8	84.4	208.2	91.6
L.S.D at 0.05		17.02	17.47	19.62	2.08	18.70	11.27	10.3	2.35

- On faba bean yield and yield components

Table 8 show that the highest values of water use efficiency were attained by faba bean varieties and Misr3 in the first season and Giza843 in the second season under effect of 100% FC with values of 0.939 and 0.947 (kg/m³) compared to the lowest values resulted from faba bean varieties Sakha4 in the first season and Giza843 in the second season under effect of 60% FC with values of 0.958 and 0.955 (kg/m³) in both seasons, respectively. Indicating that such variety can utilize from irrigation water under water deficit condition.

Data in Table 8 indicate that The highest yields of faba bean seeds were resulted from the variety Nubaria3 under effect of 100% FC with values of 6.71 and 6.93 (ardab/fed) compared to the lowest yields of seeds (ardab/fed) belonged to the variety Sakha4 under effect of 60 % FC with values of 4.57 and 3.06 (g), respectively. The results obtained were in agreement

with those obtained by Abdel-Hameed (1996), Ouda *et al.*, (2010), Ismail (2013) and Hegab *et al.* (2014).

B-Interaction between water regimes and weed control treatments

- On weeds and broomrape

The results shown in Tables 9 representing the interaction between irrigation treatments and weed control treatments. The best weed control treatments were (Select-super + Basagran + Roundup) in the first season and (Hand hoeing twice + Hand pulling) in the second season under effect of 60% FC which resulted in the lowest dry weight of total weeds with values of 41.9 and 43.2 (g) as compared to the highest values of 472.2 and 418.2 (g) resulted from control treatment (unweeded) under effect of 100% FC in both seasons, respectively. The shortest period to the broomrape emergence above soil surface were resulted from (Hand hoeing twice + Roundup) in the first season and (Hand hoeing twice + Hand pulling) in the second season

under effect of 60% FC with values which decreased by 26.0 and 29.4 days from unweeded control treatment under effect of 100 % FC with values 133.7 and 131.4 days in both seasons, respectively. Number and dry weight of broomrape spikes were significantly affected

by the interaction between irrigation and different times of glyphosate application and shortening irrigation periods decrease relatively *Orobanche* infestation.

Table 8: Effect of the interaction between water regimes and varieties on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

Water regime	Varieties	Weight seeds/plant	2012/2013				2013/2014				
			100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)	
100% FC	Giza 843	51.9	66.5	6.03	1001.4	0.930	60.0	75.4	6.00	978.7	0.947
	Misr3	57.2	70.4	5.83	955.6	0.939	60.7	72.7	5.95	982.4	0.944
	Nubaria1	62.2	72.6	5.90	973.6	0.931	63.3	73.7	6.03	1026.4	0.909
	Nubaria3	59.8	72.8	6.21	1029.3	0.927	62.0	76.3	6.53	1122.4	0.902
	Sakha4	50.8	64.9	5.80	1002.5	0.888	52.3	67.6	5.91	1123.1	0.845
60% FC	Giza843	42.9	59.1	4.91	748.7	1.019	40.3	62.1	5.05	800.7	0.955
	Misr3	47.6	61.8	5.11	751.6	1.046	46.1	69.2	5.04	763.2	1.016
	Nubaria1	54.4	65.0	4.78	717.0	1.051	52.3	71.9	4.85	740.0	1.049
	Nubaria3	48.6	63.7	5.21	735.7	1.089	47.5	69.8	5.12	738.9	1.053
	Sakha4	43.9	58.1	4.57	737.7	0.958	43.2	63.1	4.59	748.1	0.966
L.S.D at 0.05		3.59	3.33	4.52	36.63	0.08	3.23	4.45	3.24	35.75	0.04

Table 9: Effect of the interaction between water regimes and weed control treatments on dry weights of weeds and broomrape in 2012/13 and 2013/14 seasons.

Water regime	Weed control treatments	2012/13				2013/14			
		Grassy weeds g/m ²	Broad leaved g/m ²	Total weeds g/m ²	days of broomrape emergence	Grassy weeds g/m ²	Broad leaved g/m ²	Total weeds g/m ²	days of broomrape emergence
100% FC	Select-super+Basagran+Roundup	39.8	74.6	114.4	122.7	34.3	67.2	101.5	124.4
	Topik + Basagran+ Roundup	37.1	66.8	103.9	125.2	31.0	65.8	96.8	126.0
	Hand hoeing twice+ Hand pulling	27.4	54.7	82.1	124.9	22.2	41.9	64.1	123.3
	Hand hoeing twice+Roundup	23.0	45.1	68.1	125.7	22.1	35.3	57.4	126.2
	Unweeded (control).	156.8	315.5	472.3	133.2	146.9	271.4	418.3	131.4
60% FC	Select-super+ Basagran+Roundup	18.2	42.6	60.9	114.6	8.3	45.7	54.0	102.7
	Topik + Basagran+ Roundup	18.2	41.9	60.0	110.7	21.7	42.7	64.4	103.7
	Hand hoeing twice+ Hand pulling	13.2	33.9	47.0	111.0	17.4	33.6	51.0	99.4
	Hand hoeing twice+ Roundup	10.5	31.4	41.9	111.7	14.0	29.2	43.2	103.7
	Unweeded (control).	106.9	221.8	328.7	122.9	100.8	207.0	307.8	117.6
L.S.D at 0.05		17.35	14.0	14.65	3.30	15.07	10.49	19.30	2.28

- On faba bean yield and yield components

Table 10 show that the heaviest 100-seed weight and yield of faba bean seeds were resulted from (Hand hoeing twice + Hand pulling) under effect of 100% FC with values of (76.68 and 78.0 g) and (6.68 and 6.93 ardab/fed) as compared to the lowest weight of 100-seed that resulted unweeded control treatment under effect of 60% FC with values of (46.5 and 50.7 g) and (3.11 and 3.06 ardab/fed) in both seasons, respectively. The results obtained were in agreement with those obtained by Abdel-Hameed (1996) and Hegab *et al.* (2014).

The highest values of water use efficiency were attained by (Hand hoeing twice + Hand pulling) under effect of 60% FC with values of 1.132 and 1.000 (Kg/m³) as compared with the lowest values resulted from unweeded control treatment under effect of 60% FC with values of 0.870 and 0.728 (Kg/m³) in both seasons, respectively (Table 9). The results obtained were in agreement with those obtained by Tayel and Sabreen (2011).

Table 10: Effect of the interaction between water regimes and weed control treatments on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

Water regime	Weed control treatments	2012/2013				2013/2014					
		Weight seeds/plant	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)	Weight seeds/plant	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)
100% FC	Select-super+ Basagran+ Roundup	63.1	76.6	6.47	1040.1	0.961	62.9	78.0	6.53	1078.9	0.954
	Topik + Basagran+ Roundup	60.8	73.1	6.23	1041.0	0.928	65.6	76.7	6.41	1099.9	0.918
	Hand hoeing twice+ Hand pulling	51.7	68.9	6.55	1072.5	0.948	57.2	75.7	6.74	1116.1	0.943
	Hand hoeing twice+ Roundup	63.8	75.9	6.68	1090.0	0.951	65.0	74.7	6.93	1164.6	0.925
	Unweeded (control).	42.4	52.6	3.84	719.0	0.827	47.6	60.7	3.79	773.6	0.809
60% FC	Select-super+ Basagran+ Roundup	52.2	66.4	5.12	774.3	1.030	48.5	72.1	5.30	789.5	1.053
	Topik + Basagran+ Roundup	52.3	66.9	5.21	787.1	1.029	49.2	71.7	5.29	794.0	1.052
	Hand hoeing twice+ Hand pulling	45.5	60.4	5.48	771.4	1.102	45.4	69.3	5.46	774.6	1.116
	Hand hoeing twice+ Roundup	52.0	67.6	5.65	793.4	1.132	51.1	73.0	5.55	811.0	1.000
	Unweeded (control).	35.3	46.5	3.11	559.4	0.870	35.0	50.7	3.06	621.0	0.728
L.S.D at 0.05		2.44	2.10	3.57	35.20	0.08	3.89	2.93	2.24	48.11	0.05

C-Interaction between varieties and weed control treatments

- On weeds and broomrape

The results shown in Table 11 representing the interaction between irrigation treatments faba bean varieties and weed control treatments on weeds. Faba bean variety Nubaria1 under treatment of (Select-super + Basagran + Roundup) resulted in the lowest dry weight of total weeds with values of 41.2 and 37.9 (g) as compared with the highest values of 523.5 and 461.0 (g) resulted from faba bean variety Sakha4 under unweeded check treatment in both seasons, respectively.

The shortest period to the days of broomrape emergence were resulted from faba bean variety Sakha4 under the treatment of (Topik + Basagran+ Roundup) with values of 101.0 and 103.1 days compared to the longest period from faba bean variety Nubaria3 under unweeded check treatment with values 137.3 and 134.7 days in both seasons, respectively, indicating to the role of Roundup in control. The results obtained were in agreement with those obtained by Ismail (2013) how indicated that the interactions between varieties and *Orobanche* control treatments gave the highest reduction on number and dry weight of *Orobanche* spikes in both seasons.

Table 11: Effect of interaction between varieties and weed control treatments on dry weights of weeds and broomrape in 2012/13 and 2013/14 seasons.

Variants	Weed control treatments	Grassy weeds g/m ²	Broad-leaved g/m ²	Total weeds g/m ²	days of broomrape emergence	2012/13		2013/14	
						Grassy weeds g/m ²	Broad-leaved g/m ²	Total weeds g/m ²	days of broomrape emergence
Giza843	Select-super+ Basagran+ Roundup	25.3	37.4	62.8	119.0	23.0	33.9	56.9	110.7
	Topik + Basagran+ Roundup	21.8	35.4	57.2	122.0	23.9	34.4	58.3	111.2
	Hand hoeing twice+ Hand pulling	16.5	31.3	47.8	121.8	18.9	25.1	44.0	106.7
	Hand hoeing twice+ Roundup	17.0	31.1	48.0	122.2	14.6	28.0	42.6	108.2
Misr3	Unweeded (control).	131.0	210.8	341.8	128.7	118.8	199.7	318.5	126.7
	Select-super+ Basagran+ Roundup	31.6	64.7	96.4	117.5	29.1	70.9	99.9	100.5
	Topik + Basagran+ Roundup	31.7	57.0	88.6	111.2	31.1	68.4	99.5	105.0
	Hand hoeing twice+ Hand pulling	21.7	47.7	69.4	112.8	252.3	44.9	297.2	101.8
Nubaria3	Hand hoeing twice+ Roundup	13.9	37.7	51.5	114.5	18.9	35.0	53.9	105.8
	Unweeded (control).	138.0	292.3	430.3	122.5	127.2	268.3	395.6	116.3
	Select-super+ Basagran+ Roundup	17.0	38.7	55.7	124.3	16.1	35.4	51.5	125.0
	Topik + Basagran+ Roundup	18.5	37.3	55.8	122.7	19.3	35.5	54.8	126.0
Nubaria1	Hand hoeing twice+ Hand pulling	11.7	31.3	43.0	124.5	12.9	30.5	43.4	122.0
	Hand hoeing twice+ Roundup	10.9	30.3	41.2	124.3	11.7	26.2	37.9	127.0
	Unweeded (control).	97.5	228.2	325.7	132.8	100.1	191.7	291.7	130.7
	Select-super+ Basagran+ Roundup	28.7	74.6	103.3	129.5	28.3	74.3	102.6	125.8
Sakha4	Topik + Basagran+ Roundup	23.9	65.6	89.5	129.5	21.3	69.1	90.4	126.0
	Hand hoeing twice+ Hand pulling	16.3	54.5	70.8	129.7	17	43.6	60.6	122.8
	Hand hoeing twice+ Roundup	12.9	46.7	59.6	127.7	14.4	34.1	48.5	127.3
	Unweeded (control).	126.5	254.7	381.2	137.3	115.4	232.9	348.3	134.7
L.S.D at 0.05	Select-super+ Basagran+ Roundup	41.3	77.0	118.3	102.8	35.2	66.5	101.6	105.7
	Topik + Basagran+ Roundup	42.3	76.4	118.8	104.3	36.0	63.8	99.8	106.0
	Hand hoeing twice+ Hand pulling	35.2	56.7	91.9	101.0	27.9	44.7	72.5	103.0
	Hand hoeing twice+ Roundup	29.2	45.9	75.1	105.0	30.7	37.7	68.4	106.5
	Unweeded (control).	166.2	357.3	523.5	119.3	157.7	303.3	461.0	114.2
	L.S.D at 0.05	11.62	22.28	23.16	3.61	17.17	16.59	13.15	2.66

- On faba bean yield and yield components

Data in Table 12 revealed that the highest yields of faba bean seeds were resulted from the variety Nubaria1 under (Select-super + Basagran + Roundup) with values of 6.45 and 6.48 (ardab/fed) as compared to the lowest yields of seeds (ardab/fed) belonged to the varieties Sakha4 under unweeded control treatment with values of 3.18 and 3.10 (g) in both seasons, respectively. These results were in agreement with those obtained by Nassib (1982), Hassanein *et al.* (1990), Hassanein and Kholosy (1997), Al-Marsafy *et al.* (1998), Hassanein *et al.* (1998), Al-Marsafy *et al.* (2001) and Amer *et al.* (2012).

The highest values of water use efficiency were attained by faba bean varieties Nubaria1 in the first season and Misr3 in the second season both under (Select-super + Basagran + Roundup) with values of 1.191 and 1.047 (kg/m³) as compared with the lowest values resulted from faba bean variety Nubaria1 in the

first season and Sakha4 in the second season both under unweeded control treatment with values of 0.773 and 0.583 (kg/m³) in both seasons, respectively.

D-Interaction between water regimes, varieties and weed control treatments

- On weeds and broomrape

The effect's interactions between water regimes, varieties and weed control treatments had significant effect for dry weight of total weeds and broomrape in Table 13. The heights reduction for dry weight of weeds (g/m²) obtained by water regimes at 60% FC with sowing of Nubaria1 and Nubaria3 under (Select-super + Basagran + Roundup) in both seasons. Highest values of days of broomrape emergence obtained by water regimes at 100% FC with sowing of Giza843 and Nubaria1 and Nubaria3 under (Select-super + Basagran + Roundup) in both seasons.

Table 12: Effect of interaction between varieties and weed control treatments on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

Varieties	Weed control treatments	Weight seeds/plant	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)	Weight seeds/plant	100-seed weight (g)	Seed yield (ard/fed)	C.U (m ³ /fed)	WUE (Kg/m ³)
Giza843	Select-super+ Basagran+ Roundup	51.9	67.0	6.02	949.2	0.973	51.8	71.7	6.05	938.4	1.003
	Topik + Basagran+ Roundup	52.1	68.2	5.40	916.0	0.916	55.4	70.8	5.73	925.5	0.963
	Hand hoeing twice+ Hand pulling	45.4	61.1	6.18	929.8	1.042	49.3	69.8	6.05	900.1	1.054
	Hand hoeing twice+ Roundup	52.1	70.9	6.00	979.7	0.962	54.6	73.5	6.22	987.3	0.980
	Unweeded (control).	35.6	48.7	3.75	600.4	0.980	39.5	57.9	3.57	697.0	0.754
Misr3	Select-super+ Basagran+ Roundup	59.9	73.5	6.02	902.8	1.053	57.0	75.5	6.08	974.8	0.974
	Topik + Basagran+ Roundup	54.1	71.2	5.92	912.1	1.012	57.9	76.0	5.80	929.2	0.972
	Hand hoeing twice+ Hand pulling	52.4	68.3	5.82	884.3	1.027	52.6	75.6	6.00	900.8	1.043
	Hand hoeing twice+ Roundup	57.1	68.7	6.02	913.6	1.026	56.9	71.0	6.12	947.6	1.047
	Unweeded (control).	38.3	48.8	3.57	655.3	0.845	42.6	56.6	3.50	611.4	0.866
Nubaria3	Select-super+ Basagran+ Roundup	63.0	73.2	5.18	845.7	0.949	61.5	75.5	5.70	910.1	1.004
	Topik + Basagran+ Roundup	66.8	74.0	5.72	872.9	1.022	62.6	75.1	5.90	934.5	1.019
	Hand hoeing twice+ Hand pulling	51.8	68.6	6.07	937.5	1.018	57.6	76.5	6.02	955.0	1.042
	Hand hoeing twice+ Roundup	65.7	73.8	6.42	902.4	1.191	63.1	80.2	6.28	966.9	1.044
	Unweeded (control).	44.2	54.5	3.33	667.9	0.773	44.2	56.9	3.30	648.0	0.789
Nubarial	Select-super+ Basagran+ Roundup	58.4	72.9	6.17	942.1	1.032	56.8	79.0	6.25	968.4	1.025
	Topik + Basagran+ Roundup	61.2	74.6	6.32	952.1	1.046	59.7	77.6	6.27	1001.2	0.993
	Hand hoeing twice+ Hand pulling	51.7	68.1	6.08	924.1	1.038	51.3	71.4	6.45	992.5	1.036
	Hand hoeing twice+ Roundup	59.6	74.4	6.45	952.4	1.063	61.6	78.5	6.48	1054.0	0.987
	Unweeded (control).	40.1	51.2	3.55	641.9	0.863	44.5	58.9	3.37	637.8	0.850
Sakha4	Select-super+ Basagran+ Roundup	55.1	70.8	5.60	896.3	0.972	51.5	73.3	5.50	879.1	1.012
	Topik + Basagran+ Roundup	48.5	62.2	5.27	917.1	0.896	51.6	70.2	5.55	944.1	0.978
	Hand hoeing twice+ Hand pulling	41.8	57.1	5.93	934.0	1.003	45.7	69.3	5.98	978.6	0.973
	Hand hoeing twice+ Roundup	55.1	70.9	5.95	960.3	0.966	54.1	66.0	6.12	983.2	0.983
	Unweeded (control).	36.2	46.5	3.18	630.6	0.781	35.6	48.1	3.10	892.2	0.583
L.S.D at 0.05		3.61	4.63	2.38	55.65	0.12	2.66	5.64	2.36	76.07	0.08

Table 13: Effect of the interaction between water regimes, varieties and weed control treatments on yield and yield components and water use efficiency in 2012/13 and 2013/14 seasons.

water regimes	Varieties	Weed control treatments	Total weeds (g/m ²)	Days of broomrape emergence	Seed yield (ard/fed)	WUE (Kg/m ³)	Total weeds (g/m ²)	Days of broomrape emergence	Seed yield (ard/fed)	WUE (Kg/m ³)
100% FC	Giza843	Select-super+ Basagran+ Roundup	142.4	121.3	6.87	0.975	132.7	133.0	6.97	0.968
		Topik + Basagran+ Roundup	116.7	125.3	5.83	0.898	116.6	132.7	6.17	0.942
		Hand hoeing twice+ Hand pulling	86.6	125.7	6.83	0.979	72.0	133.0	7.00	1.035
		Hand hoeing twice+ Roundup	74.1	124.3	6.23	0.869	54.0	132.3	6.93	0.952
		Unweeded (control).	417.4	134.7	4.40	0.926	382.2	137.0	4.70	0.837
	Misr3	Select-super+ Basagran+ Roundup	119.2	122.0	7.17	0.947	117.6	111.7	7.37	0.928
		Topik + Basagran+ Roundup	105.3	120.3	7.13	0.967	113.9	117.7	6.97	0.949
		Hand hoeing twice+ Hand pulling	82.5	121.7	6.83	0.968	69.5	114.7	6.70	0.964
		Hand hoeing twice+ Roundup	64.3	121.0	7.07	0.980	61.6	119.0	7.23	0.957
		Unweeded (control).	516.8	129.7	4.70	0.835	451.8	122.3	4.43	0.923
	Nubaria3	Select-super+ Basagran+ Roundup	73.4	128.0	6.13	0.969	64.8	131.7	6.33	0.971
		Topik + Basagran+ Roundup	71.2	128.3	6.63	0.965	64.7	129.3	6.57	0.928
		Hand hoeing twice+ Hand pulling	57.5	129.0	7.00	0.944	53.4	125.0	7.13	0.928
		Hand hoeing twice+ Roundup	51.0	131.3	7.67	0.992	49.0	131.3	7.77	0.929
		Unweeded (control).	389.1	136.3	3.73	0.784	351.5	136.7	4.57	0.790
	Nubarial	Select-super+ Basagran+ Roundup	81.1	129.3	7.33	0.955	67.7	130.0	7.37	0.915
		Topik + Basagran+ Roundup	70.1	134.3	7.60	0.995	70.3	133.0	7.77	0.893
		Hand hoeing twice+ Hand pulling	59.1	134.0	7.17	0.940	51.6	128.7	7.43	0.919
		Hand hoeing twice+ Roundup	60.9	134.0	7.77	0.973	48.3	133.0	8.10	0.881
		Unweeded (control).	365.1	141.3	5.07	0.809	364.6	140.0	5.10	0.905
Sakha4	Select-super+ Basagran+ Roundup	151.5	112.7	6.13	0.959	124.6	115.7	6.17	0.986	
	Topik + Basagran+ Roundup	165.1	117.7	5.77	0.852	118.2	117.3	5.93	0.876	
	Hand hoeing twice+ Hand pulling	124.9	114.3	6.57	0.911	74.0	114.3	6.80	0.868	
	Hand hoeing twice+ Roundup	90.0	118.0	6.63	0.939	73.7	115.3	6.97	0.907	
	Unweeded (control).	672.7	124.3	3.90	0.781	541.2	121.0	3.73	0.589	
60% FC	Giza843	Select-super+ Basagran+ Roundup	63.3	116.7	5.60	0.970	72.5	88.3	5.53	1.039
		Topik + Basagran+ Roundup	62.3	118.7	5.07	0.935	64.3	89.7	4.80	0.983
		Hand hoeing twice+ Hand pulling	55.0	118.0	5.97	1.104	49.1	80.3	5.87	1.072
		Hand hoeing twice+ Roundup	44.1	120.0	5.53	1.054	43.0	84.0	6.13	1.007
		Unweeded (control).	344.9	121.7	3.31	1.033	314.6	116.3	3.83	0.671
	Misr3	Select-super+ Basagran+ Roundup	73.5	113.0	5.80	1.158	82.2	89.3	5.93	1.020
		Topik + Basagran+ Roundup	72.0	102.0	6.17	1.057	85.0	92.3	5.27	0.994
		Hand hoeing twice+ Hand pulling	56.2	104.0	5.73	1.087	64.8	89.0	5.80	1.121
		Hand hoeing twice+ Roundup	38.8	108.0	6.07	1.072	46.1	92.7	5.50	1.137
		Unweeded (control).	343.8	115.3	3.63	0.855	339.3	110.3	3.50	0.809
	Nubaria3	Select-super+ Basagran+ Roundup	38.0	120.7	4.63	0.929	38.1	118.3	4.83	1.036
		Topik + Basagran+ Roundup	40.3	117.0	5.33	1.080	44.8	122.7	5.23	1.109
		Hand hoeing twice+ Hand pulling	28.5	120.0	5.93	1.092	33.3	119.0	5.43	1.156
		Hand hoeing twice+ Roundup	31.4	117.3	6.17	1.390	26.8	122.7	6.47	1.156
		Unweeded (control).	262.2	129.3	2.93	0.768	231.9	124.7	3.13	0.789
	Nubarial	Select-super+ Basagran+ Roundup	44.4	129.7	5.77	1.108	46.0	121.7	5.77	1.134
		Topik + Basagran+ Roundup	44.3	124.7	5.07	1.133	46.3	119.0	6.00	1.093
		Hand hoeing twice+ Hand pulling	36.5	125.3	5.70	1.135	36.4	117.0	5.80	1.152
		Hand hoeing twice+ Roundup	35.2	121.3	6.40	1.152	36.8	121.7	6.70	1.092
		Unweeded (control).	318.4	133.7	4.00	0.917	272.3	129.3	3.63	0.795
Sakha4	Select-super+ Basagran+ Roundup	85.1	93.0	4.87	0.985	78.6	95.7	4.73	1.038	
	Topik + Basagran+ Roundup	81.4	91.0	4.77	0.940	81.5	94.7	4.90	1.079	
	Hand hoeing twice+ Hand pulling	58.9	87.7	5.40	1.095	71.1	91.7	5.63	1.079	
	Hand hoeing twice+ Roundup	60.0	92.0	4.90	0.992	63.0	97.7	5.53	1.056	
	Unweeded (control).	374.3	114.3	2.97	0.780	380.7	107.3	2.73	0.577	
L.S.D at 0.05		32.75	5.11	2.52	0.17	20.79	3.76	2.85	0.11	

- On faba bean yield and yield components

Table 13 show that highest values of seed yield (ard/fed) obtained by water regimes at 100% FC with

sowing of Nubarial (7.77 and 8.10 ard/fed) and Nubaria3 (7.67 and 7.77 ard/fed) under (Select-super + Basagran + Roundup) in both seasons. The highest

values of water use efficiency were attained by faba bean varieties Nubarial in the first season and Nubarial in the second season both under (Select-super + Basagran + Roundup) with values of 1.390 and 1.156 (Kg/m³) compared to the lowest values resulted from faba bean variety Nubarial in the first season and Sakha4 in the second season both under unweeded control treatment with values of 0.768 and 0.577 (Kg/m³) in both seasons, respectively. These results suggest that weed and broomrape management increase water use efficiency for water use to produce faba bean production due to elimination the injury of such pests on faba bean production.

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تأثير الإجهاد المائي ومعاملات مكافحة الحشائش علي مكافحة الحشائش والهالوك في بعض أصناف الفول البلدي

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أجريت هذه الدراسة في المزرعة البحثية لمحطة بحوث شنديول محافظة سوهاج بجنوب مصر على ارض مصابة طبيعياً بالهالوك. وذلك لدراسة تأثير الإجهاد المائي ومعاملات مكافحة الحشائش والهالوك علي انتاجية بعض اصناف الفول البلدي. وقد استخدم تصميم القطع المنشقة مرتين مع ثلاثة مكررات حيث تم وضع معاملات الإجهاد المائي أو نظم الري في القطع الرئيسية (الري بمعدل ٦٠ و ١٠٠٪ من السعة الحقلية) ووضعت أصناف الفول البلدي (جيزة ٨٤٣ - مصر ٣ - نوبارية ١ - نوبارية ٣ - سخاء) في القطع الشقية الأولى ووزعت عشوائياً معاملات مكافحة الحشائش والهالوك (سلكت سوبر بمعدل ٥٠٠ سم^٣/فدان + بازران بمعدل ٥٠٠ سم^٣/فدان + راونداب مرتين بمعدل ٧٥ سم^٣/فدان - توبيك بمعدل ١٤٠ جم/ف+ بازران بمعدل ٥٠٠ سم^٣/فدان + راونداب مرتين بمعدل ٧٥ سم^٣/فدان - عزيق يدوي للحشائش بعد ١٨ و ٣٠ يوم من الزراعة + نقاوة يدوية للهالوك عند ظهوره فوق سطح التربة - عزيق يدوي للحشائش بعد ١٨ و ٣٠ يوم من الزراعة + راونداب مرتين للهالوك بمعدل ٧٥ سم^٣/فدان - بدون معاملة) في القطع الشقية الثانية. أشارت النتائج الي انخفاض الوزن الجاف للحشائش الكلية بنسبة ٣٥.٨٥ و ٢٨.٢٢٪ في الموسم الأول والثاني علي التوالي عند استخدام الري بنسبة ٦٠٪ بالمقارنة بالري بنسبة ١٠٠٪ من السعة الحقلية في الموسمين. أدى الري عند ١٠٠٪ من السعة الحقلية الي انخفاض عدد ووزن شمراخ الهالوك/م^٢ بنسبة ٣٠.٤٤ و ٣١.٩٠٪ في الموسم الأول و ٢٣.١٣ و ٢٤.٣٥٪ في الموسم الثاني وكما أدى الي تأخير ظهور الهالوك فوق سطح التربة وزيادة المحصول ومكوناته مقارنة بالري عند ٦٠٪ من السعة الحقلية في الموسمين. بلغ الاستهلاك المائي للفول البلدي (٩٩٢.٥ و ٧٣٧.١) و (١٠٤٦.٦ و ٧٥٨.٠) م^٣/فدان عند الري ١٠٠ و ٦٠٪ من السعة الحقلية. سجل الري عند ٦٠٪ أعلى قيمة لكفاءة استعمال للماء والتي بلغت ١.٠٣٣ و ١.٠٠٨ كجم/م^٣ في الموسمين. سجل الصنف سخاء أعلى قيمة للاستهلاك المائي (٨٨٢.٥ و ٩٣٥.٦ م^٣/ف) وكفاءة استعمال للماء (١.٠٠٨ و ٠.٩٨٠ كجم/م^٣) في الموسمين. توقيت اصناف نوبارية ١ وجيزة ٨٤٣ ونوبارية ٣ في زيادة المحصول ومكوناته من خلال تقليل وزن الحشائش الضيقة والعريضة والكلية في الموسمين نظراً لزيادة ارتفاع النباتات وكذلك زيادة عدد الأفرع/نبات بالمقارنة بالأصناف الأخرى. كانت أصناف جيزة ٨٤٣ ومصر ٣ مقاوم جزئياً للإصابة وسخاء متحملاً للإصابة بالهالوك يعكس أصناف نوبارية ١ و ٣ التي كانت أكثر حساسية وذلك في الموسمين. أنقصت معاملات مكافحة الحشائش معنويًا الوزن الجاف للحشائش الضيقة والعريضة والكلية وكذلك تقليل عدد ووزن شمراخ الهالوك وزيادة المحصول ومكوناته في الموسمين عن معاملة المقارنة. كما ادي استخدام سوبر + بازران + راونداب ومعاملة عزيق يدوي للحشائش بعد ١٨ و ٣٠ يوم من الزراعة + نقاوة يدوية للهالوك عند ظهوره فوق سطح التربة كانت أفضل المعاملات في تقليل وزن الحشائش وعدد ووزن شمراخ الهالوك علاوة علي تأخير ظهور الهالوك فوق سطح التربة وزيادة المحصول ومكوناته في الموسمين بالمقارنة بمعاملة الكنترول. كانت التفاعلات بين نظم الري وأصناف الفول البلدي وبين نظم الري ومعاملات مكافحة الحشائش وكذلك الأصناف ومعاملات مكافحة الحشائش ونظم الري والأصناف ومعاملات مكافحة الحشائش معنوية التأثير علي الوزن الجاف للحشائش وصفات الهالوك والاستهلاك المائي وكفاءة استخدام الماء والمحصول ومكوناته في الموسمين. يمكن التوصية بزراعة الصنف جيزة ٨٤٣ ومصر ٣ لانه مقاوم نسبياً للإصابة بالهالوك أو زراعة الصنف سخاء لانه متحمل الإصابة بالهالوك. كما يمكن الري بمعدل ٦٠٪ لتقليل لاستهلاك المياه والحصول علي محصول بذور من الفول مرتفع نسبياً. كما يمكن استخدام مبيد سلكت سوبر بمعدل ٥٠٠ سم^٣/ف+ بازران بمعدل ٥٠٠ سم^٣/ف+ مبيد الراونداب مرتان بمعدل ٧٥ سم^٣/ف للحصول علي أعلى نسبة مكافحة للحشائش والهالوك وأعلى محصول من بذور الفول البلدي.