

Effect of Planting Dates, Glyphosate Application on Broomrape (*Orobanche crenata* Forsk) Control, Yield and its Components of Some Faba Bean Cultivars

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Abstract: Two field experiments were carried out at Mallawy Agric. Research Station A.R.C El-Minia Governorate, during the two growing winter seasons of 2020/21 and 2021/22 in a naturally heavily infested soil with broomrape. The objective of this study to find out the best broomrape control package using planting dates (25th October and 15th November), broomrape control treatments (glyphosate twice, glyphosate twice followed by hand pulling and untreated) and some Faba bean cultivars (Misr 3, Giza 843 and Nubaria1). The results indicated that planting Faba bean on 15th November decreased the number and weight of broomrape/m² and increased all Faba bean studied traits. Misr 3 and Giza 843 cultivars surpassed Nubaria1 in reducing number and weight of broomrape /m² and gave the highest Faba bean yield and its attributes in both seasons. The results also revealed that the application of glyphosate twice followed by one hand pulling and glyphosate twice alone reduced the number and weight of broomrape /m² and increased Faba bean yield and its attributes. All interactions significantly affected the number and weight of broomrape /m². The highest reduction in number and weight of broomrape /m² and the highest Faba bean yield and its attributes achieved by the combination of planting Misr3 in 15th of November and the application of glyphosate twice followed by hand removal of the broomrape spikes in both seasons. The correlation between number and weight of broomrape spikes/m² was high significant positive and was high significant negative with all Faba bean traits.

Key words: Broomrape • *Orobanche crenata* Forsk • Glyphosate • Hand pulling and Faba bean

INTRODUCTION

Faba bean (*Vicia faba* L.) is considered as the most important food legume in Egypt. It is very important as source of the plant protein, in addition to the dry seeds contain about 58% carbohydrates, which considered as a good source of energy. Besides its contribution to soil nitrogen fertility through N₂ fixation. The cultivated area in 2022 was 86000 fed. [1]. There is a need to increase total production to meet the increasing demand for Faba bean in Egypt. Broomrape (*Orobanche crenata*, Forsk) is considered as one of the limiting factors of growing Faba bean which can inflict devastating yield losses on Faba bean which led to decrease the Faba bean area in Egypt. However, Faba bean cultivation has declined in last 50 years due to low yields [2]. Broomrapes is a major concern in the Mediterranean Basin and west Asia [3-4]. In Egypt, broomrape can cause a total crop failure, whereas, the percentage of infection by broomrape could

reach up to 90-100% [5]. Sowing date is one of the major factors affecting the growth and development of Faba bean as well as the reduction of broomrape infestation on Faba bean. Sowing Faba bean in November decreased significantly the broomrape infestation in Faba bean compared with October plantation [6].

Fakkar *et al.* [7] revealed that Giza843 and Misr3 varieties recorded the highest reduction percentages of numbers and dry weight of broomrape spikes/m² owing to the delay of broomrape attachment and delayed the emergence above soil surface and consequently escape partially from broomrape injury with these varieties as compared with Nubaria3. Eid *et al.* [8] revealed that both Faba bean varieties Misr 3 and Giza 843 exhibited significant decrease in numbers and weight of broomrape spikes /m² (87.0 %, 91.0% and 53.3%0, respectively comparing with the susceptible variety Giza3 and significantly increased Faba bean yield and its components as compared to variety Giza3. The reduction

of broomrape infestation and the highest Faba bean yield and its components could be achieved by using some tolerant Faba bean cultivars such as Giza 843 and Misr 3 cultivars [9]. Mahmoud and Mona [10] indicated that Misr3 was seen as a very promising variety that generally combines both good yield and low number of emerged broomrape spikes compared to older varieties Giza 843 and Misr 1.

Many researches stated that glyphosate application twice at rate of 178.1 cc /ha gave broomrape control by 96% and increased Faba bean seed yield/fed. 100 % than untreated infested check [11, 12]. Bayoumi *et al.* [13], El-Ghareib *et al.* [9], Eid *et al.* [8] and Abd-El-Haleem *et al.* [14]. reported that broomrape could be controlled by using two applications of Roundup at rate of 75 cm³/fed. which gave the highest reduction of broomrape weight and number and gave the highest growth and seed yield

Marwa *et al.* [15] showed that the highest reduction in number of broomrape spikes /plant, number of broomrape/m² and dry weight of broomrape was recorded for Misr 3 variety with spraying with glyphosate twice by (96.6, 97.9 and 98.0 %) in the first season and by (96.2, 97.2 and 97.5 %) in the second season. El-Metwally *et al.* [11] reported that glyphosate application three times significantly increased seed yield over the unweeded check by 85.1%. El-Degwy *et al.* [16], Gadalla *et al.* [17], Eid *et al.* [8] and El-Ghareib *et al.* [9] reported that it is a necessary to use a complete broomrape control package to achieve the best reduction of broomrape and achieve the highest Faba bean yield and its components in the highly infested soil with broomrape by planting Misr1, Misr 3, or Giza 843 cultivars on November and using 2 applications of Roundup at 75 cm³/fed. Thus, this study was carried out to find the best broomrape control package using planting dates, broomrape control treatments and some Faba bean cultivars.

MATERIALS AND METHODS

Two field experiments were carried out at Mallawy Agric. Research Station A.R.C El-Minia Governorate, Middle Egypt, during the two growing winter seasons of 2020/21 and 2021/22 in a naturally heavily infested soil with broomrape. The objective of this study to find out the best broomrape (*Orobanche crenata* Forsk) control package using planting dates, glyphosate application and some Faba bean cultivars. The soils of this study were silty clay loam texture with 8.05 and 8.14 sand, 52.30 and 54.35 silt and 39.65 and 37.51 clay, pH was 8.01 and 8.14 and organic matter (%) were 1.14 and 1.18 during 2020/21 and 2021/22 seasons, respectively. The

experiment contains eighteen treatments which were the combinations of two planting dates, three Faba bean cultivars and three broomrape control treatments on broomrape and Faba bean yield and its attributes. The experiment laid out in randomized complete block design (RCBD) with four replicates and the treatments were arranged in split- split plot were: the planting dates 25th October and 15th November were allocated in the main plots, Faba bean cultivars: Misr 3, Giza 843 and Nubaria 1 were allocated in the sub-plots and broomrape control treatments were allocated in the sub-sub plots as follows:

- Glyphosate (*N*-(phosphonomethyl) glycine – isopropylamine) known commercially as (Roundup 48% WSC) applied at 75 cc/fed. twice at the beginning of the flowering stage and after 21 days from the first application.
- Roundup 48% WSC applied at 75 cc/fed. twice at the beginning of the flowering stage and after 21 days from the first application followed by broomrape hand pulling one month after the Roundup second application.
- Unweeded check.

Each sub-plot area was 10.5 m² (3.5 m length 3.0 m width) which contains five rows 0.6 m apart. The preceding summer crop was maize in both seasons. Roundup treatments were sprayed using knapsack sprayer (battery sprayer with constant pressure of 5 bar) equipped with one nozzle boom using 200 liters of water/fed. The normal agricultural practices for growing Faba bean (i.e. fertilization, irrigation, pest and diseases control... etc) were applied as recommended for the region During growing seasons, the following data were recorded:

Data Recorded:

- Broomrape: Before Faba bean harvest immediately both number and weight (g/m²) of broomrape spike /m² were recorded.
- Faba bean yield and its attributes: At harvest, samples of ten plants were collected randomly from the central row of each plot and the following criteria were recorded: Plant height (cm), number of branches/plants, number of pods/plants, pods weight /plant (g), seed yield/plant (g) and 100-seed weight (g). Seed yield (kg/plot) were estimated by harvesting the whole plot and seed yield (ardab/fed) was estimated by converting seed yield per plot (kg) to ardab/fed. (one ardab = 160 kg).

Statistical Analysis: All obtained data were subjected to analysis of variance as described by Gomez and Gomez [18]. Least significant difference (LSD) test at 0.05 level was used to compare between means of treatments.

RESULTS AND DISCUSSION

Main Effect

Effect of Planting Dates on

Broomrape: Results recorded in Table (1) show clearly that the effect of planting dates on broomrape. Planting Faba bean on the 15th of November significantly decreased the spike number and weight (g/m²) of broomrape spikes in both seasons, where it has decreased the number of broomrape by 11.35% and 6.23% in the first and second seasons respectively, whereas the reduction in weight of broomrape were 16.84% and 15.67% in the first and second seasons, respectively. As compared with 25th of October planting. This might be due to the reduction in air temperature, which delayed broomrape attachment to Faba bean plants and delayed emergence above soil surface in planting dates of November 15th so partially evaded broomrape harm. These findings agreed with those of El-Ghareib *et al.* [9] and Hassanein *et al.* [19].

Faba Bean Yield and its Attributes: Results presented Table (1) showed that the planting dates significantly affected all Faba bean yield and its attributes in both seasons-except- plant height in the first season and number of branches/plant in the second season. Planting Faba bean in 15th of November significantly increased all studied traits where it is increased plant height (cm) by 10% in the second season and number of branches/plants by 13.13% in the first season only, whereas, it increased the number of pods/plants by (13.23 and 15.0 %), pods weight /plant (g) by (16.66 and 16.0%), seed yield/plant (g) (14.23 and 15.0%) and 100-seed weight(g) by (4.12 and 2.2%) and seed yield (ardab/fed) by (7.30 and 6.3 %) in the first and second season, respectively. The increase of Faba bean yield and its attributes in 15th November plantings may be due to the reduction on broomrape weight and number/m² which increased the assimilation and the accumulation on Faba bean pods and consequently improved the Faba bean yield. Similar results obtained by Mekky *et al.* [6].

Effect of Faba Bean Cultivars on

Broomrape: Data in Table (2) illustrated that the Faba bean cultivars significantly reduced the number and

weight of broomrape in both seasons. Misr 3 and Giza 843 cultivars gave the lowest number and weight of broomrape, where these two cultivars reduced the number of broomrape spikes by (47.02 and 24.95%) in the first season and by (41.97 and 26.52%) in the second season, whereas reduction percentage in broomrape weight were (45.78 and 28.46%) in the first season and (46.69 and 21.49%) in the second season, respectively, as compared with Nubaria1. The reduction of broomrape by Faba bean cultivars may be due to host plants might escape from broomrape infection by reduced plant maturity. The occurrence of phenolics, carbohydrates, proteins and chlorophyll content were also recorded in extracts of host plants. Misr 3 and Giza 843 cultivars accumulated more phenolics, carbohydrate and proteins as defense mechanism against broomrape. These results are in line with those obtained by Fakkar *et al.* [7].

Faba Bean Yield and its Attributes: Results presented in Table (2) shows a significant difference between Faba bean cultivars in all yield and its attributes. Misr 3 and Giza 843 significantly surpassed Nubaria1 cultivar in all studied traits in both seasons. Misr 3 increased plant height (cm) by (12.35 and 12.96%), number of branches/plants by (39.34 and 23.03%), number of pods/plants by (30.97 and 36.60%), weight of pods/plant (g) by (39.12 and 32.60%), seed yield/plant (g) by (36.31 and 24.92%), 100-seed weight (g) by (23.44 and 19.84%) and seed yield (ardab/fed) by (50.93 and 50.11%) in the first season and the second season respectively, as compared to Nubaria1 cultivar. Whereas Giza 843 increased plant height (cm) by (25.81 and 33.75%), number of branches/plants by (45.49 and 26.92%), number of pods/plants by (24.73 and 29.14%), weight of pods/plant (g) by (31.8 and 30.87%), seed yield/plant (g) by (29.79 and 23.90%), 100-seed weight (g) by (15.78 and 14.93%) and seed yield (ardab/fed) by (33.80 and 33.43%) in the first season and the second season respectively, as compared to Nubaria1 cultivar. The increase in all yield and its attributes may be due to the tolerance of these cultivars to broomrape. Similar results were obtained by Eid *et al.* [8], El-Ghareib *et al.* [9] and Marwa *et al.* [15].

Effect of Broomrape Control Treatments on

Broomrape: The effect of broomrape control treatments on broomrape is shown in Table (3). the application of glyphosate twice followed by one hand pulling and glyphosate twice alone reduced significantly the number and weight of broomrape spikes/m² in both. Results showed clearly that these two treatments reduced the

Table 1: Effect of planting date on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Planting dates	No. broomrape spikes/m ²	Weight of broomrape (g/m ²)	Plant height (cm)	No. branches/plant	No. bods/ plant	Bods weight/plant(g)	Seed yield/ plant (g)	100 seeds weight (g)	Seed yield (Ard. /fed).
2020/2021									
25 October	135.11	718.40	97.30	2.91	9.18	115.78	98.69	61.39	5.33
15 November	119.78	594.10	105.30	3.35	10.58	138.92	115.06	64.03	5.75
F-Test	**	**	NS	*	*	**	**	**	**
2021/2022									
25 October	142.8	638.2	107.3	2.8	9.6	111.6	95.3	68.12	5.9
15 November	133.9	538.2	119.2	3.1	11.3	132.8	112.1	69.68	6.3
F-Test	**	**	*	NS	*	**	**	**	**

Table 2: Effect of Faba bean cultivars on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Cultivars	No. broomrape spikes/m ²	Weight of broomrape (g/m ²)	Plant height (cm)	No. branches/plant	No. bods/ plant	Bods weight/plant(g)	Seed yield/ plant (g)	100 seeds weight (g)	Seed yield (Ard. /fed).
2020/2021									
Misir 3	88.83	472.80	101.0	3.40	10.91	143.29	119.38	68.46	6.52
Giza 843	125.83	623.80	113.1	3.55	10.39	135.75	113.67	64.21	5.78
Nubaria 1	167.67	872.00	89.9	2.44	8.33	103.00	87.58	55.46	4.32
LSD 0.05	3.15	30.15	8.7	0.35	0.62	1.09	1.57	0.90	0.08
2021/2022									
Misir 3	104.05	405.80	110.7	3.20	11.72	133.73	111.40	73.99	7.07
Giza 843	131.75	597.60	130.9	3.30	11.08	131.98	110.49	70.96	6.52
Nubaria 1	179.30	761.20	98.00	2.60	8.58	100.85	89.18	61.74	4.71
LSD 0.05	3.33	27.21	9.8	0.32	0.75	1.27	1.44	0.73	0.07

Table 3: Effect of broomrape control treatments on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Broomrape control treatments	No. broomrape spikes/m ²	Weight of broomrape (g/m ²)	Plant height (cm)	No. branches/plant	No. bods/ plant	Bods weight/plant(g)	Seed yield/ plant (g)	100 seeds weight (g)	Seed yield (Ard. /fed).
2020/2021									
Glyphosate	85.83	497.60	100.70	3.16	10.65	136.42	114.58	63.38	5.83
Glyphosate + HW	73.33	312.90	109.50	3.55	12.94	167.42	139.62	66.25	6.31
Untreated	223.17	1158.20	93.80	2.68	6.04	78.21	66.42	58.50	4.48
LSD 0.05	3.16	28.35	7.14	0.31	0.56	1.70	1.38	0.72	0.05
2021/2022									
Glyphosate	98.82	464.60	111.60	3.00	11.40	129.62	108.79	69.63	6.43
Glyphosate + HW	79.30	294.90	124.80	3.30	14.20	147.31	122.90	71.63	6.74
Untreated	236.98	1005.20	103.20	2.60	5.80	89.63	79.37	65.43	5.12
LSD 0.05	3.55	25.01	7.92	0.27	0.68	1.81	1.98	0.64	0.05

broomrape spikes no./m² by (67.14 and 61.54%) in the first season and (66.54, 58.30%) in the second season, respectively as compared to untreated. Whereas the reduction percent in weight of broomrape were (72.98 and 57.04%) in the first season and (70.66 and 53.78%) in the second season, respectively. These results are in line with those obtained by Eid *et al.* [8], El-Ghareib *et al.* [9] El-Metwally *et al.* [11], Bayoumi *et al.* [13], Abd-El-Haleem *et al.* [14].

Faba Bean Yield and its Attributes: Results in Table (3) cleared that the broomrape control treatments significantly increased all Faba bean yield and its attributes. The application of glyphosate twice followed

by one hand pulling increased plant height (cm) by (16.74 and 20.93%), no. of branches/plants by (32.46 and 26.92%), no. of pods/plants by (114.24 and 144.83%), weight of pods/plant (g) by (114.06 and 64.35%), seed yield/plant (g) by (110.21 and 54.84%), 100-seed weight (g) by (13.25 and 9.48%) and seed yield (ardab/fed) by (40.85 and 31.64%) in the first season and second season, respectively as compared to the unweeded treatment. Whereas, glyphosate twice alone increased plant height (cm) by (7.36 and 8.14%), no. of branches/plants by (17.91 and 15.38%), no. of pods/plants by (76.32 and 96.55%), weight of pods/plant (g) by (74.43 and 44.62%), seed yield/plant (g) by (72.51 and 37.07%), 100-seed weight (g) by (8.43 and 6.42%) and seed yield (ardab/fed)

by (30.13 and 25.95%) in the first season and second season, respectively, as compared to the unweeded treatment. The increases in all yield and its attributes may be to the efficacy of these treatments on controlling broomrape and decrease its parasitism on Faba bean plants which led to increase the availability of photosynthesis metabolites to be stored in Faba bean. Similar results obtained by El-Metwally *et al.* [11] and Ismail [12].

Effect of Interactions

Interaction Between Planting Dates and Faba Bean Cultivars on

Broomrape: Results in Table (4) indicated that the interaction between planting dates and Faba bean cultivars significantly decreased the number and weight of broomrape/m² in both seasons. The highest reduction on broomrape number/m² (52.5 and 47.4%) and broomrape weight (g/m²) (53.5 and 51.8 %) obtained from planting Misr3 cultivar on 15th of November, in the first and second season, respectively, as compared to planting Nubaria1 cultivar on 25th October.

Faba Bean Yield and its Attributes: Regarding the effect of interaction between planting dates and Faba bean cultivars on Faba bean yield and its attributes, results in Table (4) indicated that planting Misr3 cultivar on 15th of November gave the highest value of pods weight /plant (158 g/plant), seed yield/plant (130 g/plant), 100-seed weight (69 g) and seed yield (6.47ardab/fed) in the

first season and seed yield/plant (119.7 g), seed yield (7.2 ardab/fed) in the second season as compared to planting Nubaria1 cultivar on 25th October which gave the lowest values of these traits. All other Faba bean studied traits didn't show any significant effect by interaction between planting dates and Faba bean cultivar.

Interaction Between Planting Dates and Broomrape Control Treatments on

Broomrape: The effect of interaction between planting dates and broomrape control treatments was statistically significant on both number and weight of broomrape /m² in both seasons. Table (5) shows that planting Faba bean on 15th of November and treating with glyphosate at rate of 75 cm³ twice followed by hand removal of broomrape spikes one month after the second application of glyphosate gave the highest reduction on the number and weight of broomrape/m² in both seasons. The reduction percents were (70.2 and 69%) in number of broomrape and (77.4 and 74.8%) in weight of broomrape respectively in the first and second seasons as compared with planting Faba bean on 25th of October with untreated plots.

Faba Bean Yield and its Attributes: Results in Table (5) indicated that the effect of interaction between planting dates and broomrape control treatments significantly increased pods weight /plant (g), seed yield/plant (g) seed yield (ardab/fed) in both seasons and 100-seed weight (g) the second season only. planting Faba bean on 15th of November and treating with glyphosate at rate of 75 cm³

Table 4: Effect of interaction between planting dates and Faba bean cultivars on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Planting dates	Cultivars	No. broomrape spikes/m ²	Weight of broomrape (g/m ²)	Bods weight/ plant(g)	Seed yield/ plant (g)	100 seeds weight (g)	Seed yield (Ard. /fed).
25 October	Misr 3	93.67	508.3	127.75	108.0	67.92	6.37
	Giza 843	134.33	706.8	126.33	107.9	62.08	5.56
	Nubaria 1	177.33	940.1	93.25	80.1	54.17	4.07
15 November	Misr 3	84.00	437.3	158.83	130.1	69.00	6.67
	Giza 843	117.33	540.8	145.17	119.4	66.33	6.00
	Nubaria 1	158.00	804.0	112.75	95.9	56.75	4.58
LSD 0.05		4.06	51.1	1.54	2.55	1.24	0.11
2021/2022							
25 October	Misr 3	112.40	432.30	121.76	103.1	73.45	6.94
	Giza 843	140.30	657.70	120.20	102.8	70.27	6.39
	Nubaria 1	175.70	824.70	92.80	79.9	60.63	4.43
15 November	Misr 3	95.70	379.30	145.69	119.7	74.54	7.20
	Giza 843	123.20	537.50	143.77	118.2	71.64	6.64
	Nubaria 1	182.90	697.70	108.90	98.4	62.86	4.98
LSD 0.05		4.41	45.82	NS	2.1	NS	0.10

Table 5: Effect of interaction between planting dates and broomrape control treatments on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Planting dates	Broomrape control treatments	No. broomrape spikes/m ²	Weight of broomrape (g/m ²)	Bods weight/plant(g)	Seed yield/ plant (g)	100 seeds weight (g)	Seed yield (Ard. /fed).
25 October	Glyphosate	91.33	530.00	121.92	103.92	62.00	5.63
	Glyphosate + HW	75.67	333.10	153.25	128.75	64.75	6.12
	Untreated	238.33	1292.20	72.17	63.42	57.42	4.25
15 November	Glyphosate	80.33	465.20	150.92	125.25	64.75	6.04
	Glyphosate + HW	71.00	292.70	181.58	150.50	67.75	6.50
	Untreated	208.00	1024.30	84.25	69.42	59.58	4.70
LSD 0.05		4.11	50.35	2.14	2.45	NS	0.09
2021/2022							
25 October	Glyphosate	102.13	512.00	115.40	98.37	68.77	6.24
	Glyphosate + HW	83.42	315.10	136.19	114.43	70.66	6.57
	Untreated	242.83	1087.70	83.17	73.04	64.92	4.96
15 November	Glyphosate	95.51	417.20	143.84	119.22	70.49	6.61
	Glyphosate + HW	75.17	274.70	158.43	131.37	72.60	6.92
	Untreated	231.13	922.70	96.10	85.70	65.95	5.29
LSD 0.05		4.67	44.81	2.16	2.61	0.79	0.08

Table 6: Effect of interaction between Faba bean cultivars and broomrape control treatments on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Cultivars	Broomrape control treatments	No. broomrape spikes/m ²	Weight of broomrape (g/m ²)	No. bods/ plant	Bods weight/plant(g)	Seed yield/ plant (g)	100 seeds weight (g)	Seed yield (Ard. /fed).
Misr 3	Glyphosate	63.50	348.00	11.59	149.00	126.25	68.75	6.75
	Glyphosate + HW	55.50	267.00	14.63	189.75	156.00	71.88	7.43
	Untreated	147.50	803.50	6.53	91.12	75.87	64.75	5.38
Giza 843	Glyphosate	74.50	484.20	11.25	143.88	118.62	64.75	5.94
	Glyphosate + HW	73.50	325.60	13.39	180.38	152.00	68.00	6.35
	Untreated	229.50	1061.60	6.53	83.00	70.38	59.88	5.05
Nubaria 1	Glyphosate	119.50	660.50	9.11	116.38	98.87	56.62	4.81
	Glyphosate + HW	91.00	346.00	10.80	132.12	110.87	58.88	5.15
	Untreated	292.50	1609.60	5.06	60.50	53.00	50.88	3.00
LSD 0.05		5.30	48.56	0.98	2.59	2.42	NS	0.11
2021/2022								
Misr 3	Glyphosate	79.21	324.00	12.53	134.90	114.36	74.81	7.27
	Glyphosate + HW	68.74	249.00	16.21	161.33	132.65	76.59	7.65
	Untreated	164.20	644.50	6.40	104.95	87.18	70.58	6.30
Giza 843	Glyphosate	87.50	466.23	12.12	139.36	114.86	72.36	6.77
	Glyphosate + HW	71.84	307.60	14.71	159.10	134.06	74.25	6.97
	Untreated	235.90	1018.99	6.40	97.50	82.54	66.27	5.81
Nubaria 1	Glyphosate	129.75	603.51	9.54	114.60	97.15	61.72	5.23
	Glyphosate + HW	97.31	328.00	11.58	121.50	102.00	64.05	5.61
	Untreated	310.85	1352.01	4.63	66.45	68.40	59.46	3.27
LSD 0.05		5.85	43.18	1.18	2.80	3.08	1.12	0.09

twice followed by hand removal of broomrape spikes gave the highest values of these traits as compared with planting Faba bean on 25th of October without the application of glyphosate.

Interaction Between Faba Bean Cultivars and Broomrape Control Treatments on

Broomrape: Results presented in Table (6) exhibited that the interaction effect between Faba bean cultivars and

broomrape control treatments significant on the number and weight of broomrape /m². These results indicated that the lowest number and weight of broomrape /m² could be achieved by the combination of planting Misr3 cultivar with the application of glyphosate at rate of 75 cm³ twice followed by hand removal of broomrape, this treatment decreased significantly the number of broomrape spikes/m² by (81.03 and 77.89%) and weight of broomrape /m² by (83.41 and 81.59%) in the first season and second

season respectively, as compared with planting Nubaria1 cultivar without the application of glyphosate. These results according to the scale suggest by Hassanein *et al.* [20] who suggested that Misr3 can be considered as resistant cultivar and Giza 843 as resistant/tolerant cultivar to broomrape infestation and the use of Roundup raised broomrape control package to almost 90% reduction. The obtained results were in agreement with those obtained by Ismail and Fakkar [21].

Faba Bean Yield and its Attributes: Results in Table (6) indicated that the interaction between Faba bean cultivars and broomrape control treatments significantly affected the number of pods/ plant, pods weight /plant (g), seed yield/plant (g) seed yield (ardab/fed) in both seasons and 100-seed weight (g) in the second season only. Misr3 cultivar treated with glyphosate at rate of 75 cm³ twice followed by hand removal of broomrape gave the highest values of number of pods/plant (14.64), pods weight/plant

Table 7: Effect of interaction between planting dates, Faba bean cultivars and broomrape control treatments on broomrape, Faba bean yield and its component in 2020/2021 and 2021/2022 seasons

Planting dates	Cultivars	Broomrape control treatments	No. broomrape spikes	Weight of broomrape (g/m ²)	Bods weight/plant	Seed yield/plant	Seed yield/fed.
2020/2021							
25 Oct.	Misr 3	Glyphosate	68.00	368.00	127.50	109.25	6.70
		Glyphosate + HW	56.00	278.00	168.25	139.50	7.25
		Untreated	157.00	879.00	87.50	75.50	5.15
	Giza 843	Glyphosate	82.00	533.00	129.25	110.00	5.68
		Glyphosate + HW	76.00	353.20	173.25	146.50	6.20
		Untreated	245.00	1234.20	76.50	67.25	4.80
	Nubaria 1	Glyphosate	124.00	689.00	109.00	92.50	4.50
		Glyphosate + HW	95.00	368.00	118.25	100.25	4.90
		Untreated	313.00	1763.20	52.50	47.50	2.80
15 Nov.	Misr 3	Glyphosate	59.00	328.00	170.50	143.25	6.80
		Glyphosate + HW	55.00	256.00	211.25	172.50	7.60
		Untreated	138.00	728.00	94.75	76.25	5.60
	Giza 843	Glyphosate	67.00	435.50	158.50	127.25	6.20
		Glyphosate + HW	71.00	298.00	187.50	157.50	6.50
		Untreated	214.00	889.00	89.50	73.50	5.30
	Nubaria 1	Glyphosate	115.00	632.00	123.75	105.25	5.12
		Glyphosate + HW	87.00	324.00	146.00	121.50	5.40
		Untreated	272.00	1456.00	68.50	58.50	3.20
LSD 0.05		7.33	73.04	3.66	3.60	0.15	
2021/2022							
25 Oct.	Misr 3	Glyphosate	82.12	350.00	121.50	104.13	7.13
		Glyphosate + HW	76.18	260.00	145.88	120.95	7.51
		Untreated	178.90	687.00	97.90	84.20	6.19
	Giza 843	Glyphosate	92.38	515.00	123.40	105.03	6.69
		Glyphosate + HW	75.27	335.20	151.30	127.93	6.86
		Untreated	253.10	1123.00	85.90	75.50	5.63
	Nubaria 1	Glyphosate	131.90	671.00	101.30	85.95	4.91
		Glyphosate + HW	98.82	350.00	111.40	94.43	5.34
		Untreated	296.50	1453.03	65.70	59.43	3.05
15 Nov.	Misr 3	Glyphosate	76.30	298.00	148.30	124.60	7.41
		Glyphosate + HW	61.30	238.00	176.78	144.35	7.79
		Untreated	149.50	602.03	112.00	90.15	6.41
	Giza 843	Glyphosate	82.62	417.50	155.33	124.60	6.86
		Glyphosate + HW	68.40	280.00	166.90	140.20	7.09
		Untreated	218.70	915.00	109.10	89.58	5.98
	Nubaria 1	Glyphosate	127.60	536.03	127.90	108.35	5.56
		Glyphosate + HW	95.80	306.00	131.60	109.55	5.89
		Untreated	325.20	1251.00	67.20	77.38	3.49
LSD 0.05		8.16	NS	3.88	4.39	0.13	

(189.75g), seed yield/plant (156.0g) seed yield (7.43 ardab/fed) in the first season. Whereas, in the second season highest values of number of pods/plant (16.21), pods weight/plant (161.21g), seed yield/plant (132.65g), 100-seed weight (76.59g) and seed yield (7.65 ardab/fed). As compared with untreated Nubaria1 which gave the lowest values of these traits.

Effect of Interaction Between Planting Dates, Faba Bean Cultivars and Broomrape Control Treatments on

Broomrape: Results recorded in Table (7) showed clearly that the number and weight of broomrape /m² significantly decreased by the interaction between planting dates, Faba bean varieties and broomrape control treatments. The highest reduction in the number and weight of broomrape /m² (82.43 and 85.48%) in the first season and (79.33 and 83.62%) in the second season, respectively, obtained from the combination of planting Misr3 cultivar in the 15th of November and the application of glyphosate twice following with hand removal of the broomrape spikes in both seasons, as compared planting Nubaria1 cultivar in 25th October without the application of glyphosate which gave the highest number and weight of broomrape /m² (272 and 1456g) in the first season and (325 and 1251 g) in the second season, respectively.

Faba Bean Yield and its Attributes: Regarding the effect of interaction between planting dates, Faba bean cultivars and broomrape control treatments on Faba bean yield and its attributes, Table (7) indicated a significant effect on

pods weight /plant (g), seed yield/plant (g) seed yield (ardab/fed) in both seasons. The highest values of these traits obtained from the combination of planting Misr3 cultivar in the 15th of November and the application of glyphosate twice following with hand removal of the broomrape spikes in both seasons. Whereas the lowest values of these traits were obtained from planting Nubaria1 cultivar in 25th October without the application of glyphosate in both seasons.

It is observed that the overall seed yield is low due to the high infestation of the trial soil with broomrape and the best package of broomrape control (planting Misr3 cultivar in the 15th of November and the application of glyphosate twice following with hand removal of the broomrape spikes) gave a maximum control percent of 85%.

Correlation Analysis: Results recoded in Table (8) illustrate that the correlation between number and weight of broomrape/m² was high significant positive in both seasons, whereas, the correlation between number and weight of broomrape and all Faba bean traits was high significant negative in both seasons. This means that number and weight of broomrape spikes/m² were more aggressive in their parasitism to seed yield (ardab/fed.) of Faba bean and its attributes. Regarding the correlation between all studied Faba bean traits, it was high significant positive in both seasons, which revealed that the yield increases were positively contributed to the increases in growth characters and yield components.

Table 8: The correlation analysis between the studied traits in 2020/2021 and 2021/2022 seasons

Traits	No. broomrape spikes	Weight of broomrape (g/m ²)	Plant height (cm)	No. branches/ plant	No. bods/ plant	Bods weight/ plant	Seed yield/ plant	100 seeds weight
2020/2021								
No. broomrape spikes	-	-	-	-	-	-	-	-
Weight of broomrape (g/m ²)	0.973 **	-	-	-	-	-	-	-
Plant height (cm)	-0.433 **	-0.454**	-	-	-	-	-	-
No. branches/plant	-0.552**	-0.564**	0.610**	-	-	-	-	-
No. bods/plant	-0.849**	-0.838**	0.493**	0.591**	-	-	-	-
Bods weight/plant	-0.867**	-0.864**	0.548**	0.678**	0.953**	-	-	-
Seed yield/ plant	-0.867**	-0.861**	0.546**	0.675**	0.953**	0.995**	-	-
100 seeds weight	-0.764**	-0.761**	0.506**	0.693**	0.741**	0.796**	0.784**	-
Seed yield/fed.	-0.854**	-0.859**	0.525**	0.692**	0.822**	0.863**	0.855**	0.949**
2021-2022								
No. broomrape spikes	-	-	-	-	-	-	-	-
Weight of broomrape (g/m ²)	0.968**	-	-	-	-	-	-	-
Plant height (cm)	-0.437**	-0.421**	-	-	-	-	-	-
No. branches/plant	-0.511**	-0.503**	0.593**	-	-	-	-	-
No. bods/plant	-0.855**	-0.837**	0.512**	0.548**	-	-	-	-
Bods weight/plant	-0.881**	-0.871**	0.628**	0.671**	0.917**	-	-	-
Seed yield/ plant	-0.837**	-0.845**	0.636**	0.660**	0.925**	0.975**	-	-
100 seeds weight	-0.696**	-0.697**	0.524**	0.667**	0.691**	0.794**	0.778**	-
Seed yield/fed.	-0.827**	-0.831**	0.535**	0.670**	0.754**	0.858**	0.816**	0.927**

CONCLUSION

From the obtained results it could be recommended that to achieve the highest reduction in number and weight of broomrape /m² and the highest Faba bean yield and its attributes is to use a package of broomrape control by planting Misr3 (broomrape tolerant cultivar) in the 15th of November and the application of glyphosate twice followed by hand removal of the broomrape spikes in both seasons.

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