Controlling weeds in Faba bean fields using clethodim and metribuzin herbicides with some additives

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ABSTRACT: Faba bean is one of the most widespread vegetable in the world, it is considered as sustainable quality plant biochemical sources, with the potential to help meet the growing global demand for more nutrition values and healthy foods. Weeds are considered one of the major factors affecting quality and quantity of Faba bean. The present work was performed to estimate the herbicidal activities of clethodim and metribuzin either at the recommended or the half recommended rate in combination with fertilizers such as urea or ammonium sulfate to control weeds in Faba bean fields during 2017-2018 and 2018-2019 seasons. The obtained results indicated that all studied treatments have significantly been reduced growth of weeds compared with the untreated plots. The hand hoeing treatment was the best option in weed control in broad weeds, followed by clethodim in weed control in grassy weeds. Furthermore, addition of urea or ammonium sulphate to the half recommended rates of metribuzin and clethodim has been recorded significant herbicidal activity similar to the recommended rates alone of pesticide. On the other hand, all studied treatments have been increased Faba bean growth and yield quantity compared with the untreated plots. Weeds control reduced competition and thus leading to improve growth of Faba bean plants and consequently seed yield

Keywords: Weed control, Faba bean, clethodim, metribuzin, herbicides and fertilizers

1.Introduction

Faba bean is vastly cultivated everywhere the world, a nutrient leguminous plants crop. The actually main producers of Faba bean are China, Ethiopia, the United Kingdom, Australia and France. Nowadays, usefulness has been growing in a human health and nutritional benefits of Faba bean and developments of diverse foods enriched with biochemical molecules with improved efficiency, functionality, nutrition value, and health benefits **(Meng *et al.*, 2021, Dhull *et al.*, 2022)**.

Weeds are a major serious pest that deteriorates most of crops. Moreover, it is an everlasting problem for our agriculture. Weeds have an ability to compete Faba bean in light, nutrient uptake, water and space, therefore are considered one of the major factors affecting growing of Faba bean. Also, sometime weeds may interfere with crop growth through producing toxic chemical compounds in the rhizosphere. According to crop type, ecological and favorable climates, overall, weeds have been caused loss in the production yield from 45 to 95% **(Narwal *et al.*, 2005; Alsaadawi *et al*, 2017; Mango *et al.*, 2022)**. In addition, weeds compete with crop for growth, are considered as hosts to other pests such as insects and fungal diseases.

Weed control includes agricultural, mechanical (hand weeding), biological and chemical methods. But, with the increase in the number of actual herbicides after 1960's, weed control procedures have become more dependent on herbicides. Due to severe scarcity of hand labour with relatively paid fares, hand weeding has come to be uneconomical method of farming. Furthermore, disadvantage of biological control is that it often takes many long times to weeds control, in most cases, its action is slow.

Herbicides are considered useful in almost any stage of growth plant. So, chemical control of weed might be suitable method to decrease the cost of hand weeding and thus, leads to increase in yield and the economic return.

Researchers indicate that there is good potential to reduce the herbicide doses. Whereas, the use of reduced herbicide doses lead to decrease cost applications. Moreover, lowering the dose of any herbicide could minimize pollution **(El-Metwally *et al.*, 2010)**. As well, combining reduced doses of herbicides with other management practices, such as tillage and fertilizers can markedly increase the odds of successful weed control **(Blackshaw *et al* 2006)**. Furthermore, in Egypt, the cost of recommended rate of herbicide is relatively high therefore, it can be mixing the chemical fertilizers to herbicide solution to make dose more effective and get lower costs.

Therefore, the goal of this research is to investigate the activities of the tested herbicides at the recommended rate and half the recommended rate with chemical fertilizers in controlling weeds. Additionally, study the effectiveness of the treatments on the yield quantity of Faba bean.

2. Materials and methods

2.1. Site of work and treatments

In order to estimate the herbicidal activity of clethodim (Select super 12.5% EC) and metribuzin (Sencore 60 % WP) in Faba bean field, the experiment was done either at the recommended rate or the half recommended rate in combination with chemical fertilizers using ammonium sulfate and urea (as a broad-spectrum fertilizer used worldwide) each of them at the concentration of 2%, compared with hand hoeing and untreated Faba bean (controlled trials). The work was done in Kafr El-Dawar District, El-Behera Governorate, Egypt, during 2017-2018 and 2018-2019 seasons. In both seasons, seeds of Faba bean Giza Blanca cultivar under study were manually sown in November. The experiments were arranged in a randomized complete blocks design with three replicates for each treatment **(Lai *et al.* 2021)**.

The most commonly metribuzin was used pre-plant herbicide and clethodim was used as a selective post-emergence **(Touloupakis *et al.*, 2005; Kandil *et al.*, 2015 El-Metwally *et al.*, 2017; Busi *et al.* 2021)**. The two tested chemical herbicides were performed by 5 liter knapsack sprayer at 200 L water fed^{-1}. On the other hand, hand hoeing was done after 20 and 40 days from sowing (Table 1).

Table 1: Treatments, rates, times of application

Treatments	Rate fed^{-1}	Application time
clethodim (Select super 12.5% EC) (at recommended rate)	350 ml	30 days after sowing
clethodim + urea	175 ml + 2%	30 days after sowing
clethodim + ammonium sulphate	175 ml + 2%	30 days after sowing
metribuzin (Sencore 60 % WP) (at recommended rate)	142.8 g	Pre plant
metribuzin + urea	71.4 g + 2%	Pre plant
metribuzin + ammonium sulphate	71.4 g + 2%	Pre plant
Hand hoeing	Two	20 and 40 days from sowing
Untreated	--	--

2.2. Data recorded

2.2.1. Weeds

Weeds in one square meter were gathered utilizing a quadrate of 50 × 50cm (0.25 m^{-2}) located at 4 randomly chosen spots in each one experimental plot after 60 and 90 days from plantation **(El-Metwally *et al.*, 2017)**. Weeds were handily sorted and weighed subsequently, the following study parameters were estimated as the following: Weed weight = Mean fresh weight of each weed (gm^{-2}).

Weed weight % = (Mean fresh weight of each weed ÷ Mean fresh weight of total weeds) × 100

Weed control efficiency formula [(C – T) ÷ C] ×100

Where: C = Mean weed fresh weight (g) in untreated plots.

T = Mean weed fresh weight (g) in each treated plots (Boutagayout *et al.*, 2020)

2.2.2. Crop

Plant height and 100-seed weight were determined as the following:

Plant height of Faba bean can be determined by using plants which were air dried after harvest, and then plants height was measured by the average from 10 plants in each plot.

Weight of 100- seeds Faba bean crop was considered as a mature when 90 % of the pods in the untreated treatment has converted from green to golden color. Faba bean were harvested from each plot area and grain yields were recorded and subsequently, the increase percent of grain yield was accurately estimated as the following:

Increase % = (T - C) ÷ C × 100

Where: T= Average weight of Faba bean grain in the treatment plot.

C= Average weight of Faba bean grain in the untreated plot.

2.3. Statistical analysis

Statistical analysis of the gathered data were liable to analysis of variance (ANOVA) utilized MSTATC statistical software package followed by means separation for their significant differences using the

least significant differences (LSD) test based on **Steel and Torrie (1984)**.

3. Results

3.1. Weed flora

Faba bean field was found to be infected with different species of broadleaf and grassy weeds. The dominated weed flora of the experimental procedure during both seasons 2017-2018 and 2018-2019 were shown in (Table 2), the data displayed that the most dominant broad leaved weeds were *Beta vulgaris, Chenopodium album, Malva parviflora, Rumex dentatus* and *Sonchus oleraceus*. On the other hand, *Lolium temulentum* and *Phalaris minor* were the most predominant grassy weeds during the two experimental seasons. Grassy weeds were less existent than broad leaved weeds.

Table 2: Predominant weed species in Faba bean field in the 2017-2018 and 2018-2019 seasons

Scientific name	Type of weed	English name
Sonchus oleraceus	broad leaved	Little
Rumex dentatus	broad leaved	Sorrel
Beta vulgaris	broad leaved	Swiss chard
Malva parviflora	broad leaved	Hibiscus
Chenopodium album	broad leaved	Pigweed
Lolium temulentum	Grassy	Pot
Phalaris minor	Grassy	Canary grass

3.2. Influence of treatments on fresh weight of weeds

The displayed data (Tables 3 and 4) showed significantly difference among the treatments on the fresh weight (gm^{-2}) of the predominant weed species during 2017-2018 and 2018-2019 seasons. The maximum weeds fresh weight was recorded in the untreated plot as follow, fresh weight of *Malva parviflora* (193.33 and 66.66), *Sanchus oleraceus* (536.33 and 460.33), *Beta vulgaris* (504.33 and 505.33), *Rumex dentatus* (213.33 and 130.33), *Chenopodium album* (86.66 and 67.33), *Phalaris minor* (199.33 and 155.00) and *Lolium temulentum* (213.33 and 176.33) gm^{-2} in 2017-2018 and 2018-2019, respectively. However, the weed fresh weights decreased significantly with treated herbicidal plots during the two application seasons. In details, the results indicated that all the tested herbicides at the recommended rates or at the half recommended rates with additives of fertilizer and hand hoeing significantly decreased fresh weight of individual weeds in Faba bean fields during both seasons as comparison with the control (Tables 3 and 4). The treatment of hand hoeing produced the best reduction of weeds and in controlling of the individual weeds during both seasons, it gave 100, 84.46, 86.71, 100, 100, 80.93 and 80.03% weed control efficiency of *M. parviflora, S. oleraceus, B. vulgaris, R. dentatus, Ch. album, Ph. minor* and *L. temulentum*, respectively, in a 2017-2018 season (Table 3). The obtained results in the second season (2018-2019) indicated that weed control treatments on individual weeds nearly had almost the same trend (Table 4).

Concerning the recommended rates of used herbicides, results in Tables 3 and 4 pointed that clethodim and metribuzin have significantly affected the fresh weight of individual weeds and got high weed control efficiency in Faba bean fields.

Controlling weeds, in first 2017-2018 season (Table 3), metribuzin was better than clethodim. In addition, metribuzin was more effective against broad weeds, especially in *M. parviflora* and *R. vesicarius*, as the percentage was 97.40 and 100.00%, respectively. Moreover, clethodim had the best effectiveness against grassy weeds, *Ph. minor* and *L. temulentum*, as the percentage were 93.33 and 95.31%, respectively. Furthermore, the obtained results in the second 2018-2019 season (Table 4) were completely identical to the first season, which constitutes a confirmation of the results of the first season with regard to controlling broad and grassy weeds.

The given results in (Table 3) indicated that clethodim and metribuzin at the half recommended rates with additives (urea or ammonium sulfate) have a good herbicidal activity similar to the recommended rates alone of pesticide. For example, weed control efficiency of metribuzin at the recommended rates alone and at the half recommended rates with urea have recorded (47.29 and 46.24%) for *S. oleraceus*, (42.10 and 42.96 %) for *B. vulgaris*, and (52.96 and 53.12 %) for *R. vesicarius*, respectively, in the first season 2017-2018. Similar trend of obtained results was considerably observed in the second season 2018-2019 (Table 4). It is clear that from the previous results, using half of the recommended rates of the herbicides is safer, which effectively reduces environmental pollution.

Adding chemical fertilizers (urea or ammonium sulfate) to the half rate of metribuzin herbicide was interestingly better than adding fertilizers to the half rate of clethodim in weed control. For example, addition of urea with metribuzin and clethodim was as the following; *M. parviflora* (93.27 and 88.27%), *S. oleraceus* (67.80 and 46.24%), *B. vulgaris* (67.01 and 42.96%), and *R. vesicarius* (68.28 and 53.12%) respectively. In some treatments, it was found that adding fertilizers to half of recommended rates of the herbicides resulted in more effective weed control compared to the full recommended rates herbicide. For example, additions of urea and ammonium sulfate with half of recommended

Table 3: Effect of different treatments on individual weeds in Faba bean in 2017/2018 season

Treatments	Rate fed.$^{-1}$	*Malva parviflora*		*Sonchus oleraceus*		*Beta vulgaris*		*Rumex vesicarius*		*Chenibudium album*		*Phalaris minor*		*Lolium temulentum*	
		F. W*.	R**%	F. W.	R%	F. W.	R%	F. W.	R%	F. W.	R%	F. W.	R%	F. W.	R%
Clethodim	350 ml	12.66	93.45	282.66	47.29	292.33	42.10	100.33	52.96	14.66	83.08	12.00	93.33	10.00	95.31
Clethodim + urea at 2%	175 ml	22.66	88.27	288.33	46.24	287.66	42.96	100.00	53.12	6.66	92.31	19.00	90.48	15.00	92.97
Clethodim + ammonium sulfate at 2 %	175 ml	23.00	88.10	283.33	47.17	291.33	42.23	92.00	56.87	8.33	90.03	18.00	90.96	18.33	91.42
Metribuzin	142.7 g	5.00	97.40	156.33	70.58	145.33	71.18	0.00	100.00	9.33	89.23	67.00	66.22	38.66	81.87
Metribuzin + urea 2%	71.35 g	13.00	93.27	172.66	67.80	166.33	67.01	67.66	68.28	12.66	85.39	80.33	59.69	85.66	59.84
Metribuzin + ammonium sulfate at 2 %	71.35 g	19.33	90.00	161.66	69.85	165.66	67.15	59.66	72.03	12.66	85.39	73.66	63.04	81.33	61.87
Hand hoeing	Twice	0.00	100.00	83.33	84.46	67.00	86.71	0.00	100.00	0.00	100.00	38.00	80.93	42.66	80.03
Control	-	193.33		536.33		504.33		213.66		86.66		199.33		213.66	
L.S.D*5%**		8.85		12.10		10.40		6.54		5.47		9.13		9.26	

* F.W.= weed fresh weight (g m^{-2}). ** R %: reduction percent weeds. *** L.S.D Least Significant Differences Test

Table 4: Effect of different treatments on individual weeds in faba bean fields in 2018/2019 season

Treatments	Rate fed.$^{-1}$	*Malva parviflora*		*Sonchus oleraceus*		*Beta vulgaris*		*Rumex vesicarius*		*Chenibudium album*		*Phalaris minor*		*Lolium temulentum*	
		F. W*.	R**%	F. W.	R%	F. W.	R%	F. W.	R%	F. W.	R%	F. W.	R%	F. W.	R%
Clethodim	350 ml	6.00	90.99	346.66	24.67	301.66	40.30	1.00	99.23	8.33	77.29	6.33	95.91	6.66	96.22
Clethodim + urea at 2%	175 ml	0.00	100.00	330.33	28.24	294.33	41.75	59.00	54.73	5.66	80.79	20.33	86.88	21.33	87.90
Clethodim + ammonium sulfate at 2%	175 ml	1.66	97.50	346.33	24.76	314.00	37.00	4.00	96.93	10.00	75.00	20.33	86.88	16.66	90.55
Metribuzin	142.7 g	0.00	100.00	69.66	84.68	105.00	79.22	0.00	100.00	6.00	91.80	24.66	84.09	15.33	89.77
Metribuzin + urea at 2 %	71.35 g	0.00	100.00	62.33	86.45	109.33	78.36	53.66	58.82	0.00	100.00	46.00	70.32	36.66	79.20
Metribuzin + ammonium sulfate at 2 %	71.35 g	0.00	100.00	64.00	86.09	117.33	76.78	0.00	100.00	0.00	100.00	44.33	71.4	48.66	76.29
Hand hoeing	Twice	0.00	100.00	39.33	91.45	58.33	88.00	30.00	76.91	6.33	90.59	22.66	85.38	32.66	85.86
Control	-	66.66		460.33		505.33		130.33		67.33		155.00		176.33	
L.S.D*5%**		6.24		14.02		17.27		7.93		6.73		11.67		11.50	

* F.W.= weed fresh weight (g m^{-2}). ** R %: reduction percent weeds. *** L.S.D Least Significant Differences Test

rates clethodim have recorded 92.31and 90.03%, respectively, against *Ch. album* compared to 83.08% at recommended rate of clethodim.

In general, all treatments have been achieved a highly herbicidal activity of individual weeds compare to untreated in all both seasons. In details, hand hoeing treatment was the best option in weed control in broad weeds, *M. parviflora*, *S. oleraceus*, *B. vulgaris*, *R. dentatus* and *Ch. album* followed by clethodim treatment at the recommended rate. While, clethodim at the recommended rate was the best option in weed control in grassy weeds, *Ph. minor* and *L. temulentum.*

3.3. Effect on grassy and broad-leaved weeds

Mentioned data in (Figure 1) showed that clethodim treatment at the recommended rate has been accomplished maximum reduction in fresh weight of grassy weeds (92.00 and 96.40%) during the two studied seasons, 2017-2018 and 2018-2019, respectively. Adding urea and ammonium sulfate to clethodim spray solution at the half recommended rates have been given (91.00 and 91.20%) in the first season and (88.47 and 89.66 %) in the second seasons, respectively on grassy weeds.

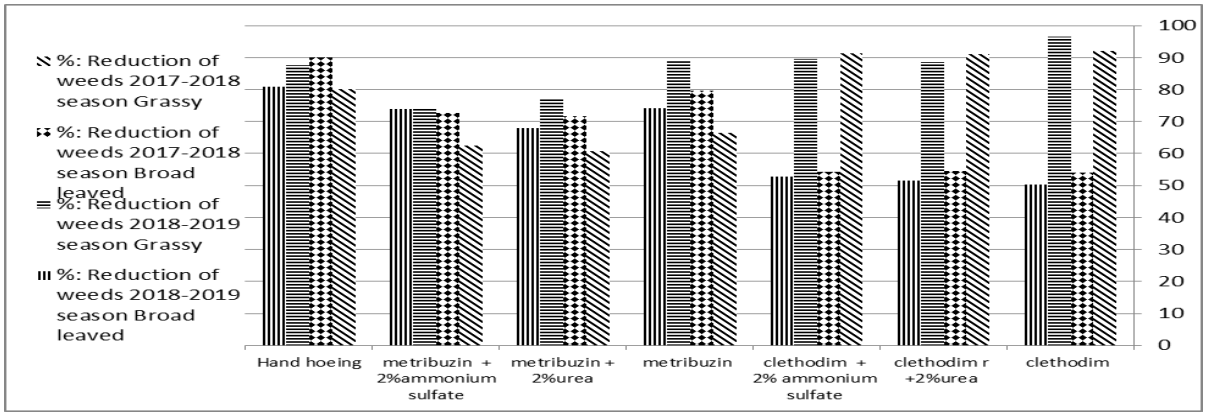

Figure 1 Effect of treatments on percent reduction of grassy and broad-leaved weeds

Furthermore, data shown in (Figure 1) indicated that clethodim at recommended rate has been fulfilled (66.50 and 88.92 %) in the two application seasons, respectively. However, addition of urea or ammonium sulfate to metribuzin at the half recommended rate has been got (60.61 and 62.46 %) and (77.12 and 74.26%) in the two applied seasons, respectively on grassy weeds. Percent reduction of broad-leaved weeds significantly affected by different weed control treatments in both studied seasons (Figure 1). Hand hoeing treatment was the best in controlling broadleaved weeds, followed by metribuzin then clethodim. Twice hand hoeing, metribuzin and clethodim at recommended rates gave 90.02 and 80.85%, 79.59 and 74.19 % and 54.04 and 50.28 % on broad-leaved weeds in 2017-2018 and 2018-2019 seasons, respectively.

3.4. Effect of weed control on yield

3.4.1. Effect on plant height and 100-grain weight

The obtained data in Table (5) indicated that there were significant differences among all treatments and the weedy check. Clethodim at the recommended rate recorded 87.40 cm of plant height in 2017-2018 season and 90.37 cm of plant height in 2018-2019 season. It was noted that addition either urea or ammonium sulfate to clethodim at half recommended rate increased the plant height. For example, adding urea and ammonium sulfate to clethodim at the half recommended rates recorded 104.5 and 99.76 cm and 100 and 106.33 cm of plant height, respectively, during the two experimental seasons.

Concerning the effect of weed control on 100-grain weight, the data (Table 5) showed that the high weight for 100-seed (g) was recorded in hand hoeing twice (106.00 and 103.33 g), followed by clethodim at the recommended rate (96.33 and 99.53 g), while, the least weight for 100-seed (g) was recorded in the unwedded treatment (80.66 and79.66 g) during 2017-2018 and 2018-2019 seasons, respectively. Adding urea and ammonium sulfate with clethodim at half recommended rate recorded (93.66 and 89.33 g) and (96.33 and 93.25 g) for 100-seed weight, respectively, during the two experimental seasons. Also, data presented in Table (5) showed that metribuzin at the recommended

Table 5: Effect of treatments on Faba bean plant heights (cm) and 100-seed weight (g) during two seasons

Treatments	2017-2018 season		2018-2019 season	
	plant height (cm)	100-seed weight (g)	Plant height (cm)	100-seed weight (g)
Clethodim at 350 ml	87.40	96.33	90.37	99.53
Clethodim at 175 ml + urea at 2%	104.50	93.66	100.00	96.33
Clethodim at 175 ml + ammonium sulphate at 2%	99.76	89.33	106.33	93.25
Metribuzin at 142.8 g	91.96	96.33	99.33	95.32
Metribuzin at 71.40 g + urea at 2%	95.13	93.66	98.66	93.00
Metribuzin at 71.40 g + ammonium sulphate at 2%	89.46	95.33	93.34	94.50
Hand hoeing	102.93	106.00	99.33	103.33
Control	81.46	80.66	74.66	79.66
L.S.D* at 5%	2.21	3.27	3.52	1.99

*L.S.D : Least Significant Differences Test

rate recorded(96.33 and 95.32 g) for 100-seed weight during the two experimental seasons. Adding urea and ammonium sulfate with metribuzin at the half recommended rates recorded (93.66 and 95.33 g) and (93.00 and 94.50 g) for 100-seed weight during the two experimental seasons.

3.4.2. Effect on grain yield (kg fed^{-1})

Obtained data in Table (6) showed effect weeds control on increase percent of grain yield of Faba bean. In general, all treatments had positively increased of yield compared to untreated control. The highest percentages of increase were recorded 21.76 and 23.15% for hand hoeing treatment followed by metribuzin at the recommended rate 17.69 and 22.00% then metribuzin at half the recommended rate with ammonium sulphate 16.92 and 21.10% during the both tested seasons 2017/2018 and 2018/2019, respectively. Also, results indicated that metribuzin at the half recommended rate with urea gave 16.00 in 2017/2018 and 20.77% in 2018/2019 season. While, clethodim at the half recommended rate with urea increased grain yield of faba bean by 15.38 and 18.47 %, while, with ammonium sulphate gave 14.61 and 17.89% in 2017/2018 and 2018/2019 season, respectively.

Table 6: **Effect of treatments on Faba bean grain yield (kg fed^{-1}) during two seasons**

Treatments	2017-2018 season		2018-2019 season	
	Grain yield (kg fed^{-1})	Increment %	Grain yield (kg fed^{-1})	Increment %
Clethodim at 350 ml fed^{-1}	1510.00	16.15	1460.00	19.86
Clethodim at 175 ml fed^{-1} + urea at 2 %	1500.00	15.38	1443.00	18.47
Clethodim at 175 ml fed^{-1} + ammonium sulphate at 2%	1490.00	14.61	1436.00	17.89
Metribuzin at 142.8 g fed^{-1}	1530.00	17.69	1486.00	22.00
Metribuzin at 71.40 g fed^{-1} + urea at 2%	1508.00	16.00	1471.00	20.77
Metribuzin at 71.40 g fed^{-1} + ammonium sulphate at 2%	1520.00	16.92	1475.00	21.10
Hand Hoeing	1583.00	21.76	1500.00	23.15
Untreated (weed free)	1300.00	---	1218.00	---
L.S.D. at 5%	48.41	-----	62.28	------

4. DISCUSSION:

Weeds are considered as one of the most important factors affecting characteristic growth of faba bean. The data has shown that Faba bean field was found to be vulnerable to invasion by both broad and grassy weeds. Our results are in accordance with previously data indicated by (El-Metwally and Shalby, 2007; Kavurmaci *et al.*, 2010; Alsadawi *et al.*; 2013 Mukhtar *et al.*, 2013; Mango *et al.*, 2022; Kalyani *et al.* 2024).

The shown data (Tables 3 and 4) indicated that all the investigated treatments in particular, hand hoeing were efficient in control weeds of faba bean. As a result, all the mentioned treatments have considerably minimized fresh weight of weeds in Faba bean during the seasons compared to the untreated plots. The analyzing data support the findings of published results demonstrated by Acciaresi *et al.*, 2003; El-Metwally and Abdelhamid, 2008; El-Gedwy *et al.*, 2020 which showed that hand hoeing is the best treatment to control weeds in Faba bean fields whereas; it reduced the weight of broad and grassy weeds. Furthermore, Abdallah *et al*. (2021) demonstrated that hand hoeing got good results in controlling weeds in similar species of Pea crop. However, the labor and economic feasibility cost is very expensive compared with other treatments (Tamira *et al.* 2024).

The recommended rates of two applied herbicides, especially clethodim, have significantly affected the fresh weight of weeds and thus, gave high weed control efficiency and effectiveness in Faba bean fields (Table 3 and 4). Similar findings have been reported by Khozimy (2006) which indicated that tested clethodim had high ability in reduction of weeds weight after 45 days from sowing. Singh and Wright (2002) showed that effectively using pre emergence herbicides in Faba bean significantly controlled the most of weeds in legumes. Moshtohry *et al*. (2007) showed that clethodim gave a good efficiency against among all grassy weeds. In addition, Nassar and Osman (2008) proved that applying clethodim have been reduced narrow leaved weeds in faba bean crop. The effect of clethodim herbicide could be due to the inhibition of amino acid biosynthesis by interfering with the acetolactate synthase enzyme, which causes rapid lack of cell division (El-Dabaa *et al*., 2019) or the inhibition of acetyl CoA carboxylase (Sehgal *et al*. 2024).

Furthermore, the obtained results confirmed that the tested herbicides at the half recommended rates with additives (urea or ammonium sulfate both at 2%) gave good herbicidal activities against weeds compared to the untreated plot. Such obtained results may be resulted in that an ammonium sulphate or urea additive has capacity to give synergistic effects with used herbicides that reflected positively by the higher reduction in weed growth. These results are in accordance with those obtained results by Metwally and Hassan (2001) who recorded that mixing some additives to an herbicide solution; especially nitrogen fertilizers could significantly increase the herbicidal activity. As well as, Turner (2008) proved that using of ammonium sulfate as additives could improve the herbicide activity in hard water via slightly adjusting pH that acting as a buffering agent and thus, improving herbicide uptake and activity. Furthermore, Tahir *et al*. (2011) found that combinations of herbicides with urea additive have been increased efficacy of herbicidal activities. Also, Abouziena *et al*. (2013) indicated that using the fertilizers such as urea, ammonium sulfate and ammonium nitrate with herbicide solution lead to reduced cost, energy and time. As a result, increase the effectiveness and efficacy of herbicidal activity in controlling weeds. Aboali and Saeedipour (2015) reported that ammonium sulfate has been showed more herbicidal activity than urea when tank mixed with herbicides in Faba bean fields.

The results have been showed that an increase in plant height and 100-grain weight of Faba bean, this could be due to the control of weeds. On the other hand, increase availability of nitrogen by adding nitrogen fertilizer, which lead to accelerate photosynthetic process and thus leading to the production of more carbohydrates, consequently it improved growth of Faba bean plant and thus, competitive ability of Faba bean to weeds which resulted in increasing seed yield. The previous results are matched with Fakkar and Khlifa (2018) results which explained that seed yield of Faba bean crops considerably increased because of hand hoeing as well as some herbicidal treatments. Evari *et al*. (2020) reported that using ammonium sulfate as fertilizer with herbicides was the best for controlling weeds in the saffron crop and thus increasing the yield to 40%.

In general, all previous treatments positively increased of yield compared to untreated plots in both seasons. Clearly, significant increase of Faba bean grain yield may be attributed to the reduction of weed competition with Faba bean plant controlled by using studied various treatments. Studied chemical and mechanical treatments have given suitable opportunity of Faba bean growth and subsequently, lead to

improved grain yield. Baghestani *et al.* (2008); Chhokar *et al*. (2008); Saad El-Din, 2003 and Abd El-Razik (2006) reported that herbicides offer sizeable increase in crop productivity. In addition, El-Rokiek *et al*. (2015) found that maximum yield was obtained with the addition of ammonium sulfate to glyphosate at 37.5 ml fed^{-1} or imazapic at 100 ml fed^{-1} compared with the control. Asmaa and Bahy (2024) reported that the interaction between chemical system, such as glyphosate and hand hoeing treatments gave the highest reduction in dry weight of Broomrape in both seasons and increased the Faba bean seed yield, consequently, the economic return also increased.

Finally, in order to increase significantly grain yield, tested herbicides can be used alone or in combination with fertilizers via increasing the competitive power of the Faba bean versus broad and grassy weeds. The results confirmed that the mixing of herbicides with fertilizers were considerably effective to increase Faba bean yield. For example, application of 50% of recommended rate of tested herbicides with fertilizers led to increase Faba bean yield by 14.61 to 21.10% during both seasons (2017-2018 and 2018-2019).

Further studies are needed on using other fertilizers like phosphorus fertilizers as well as utilizing biologically additives, such as allelopathy to investigate negative effects on weeds.

Conclusion

Weeds are considered one of the main factors affecting quality and quantity of Faba bean. The current research was done to evaluate the herbicidal activities of clethodim and metribuzin when mixing with urea or ammonium sulfate as ferlilizers to control weeds in Faba Bean fields during 2017-2018 and 2018-2019 seasons.

All studied treatments are been effective in controlling of weeds compared with the untreated plot. Furthermore, the hand hoeing treatment was the best choice in weed control followed by clethodim in controlling grassy weeds. Significantly, addition of urea or ammonium sulphate to the half recommended rates of metribuzin or clethodim showed herbicidal activity similar to the recommended rates of herbicide. On the other hand, all studied treatments illustrated increased Faba bean growth and yield quantity compared with the untreated plots.

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مكافحة الحشائش في حقول الفول البلدي باستخدام مبيدات الحشائش الكلثوديم والمتريبوزين مع بعض الإضافات

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الملخص العربى:

يعد الفول البلدى من أكثر الخضروات البقولية انتشارًا في العالم، ويعتبر مصدرًا نباتيًا عالي الجودة. وتعتبر الحشائش أحد العوامل الرئيسية التي تؤثر على جودة وكمية محصول الفول البلدي. تم إجراء هذا العمل البحثى لتقييم كفاءة مبيدي الحشائش الكلثوديم والمتريبوزين بالمعدل الموصى به ونصف المعدل الموصى به مع الأسمدة مثل اليوريا أو كبريتات الأمونيوم لمكافحة الحشائش الضارة في حقول الفول البلدي خلال موسمي ٢٠١٧-٢٠١٨ و٢٠١٨-٢٠١٩م. ولقد أشارت النتائج المتحصل عليها إلى أن جميع المعاملات المدروسة أدت إلى إنخفاض معنوي في نمو الحشائش مقارنة بغير المعامل. وكانت معاملة العزيق اليدوي هي الخيار الأفضل في مكافحة الحشائش العريضة ، تليها معاملة الكلثوديم في مكافحة الحشائش الرفيعة. علاوة على ذلك، فإن إضافة اليوريا أو كبريتات الأمونيوم إلى نصف المعدلات الموصى بها من الكلثوديم والمتريبوزين قد سجل فى بعض المعاملات كفاءة مماثلة للمعدلات الموصى بها من المبيدات منفردة. من ناحية أخرى، أظهرت جميع المعاملات المدروسة زيادة في نمو الفول البلدى وكمية المحصول مقارنة بغير المعامل. من ذلك يتضح أن مكافحة الحشائش تعمل على تقليل المنافسة مما يؤدي إلى تحسين نمو نباتات الفول البلدى وبالتالي إنتاجية البذور.

كلمات مساعدة: مكافحة الحشائش – الفول – كليتوديم – ميتريبوزين – مبيدات الحشائش مع الأسمدة