

**GARLIC RELAY INTERCROPPING WITH SELECTED
FABA BEAN CULTIVARS AND ROUND UP HERBICIDE
FOR BROOMRAPE CONTROL AND ENHANCING CROP
PRODUCTIVITY AND ECONOMIC RETURN**

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ABSTRACT

*The present study was conducted under naturally infested soils with broomrape (*Orobanche crenata* Forsk.), at El-Gemmeiza Research Station, Agricultural Research Center, Gharbia governorate, Egypt during 2022/2023 and 2023/2024 seasons. The aim of this study was to compare the using of four faba bean cultivars (Giza 429- Misr 1- Giza 716- Giza 3) under three densities of garlic relay intercropping with two applications of Round up star on controlling broomrape and improvement of faba bean productivity and quality. A split plot design was used with three replicates; the main plots were assigned to cultivars, while the subplots were assigned to garlic densities as single row at 150 kg, two rows at 300 kg and three rows at 450 kg/feddan, roundup herbicide at 75 cm/feddan twice applications, hand pulling twice and untreated control. The highest significant reduction in broomrape infestation which was reflected in the greatest increase in faba bean yield and components as well as improvements in protein, proline and carbohydrate contents together with the highest net return and benefit/cost ratio for seed and straw yields was obtained by the cultivars Giza 429 and Misr 1 when treated with Round up star at 75 cm/feddan at the flowering stage and again after 21days interval. The next best results were achieved by these two cultivars when grown under garlic intercropping at the previous three densities gradually.*

Key words: *Faba bean, Orobanche crenata, garlic, Hand bulling, Round up, Net income.*

INTRODUCTION

One of Egypt's major winter legume crops for human food is the faba bean (*Vicia faba* L.); it is the fourth most important leguminous crop in the world. Its seeds contain about 58% carbohydrate, 26% protein, 2% fat, some vitamins (vitamin B1, vitamin B2, vitamin B3, vitamin B6, vitamin B9, vitamin C and vitamin K) and some minerals (calcium, copper, iron, manganese, magnesium, potassium, selenium, sodium and zinc) (Alghamdi 2009). It is also a good source of lysine-rich protein and good source of levadopa (L-dopa) a precursor of dopamine, and it can be potentially used as medicine for the treatment of Parkinson's disease (Singh *et al* 2013), so that it is a common breakfast food in Egypt and the best crop. Because of their ability for N₂-fixation through root nodule bacteria, which are crucial for improving soil fertility, faba beans are an important part of Egypt's crop rotations. But the production of faba beans has significantly decreased due to foliar diseases such as chocolate spots and rust diseases), aphids, and broomrape.

The broomrape (*Orobanche crenata* Forsk.) is one of the most important species in the Middle East and Mediterranean. It is an obligate parasitic plant, which attach itself to the roots of many plant species with haustorium and obtain nutrients and water from its host. In Egypt broomrape parasitic weed is a detrimental pest for the cultivation of faba bean which cause significant losses in the yield of faba bean up to 80%. Some cases make farmers stop to growing faba bean under heavy infestation conditions (Abd El-Ghafar *et al* 2024). The parasitism by broomrape significantly reduced the dry weight/plant, plant height, the number of branches/plant, the number of mature pods/plant and seed yield kg/fed. In addition, the carbohydrates were much lower in the *Orobanche* parasitized faba bean plants compared to values in the free-infested ones Ghobashy (1997). Up till now no single control measure is sufficient by itself to control this parasite in this crop. Thus, a successful strategy for broomrape management that depends on adopting of integral effects of the combination of tolerant cultivars and rationale chemical control measures and suitable cultural practices is necessary (Eid *et al* 2017). EL-Metwally *et al* (2013) reported that glyphosate application twice at the rate of 178.7 cc/ha had got broomrape control by 96-99.1% and enhanced faba bean seed yield /feddan by 100-149.5 kg. than untreated infested plants. The effects of Round up on broomrape tubercle are attributable to its selective accumulation in the young parasite plant up to a level of three times as high as that in faba bean root three days after spraying (Hassanein and Kholosy 1997; Fernández-Aparicio *et al* 2016).

Trap or companion crops can be defined as false-host plants which turn out of exudates that support broomrape germination, but they don't permit the broomrape to attach the roots or develop tubercles and do not hamper the growth and yield of crops (Dhanapal *et al* 1996).

Some studies have indicated that trap crops could significantly contribute by encouraging the germination of root parasites without becoming parasitized themselves (Fernández-Aparicio *et al* 2009). Current strategies for managing broomrapes emphasize decreasing the soil seed bank, preventing seed production, and limiting the movement of seeds from infested areas to those that are not (Rubiales *et al* 2009). Intercropping

garlic, onion or caraway with faba bean minimized both pre and post-emergence damping-off and root rot compared to growing faba bean alone (Mousa and El-Sayed 2016). Similarly, intercropping faba bean with fenugreek, lupine, Egyptian clover, or flax decreased *O. crenata* infestations and resulted in higher yields, LER, and net returns (Safina 2017). The suppression of *O. crenata* seed germination when fenugreek was intercropped with leguminous plants is attributed to allelopathy and the isolation of the primary inhibiting metabolite (Abbes *et al* 2019). Nevertheless, the levels of *Orobanch*e infestation differed among the various intercropped species (Abu-Shall and Ragheb 2014). Also, intercropping garlic with faba bean exhibited highly significant decreasing in the number of spikes/plot and dry weight of spikes/plot compared to sole faba bean (Amira *et al* 2022). The decomposed garlic stalk showed marketable allelopathic effect on growth of lettuce plant. These findings provide evidence that the decomposed garlic stalk may contain some **allelochemicals** and causes allelopathy through releasing the allelochemicals to environment (Xu *et al* 2013). EL-Sherbeni *et al* (2021) found that the highest reduction percentage on number and dry weight of broomrape spikes obtained by garlic, fenugreek and hand pulling were (74.5, 72.6 and 67%) and (72.2, 69.9 and 61.3%), respectively, in both seasons, as compared with untreated plots. The interaction between cultivars and trap crops gave the highest reduction in the number and dry weight of broomrape spikes which reflected on yield and its components. They found that the best seed yield was obtained from the interaction between faba bean cultivar Giza 843 with glyphosate once or twice and garlic as a trap crop seemed to be excellent treatments in controlling broomrape in faba bean fields.

This study was conducted to compare the impact of four faba bean cultivars (Giza 429, Misr 1, Giza 716 and Giza 3) under three densities of garlic intercropping with these cultivars treated by two applications of Round up Star on suppression of *Orobanch*e *crenata* enhancing the productivity of faba bean and increasing economic return.

MATERIALS AND METHODS

The present study was carried out at El-Gemmeiza Research Station, Gharbia Governorate, Egypt, during the 2022/2023 and 2023/2024 growing

seasons. This study aimed to investigate the effect of relay intercropping faba bean cultivars with garlic (trap crop) compared to spraying with Round up on the productivity of faba bean cultivars. The field was heavily and naturally infested with *Orobanche crenata* seeds. The preceding crop was maize (*Zea mays* L.) in both seasons. The origin and pedigree of the studied cultivars are presented in Table (1).

Table 1. The pedigree and *Orobanche spp* reaction of the genotypes used in the study.

No.	Cultivars	Pedigree	<i>Orobanche spp</i> reaction
1	Giza 429	Individual plant selection from Giza 402	Tolerant
2	Misr 1	Giza 3 X 123 A / 45 / 76	Tolerant
3	Giza 716	461/842/83 X 503/453/83	Susceptible
4	Giza 3	Giza 1 X NA29	Susceptible

The mechanical and chemical analysis of the experimental site soil is presented in Table (2), according to Jackson (1973).

Table 2. Physical and chemical properties of the soils (0-30 cm).

Seasons	Organic matter (%)	pH soil	Sand (%)	Silt (%)	Clay (%)	Texture class	N (ppm)	P (ppm)	K (ppm)
2022/23	1.30	7.5	20.7	30.5	48.8	Clay	32.0	2.42	244
2023/24	1.65	7.7	21.54	28.16	50.3	Clay	33.0	2.64	246

Three rates of garlic (150, 300 and 450 kg/fed) were used as a trap crop, seeds were planted on 16th and 19th of September in the first and second seasons, respectively, while faba bean seeds were sown on 14th and 16th of November in the first and second seasons, respectively.

A split plot design in RCBD arrangement was used with three replications; the main plots were randomly devoted to four cultivars; the sub plots were randomly devoted to broomrape control treatments as follow:

A- Main plots (cultivars of faba bean):

Giza 429, Misr 1, Giza 716 and Giza 3

B-Sub plots (broomrape control treatments):

T1: Planting faba bean seeds on the top of ridge 20 cm between hills, two seeds / hill, while garlic was sown in hills at 20 cm spacing on one side of faba bean ridge (one row at 150 kg /fed) (Fig. 1a).

T2: Planting faba bean plants on the top of ridge 20 cm between hills, two seeds / hill, while garlic was sown in hills at 20 cm spacing on the both sides of ridge (two rows at 300 kg /fed) (Fig. 1b).

T3: Planting faba bean plants on the top of ridge 20 cm between hills, two seeds / hill, while garlic was sown in hills at 20 cm spacing on the both sides of ridge, the third row grown between hills of faba bean (three rows at 450 kg /fed) (Fig. 1c).

T4: Round up star 44.1% SLapplied twice at 75 cm fed⁻¹ at the beginning of faba bean flowering stage and the same rate after 21 days interval. The Round up herbicide in both experiments was sprayed by knapsack sprayer CP3 with a water volume of 200 liters fed⁻¹.

T5: Hand pulling of *Orobanche* spikes (twice) at 80 and 100 days from sowing.

T6: Untreated (control).

The experimental plot consisted of five rows 70 cm apart and 3 m long (3.5 x 3 m = 10.5 m²). Recommended agricultural practices for faba bean and garlic production were applied at the proper time. In both seasons, calcium superphosphate fertilizer was used at 150 kg P₂O₅/fed during land preparation.

Data recorded

On broomrape weed:

Date of *Orobanche* emergence was at 70 days from the sowing. Prior to faba bean harvesting number of *Orobanche* spikes/m², *Orobanche* spikes dry weight (g/m²), and *Orobanche* spike length (cm) were estimated.

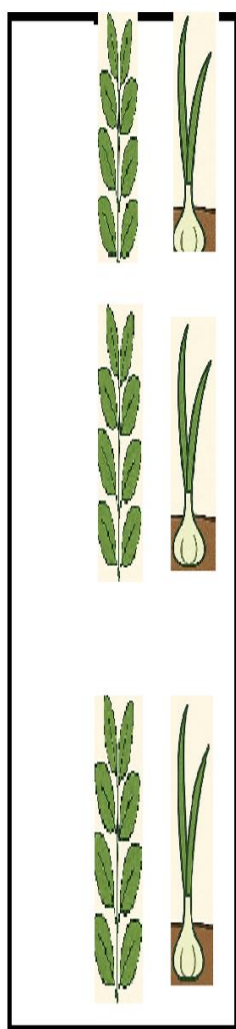


Fig. 1a. Garlic single row

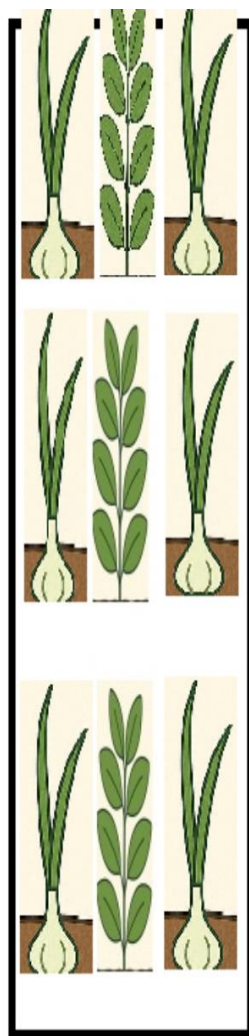


Fig. 1b. Garlic two rows

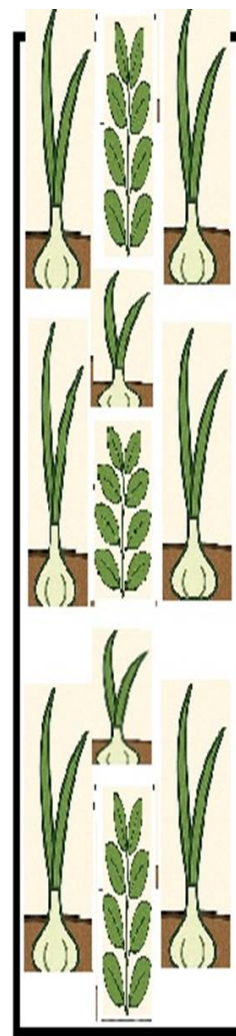


Fig. 1c. Garlic three rows

Fig.1. Planting method of faba bean and garlic on the ridge.

Faba bean yield and its component criteria

At harvest, 15th April, samples of ten plants were collected randomly from the central rows of each plot to study the following criteria: number of branches/plant, number of pods/plant, number of seeds/plant, 100-seed weight (g) and seed yield/plant (g), while straw yield (ton/fed) and seed yield (ardab/fed) were calculated for the whole plots area.

Biochemical analysis of seed samples

a. Determination of total proteins

Total nitrogen was determined using the modified Micro-Kjeldahl method (AOAC 1988). The total protein was calculated by multiplying the values of total nitrogen by 6.25.

b. Determination of amino acid prolines

Proline content of leaves (mg g⁻¹FW) was determined according to Bates *et al* (1973)

c. Determination of total carbohydrates content

Total carbohydrates were determined in the dried seeds, using phenol sulphuric method (Dubois *et al* 1956).

Economic evaluation

Economic evaluation due to broomrape control treatments was calculated according to Heady and Dillon (1961) as follows:

Total costs = costs, fertilization, irrigation, insect, pathogen and weeds control, harvesting and rental value/fed of land preparation, planting, post sowing activities.

Gross income (L.E.) = (faba bean yield (ardab/fed) x price of ardab (L.E.)) + (Straw yield (ton/fed) x price of ton (L.E.) + (garlic yield (ton/fed)) x price of ton (L.E.))

Net benefit (L.E.) = gross income - total cost (L.E.).

Benefit/cost ratio = gross income/total cost.

The average of faba bean price from the Bulletin of Statistical Cost Production and Net Return (2021) were used to compute gross income. The garlic yield prices were 20000 LE/ ton, meanwhile faba bean prices were 4500 LE/ardab of seeds and 620 LE/ ton of straw.

Statistical analysis

The collected data were subjected to proper statistical analysis of split-plot design according to the procedure outlined by Snedecor and Cochran (1980). The least significant differences (LSD) at a 5% significance level were calculated.

RESULTS AND DISCUSSION

Effect of faba bean cultivars on broomrape control:

The data in Table (3), confirmed, the broomrape stems (spikes) emergence above ground. The emergence was delayed with (Giza 429 and Misr 1) cultivars at least two weeks compared to (Giza 716 and Giza 3) as susceptible cultivars. Tantawy *et al* (2022) reported that in sensitive cultivars (e.g., Giza 3, Sakha 1); *Orobanche* emergence occurs early, because these cultivars release higher amounts of germination stimulants, which trigger earlier *Orobanche* seed germination. While tolerant/resistant cultivars (e.g., Giza 843, Misr 3); *Orobanche* spikes emergence were delayed to more than 90 days from the sowing, because these cultivars have biochemical or structural resistance that hinders *Orobanche* attachment and growth. In this study, Giza 429 delaying ratio was about 10%, Misr 1 cultivar recorded 7% and Giza 716 was the lowest one (3%) as compared with Giza 3 cultivar. Susceptible cultivar (Giza 3) recorded the highest mean value (37.9, 279.0 and 39.6) for No. of *Orobanche* spikes/m², *Orobanche* dry weight (g/m²) and *Orobanche* spikes length (cm.), respectively. These results are in agreement with Abd El-Mohsen *et al* (2016). The tolerant cultivar Giza 429 was the best cultivar under *Orobanche* infection in this study followed by Misr 1, therefore, faba bean plants from these cultivars have a low exposure to stress from the broomrape parasitic weeds, allowing them to produce the highest biological yield, seed yield and straw yield under these conditions compared to other genotypes susceptible to broomrape infection. Such findings are in agreement with those obtained by Zeid and Mona (2019). Comparing with Giza 3 cultivar, Giza 429 had a decrease of about 41, 40 and 22% for No. of *Orobanche* spikes/m², *Orobanche* dry weight (g/m²) and *Orobanche* spikes length (cm.), respectively. Additionally, Misr 1 had 37, 37 and 19% for the same traits, respectively. Tantawy *et al* (2022) reported that findings may be explained

by the behavior of the examined cultivars, which is controlled by genetic components and how they interact with the growing season's environmental factors, while El-Degwey *et al* (2010) attributed the difference between tolerant and sensitive genotypes to the production of stimulant or production of inhibitors.

Table 3. Effect of faba bean cultivars and broomrape control treatments on broomrape spikes during 2022/23 and 2023/24 winter seasons.

Cultivars	Broomrape											
	Days to <i>Orobanche</i> emergence			No of <i>Orobanche</i> spikes /m ²			<i>Orobanche</i> dry weight (g / m ²)			<i>Orobanche</i> spike Length (cm)		
	1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean
Giza 429	102.7	97.1	99.87	23.7	21.2	22.5	192.6	142.7	167.7	32.9	29.1	31.0
Misr 1	99.7	94.3	97.01	25.3	22.4	24.0	204.7	149.1	176.9	33.9	30.3	32.1
Giza 716	95.7	90.5	93.07	27.3	24.7	26.1	225.9	166.5	196.2	34.8	31.1	33.0
Giza 3	93.1	88.1	90.55	39.6	36.3	37.9	320.9	237.1	279.0	41.7	37.4	39.6
L.S.D. _{0.05}	3.82	3.35	3.41	8.24	7.74	7.63	58.78	37.89	48.31	3.23	2.50	2.84
Treatments												
Single row of garlic	92.4	87.3	89.9	22.0	19.8	20.9	146.0	107.6	127.8	33.9	29.5	31.7
Two rows of garlic	105.7	99.7	102.6	21.2	18.7	19.9	138.0	103.8	120.9	29.3	25.7	27.5
Three rows of garlic	109.2	103.1	106.1	19.3	17.2	18.3	127.0	95.5	111.2	25.7	21.6	23.6
Round up Star 44.1% SL at 75 cm ³ /fed twice	128.3	121.3	124.8	7.7	6.4	7.0	48.3	37.2	42.8	13.1	11.6	12.3
Hand pulling twice	76.6	72.6	74.6	28.6	25.6	27.2	188.8	141.9	165.3	43.9	38.7	41.3
Untreated control	74.7	71.1	72.8	75.3	69.5	72.5	767.9	555.3	661.6	68.9	64.9	66.9
L.S.D. _{0.05}	7.19	6.57	6.85	2.33	2.05	2.06	22.52	15.21	18.66	3.15	3.59	3.27

Effect of broomrape control treatments on broomrape

In Table (3), there was a significant effect on controlling broomrape infestation with the used treatments. Round up star at 75 cm³/fed at twice applications gave the highest significant reduction on *Orobanche* components: emergency spike's delayed by (71%), both No. of *Orobanche* spikes/m² and *Orobanche* dry weight (g/m²) reduced by (90%) and (94%), respectively. These results are in harmony with results obtained by Kenepere

et al (2023). As a result of applied Round up, supply of nutrients to the underground tubercles of *Orobanche crenata* attachment the host root and their hairs is reduced, leading to starvation and eventually death. Garlic single row, two rows and three rows planting also had a positive effect on delaying *Orobanche* emergence (46%, 41% and 23%, respectively), as well as decreasing No. of *Orobanche* spikes/m² (75%, 73% and 71%, respectively), *Orobanche* dry weight (g/m²) (83%, 82% and 81%, respectively) and *Orobanche* spikes length (cm.) (65%, 59% and 53%, respectively). The more rows planted with garlic, the later appearance of *Orobanche* spikes and lower No. of *Orobanche* spikes /m², *Orobanche* dry weight (g/m²) and *Orobanche* spikes length (cm.) as compared to untreated control treatment. In the same time, hand pulling treatment had high effect in reducing No. of *Orobanche* spikes /m² (62%), *Orobanche* dry weight (g/m²) (75%) as well as *Orobanche* spikes length (cm.) (38%). These results are similar to those found by El-Sherbeni *et al* (2021) who discovered that using glyphosate twice or once, garlic as a trap crop and hand pulling seemed to be excellent treatments in controlling broomrape in faba bean fields. Abu-Shall and Ragheb (2014) studied the effect of intercropping garlic, celery, radish, flax, Egyptian clover and fenugreek with broad bean on reducing *Orobanche crenata* seed bank in the soil. Among the trap crop plants, garlic gave significant highest mean value, followed by flax crop with insignificant difference; the decrease in *Orobanche* infestation by the intercropping system may be due to the fact that these crops secrete some chemicals inhibit the germination of *Orobanche* seeds or prevent the infestation of faba bean by *Orobanche* (Bakheit *et al* 2002). While, Acharya (2012) stated that trap crops or non-host plants stimulate the germination of the parasite seed but cannot be infested and thus reduces seeds in the soil due to suicidal germination.

Effect of faba bean cultivars on seed yield and its components:

Tables (4 and 5) show the effect of faba bean cultivars and broomrape control treatments on seed yield and its components criteria. These tables show that the tolerant cultivars (Giza 429 and Misr 1) had high seed yield and yield components as comparing to the sensitive cultivars Giza 716 and Giza 3.

Table 4. Effect of faba bean cultivars and weed control treatments on No. of branches plant⁻¹, No. of pods plant⁻¹ and No. of seeds plant⁻¹ during 2022/23 and 2023/24 winter seasons.

Cultivars	No. of branches plant ⁻¹			No. of pods plant ⁻¹			No. of seeds plant ⁻¹		
	1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean
Giza 429	3.3	3.0	3.2	12.0	11.2	11.6	39.4	36.7	38.0
Misr 1	3.0	2.9	2.9	9.2	8.7	8.9	30.3	28.5	29.4
Giza 716	2.7	2.5	2.6	7.6	7.5	7.5	24.8	24.7	24.8
Giza 3	2.5	2.4	2.4	6.4	6.0	6.2	21.2	19.7	20.5
L.S.D. _{0.05}	0.63	0.30	4.50	0.59	0.36	4.50	1.98	1.04	1.08
Treatments									
Single row of garlic	2.5	2.4	2.4	7.7	7.3	7.5	25.7	24.4	25.1
Two rows of garlic	3.1	2.9	3.0	9.4	8.8	9.1	31.4	29.3	30.4
Three rows of garlic	3.3	3.1	3.2	10.0	9.6	9.8	33.4	32.1	32.7
Round up Star 44.1% SL at 75 cm ³ /fed twice	3.9	3.7	3.8	12.7	12.2	12.4	42.4	40.6	41.5
Hand pulling twice	2.4	2.2	2.3	7.0	6.7	6.9	22.4	21.3	21.8
Untreated control	2.1	2.0	2.0	5.9	5.4	5.7	18.2	16.7	17.4
L.S.D. _{0.05}	0.37	0.30	3.64	0.58	0.30	3.64	1.83	1.17	1.10

Table 5. Effect of faba bean cultivars and weed control treatments on Seed yield plant⁻¹ (g), 100-seed weight (g), Straw yield ton fed⁻¹ and Seed yield ardab fed⁻¹ during 2022/23 and 2023/24 winter seasons.

Cultivars	Seed yield plant ⁻¹ (g)			100-seed weight (g)			Straw yield ton fed ⁻¹			Seed yield ardab fed ⁻¹		
	1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	mean	1 st	2 nd	Mean
Giza 429	30.90	28.61	29.73	78.18	77.42	77.80	1.77	1.64	1.71	8.24	7.57	7.90
Misr 1	21.37	19.68	20.53	70.06	68.35	69.22	1.43	1.33	1.38	5.68	5.25	5.46
Giza 716	17.40	16.93	17.17	69.42	67.73	68.57	1.19	1.13	1.16	4.58	4.43	4.51
Giza 3	15.67	14.37	15.02	72.14	70.64	71.39	1.35	1.26	1.31	4.13	3.81	3.97
L.S.D. _{0.05}	1.09	0.84	0.50	2.23	2.23	0.97	0.07	0.12	0.09	0.28	0.23	0.22
Treatments												
Single row of garlic	18.60	17.54	18.03	72.11	71.39	71.77	1.31	1.23	1.27	5.04	4.73	4.89
Two rows of garlic	23.42	21.46	22.45	74.16	72.98	73.57	1.62	1.50	1.56	6.35	5.82	6.08
Three rows of garlic	25.17	23.90	24.54	74.94	74.06	74.50	1.71	1.62	1.67	6.82	6.48	6.65
Round up star 44.1% SL at 75 cm ³ /fed twice	32.29	30.65	31.47	75.74	75.05	75.39	1.95	1.85	1.90	8.75	8.30	8.53
Hand pulling twice	15.93	14.65	15.29	69.95	67.36	68.65	1.06	1.00	1.03	3.90	3.60	3.75
Untreated control	12.59	11.16	11.88	67.80	65.38	66.59	0.95	0.84	0.89	3.09	2.66	2.88
L.S.D. _{0.05}	1.50	0.82	0.80	2.32	2.39	1.80	0.10	0.09	0.06	0.46	0.25	0.21

Tantawy *et al* (2022) reported that tolerant cultivars exposed to low stress from broomrape parasitic weed resulted in an increase in seed yield and its components. This is because tolerant cultivars have a greater effect on plant vigor, assimilate formation, and translocation from source to sink, which increases the accumulation of dry matter (mass) in seeds and lowers the rate of seed abortion. This leads to enhanced yield components, which enable them to produce the highest biological yield, seed yield, and straw yield under these conditions in comparison to other genotypes. The same trend was reported by Zeid and Mona (2019).

There were highly significant differences among all genotypes and among treatments under study in both seasons (2022/23 and 2023/24) as well as combined data between them. Giza 429 cultivar was the best one, it recorded high increase in No. of branches, pods, seeds, seed yield plant⁻¹, 100-seed weight (g), straw yield ton fed⁻¹ and seed yield ardab fed⁻¹ as comparing to Giza 3 cultivar; this increase reached about 25%,47%,46%,50%,8%,23% and 50%, respectively. Misr 1 cultivar recorded 17%, 30%,30%, 27%5% and 27% increase for No. of branches, pods, seeds, seed yield plant⁻¹, straw yield ton fed⁻¹ and seed yield ardab fed⁻¹, respectively. Meanwhile Giza 716 cultivar had little increase (8%, 17%,7%,13%, 13% and 12%) for the pervious traits, respectively. 100-seed weight (g) was low in both cultivars Misr 1 and Giza 716 (3% and 4%) as comparing to cultivar Giza 3.

Effect of broomrape control treatments on seed yield and its components criteria:

Tables (4 and 5) indicated that treatment with Round up Star 44.1% SL at 75 cm³/fed twice and garlic three rows planting treatments had also a positive effect on increasing yield and yield components criteria as comparing to other treatments. Faba bean plants grown under these treatments have low exposure to broomrape stress as a result of decreasing No. of *Orobanche* spikes /m², *Orobanche* dry weight (g/m²) and *Orobanche* spikes length (cm) (Table 3). This affects plant vigor, assimilate formation, and its translocation from source to sink. This decreases the rate of seed abortion and increases the accumulation of dry matter (mass) in seeds, leading to improved yield components like number of pods/plant, number of

seeds/pod, and 100-seed weight. Under these circumstances, they can produce the highest biological yield, seed yield, and straw yield.

The Round up Star 44.1% SL at 75 cm³/fed twice had the highest increase; it reached 47%, 54%, 58%, 62%, 53% and 66% for No. of branches, pods, seeds, seed yield plant⁻¹, 100-seed weight (g), straw yield ton fed⁻¹ and seed yield ardab fed⁻¹, respectively as comparing to untreated control treatment. These results are in parallel to those results obtained by Kandil *et al* (2015). There was a positive correlation between increasing number of garlic rows planting and increasing yield and yield components criteria in this study. The garlic three rows planting treatment increased about 38%, 42%, 47%, 52%, 52%, 47% and 57%, for No. of branches, pods, seeds, seed yield plant⁻¹, 100-seed weight (g), straw yield ton fed⁻¹ and seed yield ardab fed⁻¹, respectively. The two garlic rows planting treatment recorded 33%, 37%, 43%, 47%, 47%, 43% and 53% for the pervious criteria, respectively. While the increase in these traits by using garlic single row planting treatment was lower than the last treatment it reached 17%, 24%, 31%, 34%, 34%, 30% and 41% for the same traits, respectively. Hand pulling twice treatment had about 13%, 17%, 20%, 22%, 22 %, 14% and 23% for these traits. El-Sherbeni *et al* (2021) revealed that the increase of seed yield in glyphosate twice or once, garlic as a trap crop and hand pulling treatments was due to the increased number of branches/plant, number of pods/plant, weight of pods (g/plant), seed weight (g/plant) and due to the decrease in the number and dry weight of broomrape spikes.

Effect of faba bean cultivars on chemical composition (proline, protein and carbohydrate) contents:

In general, *Orobanche*, a parasitic plant, significantly impacts the host plant's metabolism, particularly affecting proline, protein, and carbohydrate levels. *Orobanche* infestation can lead to a decrease in host plant carbohydrates, potentially impacting yield and quality. The data presented in Table (6) mentioned that the combined mean values of proline, protein and carbohydrate content were higher in the cultivars (Giza 429, Misr 1 and Giza 716) as comparing to cultivar Giza 3. The increase % in proline content was 22%, 19% and 5% in these cultivars, respectively, as comparing to Giza 3 cultivar.

Table 6. Effect of faba bean cultivars and broomrape control treatments on protein, proline and carbohydrate during 2022/23 and 2023/24 winter seasons.

Cultivars	Proline content%			Protein content%			Carbohydrate content%		
	1 st	2 nd	mean	1 st	2 nd	mean	1 st	2 nd	mean
Giza 429	1.83	1.87	1.85	11.78	12.08	11.93	57.71	61.03	59.37
Misir 1	1.73	1.80	1.77	9.93	10.24	9.70	54.59	56.29	55.45
Giza716	1.48	1.57	1.52	9.42	9.98	9.70	49.45	50.63	50.04
Giza 3	1.42	1.46	1.44	9.11	9.44	9.28	47.64	49.33	48.48
L.S.D. _{0.05}	0.28	0.05	0.16	1.09	0.93	0.99	5.06	2.09	3.35
Treatments									
Single row of garlic	1.54	1.58	1.56	9.34	9.63	9.49	51.33	52.95	52.14
Two rows of garlic	1.70	1.75	1.72	10.34	10.66	10.50	54.74	56.77	55.75
Three rows of garlic	1.77	1.85	1.81	10.73	11.16	10.95	56.65	58.55	57.60
Round up Star 44.1% SL at 75 cm ³ /fed twice	1.88	1.97	1.93	11.69	12.26	11.98	58.20	60.46	59.33
Hand pulling twice	1.46	1.51	1.49	9.28	9.57	9.43	48.36	50.15	49.25
Untreated control	1.33	1.39	1.36	9.00	9.34	9.17	44.80	47.06	45.93
L.S.D. _{0.05}	0.09	0.04	0.05	0.35	0.55	0.41	2.48	1.54	1.75

The same results were found by Marwa *et al* (2024), who measured proline in both cultivars Giza 843 (tolerant) and Nubaria 1 (sensitive) and found that there was high content in Giza 843 as comparing to Nubaria 1. This increase in proline content because it is one of the metabolic products that frequently accumulate in response to variety of environmental stresses. This buildup might be explained by the host root's osmotic potential being reduced, which would limit the flow of water to the broomrape. Additionally, by creating strong cross-links between hydroxyl proline-rich glycol proteins and the cellulose of secondary cell walls, proline might be regarded as one of the key components of plant defense systems.

The same direction was detected in protein and carbohydrate content criteria, the protein content increase with 22%, 8% and 4% in the three cultivars Giza 429, Misir 1 and Giza 716, respectively. Eman *et al* (2012), determined total protein in two cultivars; Giza 3 and Giza 843 under *Orobanche* infection and found that Giza 3 had low total protein; on the contrary, Giza 843 exhibited high level of total protein. Additionally Abbas

et al (2009), stated that the high content of total protein in tolerant faba bean may be due to the fast change of inorganic nitrogen (ammonia and nitrate) to protein that decrease inorganic nitrogen in the phloem of tolerant faba bean. Mean values of the combined data of both years showed that carbohydrate content increased by about 18%, 13% and 3% in the three cultivars Giza 429, Misr 1 and Giza 716, respectively. These results are similar to those found by Marwa *et al* (2024).

Effect of broomrape control treatments on chemical composition (proline, protein and carbohydrate) contents

Table (6) also showed that Round up Star 44.1% SL at 75 cm³/fed twice treatment recorded the highest increase in proline, protein and carbohydrate content than the three garlic planting treatments as comparing to untreated control. Round up star treatment recorded 30% 23% and 23% increase in proline, protein and carbohydrate content, respectively. Followed by garlic three rows planting that had increased 25%, 16% and 20% for the same traits, respectively. Also, garlic two rows planting increased with 21%, 13% and 18%, while garlic one row planting recorded 13, 3 and 12% increase, respectively. The lowest increase was in hand pulling treatment; it had 9, 3 and 7%. These results are similar to seed yield and its components criteria results in Tables (4 and 5). Abd El-Ghafar (2024) and Marwa *et al* (2024) suggested that intercropping systems especially increased yield and its components due to improving endogenous plant hormones, which stimulated the consumption of soluble carbohydrates.

The effect of interaction between faba bean cultivars and broomrape control treatments on broomrape:

The effect of interaction between faba bean cultivars and weed control treatments on broomrape spikes during seasons (2022/2023 and 2023/2024) is presented in Table (7). There were no significant differences in both seasons (2022/23 and 2023/24) as well as combined data between them for days to *Orobanche* emergence and *Orobanche* spikes length (cm.) characters. Giza 429 cultivar treated with Round up Star 44.1% SL at 75 cm³/fed twice was delayed in *Orobanche* emergence (129.7 days after sowing), while Giza 3 cultivar under untreated control was the earliest one (67.9 days after sowing).

Table (7): Effect of interaction between faba bean cultivars and weed control treatments on broomrape spikes during 2022/23 and 2023/24 seasons.

Cultivars	Treatments (rate fed ⁻¹)	Broomrape											
		Days to <i>Orobanche</i> emergence			No of <i>Orobanche</i> spikes /m ²			<i>Orobanche</i> dry weight (g /m ²)			<i>Orobanche</i> spike Length (cm)		
		1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean
Giza 429	Single row of garlic	97.0	91.7	94.3	17.3	15.7	16.7	116.7	89.7	103.2	31.6	27.5	29.6
	Two rows of garlic	110.0	104.0	107.1	16.7	15.0	16.0	111.5	86.0	98.7	22.4	19.2	20.8
	Three rows of garlic	113.3	107.0	110.1	14.0	12.3	13.3	91.5	71.1	81.3	27.5	23.9	25.7
	Round up Star 44.1% SL at 75 cm ³ /fed twice	133.3	126.0	129.7	5.7	4.7	5.0	35.0	27.6	31.3	11.4	9.9	10.6
	Hand pulling twice	82.7	78.3	80.5	25.0	21.7	23.3	159.7	119.3	139.5	41.4	36.9	39.2
	Untreated control	79.7	75.7	77.6	63.3	58.0	60.7	641.0	462.9	252.0	62.9	57.0	60.0
Misr 1	Single row of garlic	94.3	89.3	91.9	18.3	16.0	17.3	119.0	88.1	103.5	32.6	27.9	30.2
	Two rows of garlic	108.0	102.0	105.0	18.0	15.0	16.3	111.6	82.6	97.1	23.8	19.6	21.7
	Three rows of garlic	112.3	106.0	109.1	15.7	13.7	14.7	101.3	75.1	88.2	26.2	23.4	24.8
	Round up Star 44.1% SL at 75 cm ³ /fed twice	130.7	123.3	127.0	5.7	4.7	5.3	37.2	25.8	31.5	12.2	10.6	11.4
	Hand pulling twice	77.7	73.7	75.7	26.0	23.0	24.7	170.3	126.2	148.2	42.3	37.4	39.9
	Untreated control	75.3	71.7	73.4	68.3	62.3	65.7	688.9	496.7	592.8	66.5	62.9	64.7
Giza716	Single row of garlic	89.7	84.7	87.1	26.3	16.3	17.3	120.4	90.5	105.4	32.4	28.0	30.2
	Two rows of garlic	103.0	97.0	99.9	18.3	16.0	17.0	117.9	88.3	103.1	24.2	20.4	22.3
	Three rows of garlic	106.3	100.3	103.3	17.7	15.3	16.3	113.5	86.4	99.9	27.7	24.1	25.9
	Round up Star 44.1% SL at 75 cm ³ /fed twice	126.0	119.0	122.5	7.7	6.3	6.7	47.8	38.0	42.9	12.8	11.2	12.0
	Hand pulling twice	75.3	71.3	73.3	17.3	23.7	25.3	174.7	130.7	152.7	43.4	38.9	41.1
	Untreated control	74.0	70.7	72.4	76.7	70.7	73.7	781.2	565.3	673.3	68.3	64.3	66.3
Giza 3	Single row of garlic	88.7	83.7	86.1	34.0	31.0	32.3	228.0	170.1	199.3	39.3	34.6	37.0
	Two rows of garlic	101.7	95.7	98.5	32.3	28.7	30.3	211.2	158.1	184.6	32.5	27.1	29.8
	Three rows of garlic	104.7	99.0	101.9	30.0	27.3	28.7	201.7	149.4	175.6	35.9	31.3	33.6
	Round up Star 44.1% SL at 75 cm ³ /fed twice	123.3	116.7	120.1	11.7	10.0	11.0	73.2	57.6	65.4	15.9	14.7	15.3
	Hand pulling twice	70.7	67.0	68.8	37.0	34.0	35.3	250.6	191.3	221.0	48.5	41.5	45.0
	Untreated control	69.7	66.3	67.9	92.7	87.0	90.0	960.4	696.3	828.4	78.0	75.2	76.6
L.S.D. _{0.05}		N.S	N.S	N.S	3.87	3.40	3.41	37.33	25.22	30.93	N.S	N.S	N.S
C.V %		7.01	6.77	6.86	7.67	7.45	7.10	9.09	8.33	8.67	8.38	10.69	9.20

The lowest mean value of No. of *Orobanche* spikes/m², *Orobanche* dry weight (g/m²) and *Orobanche* spikes length (cm.) criteria in the combined mean across seasons was found in Giza 429 cultivar treated with Round up Star 44.1% SL at 75 cm³/fed twice; it was 5.0, 31.3 and 10.6 for these traits, respectively. The highest mean value was recorded in Giza 3 cultivar under untreated check.

The effect of interaction between faba bean cultivars and broomrape control treatments on seed yield and its components criteria:

The effect of interaction between faba bean cultivars and weed control treatments on seed yield and its components criteria during seasons (2022/2023 and 2023/2024) was presented in Tables (8 and 9).

Table 8. Effect of interaction between cultivars and weed control treatments on number of branches plant⁻¹, number of pods plant⁻¹ and number of seeds plant⁻¹ during 2022/23 and 2023/24 seasons.

Cultivar _s	Treatments (rate fed ⁻¹)	No. of branches plant ⁻¹			No. of pods plant ⁻¹			No. of seeds plant ⁻¹		
		1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean
Giza 429	Single row of garlic	2.9	2.8	2.8	10.6	9.9	10.2	35.5	32.9	34.2
	Two rows of garlic	3.5	3.3	3.4	12.0	10.6	11.3	40.0	35.4	37.7
	Three rows of garlic	3.7	3.5	3.6	13.1	12.2	12.7	43.6	40.8	42.2
	Round up Star 44.1% SL at 75 cm ³ /fed twice	4.3	4.0	4.2	17.4	16.8	17.1	58.0	56.0	57.0
	Hand pulling twice	2.8	2.6	2.7	10.0	9.5	9.8	32.0	30.4	31.2
	Untreated control	2.4	2.3	2.3	8.8	8.0	8.4	27.1	24.6	25.9
Misr 1	Single row of garlic	2.5	2.5	2.5	8.8	8.2	8.4	29.2	27.2	28.2
	Two rows of garlic	3.4	3.2	3.3	9.4	9.1	9.2	31.3	30.4	30.8
	Three rows of garlic	3.6	3.5	3.5	10.5	10.0	10.2	34.9	33.4	34.2
	Round up Star 44.1% SL at 75 cm ³ /fed twice	4.1	3.9	4.0	12.4	11.8	12.1	41.5	39.3	40.4
	Hand pulling twice	2.4	2.2	2.3	7.5	7.0	7.2	23.9	22.2	23.0
	Untreated control	2.2	2.0	2.1	6.8	6.0	6.4	20.9	18.3	19.6
Giza716	Single row of garlic	2.3	2.2	2.3	6.9	7.0	7.0	23.1	23.33	23.2
	Two rows of garlic	2.9	2.7	2.8	7.9	7.5	7.7	26.4	25.2	25.8
	Three rows of garlic	3.2	3.0	3.1	7.7	8.0	7.8	25.7	26.5	26.1
	Round up Star 44.1% SL at 75 cm ³ /fed twice	3.8	3.6	3.7	11.1	11.0	11.1	37.1	36.8	36.9
	Hand pulling twice	2.3	2.0	2.1	6.8	6.7	6.8	21.6	21.5	21.5
	Untreated control	2.0	1.8	1.9	4.9	4.9	4.9	15.2	15.1	15.1
Giza 3	Single row of garlic	2.2	2.1	2.2	4.6	4.3	4.4	15.2	14.3	14.7
	Two rows of garlic	2.6	2.5	2.5	8.4	7.9	8.2	28.0	26.4	27.2
	Three rows of garlic	2.8	2.6	2.7	8.8	8.3	8.6	29.4	27.6	28.5
	Round up Star 44.1% SL at 75 cm ³ /fed twice	3.5	3.3	3.4	9.9	9.1	9.5	32.9	30.2	31.6
	Hand pulling twice	2.1	2.0	2.0	3.8	3.5	3.6	12.1	11.1	11.6
	Untreated control	1.9	1.8	1.9	3.1	2.9	3.0	9.5	8.8	9.2
L.S.D. _{0.05}		N.S	N.S	N.S	0.96	0.50	3.01	3.04	1.93	1.83
C.V %		12.22	10.68	8.75	6.25	3.42	3.53	6.05	4.06	3.73

N.S = not significant

Table 9. Effect of interaction between cultivars and weed control treatments on Seed yield plant⁻¹ (g), 100-seed weight (g), Straw yield ton fed⁻¹ and Seed yield ardab fed⁻¹ during 2022/23 and 2023/24 seasons.

Cultivars	Treatments (rate fed ⁻¹)	Seed yield plant ⁻¹ (g)			100-seed weight (g)			Straw yield ton fed ⁻¹			Seed yield ardab fed ⁻¹		
		1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean
Giza 429	Single row of garlic	27.04	25.25	25.98	76.34	75.87	76.10	1.66	1.54	1.60	7.33	6.75	7.04
	Two rows of garlic	31.50	27.58	29.54	78.80	78.06	78.43	1.87	1.67	1.77	8.54	7.47	8.01
	Three rows of garlic	34.77	32.32	33.55	79.73	79.29	79.51	1.98	1.89	1.95	9.42	8.76	9.09
	Round up Star 44.1% SL at 75 cm ³ /fed twice	46.62	44.80	45.71	80.36	79.96	80.16	2.46	2.36	2.41	12.63	12.14	12.39
	Hand pulling twice	24.88	23.45	24.17	77.82	77.26	77.54	1.38	1.34	1.36	6.08	5.89	5.99
	Untreated control	20.61	18.24	19.43	76.04	74.08	75.06	1.24	1.04	1.14	5.43	4.37	4.90
Misr 1	Single row of garlic	20.23	18.55	19.39	69.38	68.27	68.92	1.41	1.31	1.36	5.48	5.03	5.25
	Two rows of garlic	22.35	21.17	21.76	71.51	69.68	70.59	1.53	1.46	1.50	6.06	5.74	5.90
	Three rows of garlic	25.18	23.90	24.54	72.18	71.46	71.82	1.70	1.62	1.66	6.82	6.48	6.65
	Round up Star 44.1% SL at 75 cm ³ /fed twice	30.35	28.47	29.42	73.12	72.39	72.76	1.83	1.72	1.78	8.22	7.71	7.97
	Hand pulling twice	16.32	14.35	15.34	68.34	64.78	66.56	1.11	1.00	1.05	4.13	3.62	3.87
	Untreated control	13.77	11.63	12.70	65.81	63.53	64.67	0.99	0.89	0.94	3.35	2.90	3.13
Giza 716	Single row of garlic	15.86	15.91	15.89	68.66	68.21	68.44	1.15	1.08	1.11	4.30	4.31	4.31
	Two rows of garlic	18.70	17.50	18.10	70.82	69.67	70.25	1.32	1.22	1.26	5.07	4.74	4.91
	Three rows of garlic	18.48	18.66	18.58	72.02	70.36	71.19	1.30	1.24	1.27	5.01	5.06	5.03
	Round up Star 44.1% SL at 75 cm ³ /fed twice	27.05	26.37	26.71	73.01	71.82	72.41	1.63	1.60	1.62	7.33	7.14	7.24
	Hand pulling twice	14.44	13.79	14.12	67.00	64.29	65.64	0.94	0.88	0.91	3.35	3.18	3.27
	Untreated control	9.86	9.34	9.60	65.01	62.02	63.52	0.80	0.74	0.77	2.44	2.16	2.30
Giza 3	Single row of garlic	11.26	10.44	10.85	74.05	73.21	73.63	1.03	0.97	1.00	3.05	2.83	2.94
	Two rows of garlic	21.15	19.61	20.38	75.50	74.50	75.00	1.77	1.65	1.71	5.73	5.31	5.52
	Three rows of garlic	22.25	20.74	21.50	75.80	75.14	75.45	1.84	1.74	1.78	6.03	5.62	5.82
	Round up Star 44.1% SL at 75 cm ³ /fed twice	25.14	22.96	24.05	76.47	76.01	76.24	1.88	1.72	1.81	6.81	6.22	6.52
	Hand pulling twice	8.07	7.01	7.54	66.64	63.10	64.87	0.82	0.79	0.80	2.02	1.68	1.85
	Untreated control	6.14	5.44	5.79	64.36	61.91	63.13	0.76	0.68	0.72	1.17	1.21	1.19
L.S.D. _{0.05}		2.48	1.35	1.32	3.85	3.96	2.90	0.16	0.15	0.11	0.76	0.41	0.36
C.V %		6.69	3.91	3.68	3.06	3.20	2.39	9.49	6.36	4.45	7.75	4.47	3.74

There were no significant differences in both seasons (2022/23 and 2023/24) as well as their combined data for No. of branches plant⁻¹ only. Giza 429 cultivar treated with Round up Star 44.1% SL at 75 cm³/fed twice was the best one; it recorded 4.2, 17.1, 57.0, 45.71, 80.16, 2.41 and 12.39 for No. of branches, pods, seeds, seed yield plant⁻¹, 100-seed weight (g), straw yield ton fed⁻¹ and seed yield ardab fed⁻¹, respectively. The lowest mean values 1.9, 3.0, 9.2, 5.79, 63.13, 0.72 and 1.19 for the same criteria, respectively were recorded in Giza 3 cultivar under untreated control.

The effect of interaction between faba bean cultivars and broomrape control treatments on chemical composition (proline, protein and carbohydrate) contents:

The effect of interaction between faba bean cultivars and weed control treatments for chemical composition (proline, protein and carbohydrate) contents during seasons (2022/2023 and 2023/2024) is presented in (Table 10). There were no significant differences in season 2023/24 only for protein content. Giza 429 cultivar treated with Round up Star 44.1% SL at 75 cm³/fed twice had the highest mean value in the combined mean between both seasons (2.19, 13.90 and 61.17) for proline, protein and carbohydrate contents, respectively. While, Giza 3 cultivar under untreated check recorded the lowest mean values (1.28, 8.38 and 42.61) for the pervious traits, respectively.

Economic evaluations:

Table (11) shows that the garlic price was 20000 LE/ ton, meanwhile faba bean prices were 4500 LE/ardab of seeds and 620 LE/ ton of straw. The total income and net return (LE) for all broomrape control treatments with all faba bean cultivars were found to be superior to the Hand pulling twice and Untreated control treatments. The highest net return (LE 42427) and Benefit costs ratio (2.87) was recorded in the cultivar Giza 429 treated with Round Up, followed by the stimulation effect of garlic three and two rows planting recorded LE 35171 and LE 33853 Net return, with Benefit costs ratio of 0.76 and 0.86, respectively. While the lowest net return and Benefit costs ratio were found in Hand pulling twice treatment for the sensitive cultivars Giza 716 and Giza 3, as well as garlic single row treatment in Giza 3 which resulted in negative value.

Table 10. Effect of interaction between cultivars and weed control treatments on protein, proline and carbohydrate during 2022/23 and 2023/24 winter seasons.

Cultivars	Treatments (rate fed ⁻¹)	Proline content %			Protein content %			Carbohydrate content %		
		1 st	2 nd	Mean	1 st	2 nd	Mean	1 st	2 nd	Mean
Giza 429	Single row of garlic	1.55	1.59	1.57	10.83	11.01	10.93	56.95	59.55	58.25
	Two rows of garlic	1.94	1.98	1.96	12.08	12.39	12.24	62.3	66.10	64.20
	Three rows of garlic	1.97	2.05	2.01	12.96	13.28	13.12	63.63	66.53	65.08
	Round up Star 44.1% SL at 75 cm ³ /fed twice	2.14	2.25	2.19	13.65	14.15	13.90	63.42	67.30	65.36
	Hand pulling twice	1.44	1.49	1.47	10.78	11.01	10.90	51.42	54.68	53.05
	Untreated control	1.36	1.42	1.40	10.4	10.63	10.51	48.54	52.03	50.29
Misr 1	Single row of garlic	1.85	1.88	1.87	8.45	8.97	8.72	51.46	53.00	52.23
	Two rows of garlic	1.92	1.97	1.94	9.71	10.15	9.93	58.46	60.05	59.26
	Three rows of garlic	1.96	2.01	1.99	10.23	10.88	10.56	59.39	61.11	60.25
	Round up Star 44.1% SL at 75 cm ³ /fed twice	2.01	2.08	2.05	11.53	12.36	11.95	60.22	62.11	61.17
	Hand pulling twice	1.78	1.82	1.80	8.36	8.74	8.55	51.05	52.85	51.95
	Untreated control	1.45	1.48	1.46	8.27	8.78	8.53	46.98	48.64	47.81
Giza716	Single row of garlic	1.38	1.46	1.42	9.33	9.58	9.46	49.5	50.71	50.11
	Two rows of garlic	1.48	1.55	1.52	10.29	10.60	10.45	50.36	51.20	50.78
	Three rows of garlic	1.67	1.78	1.73	10.37	10.74	10.56	52.45	53.56	53.00
	Round up Star 44.1% SL at 75 cm ³ /fed twice	1.74	1.87	1.81	11.18	11.57	11.38	55.53	56.76	56.15
	Hand pulling twice	1.32	1.38	1.35	9.29	9.56	9.43	46.58	47.76	47.17
	Untreated control	1.27	1.35	1.31	9.12	9.41	9.27	42.25	43.79	43.02
Giza 3	Single row of garlic	1.37	1.41	1.39	8.75	8.95	8.85	47.42	48.53	47.97
	Two rows of garlic	1.45	1.49	1.47	9.29	9.48	9.39	47.83	49.71	48.77
	Three rows of garlic	1.53	1.55	1.53	9.36	9.73	9.55	51.34	52.98	52.16
	Round up Star 44.1% SL at 75 cm ³ /fed twice	1.64	1.70	1.67	10.39	10.97	10.69	53.42	55.66	54.54
	Hand pulling twice	1.3	1.33	1.32	8.69	8.97	8.83	44.4	45.29	44.85
	Untreated control	1.26	1.30	1.28	8.21	8.55	8.38	41.44	43.77	42.61
L.S.D. _{0.05}		0.14	0.07	0.08	0.59	N.S	0.68	4.11	2.56	2.90
C.V %		5.01	2.46	2.76	3.36	5.06	3.83	4.51	2.71	3.13

Table 11. Economic performance of garlic faba bean intercropping system of the mean between both seasons 2022/23 and 2023/24.

Cultivars	Treatments (Rate fed ⁻¹)	Garlic yield	Faba bean yield		Actual yield (L.E)		Total income (L.E)/ Fed	Total cost	Net return L.E/ Fed	Benefit costs ratio
		(Ton/Fed)	Straw weight (Ton/ Fed)	Seed yield (ardab/ fed)	Garlic	Faba bean				
Giza 429	Single row of garlic	0.78	1.60	7.04	15517	32672	48189	23400	24789	1.06
	Two rows of garlic	1.44	1.77	8.01	28833	37120	65953	32100	33853	1.05
	Three rows of garlic	1.71	1.94	9.09	34167	42105	76271	41100	35171	0.86
	Round up Star 44.1% SL at 75 cm ³ /fed twice	-	2.41	12.39	-	57227	57227	14800	42427	2.87
	Hand pulling twice	-	1.36	5.99	-	27776	27776	15600	12176	0.78
	Untreated control	-	1.14	4.90	-	22757	22757	14100	8657	0.61
Misr 1	Single row of garlic	0.72	1.36	5.26	14467	24491	38957	23400	15557	0.67
	Two rows of garlic	1.40	1.50	5.90	28033	27477	55510	32100	23410	0.73
	Three rows of garlic	1.67	1.66	6.65	33333	30954	64288	41100	23188	0.56
	Round up Star 44.1% SL at 75 cm ³ /fed twice	-	1.78	7.97	-	36943	36943	14800	22143	1.50
	Hand pulling twice	-	1.06	3.88	-	18092	18092	15600	2492	0.16
	Untreated control	-	0.94	3.13	-	14645	14645	14100	545	0.04
Giza 716	Single row of garlic	0.59	1.12	4.31	11867	20064	31930	23400	8530	0.36
	Two rows of garlic	1.25	1.27	4.91	25083	22860	47943	32100	15843	0.49
	Three rows of garlic	1.59	1.27	5.04	31750	23445	55195	41100	14095	0.34
	Round up Star 44.1% SL at 75 cm ³ /fed twice	-	1.62	7.24	-	33559	33559	14800	18759	1.27
	Hand pulling twice	-	0.91	3.27	-	15257	15257	15600	-343	-0.02
	Untreated control	-	0.77	2.30	-	10827	10827	14100	-3273	-0.23
Improved Giza 3	Single row of garlic	0.56	1.00	2.94	11233	13850	25083	23400	1683	0.07
	Two rows of garlic	1.22	1.71	5.52	24433	25900	50334	32100	18234	0.57
	Three rows of garlic	1.49	1.79	5.83	29800	27322	57122	41100	16022	0.39
	Round up Star 44.1% SL at 75 cm ³ /fed twice	-	1.80	6.52	-	30434	30434	14800	15634	1.06
	Hand pulling twice	-	0.81	1.85	-	8824	8824	15600	-6776	-0.43
	Untreated control	-	0.72	1.19	-	5801	5801	14100	-8299	-0.59

The garlic yield prices were 20000 LE/T, meanwhile faba bean prices were 4500 LE/ardab of seeds and 620 LE/ T of straw.

Abu-Shall and Ragheb (2014) stated that by planting two or more crops under an intercropping system, the danger of unanticipated price fluctuations may be reduced, perhaps mitigating the effects of unpredictable market pricing. Nath *et al* (2024) also reported that intercropping offers a non-chemical approach to weed control, minimizing the environmental impact associated with herbicide application.

CONCLUSION

Manual removal of the broomrape spikes is not direct method for broomrape control, rather, it helps reduce crop losses and decreases the broomrape seed bank. In fields infested with broomrape, faba bean cultivar. Giza716, which is preferred by some farmers, should not be cultivated as it will suffer yield losses. Instead, tolerant cultivars combined with Round up, since the herbicide control broomrape at an early stages and reduces the seed bank in the soil especially as some seeds may still escape from the spikes exists on the tolerant cultivars. Garlic intercropping with faba bean as a trap crop leads to depletion of the broomrape seed bank, thereby preventing faba bean yield losses, and providing an additional economic return.

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فاعلية التحميل المناوب للثوم مع أصناف مختارة من الفول البلدي ، مع مبيد الراوند أب على مكافحة الهالوك و تحسين إنتاجية الفول البلدي وكذلك العائد الإقتصادي

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أُجريت تجربة في تربة مصابة طبيعيًا ببذور نبات الهالوك (*Orobanche crenata Forsk.*) في محطة بحوث الجميزة، التابعة لمركز البحوث الزراعية، محافظة الغربية، مصر، خلال موسمي ٢٠٢٢/٢٠٢٣ و ٢٠٢٣/٢٠٢٤. تهدف هذه الدراسة إلى مقارنة استخدام أربعة أصناف من الفول البلدي (جيزة ٤٢٩ ، مصر ١ ، جيزة ٧١٦ ، جيزة ٣) تحت ثلاث كثافات من الثوم المحمل بالتناوب على الفول البلدي، مع تطبيق مبيد "راوند أب ستار" مرتين لمكافحة الهالوك وتحسين إنتاجية وجودة الفول البلدي. تم استخدام تصميم القطع المنشقة في ثلاث مكررات؛ تم وضع الاصناف في القطع الرئيسية ، بينما تم تخصيص القطع المنشقة للثلاث كثافات من الثوم حيث استخدم ١٥٠ كجم/الفدان، في زراعة ريشة واحدة ٣٠٠ كجم/الفدان لزراعة ريشتين، ٤٥٠ كجم/فدان لزراعة ٣ ريشة، و تطبيق مبيد الراوند أب بمعدل ٧٥ سم/فدان مرتين و النقاوة اليدوية مرتين والغير معامل. كان أعلى انخفاض في الإصابة بالهالوك والذي انعكس على زيادة كبيرة في محصول الفول البلدي ومكوناته بالإضافة إلى زيادة محتوى البروتين والبرولين والكربوهيدرات جنبًا إلى جنب مع أعلى صافي عائد ونسبة فائدة/تكلفة محصول البذور والقش لصنف جيزة ٤٢٩ و مصر ١ عند استخدام مبيد راوند أب بمعدل ٧٥ سم/فدان في مرحلة الإزهار ومرة أخرى بعد ٢١ يومًا. يلي ذلك زراعة هذين الصنفين محمل مع الثوم بالكثافات الثلاثة المذكورة تدريجيًا.

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