

INFLUENCE OF HERBICIDAL WEED CONTROL TREATMENTS ON WEED GROWTH, NUTRIENT UPTAKE, YIELD AND YIELD COMPONENTS OF FABA BEAN (*Vicia faba*, L.)

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ABSTRACT

Two field experiments were carried out at the Experimental Farm of National Research Centre, at Shalakan, Kalubia, Governorate, Egypt, during 1997/1998 and 1998/1999 seasons to study weed growth, nutrient uptake, yield and yield components of faba bean under herbicidal weed control efficiency. In general, increasing the dose of herbicides used reduced the dry weight of annual weeds. Bentazon at 0.240 kg or 0.360 kg/fed post-emergence and hand hoeing treatment gave the best control of annual broad-leaved weeds. Whereas, Fluazifop-butyl at 0.500 kg or 0.750 kg/fed post-emergence as well as hand hoeing treatment gave the best control of annual grass weeds. The best treatments were hand hoeing twice (4 and 6 WAS), fluazifop-butyl at 0.750 kg/fed or bentazon at 0.360 kg/fed applied post-emergence. These treatments showed higher weed control efficiency, lower NPK depletion by annual weeds, higher NPK uptake by crop plants and increasing the plant height, number of pods per plant, 100-seed weight, seed and straw yields per feddan, when compared with the other treatments and unweeded control. While, combination of bentazon at 0.240 kg + fluazifop-butyl at 0.500 kg/fed applied post-emergence come in the second rank.

It can be concluded that addition of fluazifop-butyl at 0.750 kg/fed or bentazon at 0.360 kg/fed (at 3-4 leaf stage of growth) as herbicides was the recommended treatment for obtaining the highest seed and straw yields from faba bean cultivar Giza 716 under the environmental conditions of the present study.

INTRODUCTION

Weeds are one of the major factors affecting crop production. It removes more nutrients compare to crops and accumulate large quantities of NPK when allowed to compete till harvest (Yadav *et al.*, 1986). Anonymous (1980) showed that faba beans have low ability to compete with associated weeds. Aslo, El-Shandidy *et al.* (1983) and Rogall and Pallutt (1992) reported that weed competition is a serious problem in faba beans especially during the first 30 to 90 days after plant emergence. Reduction in faba bean yield resulting from weed competition accounted for about 30 to 44 % (Samia-Hassan, 1987). Thus, control of weeds is vitally important to minimize the magnitude of nutrient drain by weeds and more effective utilization of the applied fertilizer by crop (Mani, 1975). Maurya *et al.* (1990) reported that herbicide causes an appreciable decrease in nutrient depletion by weed growth as a consequence of which considerable improvement in nutrient uptake of the crop plants and enhancement in crop yields occurred. With respect to chemical weed control, selective herbicides proved to be effective against annual weeds and obtained high yield of faba beans such as

fluazifop-butyl (Melander, 1990 and Tanji, 1994) and bentazon (Abdallah *et al.*, 1991; Baumann, 1992 and Heath *et al.*, 1992) as well as hand hoeing (Timmer *et al.*, 1993 and Soliman *et al.*, 1998).

Therefore, the present investigation was planned to study the effect of herbicidal weed control treatments on weed growth, nutrient uptake, yield and yield components of faba beans.

MATERIALS AND METHODS

Two field experiments were conducted on a clay loam soil in the Agricultural Experimental Station of the National Research Centre at Shalakan, Kalubia Governorate, Egypt, to study annual weed growth, nutrient uptake, yield and yield components of faba beans under herbicidal weed control efficiency during two successive seasons of 1997/98 and 1998/99. The chemical analysis of the experimental soil was as follows :

pH	Organic matter %	Total N %	P ppm	K ppm	CaCO ₃ %	E.C. mmhos
8.12	1.73	0.10	16.1	26.83	2.81	0.32

The experimental area was divided into plots. Each plot consisted of 5 rows, 4m long and 70 cm apart. The plot area was 14 m² (1/300 feddan). Seeds of faba bean (*Vicia faba*, L.) cv. "Giza 716" were planted in hills 20 cm apart. Sowing dates were 14th and 12th November in the first and second seasons, respectively. All the normal cultural practices of growing faba beans recommended for the region, were followed. The experiment included 9 treatments, which were arranged in a randomized complete block design with four replicates. The various weed control treatments, rates of herbicide used, time and method of application are presented in Table 1. All treatments of bentazon (Bazagran 48 % EC) (3-isopropyl 1H-2,1,3-benzothiazin-3(H)-one-2,2-dioxide) and fluazifop-butyl (Fusilade 25 % EC) [Butyl 2-(4-(5-trifluoromethyl-2-pyridyloxy) Phenoxy) Propionate], were applied by knapsack sprayer using a volume of 200 litres water per feddan. All rates were expressed as active ingredient of herbicides in kg/fed. The herbicidal treatments were compared to conventional hoeing twice at 4 and 6 weeks after sowing (WAS) and the untreated control. A weed sample was randomly taken from an area of one square meter for each plot at 75 days after sowing (DAS). Weeds were identified and classified into annual broad leaves and annual grasses, the dry weight of weed species were recorded. At harvest, samples of ten crop plants were randomly collected from each plot to study the following characters. i.e. plant height (cm), number of branches per plant, number of pods per plant and 100-seed weight (g). Seed and straw yields from each plot were determined and calculated in tons/fed. The N, P and K contents in annual weeds and crop plants at 75 days after sowing were estimated as described by Jackson (1973), nutrient uptake by annual weeds and crop plants were calculated. Combined data for the two seasons were analyzed according to Gomez and Gomez (1984).

Table 1 : Weed control treatments, rates of herbicides, time and method of application during the two growing seasons.

Treatments	Rates kg a.i.*/fed	Time and method of application
Bentazon	0.120	Post-emergence (4 WAS**)
Bentazon	0.240	" " "
Bentazon	0.360	" " "
Fluazifop-butyl	0.250	" " "
Fluazifop-butyl	0.500	" " "
Fluazifop-butyl	0.750	" " "
Bentazon	0.240	Post-emergence
+	+	+
Fluazifop-butyl	0.500	Post-emergence
Hand hoeing twice	-	Twice (4 and 6 WAS)
Unweeded check	-	Left without weed removal

*a.i. = active ingredient.

**WAS = weeks after sowing.

RESULTS AND DISCUSSION

A. Weed growth:

Dry weight of annual weeds and the efficiency of herbicidal treatments for the different weed groups at 75 days from sowing are shown in Table 2. It is worthy to note that the soil of the experimental farm at Shalakan, Kalubia Governorate was free from parasitic weeds particularly, *Orobanche crenata*.

1. Annual broad-leaved weeds :

The dominant annual broad-leaved weeds in both growing seasons were: *Medicago hispida* (Gaerth), *Ammi majus*, L.; *Beta vulgaris*, L.; *Anagallis arvensis*, L. and *Rumex dentatus*, L. data in Table 2 show that all weed control treatments significantly reduced the dry weight of annual broad-leaved weeds at 75 days from sowing compared to the unweeded check. Bentazon at 0.240 or 0.360 kg/fed as post-emergence and hand hoeing treatment gave the best control for annual broad-leaved weeds (89.16 to 96.35 % control). While, fluazifop-butyl at the two lower doses gave the least weed control efficiency (42.44 and 50.83 % control), compared to all the other treatments. The rest treatments ranked secondly (71.55 to 79.59 % control), but were statistically lower or equal with the hoeing treatment. Similar results were obtained by Hallgren (1989); Praczyk (1991) and Heath *et al.* (1992) reported that Bentazon as well as the hoeing treatment gave the best broad-leaved weed control in faba bean fields.

2. Annual grass weeds:

The most common grassy weeds during the two seasons were. *Lolium temulentum*, L. and *Phalaris minor*, Retz. Data in Table 2 show that all treatments significantly caused a reduction in the dry weight of annual grass weeds after 75 days from sowing as compared with the unweeded

Table 2 : Dry weight of annual weeds (g/m²) as affected by weed control treatments at 75 days from sowing faba bean (Combined analysis for the two seasons).

Treatments	Rates (kg a.i./ fed)	Annual broad-leaved weeds		Annual grass weeds		Total annual weeds	
		Dry wt. (g/m ²)	Control (%)	Dry wt. (g/m ²)	Control (%)	Dry wt. (g/m ²)	Control (%)
Bentazon	0.120	24.40 c	71.55	34.83 b	50.10	59.23 bc	61.92
Bentazon	0.240	9.30 d-f	89.16	28.50 bc	59.17	37.80 de	75.70
Bentazon	0.360	3.13 f	96.35	22.40 cd	67.91	25.53 ef	83.59
Fluazifop-butyl	0.250	49.36 b	42.44	17.19 c-e	75.37	66.55 b	57.22
Fluazifop-butyl	0.500	42.17 b	50.83	6.13 e-g	91.22	48.30 cd	68.95
Fluazifop-butyl	0.750	22.53 cd	73.73	3.60 g	94.84	26.13 ef	83.20
Bentazon + Fluazifop-butyl	0.240 + 0.500	17.50 cde	79.59	15.30 d-f	78.08	32.80 de	78.91
Hand hoeing twice	-	7.27 ef	91.52	4.20 fg	93.98	11.47 f	92.63
Unweeded check	-	85.76 a	00.00	69.80 a	00.00	155.56 a	00.00

check. The best grass weed control achieved by fluazifop-butyl at 0.500 or 0.750 kg/fed applied post-emergence and hand hoeing treatment. The efficiency for these treatments ranged from 91.22 to 94.84 % control. Moreover, bentazon at 0.240 kg + fluazifop-butyl at 0.500 kg/fed post-emergence was inbetween and statistically equal with the hoeing treatment. The remaining treatments were significantly lower efficient than the hand hoeing treatment (50.10 – 75.37 % control). These results are similar to those obtained by Melander (1990), Abdallah *et al.* (1991) and Tanji (1994) reported that fluazifop-butyl applied post-emergence gave good control of annual grass weeds in faba beans.

3. Total annual weeds :

Significant differences between the various treatments in dry weight of total annual weeds after 75 days from sowing were obtained (Table 2). All tested treatments significantly decreased the dry weight of total annual weeds more than the unweeded check. In general, increasing the dose of herbicide used reduced the dry weight of total annual weeds. Hand hoeing treatment as well as bentazon and fluazifop-butyl at the highest dose gave higher weed control efficiency (92.63, 83.59 and 83.20 % respectively), compared to the unweeded check. Whereas, weed control efficiency for the other treatments ranged from 57.22 to 78.91 %, but were significantly less efficient than hand hoeing treatment. It could be concluded that hand hoeing twice (4 and 6 WAS), bentazon at 0.360 kg/fed or fluazifop-butyl at 0.750 kg/fed applied post-emergence were the most effective against the annual weeds, they depressed the growth of annual weeds until 75 days after sowing and kept the crop free from annuals through this critical stage of growth. Previous results are in accordance with those obtained by (Abdallah *et al.*, 1991; Praczyk, 1991 and Baumann, 1992) with bentazon, (Salem, 1989; Melander, 1990 and Tanji, 1994) using fluazifop-butyl and (Timmer *et al.*, 1993 and soliman *et al.*, 1998) as for hand hoeing.

B. Nutrients uptake by weeds and crop :

Data in Table 3 revealed that NPK depletion by annual weeds at the period of 75 days after sowing were mostly significantly reduced under all weed control treatments. The annual weeds depleted the soil fertility by taking 26.98 kg N/fed, 3.15 kg P/fed and 23.22 kg K/fed under the unweeded check. Hand hoeing treatment as well as bentazon and fluazifop-butyl at the highest dose showed superiority in decreasing NPK depletion by the annual weeds. These treatments resulted in saving of 24.16, 22.40 and 21.58 kg N/fed, 3.01, 2.84 and 2.76 kg P/fed and 21.50, 19.99 and 19.41 kg K/fed, respectively compared with the unweeded check. The reason due to higher weed control efficiency for the previously treatments (Table 2). The rest treatments were occupied the following orders with significant effects on NPK uptake by the annual weeds compared to the unweeded check. Concerning nutrient uptake by crop plants, data in Table 3, show that all weed control treatments significantly increased the NPK uptake by crop plants compared with the unweeded check. Hand hoeing treatment equally with bentazon, fluazifop-butyl at the highest dose and bentazon + fluazifop-butyl gave the

Table 3 : Depletion and uptake of nutrients as affected by weed control treatments at 75 days form sowing faba bean. (Combined analysis for the two seasons).

Treatments	Rates (kg a.i./fed)	Nutrient depletion by annual weeds at 75 days (kg/fed)			Nutrient uptake by crop plants at 75 days (kg/fed)		
		N	P	K	N	P	K
Bentazon	0.120	13.06 b	0.99 bc	9.58 b	18.85 c	1.24 d	11.26 c
Bentazon	0.240	7.45 cd	0.58 de	5.11 cd	22.92 bc	1.57 bc	12.05 bc
Bentazon	0.360	4.58 de	0.31 fg	3.23 de	28.11 ab	1.89 a	15.12 ab
Fluazifop-butyl	0.250	14.28 b	1.15 b	10.76 b	18.90 c	1.38 cd	11.12 c
Fluazifop-butyl	0.500	9.09 c	0.75 cd	6.96 c	22.89 bc	1.53 c	11.99 bc
Fluazifop-butyl	0.750	5.40 de	0.39 e-g	3.81 de	26.38 ab	1.83 c	14.56 a-c
Bentazon + Fluazifop-butyl	0.240 + 0.500	6.65 cd	0.44 ef	4.34 d	25.73 ab	1.77 ab	13.96 a-c
Hand hoeing twice	-	2.82 e	0.14 g	1.72 e	29.58 a	1.98 a	17.50 a
Unweeded check	-	26.98 a	3.15 a	23.22 a	11.97 d	0.80 e	5.79 d

highest uptake of nutrients (147.1, 134.8, 120.4 and 115.0 % N, 147.5, 136.3, 128.8 and 121.3 % P and 202.2, 161.1, 151.5 and 141.1 % K), respectively than the unweeded check. The remaining treatments gave positive effect in increasing NPK uptake by crop plants, but were significantly less effective than hand hoeing treatment. Generally, it could be concluded from the aforementioned discussion that hand hoeing twice (4 and 6 WAS) or bentazon or fluzifop-butyl at the highest dose applied post-emergence gave significantly the lowest NPK depletion by the annual weeds and the highest NPK uptake by faba bean plants until 75 days after sowing. The improvement under these treatments was mainly due to the higher weed control efficiency then the competition ability of weeds was poor, which gave a competitive advantage to the faba bean plants in utilizing the necessary demands of nutrients. These conclusions supported the findings mentioned previously and closely related with Kumar *et al.* (1989); Ambulkar *et al.* (1993); Casquero *et al.* (1993) and Rao *et al.* (1995).

C. Yield and yield components:

1. Plant height (cm):

As shown in Table 4 all weed control treatments significantly increased plant height compared to the unweeded check. The tallest plants were obtained by hand hoeing treatment, bentazon at 0.360 kg/fed, fluzifop-butyl at 0.750 kg/fed and combination of bentazon at 0.240 kg + fluzifop-butyl at 0.500 kg/fed as post-emergence compared with the unweeded check. This could be attributed to the higher efficiency in controlling the annual weeds (Table 2). On the contrary, the shortest plant height was obtained from the unweeded check. All herbicidal treatments at the two lower doses were significantly lower than the hoeing treatment. Similar results were obtained by Yehia *et al.* (1987), Jovicevic *et al.* (1992) and Tanji (1994).

2. Number of branches per plant :

No significant differences were found among treatments in this respect when compared with the unweeded check (Table 4). This mean that this character was not affected by any of the weed control treatments. El-Wekil *et al.* (1987) came to the same conclusion.

3. Number of pods per plant :

All herbicidal treatments and hand hoeing treatment significantly increased the number of pods per plant over the weedy check (Table 4). Hand hoeing treatment equally with fluzifop-butyl at 0.750 kg/fed, bentazon at 0.360 kg/fed and bentazon at 0.240 kg + fluzifop-butyl at 0.500 kg/fed applied post-emergence produced the highest number of pods per plant. Such superiority may be due to that these treatments decreased the competition between the associated weeds and faba bean plants (Table 3). This resulted in increased metabolite synthesise by faba bean leaves. Thus, healthy plants were able to produce higher number of flowers and consequently higher number of pods. The rest treatments were less effect than hand hoeing treatment. Similar results were obtained by Salem (1989) and Soliman *et al.* (1998).

Table 4 : Effect of weed control treatments on yield and yield components of faba bean at harvest. (Combined analysis for the two seasons).

Treatments	Rates (kg a.i./fed)	Plant height (cm)	No. of branches per plant	No. of pods per plant	100-seed weight (g)	Seed yield (ton/fed)	Relative seed yield (%)	Straw yield (ton/ fed)	Relative straw yield (%)
Bentazon	0.120	136.30c	3.75	18.04c	79.70cd	1.659ef	136.7	2.784e	137.3
Bentazon	0.240	139.10bc	3.70	21.07bc	81.13bc	1.879cd	154.8	3.013cd	148.6
Bentazon	0.360	142.0ab	3.20	22.62ab	84.0a	2.041ab	168.1	3.216ab	158.6
Fluazifop-butyl	0.250	137.60bc	3.63	18.21c	78.45d	1.618f	133.3	2.722e	134.2
Fluazifop-butyl	0.500	139.45bc	3.45	20.95bc	80.50bc	1.796de	147.9	2.899de	143.0
Fluazifop-butyl	0.750	141.68ab	3.35	23.22ab	85.30a	2.133a	175.7	3.305a	163.0
Bentazon + Fluazifop-butyl	0.240 + 0.500	140.40a-c	3.13	21.43ab	81.58b	1.961bc	161.5	3.101bc	152.9
Hand hoeing twice	-	144.20a	3.38	24.40a	83.90a	2.155a	177.5	3.380a	166.7
Unweeded check	-	128.38d	2.83	14.10d	75.65e	1.214g	100.00	2.028f	100.0

4. Weight of 100-seed in grams:

Data in Table 4 show that the weight of 100-seed of all weed control treatments was significantly higher than the unweeded control. The highest values of 100-seed weight was obtained by fluzifop-butyl at 0.750 kg/fed and bentazon at 0.360 kg/fed as post-emergence as well as hand hoeing treatment compared with the other treatments. This increase may be due to excellent control of annual weeds and minimizing weed competition with faba bean plants giving good chance for crop growth and improve the filling of seeds resulting in heavier seeds. In contrast, the lowest weight of 100-seed was obtained from unweeded control. The rest treatments ranked secondly. Similar results were reported by El-Wekil *et al.* (1987) and Soliman *et al.* (1998).

5. Seed and straw yields per feddan :

Significant differences among weed control treatments in seed and straw yield per feddan were found as shown in Table 4. In general, all herbicide and hand hoeing treatments significantly achieved higher seed and straw yields per feddan more than the unweeded check. The best treatments were hand hoeing twice (4 and 6 WAS), fluzifop-butyl and bentazon at the highest dose applied as post-emergence. These treatments gave 177.5, 175.7 and 168.1 % increases in seed yield per feddan and 166.7, 163.0 and 158.6 % increases in straw yield per feddan, respectively over the unweeded check. The aforementioned increases in seed and straw yields of faba bean might be attributed to the favorable effects exhibited by those treatments on growth characters correlated with their good efficiency in controlling annual weeds (Table 2). However, fluzifop-butyl and bentazon at minimum doses induced least increase in seed and straw yields per feddan compared to the other treatments. This, could be due to lower weed control efficiency. On the other side, weed competition was responsible for the significant reduction in seed and straw yield/feddan in the unweeded check. The rest treatments were in between. These results are generally similarity with those obtained by Salem (1989); Abdallah *et al.* (1991); Heath *et al.* (1992); Timmer *et al.* (1993) and soliman *et al.* (1998).

It can be concluded that addition of fluzifop-butyl at 0.750 kg/fed or bentazon at 0.36 kg/fed (at 3-4 leaf stage of growth) as herbicides was the recommended treatment for obtaining the highest seed and straw yields from faba bean cultivar Giza 716 under the environmental conditions of the present study.

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تأثير معاملات مبيدات مقاومة الحشائش على امتصاص العناصر الغذائية
والمحصول ومكوناته للقول البلدى
جمال الدين مصطفى متولى
قسم النبات - المركز القومى للبحوث - الدقى - القاهرة

أجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث بشلقان - محافظة القليوبية في موسمى ١٩٩٧/١٩٩٨ ، ١٩٩٨/١٩٩٩ لدراسة تأثير بعض مبيدات الحشائش المضافة بعد الانبات على نمو الحشائش الحولية العريضة والضيقة الاوراق وامتصاص العناصر الغذائية والمحصول ومكوناته للقول البلدى صنف جيزة ٧١٦ وقد اوضحت النتائج مايلى :

- بصفة عامة كلما زاد تركيز المبيدات زادت مقاومة الحشائش الحولية في كلا الموسمين .
- اظهرت معاملة البنزازون بمعدل ٠,٢٤٠ كجم او ٠,٣٦٠ كجم/فدان وكذلك معاملة العزيق اليدوى احسن مقاومة للحشائش الحولية العريضة في كلا الموسمين .
- اظهرت معاملة الفلوزيفوب بيوتيل بمعدل ٠,٥٠٠ كجم او ٠,٧٥٠ كجم /فدان وكذلك معاملة العزيق اليدوى احسن مقاومة للحشائش الحولية النجيلية في كلا الموسمين .
- اعطت معاملات العزيق اليدوى مرتين بعد ٤ ، ٦ اسابيع من الزراعة ، الفلوزيفوب بيوتيل بمعدل ٠,٧٥٠ كجم/فدان ، البنزازون بمعدل ٠,٣٦٠ كجم/فدان اعلى كفاءة في مقاومة الحشائش الحولية . واقل استنزاف لعناصر النتروجين والفوسفور والبوتاسيوم بواسطة الحشائش الحولية واعلى امتصاص ليذه العناصر بواسطة نباتات الفول وايضا زيادة طول النبات ، عدد القرون بالنبات ، ووزن المائة بذرة ومحصول البذور والقش بالفدان مقارنة بالمعاملات الاخرى ومعاملة الكنترول في حين حققت معاملة البنزازون بمعدل ٠,٢٤٠ كجم + الفلوزيفوب بيوتيل بمعدل ٠,٥٠٠ كجم/فدان المرتبة الثانية .
- توصى الدراسة بزراعة القول البلدى صنف جيزة ٧١٦ ومقاومة الحشائش الحولية المصاحبة باستخدام مبيد الحشائش الفلوزيفوب بيوتيل بمعدل ٠,٧٥٠ كجم/فدان او البنزازون بمعدل ٠,٣٦٠ كجم/فدان (مرحلة ٣ - ٤ ورقات) للحصول على اعلى محصول من البذور والقش .