

Evaluation of Planting Methods and Herbicide Combinations on Weeds Density and Lentil Crop Productivity

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Abstract: Two field experiments were carried out at Gemmieza Research Station during 2020/2021 and 2021 / 2022 winter seasons to investigate the effect of two planting methods (Afir and Improved afir) and some herbicide combinations on weed traits, growth characters, yield and its components of lentil (*Lens culinaris*, Medik). The herbicide combinations included (Sencor at 150 cm³fed⁻¹+ Fusilade forti at 1.25 Lfed⁻¹ (T1) or hand weeding (T2), Broadstrike at 30 g fed⁻¹ + Fusilade forti at 1.25 L fed⁻¹ (T3) or hand weeding (T4), Amex at 2 L fed⁻¹ + Select supar at 250 cm³ fed⁻¹ (T) or hand weeding (T6) and hand weeding twice (T7). The results indicated that, improved Afir method had the highest significant reduction in fresh weight of total annual weeds (25.8 and 20.8 %) at 90 days from sowing and increased lentil yield (ardab/fed) by (19.7 and 16.1 %) in the first and second seasons, respectively as compared to Afir method. The previous herbicide combinations reduced the fresh weight of total annual weeds by (84.7, 87.3, 84.6, 86.3, 84.0, 86.6 and 82.8 %), respectively at 90 days from sowing and increased seed yield of lentil (4.55, 4.75, 5.12, 5.37, 4.77, 4.92 and 3.04 ard/fed), as compared to untreated control by (1.35 ardab/fed), in the first season. The results were the same trend in the second season. Economic evaluation indicated that using improved Afir method with T4 or T3 herbicide combination gave the highest economic values and high increase in farmer income in both growing seasons.

Key words: Lentil • *Lens culinaris* • Planting methods • Herbicides • Weed control • Yield • Yield parameters

INTRODUCTION

Lentil (*Lens culinaris*, Medik) is one of the important pulse crops of world. Its seed is a rich source of protein, minerals and vitamins for human nutrition and the straw is a valued animal feed. Its ability in nitrogen and carbon sequestration adds to soil fertility [1]. With rising interest in plant-based protein among health-conscious people, the gap between demand and supply of protein-rich lentils is increasing [2]. The nutrient value of lentil composed of 60% of carbohydrates, 26% of protein, 7.5% of iron, 2% of sugars and 0.87 of thiamine vitamin B1 [3].

The average cultivated area during 2019 to 2022 in Egypt was 528 fed, with average seed yield of 6.25 ardab/fed and total production of approximately 531 tons which covers about 5 % of the total national consumption [4]. Farag [5] noticed that the cultivated area of lentils in Egypt decreased from about 2.52 thousand feddans in 2011 to about 528 feddans in 2020, or about 79%. The problem resulting from the inability of production to keep up with consumption of the lentil crop has led to an increase in prices.

Weed infestation is one of the limiting factors in achieving optimum yield of lentil. Among the different crop management practices, weed management is of key importance as 20 to 30% losses in grain yield are quite usual and may increase even 50 %, if the weed management practices are not properly done [6]. The estimated yield losses caused by these annual weeds vary from 20 to 80% and may reach 100% in highly infested fields [7]. Most of the farmers are found reluctant to weed control in lentil field timely and finally loses yield. Lentil is infested with grassy as well as broad leaf weeds in initial and later part of crop growth. Weed reduces yield through competition with crop plants for space, moisture, light and plant nutrients. The extent of yield reduction depends upon time, duration and intensity of weed infestation and weed competition with crops for growth resources. Inadequate weed control was found to reduce the yield 40-66 % in lentil [8].

Many investigations indicated that the sowing methods could be reducing the number and the weight of weeds and increasing lentil yield [9, 10]. Hand weeding twice recorded the best grasses control and gave the

highest lentil seed yield Rizk [11]. Prometryn treatment proved to be the best herbicide for controlling weed in lentil and behaved as hand weeding [12]. Hand weeding twice and prometryn + clethodim treatments significantly reduced the dry weight of total annual weeds from (89.4 to 95.5%) and (89.2 to 93.3%), respectively and increased seed yield of lentil ranged from 3.8 to 3.9 ard/fed in the first season and from 3.3 to 3.4 ard/fed in the second season, as compared with unweeded check [10]. In Australia, metribuzin tolerance in lentils has been identified as a means of enabling the control of broadleaf weeds [13].

Singh *et al.* [14] revealed that the application of pedimethalin as pre-emergence and quizalofop-p-ethyl as post-emergence in lentil are quite effective in reducing the weed infestation and improvement in grain yield of lentil. The farmers under test were satisfied with the technology of weed control practices in reducing the weed infestation and improvement in grain yield of lentil. The pre-emergence application of broad-spectrum herbicides such as metribuzin and imazethapyr is regarded as one of the most effective and economical methods to control weeds in lentil fields because of their ability to suppress weed growth and prevent yield losses [15]. Indeed, lentil cultivars are highly sensitive to these herbicides when used as post-emergence treatment. Metribuzin, which belongs to the triazinone family is a pre- and post-emergence herbicide used to control both broadleaf and grass weeds in crops like soybeans [16]. Imazethapyr, an imidazolinone herbicide, can be used as a pre- and post-emergence herbicide to effectively control a wide range of weeds in legume crops, especially lentils [17, 18].

Therefore, the present study was designed to investigate the effect of two planting methods and eight herbicides in combinations or with weeding on annual weeds traits, growth characters, yield and its components of lentil crop under Gharbia Governorate conditions.

MATERIALS AND METHODS

Two field experiments were conducted at Gemmeiza Agricultural Research Station Farm, Gharbia Governorate, Egypt, (Middle Nile Delta, Lat. 30.47 Long. 31.00) during 2020/2021 and 2021/2022 winter seasons. The experiments aimed to study the effect of two planting methods (Afir and Improved afir) and weed control treatments on fresh weight of annual grassy, broad-leaf and total annual weeds (gm^{-2}) as well as growth characters, yield and its components of lentil. Afir methods means plant lentil seeds in dry soil then give sowing irrigation immediately

after sowing. In improved afir method an extra irrigation was given before sowing then remove all germinated weeds by soil preparation then sowing lentil and gave a sowing irrigation. The treatments were arranged in split plot design with four replicates where planting methods were arranged in the main plots, while weed control treatments were arranged in the sub plots as follows:

The Main Plots (Planting Methods):

- 1- Afir
- 2- Improved afir.

The Sub Plots (Weed Control Treatments):

- T1- Sencor 60% SC at $150 \text{ cm}^3 \text{ fed}^{-1}$ applied as post sowing and before irrigation directly + Fusilade forti 15 % EC at 1.25 L fed^{-1} applied at 30 days after sowing.
- T2- Sencor 60% SC at $150 \text{ cm}^3 \text{ fed}^{-1}$ applied as post sowing and before irrigation directly + Hand weeding once at 35 days after sowing.
- T3- Broadstrike 80 % WG at 30 g fed^{-1} applied as post sowing and before irrigation directly + Fusilade forti 15 % EC at 1.25 L fed^{-1} applied at 30 days after sowing.
- T4- Broadstrike 80 % WG at 30 g fed^{-1} applied as post sowing and before irrigation directly + Hand weeding once at 35 days after sowing.
- T5- Amex 48 % EC at 2 L fed^{-1} applied as post sowing and before irrigation directly + Select super 24 % EC at $250 \text{ cm}^3 \text{ fed}^{-1}$ applied at 30 days after sowing.
- T6- Amex 48 % EC at 2 L fed^{-1} applied as post sowing and before irrigation directly.+ Hand weeding once at 35 days after sowing.
- T7- Hand weeding twice at 21 and 35 days after sowing.
- T8- Untreated (control).

The plot area was 10.5 m^2 consisted of five ridges (3.5 m length and 60 cm width). The seeds of lentil variety Giza 51 were treated by (*Rhizobium leguminosrum*) as bacterial inoculation. Lentil seeds at the rate of 50 kg fed^{-1} , were hand planted in hills spaced 5 cm on both sides of each ridge in the 14 and 18 of November during the two seasons. The summer preceding crop was maize during both seasons. All herbicidal treatments were sprayed with a knapsack sprayer at water volume of 200 L fed^{-1} . The mechanical and chemical analyses of the experimental site soil are presented in Table (a), according to Jackson [19].

The main characters for herbicides were tested in the experiments as individually, Table (b) according to Ashton and Crafts [20].

Table A: Physical and chemical properties of the experimental soil (0-30 cm) in 2020/21 and 2021/22 seasons

Seasons	Particle size distribution			Chemical analyses						
	Sand %	Silt %	Clay %	Soil texture	EC (dsm-1) (1:5)	pH (1:1)	Organic matter %	Available (mg kg ⁻¹)		
								Total N (%)	P (ppm)	K (ppm)
2020/21	19.2	32.5	48.3	Clay	2.14	7.70	1.64	30	2.61	240
2021/22	18.6	27.3	54.1	Clay	2.18	7.85	1.36	33	2.43	242

Table B: Trade, Common names, Chemical group and Site of action

Common name	Trade name	Chemical name	Family	Site of action
Metribuzin	Sencor 60 % SC SC = Suspension Concentrate	[N-(1-ethylpropyl)-2,6-dinitro-3,4-xylidine]	Triazinone	Inhibition of PS II
Flumetsulam	Broadstrike 80%WG WG = Water dispersible granules	N-(2,6-difluorophenyl)-5-methyl-[1,2,4] triazolo [1,5-a] pyrimidine-2-sulfonamide	Triazolopyrimidine	Inhibition of ALS (AHAS)
Butralin	Amex 48 % EC EC = Emulsifiable Concentrate	N-butan-2-yl-4-tert-butyl-2,6-dinitroaniline	Dinitroaniline	Microtubule assembly inhibition
Fluazifop-P-butyl (ISO):	Fusilade forti 15 % EC EC = Emulsifiable Concentrate	butyl (R)-2-[4-(5-trifluoromethyl-2-pyridyloxy)phenoxy]propionate	Aryloxyphenoxy-propionate 'FOPs'	Inhibition of (ACCCase)
Clethodium	Select supar 24 % EC EC = Emulsifiable Concentrate	(±)-2-[(E)-1-[(E)-3-chloroallyloxyimino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxycyclohex-2-enone	Cyclohexanedione 'DIMs'	Inhibition of (ACCCase)

Table C: Scientific, English and Family names for weeds accompanied lentil crop in the experimental site during 2020/21 and 2021/22 seasons

Weed types	Scientific name	English name	Family name
Grassy weeds	<i>Phalaris sp., L.</i>	Hood canary-grass	Gramineae
	<i>Avena sp., L.</i>	Wild-oat	Gramineae
Broad-leaved weeds	<i>Rumex acetosella, L.</i>	Curly dock	Polygonaceae
	<i>Chenopodium sp., L.</i>	Lambsquarters	Chenopodiaceae
	<i>Anagallis arvensis L.</i>	Preinpernel	Primulaceae
	<i>Beta vulgaris, L.</i>	Wild beet, sea beet	Chenopodiaceae
	<i>Medicago polymorpha, L.</i>	Toothed medik, Bur clover	Leguminosae
	<i>Coronopus didymus, L.</i>	Lesser swine-cress	Brassicaceae

All cultural practices of growing lentil were conducted according to the crop recommendation.

Recorded Data: The dominated weed species counted in the experimental plots in both seasons were shown in Table (c).

The Main Characters for Annual Weeds: Weed assessment was carried out at 60 and 90 days after sowing. Weeds were hand pulled from one square meter chosen at random from each plot. Weeds were classified into their species and divided into the following groups:

- 1- Fresh weight of annual grassy weeds (gm⁻²).
- 2- Fresh weight of annual broad-leaved weeds (gm⁻²).
- 3- Fresh weight of total annual weeds (gm⁻²).

Growth Characters: Samples of five plants were chosen at random from the two central rows of each plot after 90

days from sowing to determine the following characters:

- 1- Plant height (cm)
- 2- Number of branches plant⁻¹.
- 3- Dry weight plant⁻¹.

Yield Components: At harvest, ten plants were taken randomly from the two central rows of each plot to determine the following characters:

- 1- Number of pods plant⁻¹.
- 2- Number of seeds plant⁻¹.
- 3- Weight of seeds plant⁻¹ (g).
- 4- Weight of 1000 seeds (g).

Yield: At harvest, the following characters were determined from each plot (10.5 m²):

- 1- Biological yield (ton fed⁻¹).
- 2- Straw yield (ton fed⁻¹).
- 3- Seed yield (ton fed⁻¹).

Economic Evaluation: Economic evaluation for the results was done to investigate the differences between the different studied factors to get the highest profitability by using some economic criteria as gross income, net income, gross margin, benefit/ cost ratio and profitability. Economic criteria were used according to the method described by Farag [5]. Economic criteria were estimated from the following formulas:

- 1- Total costs = costs, fertilization, irrigation, insect, pathogen and weeds control, harvesting and rental value / fed of land preparation, planting, post sowing activities.
- 2- Total income (GI) = (yield (ton fed⁻¹) x price of ton (L.E.)) + (Straw yield (ton fed⁻¹) x price of ton (L.E.))
- 3- Net income (NI) = total income - total cost (L.E.).
- 4- Profitability (P) = (net income / total costs).
- 5- Benefit/Cost ratio (B/C) = (total income/total cost).

The average of Lentil price from the Bulletin of Statistical Cost Production and Net Return (2021) were used to compute gross income. The Lentil price was 3336 LE /ardab of seed and 1050 LE / ton of the straw.

Statistical Analysis: Statistical analysis was carried out according to Gomez and Gomez [21], using (MSTAT) computer software. The mean values were compared at 5% level of significance by using LSD test.

RESULTS and DISCUSSION

Effect of Plating Methods and Weed Control Treatments on Fresh Weight of Annual Weeds (gm⁻²) at 60 Days after Sowing: Data in Table (1) showed that the improved Afir method reduced the fresh weight of broad-leaved, grassy and total weeds by (40.9, 26.9 and 35.6 %) in first season and by (32.2, 23.7 and 29.1 %) in second season, respectively at 60 days after sowing as compared to Afir method. These results are in agreement with those obtained by Erman *et al.* [7].

Also, the results indicated that all weed control treatments affected significantly the fresh weight of broad-leaved, grassy and total annual weeds (gm⁻²) at 60 days after sowing in both growing seasons. T1, T2, T3, T4, T5, T6 and T7 gave the high reduction percentage on fresh weight of broad-leaved weeds (g/m²) by (88.1, 93.1, 88.6, 92.9, 82.7, 88.3 and 82.7 %), grassy weeds by (89.4, 83.9, 87.5, 80.36, 88.5, 87.4 and 83.4 %) and total weeds by (88.6, 89.5, 88.2, 88.1, 87.2, 87.9 and 83.0 %) at the 60 days after sowing, in the first season, respectively, as compared to untreated control treatment. The results

had the same trend in the second season. Several studies revealed the superiority of Sencor, Amex and hand weeding twice treatments in reducing the dry weight of annual weeds. These results are in harmony with those obtained by Singh *et al.* [14].

Effect of Planting Methods and Weed Control Treatments on Fresh Weight of Annual Weeds (gm⁻²) at 90 Days after Sowing: Data in Table (2) indicated that planting methods had significant effects on the fresh weight of annual weeds (gm⁻²) at 90 days after sowing in both growing seasons. The reduction percentage due to improved Afir method on the fresh weight of broad-leaved, grassy and total annual weeds were (28.5, 19.6 and 25.8 %) in the first season and (23.6, 14.7 and 20.8 %) in the second season, respectively, as compared to Afir method. Several investigators reported that the fresh weight of annual weeds decreased under the wet methods of sowing as improved afir [10].

All weeds control treatments affected significantly the fresh weight of broad-leaved, grassy and total annual weeds at 90 days after sowing, in both growing seasons. The treatments of T1, T2, T3, T4, T5, T6 and T7 were the most effective treatments to control broad-leaved weeds by (84.2, 89.4, 85.0, 88.9, 81.5, 86.5 and 83.1 %), grassy weeds by (85.9, 82.5, 84.0, 80.7, 89.7, 86.7 and 82.1 %) and total annual weeds by (84.7, 87.3, 84.7, 86.3, 84.0, 86.6 and 82.8 %), respectively at 90 days after sowing, in first seasons, as compared to the untreated control treatment. The results had the same trend in the second season. These results are in harmony with those obtained by Teja *et al.* [18] and Singh *et al.* [14]

Effect of Planting Methods and Weed Control Treatments on Growth Characters of Lentil:

Plant Height (cm): Data in Table (3) revealed that planting methods had significant effect on plant height (cm) at 90 days after sowing in both growing seasons. Improved afir method gave the highest values of plant height (34.8 and 33.0 %), at 90 days after sowing in the first and second seasons, respectively.

Untreated (control) treatment gave the lowest plant height at 90 days after sowing, in both seasons. While, weed control treatments, (T1, T2, T5, T6, T3 and T4) treatments gave the tallest plant at 90 days after sowing as compared to T8 untreated (control) treatment, in both growing seasons. These results may be due to the severe competition occurred between weeds and lentil plants. These results are in agreement with those reported by Singh *et al.* [14].

Table 1: Effect of planting methods and weed control treatments on fresh weight of annual weeds gm^{-2} at 60 day after sowing during, 2020/21 and 2021/22 seasons

Treatment	Fresh weight of annual weeds gm^{-2} at 60 day after sowing					
	Broad-leaved weeds		Grassy weeds		Total weeds	
	1 st	2 nd	1 st	2 nd	1 st	2 nd
Planting methods:						
Afir	325.1	374.8	198.3	226.6	523.3	601.4
Improved afir	192.0	254.0	144.9	172.8	337.0	426.8
LSD _{0.05}	31.17	14.65	8.46	21.10	27.95	29.12
Weed control treatments (Rate / fed.):						
T1- Sencor at 150 cm^3 + Fusilade forti at 1.25 L	134.3	181.6	74.8	89.9	209.1	271.5
T2- Sencor at 150 cm^3 + Hand weeding once	77.9	116.1	114.3	141.1	192.2	257.2
T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	128.2	172.5	88.9	110.8	217.2	283.3
T4- Broadstrike at 30 g + Hand weeding once	79.6	118.4	139.6	173.1	219.2	291.5
T5- Amex at 2 L + Select supar at 250 cm^3	194.7	224.2	40.9	50.5	235.6	274.6
T6- Amex at 2 L + Hand weeding once	131.9	185.3	89.6	117.1	221.5	302.4
T7- Hand weeding twice	195.1	245.5	116.3	139.9	311.4	385.4
T8- Untreated (control)	1126.6	1271.9	708.3	775.0	1834.9	2046.9
LSD _{0.05}	59.50	56.54	64.49	49.34	87.46	80.25

Table 2: Effect of planting methods and weed control treatments on fresh weight of annual weeds gm^{-2} at 90 day after sowing during, 2020/21 and 2021/22 seasons

Treatment	Fresh weight of annual weeds gm^{-2} at 90 day after sowing					
	Broad-leaved weeds		Grassy weeds		Total weeds	
	1 st	2 nd	1 st	2 nd	1 st	2 nd
Planting methods:						
Afir	1004.9	1045.9	437.8	479.2	1442.7	1525.1
Improved afir	718.8	799.3	351.8	408.7	1070.6	1208.0
LSD _{0.05}	61.97	84.39	8.57	97.53	66.81	172.94
Weed control treatments (Rate fed ⁻¹):						
T1- Sencor at 150 cm^3 + Fusilade forti at 1.25 L	540.9	586.7	213.4	256.4	754.3	843.1
T2- Sencor at 150 cm^3 + Hand weeding once	364.3	439.8	262.1	302.5	626.4	742.3
T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	512.5	571.6	242.5	281.4	755.0	853.0
T4- Broadstrike at 30 g + Hand weeding once	381.3	427.3	293.5	309.3	674.8	736.6
T5- Amex at 2 L + Select supar at 250 cm^3	633.1	622.1	155.5	210.3	788.6	832.4
T6- Amex at 2 L + Hand weeding once	461.4	517.7	202.1	279.1	663.5	796.8
T7- Hand weeding twice	579.1	622.2	272.1	310.1	851.2	932.3
T8- Untreated (control)	3422.4	3593.5	1516.7	1602.3	4939.1	5195.8
LSD _{0.05}	163.10	158.74	84.06	88.82	127.5	133.42

Table 3: Effect of planting methods and weed control treatments on same growth characters during 2020/21 and 2021/22 seasons.

Treatment	Plant height (cm)		No. branches plant ⁻¹		Dry weight of plant	
	1 st	2 nd	1 st	2 nd	1 st	2 nd
	Planting methods:					
Afir	35.00	32.89	3.77	3.61	1.52	1.43
Improved afir	53.69	49.11	4.81	4.05	1.94	1.86
LSD _{0.05}	13.95	13.24	0.87	0.54	0.21	0.16
Weed control treatments (Rate fed ⁻¹):						
T1- Sencor at 150 cm^3 + Fusilade forti at 1.25 L	45.00	41.33	5.57	5.02	1.89	1.87
T2- Sencor at 150 cm^3 + Hand weeding once	49.83	45.66	5.11	5.08	2.05	1.72
T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	47.60	43.85	4.80	4.22	1.72	1.69
T4- Broadstrike at 30 g + Hand weeding once	52.53	48.39	4.44	3.87	1.68	1.54
T5- Amex at 2 L + Select supar at 250 cm^3	45.57	41.89	5.05	4.43	1.40	1.36
T6- Amex at 2 L + Hand weeding once	48.63	44.79	4.40	3.55	1.33	1.28
T7- Hand weeding twice	37.57	35.08	3.13	2.73	1.25	1.21
T8- Untreated (control)	28.05	26.98	1.83	1.72	0.96	0.86
LSD _{0.05}	4.65	4.30	0.66	0.69	0.07	0.04

Table 4: Effect of planting methods and weed control treatments on yield components at harvest during 2020/21 and 2021/22 seasons.

Treatment	Number of pods plant ⁻¹		Number of seeds plant ⁻¹		Dry weight of seeds (g plant ⁻¹)		Weight of 1000 seeds (g)	
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
Planting methods								
Afir	30.14	29.19	37.68	36.50	0.83	0.80	23.05	21.10
Improved afir	39.68	37.46	49.61	46.82	1.33	1.26	29.31	25.94
LSD _{0.05}	8.78	7.95	10.97	9.96	0.35	0.33	2.94	2.61
Weed control treatments (Rate fed ⁻¹)								
T1- Sencor at 150 cm ² + Fusilade forti at 1.25 L	38.5	36.95	48.13	46.21	1.20	1.15	27.27	24.58
T2- Sencor at 150 cm ² + Hand weeding once	41.55	39.88	51.94	49.86	1.32	1.27	28.50	25.14
T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	40.92	38.67	51.15	48.34	1.28	1.21	27.63	24.76
T4- Broadstrike at 30 g + Hand weeding once	42.23	40.43	52.80	50.54	1.35	1.29	28.32	25.17
T5- Amex at 2 L + Select supar at 250 cm ³	38.22	36.73	47.77	45.92	1.19	1.14	27.53	24.56
T6- Amex at 2 L + Hand weeding once	40.98	39.32	51.23	49.15	1.33	1.27	28.57	25.52
T7- Hand weeding twice	27.23	26.08	34.04	32.60	0.77	0.74	24.55	22.33
T8- Untreated (control)	9.66	8.53	12.09	10.67	0.20	0.18	17.07	16.09
LSD _{0.05}	1.51	1.47	1.89	1.83	0.07	0.06	1.18	0.95

Table 5: Effect of planting methods and weed control treatments on straw yield (ton fed⁻¹), biological yield (ton/fed) and seed yield (ardab fed⁻¹) at harvest during 2020/21 and 2021/22 seasons

Treatment	Straw yield (ton fed ⁻¹)		Biological yield (ton fed ⁻¹)		Seed yield (ardab fed ⁻¹)	
	1 st	2 nd	1 st	2 nd	1 st	2 nd
Planting methods						
Afir	1.73	1.64	2.34	2.21	3.80	3.55
Improved afir	2.53	2.39	3.28	3.07	4.73	4.23
LSD _{0.05}	0.15	0.24	0.16	0.29	0.54	0.50
Weed control treatments (Rate fed ⁻¹)						
T1- Sencor at 150 cm ² + Fusilade forti at 1.25 L	2.26	2.12	2.99	2.78	4.55	4.15
T2- Sencor at 150 cm ² + Hand weeding once	2.35	2.15	3.10	2.83	4.72	4.28
T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	2.37	2.31	3.19	3.05	5.12	4.66
T4- Broadstrike at 30 g + Hand weeding once	2.52	2.39	3.38	3.17	5.37	4.89
T5- Amex at 2 L + Select supar at 250 cm ³	2.21	2.11	2.98	2.81	4.77	4.35
T6- Amex at 2 L + Hand weeding once	2.33	2.18	3.12	2.89	4.92	4.49
T7- Hand weeding twice	1.98	1.93	2.51	2.41	3.33	3.04
T8- Untreated (control)	1.01	0.96	1.22	1.16	1.35	1.25
LSD _{0.05}	0.21	0.16	0.23	0.18	0.30	0.27

Number of Branches Plant⁻¹: The effect of planting methods was significant on number of branches at 90 days after sowing in both seasons (Table 3). Improved afir method gave the highest values in number of branches (21.6 and 10.9 %), respectively, in the first and second seasons, as compared to Afir method.

Weed control treatments (T1, T2, T5, T6, T3 and T4) treatments gave the highest values in number of branches plant⁻¹ (67.2, 64.2, 63.8, 58.4, 61.9, 58.8 and 41.5 %) in the first season and (65.7, 66.1, 61.2, 51.6, 59.2, 55.6 and 37.0 %), in the second season, respectively, as compared to untreated control treatment. These results are in harmony with those reported by Teja *et al.* [18] and McMurray [13].

Dry Weight (g plant⁻¹): Data in Table (3) indicated that planting methods had significant effect on dry weight (g plant⁻¹) at 90 days after sowing in the first and second

seasons. Improved afir method gave the highest values of dry weight (g plant⁻¹) (1.94 and 1.86 g) as compared to afir method (1.52 and 1.43 g).

All weed control treatments significantly affected dry weight (g plant⁻¹) at 90 days after sowing in both seasons. (T1, T2, T5, T6, T3 and T4) treatments gave the highest dry weight (g plant⁻¹) values at 90 days after sowing in both growing seasons, as compared to untreated (control) treatment. Similar results were reported by Rizk and Daie [10] and McMurray [13].

Effect of Planting Methods and Weed Control Treatments on Yield and its Components: Data in Tables (4 and 5) showed that planting methods significantly affected the number of pods plant⁻¹, number of seeds plant⁻¹, weight of seeds (g plant⁻¹), weight of 1000 seeds (g), straw yield (ton fed⁻¹), biological yield (ton fed⁻¹) and seed yield (ardab fed⁻¹).

Improved afir method significantly increased number of pods plant⁻¹, number of seeds plant⁻¹, weight of seeds (g plant⁻¹) and weight of 1000 seeds (g) by (24.0, 24.1, 37.6 and 21.4%) respectively, in the first seasons and by (22.1, 22.0, 36.5 and 18.7%) in the second season, respectively (Table 4). Also, gave highest significant values of straw yield (ton fed⁻¹) and biological yield (ton fed⁻¹) by (31.6 and 28.7 %), in first season and by (31.4 and 28.0 %) in second season, respectively. Also, it significantly increased seed yield (ardab fed⁻¹) by (19.7 and 16.1 %) in both growing seasons, respectively as compared to Afir methods (Table 5). As similar finding was noted by Singh *et al.* [14] and McMurray [13]. All weed control treatments had significant effects on number of pods plant⁻¹, number of seeds plant⁻¹, weight of seeds (g plant⁻¹), weight of 1000 seeds (g), straw yield (ton fed⁻¹), biological yield (ton fed⁻¹) and seed yield (ardab fed⁻¹) in both growing seasons. (T1, T2, T3, T4, T5 and T6) treatments gave the highest number of pods plant⁻¹, number of seeds plant⁻¹ and weight of seeds (g plant⁻¹) in both seasons. Regarding to 1000- seed weight, the previous treatments gave the highest 1000- seed weight determined by (37.4, 40.1, 38.2, 39.7, 38.0 and 40.3%) in the first season, respectively, as compared to untreated (control) treatment (Table 4). The results had the same trend in the second season.

Seed yield was significantly affected by weed control treatments in both seasons. Applying the previous treatments gave the highest values of seed yield (ard fed⁻¹) by (70.3, 71.4, 73.6, 74.9, 71.7 and 72.6%) in the first season and (69.9, 70.8, 73.2, 74.4, 71.3 and 72.2%) in the second season, respectively, as compared to untreated (control) treatment (Table 5). The superiority of the previous treatments may be due to the reduction of fresh weight of total annual weeds which minimize the competition between lentils and weed plants on essential growth factors such as nutrients, water and light and hence maximizing lentil grain yield. These results are in agreement with those obtained by Singh *et al.* [14] and McMurray [13].

Straw and biological yield (ton fed⁻¹) influenced significantly by weed control treatments in both growing seasons. The previous treatments gave the highest values of straw yield (2.26, 2.35, 2.37, 2.52, 2.21 and 2.33 ton fed⁻¹) and biological yield (2.99, 3.10, 3.19, 3.38, 2.98 and 3.12 ton fed⁻¹), respectively, in the first season, as compared to untreated (control) treatment (1.01 and 1.22 ton fed⁻¹). The results had the same trend in the second season. Similar results were reported by Singh *et al.* [14].

Improved afir method appeared as a best method for weed control and increasing lentil yield. Sencor at 150 cm³fed⁻¹, Amex at 2 L fed⁻¹ and Broadstrike at 30 g fed⁻¹ + Fusilade forti at 1.25 L fed⁻¹ or hand weeding are the best weed control treatments regarding to seed yield increases and weed control.

Effect of Interaction Between Planting Methods and Weed Control Treatments on Fresh Weight of Annual Weeds (g m⁻²) at 60 Day after Sowing: Data in Table (6) cleared that the interaction between planting methods and weed control treatments significantly affected the fresh weight of broad-leaved, grassy and total annual weeds (gm⁻²) at 60 day after sowing, in both growing seasons. Under improved afir method, (T1, T2, T5, T6, T3, T4 and T7) treatments at 60 days after sowing, significantly reduced the fresh weight of broad-leaved, grassy and total annual weeds in the first and second seasons, respectively. These results are in agreement with those obtained by Singh *et al.* [14].

Effect of Interaction Between Planting Methods and Weed Control Treatments on Fresh Weight of Annual Weeds (g/m²) at 90 Day after Sowing: The results in Table (7) and Fig (1) revealed that the interaction between planting methods and weed control treatments significantly affected the fresh weight of broad-leaved, grassy and total annual weeds at 90 days after sowing in both growing seasons. Under improved afir method, (T1, T2, T5, T6, T3, T4 and T7) treatments, in both seasons gave the highest reduction percentage in the fresh weight of broad-leaved, grassy and total annual weeds (gm⁻²) at 90 days after sowing in first and second seasons. These results are in agreement with those obtained by Rizk and Daie [10].

Effect of Interaction Between Planting Methods and Weed Control Treatments on Same Growth Characters at 90 Days after Sowing: The results in Table (8) indicated that the interaction between planting methods and weed control treatments significantly affected plant height, number of branches and dry weight of plant at 90 days after sowing in both growing seasons. (T1, T2, T5, T6, T3 and T4) treatments under Improved afir method gave the highest values of plant height, number of branches plant⁻¹ and dry weight plant⁻¹ in the first and second seasons, respectively, as compared with (T8) untreated control treatment under Afir method. These results are in agreement with those of McMurray [13].

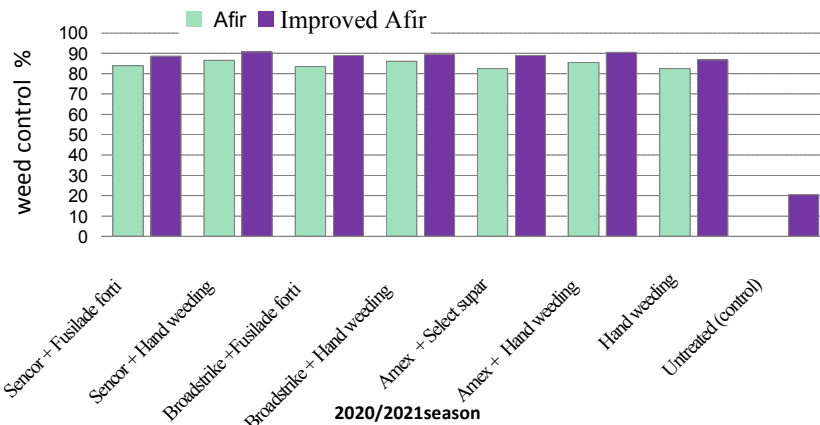


Fig 1: Effect of interaction between planting methods and weed control treatments on fresh weight of annual weeds (gm²) at 90 day after sowing during 2020/21 and 2021/22 seasons.

Table 6: Effect of interaction between planting methods and weed control treatments on fresh weight of annual weeds (gm⁻²) at 60 day after sowing during 2020/21 and 2021/22 seasons.

Planting methods	Weed control treatments (Rate fed ⁻¹)	Fresh weight of annual weeds (gm ⁻²) at 60 day after sowing					
		Broad-leaved weeds		Grassy weeds		Total weeds	
		1 st	2 nd	1 st	2 nd	1 st	2 nd
Afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	176.9	223.6	91.9	112.3	268.8	335.9
	T2- Sencor at 150 cm ³ + Hand weeding once	106.5	143.6	138.0	160.8	244.5	304.4
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	168.4	210.0	117.6	142.4	285.9	352.4
	T4- Broadstrike at 30 g + Hand weeding once	110.8	151.4	168.7	194.3	279.5	345.8
	T5- Amex at 2 L + Select supar at 250 cm ³	247.5	268.8	65.2	76.2	312.7	345.0
	T6- Amex at 2 L + Hand weeding once	180.7	236.0	108.9	133.8	289.6	369.8
	T7- Hand weeding twice	248.1	290.8	129.2	154.3	377.3	445.2
	T8- Untreated (control)	1361.7	1474.1	766.7	838.5	2128.4	2312.6
	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	91.8	139.5	57.6	67.6	149.4	207.2
Improved afir	T2- Sencor at 150 cm ³ + Hand weeding once	49.3	88.6	90.5	121.4	139.8	210.0
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	88.1	135.0	60.3	79.3	148.5	214.3
	T4- Broadstrike at 30 g + Hand weeding once	48.3	85.3	110.6	151.9	158.9	237.2
	T5- Amex at 2 L + Select supar at 250 cm ³	141.8	179.5	16.8	24.7	158.5	204.2
	T6- Amex at 2 L + Hand weeding once	83.1	134.5	70.4	100.5	153.5	235.0
	T7- Hand weeding twice	142.2	200.1	103.4	125.6	245.6	325.7
	T8- Untreated (control)	891.5	1069.7	650.0	711.5	1541.5	1781.2
	LSD _{0.05}	145.75	135.5	107.98	120.85	214.25	196.60

Table 7: Effect of interaction between planting methods and weed control treatments on fresh weight of annual weeds (gm⁻²) at 90 day after sowing during 2020/21 and 2021/22 seasons

Planting methods	Weed control treatments (Rate fed ⁻¹)	Fresh weight of annual weeds (gm ⁻²) at 90 day after sowing					
		Broad-leaved weeds		Grassy weeds		Total weeds	
		1 st	2 nd	1 st	2 nd	1 st	2 nd
Afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	636.4	661.9	249.6	287.6	886.0	949.5
	T2- Sencor at 150 cm ³ + Hand weeding once	449.6	518.5	291.8	323.7	741.4	842.2
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	615.0	664.5	287.6	309.1	902.6	973.6
	T4- Broadstrike at 30 g + Hand weeding once	460.1	491.9	306.3	336.4	766.4	828.3
	T5- Amex at 2 L + Select supar at 250 cm ³	752.0	707.5	212.5	254.9	964.5	962.4
	T6- Amex at 2 L + Hand weeding once	572.5	611.5	231.6	303.0	804.1	914.5
	T7- Hand weeding twice	672.2	701.9	298.9	334.2	971.1	1036.1
	T8- Untreated (control)	3881.5	4009.7	1623.8	1684.4	5505.3	5694.1

Table 7: Continue

Planting methods		Fresh weight of annual weeds (gm ⁻²) at 90 day after sowing					
		Broad-leaved weeds		Grassy weeds		Total weeds	
		1 st	2 nd	1 st	2 nd	1 st	2 nd
	Weed control treatments (Rate fed ⁻¹)						
Improved afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	445.4	511.5	177.3	225.2	622.7	736.7
	T2- Sencor at 150 cm ³ + Hand weeding once	278.9	361.0	232.4	281.2	511.3	642.2
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	409.8	478.9	197.6	253.9	607.4	732.8
	T4- Broadstrike at 30 g + Hand weeding once	302.6	362.5	280.7	282.2	583.3	644.7
	T5- Amex at 2 L + Select supar at 250 cm ³	514.2	536.6	98.5	165.7	612.7	702.3
	T6- Amex at 2 L + Hand weeding once	350.3	424.0	172.8	255.1	523.1	679.1
	T7- Hand weeding twice	486.0	542.4	245.4	286.1	731.4	828.5
	T8- Untreated (control)	2963.3	3177.2	1409.5	1520.3	4372.8	4697.5
	LSD _{0.05}	399.51	388.82	205.91	217.58	312.31	326.82

Table 8: Effect of interaction between planting methods and weed control treatments on growth characters during 2020/21 and 2021/22 seasons

Planting methods		Plant height (cm)		No. branches plant ⁻¹		Dry weight of plant	
		1 st	2 nd	1 st	2 nd	1 st	2 nd
			Weed control treatments (Rate fed ⁻¹)				
Afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	35.03	32.85	4.97	4.80	1.83	1.72
	T2- Sencor at 150 cm ³ + Hand weeding once	41.23	38.17	4.23	4.77	1.92	1.82
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	35.70	33.58	4.47	4.13	1.73	1.64
	T4- Broadstrike at 30 g + Hand weeding once	41.90	39.37	4.04	3.70	1.85	1.72
	T5- Amex at 2 L + Select supar at 250 cm ³	35.63	33.30	4.48	4.13	2.14	1.93
	T6- Amex at 2 L + Hand weeding once	38.10	35.75	3.50	3.20	1.91	1.97
	T7- Hand weeding twice	29.87	28.27	2.73	2.50	1.12	1.09
	T8- Untreated (control)	22.53	21.83	1.73	1.67	0.92	0.85
Improved afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	54.97	49.82	6.17	5.23	1.96	1.92
	T2- Sencor at 150 cm ³ + Hand weeding once	58.43	53.15	5.98	5.40	1.92	1.88
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	59.50	54.11	5.12	4.30	1.81	1.76
	T4- Broadstrike at 30 g + Hand weeding once	63.17	57.42	4.83	4.03	1.78	1.72
	T5- Amex at 2 L + Select supar at 250 cm ³	55.50	50.48	5.61	4.73	2.09	2.13
	T6- Amex at 2 L + Hand weeding once	59.17	53.83	5.31	3.90	1.98	1.96
	T7- Hand weeding twice	45.27	41.90	3.53	2.97	1.17	1.13
	T8- Untreated (control)	33.57	32.13	1.68	1.77	1.05	1.03
LSD _{0.05}	9.38	7.53	1.63	2.01	0.08	0.05	

Table 9: Effect of interaction between planting methods and weed control treatments on yield components at harvest during 2020/21 and 2021/22 seasons.

Planting methods		Number of pods plant ⁻¹		Number of seeds plant ⁻¹		Weight of seeds (g plant ⁻¹)		Weight of 1000 seeds (g)	
		1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
			Weed control treatments (Rate fed ⁻¹)						
Afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	33.57	32.73	41.96	40.91	0.92	0.89	23.87	21.80
	T2- Sencor at 150 cm ³ + Hand weeding once	36.40	35.20	45.50	44.00	1.04	1.00	25.43	22.78
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	34.60	33.63	43.25	42.04	0.97	0.94	24.50	22.42
	T4- Broadstrike at 30 g + Hand weeding once	36.50	35.43	45.63	44.29	1.04	1.01	24.93	22.88
	T5- Amex at 2 L + Select supar at 250 cm ³	33.20	32.33	41.50	40.42	0.92	0.89	24.40	22.15
	T6- Amex at 2 L + Hand weeding once	35.83	34.90	44.79	43.63	1.02	1.00	25.00	22.84
	T7- Hand weeding twice	23.10	22.40	28.88	28.00	0.57	0.56	21.44	19.76
	T8- Untreated (control)	7.93	6.93	9.92	8.67	0.14	0.12	14.83	14.12
Improved afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	43.43	41.20	54.30	51.50	1.49	1.41	30.67	27.35
	T2- Sencor at 150 cm ³ + Hand weeding once	46.70	44.57	58.38	55.71	1.61	1.54	31.57	27.49
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	47.23	43.70	59.04	54.63	1.60	1.48	30.77	27.10
	T4- Broadstrike at 30 g + Hand weeding once	47.97	45.43	59.96	56.79	1.65	1.56	31.70	27.45
	T5- Amex at 2 L + Select supar at 250 cm ³	43.23	41.13	54.04	51.42	1.46	1.39	30.67	26.97
	T6- Amex at 2 L + Hand weeding once	46.13	43.73	57.67	54.67	1.63	1.54	32.13	28.19
	T7- Hand weeding twice	31.36	29.75	39.21	37.19	0.97	0.93	27.67	24.89
	T8- Untreated (control)	11.40	10.13	14.25	12.67	0.26	0.23	19.30	18.05
LSD _{0.05}	3.71	3.59	4.63	4.49	0.17	0.16	2.88	2.33	

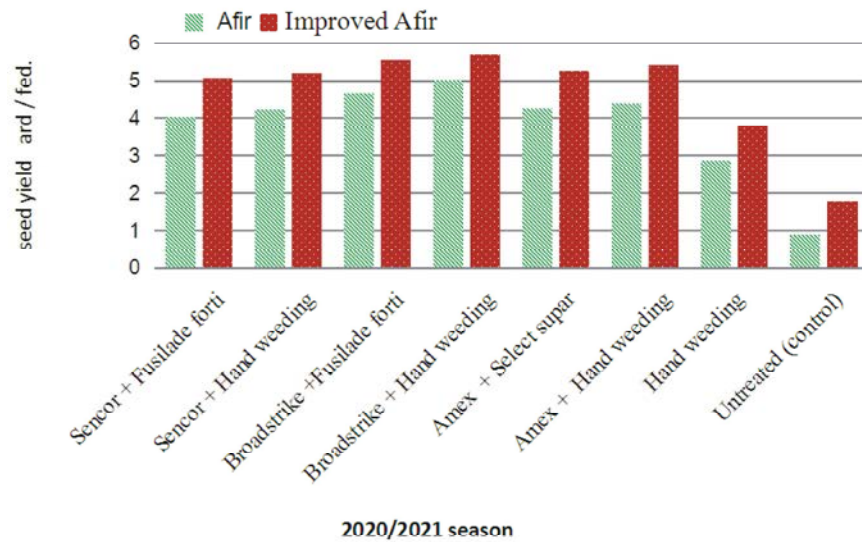


Fig 2: Effect of interaction between planting methods and weed control treatments on seed yield ardab fed⁻¹ during 2020/21 and 2021/22 seasons.

Table 10: Effect of interaction between planting methods and weed control treatments on straw yield ton fed⁻¹, biological yield ton fed⁻¹ and seed yield ardab fed⁻¹ during 2020/21 and 2021/22 seasons.

Planting methods	Weed control treatments (Rate fed ⁻¹)	Straw yield ton fed ⁻¹		Biological yield ton fed ⁻¹		Seed yield ardab fed ⁻¹	
		1 st	2 nd	1 st	2 nd	1 st	2 nd
Afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	1.72	1.66	2.36	2.27	4.03	3.80
	T2- Sencor at 150 cm ³ + Hand weeding once	1.80	1.69	2.48	2.32	4.23	3.93
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	1.92	1.86	2.67	2.56	4.67	4.37
	T4- Broadstrike at 30 g + Hand weeding once	2.10	1.92	2.91	2.67	5.03	4.70
	T5- Amex at 2 L + Select supar at 250 cm ³	1.83	1.79	2.51	2.43	4.27	3.99
	T6- Amex at 2 L + Hand weeding once	1.96	1.82	2.66	2.48	4.40	4.13
	T7- Hand weeding twice	1.70	1.63	2.16	2.06	2.87	2.68
	T8- Untreated (control)	0.80	0.79	0.95	0.92	0.90	0.83
Improved afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	2.80	2.57	3.61	3.29	5.07	4.50
	T2- Sencor at 150 cm ³ + Hand weeding once	2.90	2.61	3.73	3.35	5.20	4.63
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	2.83	2.76	3.72	3.55	5.57	4.95
	T4- Broadstrike at 30 g + Hand weeding once	2.94	2.86	3.85	3.68	5.70	5.08
	T5- Amex at 2 L + Select supar at 250 cm ³	2.60	2.44	3.44	3.19	5.27	4.72
	T6- Amex at 2 L + Hand weeding once	2.70	2.53	3.57	3.31	5.43	4.84
	T7- Hand weeding twice	2.25	2.22	2.86	2.77	3.80	3.40
	T8- Untreated (control)	1.20	1.12	1.49	1.39	1.80	1.68
LSD _{0.05}	0.52	0.38	0.53	0.48	0.74	0.67	

Effect of the Interaction Between Planting Methods and Weed Control Treatments on Yield and its Components:

Data in Tables (9 and 10) and Fig (2) revealed that the interaction between planting methods and weed control treatments affected significantly affected number of pods plant⁻¹, number of seeds plant⁻¹, of seeds plant⁻¹, 1000-seed weight, straw yield, biological yield and seed yield in both growing seasons.

Seed yield (ardab fed⁻¹) was significantly affected by the interaction between improved afir method and herbicides + hand weeding or combinations. (T1, T2, T3, T4, T5 and T6) treatments under Improved afir method

gave the highest values of seed yield (5.07, 5.20, 5.57, 5.70, 5.27 and 5.43 ardab fed-1) in first season, respectively, as compared to untreated (control) treatment under Afir method (0.90 ardab fed⁻¹). The results had the same trend in second season.

Economic Evaluation: Data in Table (11) and Fig (3) demonstrate the total costs of lentil production fed⁻¹ as affected by the applied different treatments (average of 2020/21 and 2021/22 seasons). From such data, it is clear that the minimum total costs were obtained with all planting methods and untreated check, being 12.87 and

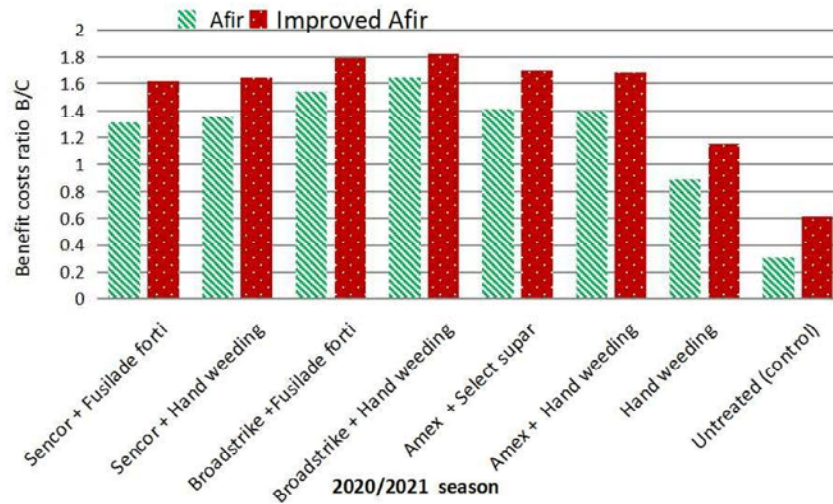


Fig. 3: Determination of benefit costs ratio (B/C) for interaction between planting methods and weed control treatments during 2020/21 and 2021/22 winter seasons.

Table 11: Determination of economic performance for interaction between planting methods and weed control treatments during 2020/21 and 2021/22 seasons.

Planting methods	Treatments	Total income (Thousand L.E.)		Total costs (Thousand L.E.)		Net income (Thousand L.E.)		Benefit costs ratio (B/C)	
		1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
Afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	17.67	17.94	13.49	14.04	4.18	3.9	1.31	1.28
	T2- Sencor at 150 cm ³ + Hand weeding once	18.54	18.55	13.64	14.19	4.9	4.36	1.36	1.31
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	20.47	20.63	13.31	13.86	7.16	6.76	1.54	1.49
	T4- Broadstrike at 30 g + Hand weeding once	22.05	22.18	13.46	14.01	8.59	8.17	1.64	1.58
	T5- Amex at 2 L + Select supar at 250 cm ³	18.72	18.83	13.27	13.82	5.45	5.02	1.41	1.36
	T6- Amex at 2 L + Hand weeding once	19.29	19.49	13.77	14.32	5.52	5.18	1.4	1.36
	T7- Hand weeding twice	12.58	12.65	14.17	14.72	-1.59	-2.07	0.89	0.86
	T8- Untreated (control)	3.95	3.92	12.57	13.12	-8.63	-9.2	0.31	0.3
Improved afir	T1- Sencor at 150 cm ³ + Fusilade forti at 1.25 L	22.23	21.24	13.79	14.24	8.44	7	1.61	1.49
	T2- Sencor at 150 cm ³ + Hand weeding once	22.8	21.85	13.94	14.39	8.86	7.46	1.64	1.52
	T3- Broadstrike at 30 g + Fusilade forti at 1.25 L	24.42	23.36	13.61	14.06	10.81	9.3	1.79	1.66
	T4- Broadstrike at 30 g + Hand weeding once	24.99	23.98	13.76	14.01	11.23	9.96	1.82	1.71
	T5- Amex at 2 L + Select supar at 250 cm ³	23.1	22.28	13.57	14.02	9.54	8.26	1.7	1.59
	T6- Amex at 2 L + Hand weeding once	23.81	22.85	14.07	14.52	9.74	8.33	1.69	1.57
	T7- Hand weeding twice	16.66	16.05	14.47	14.92	2.19	1.13	1.15	1.08
	T8- Untreated (control)	7.89	7.93	12.87	13.32	-4.98	-5.39	0.61	0.6

13.32 thousand L.E, respectively. The maximum total costs were obtained from all planting methods treated with mechanical weed control by Hand weeding being 14.47 and 14.92 thousand L.E fed⁻¹, respectively, in the both seasons. The total income of lentil seed yield in L.E. fed⁻¹ was affected by applying different treatments in both seasons, respectively.

From such results, it is clear that the highest total income of seed yield fed⁻¹ was detected with planting methods Improved afir by (T3 and T4) treatments which was 24.42 and 24.99 thousand L.E fed⁻¹ with reduction 83.8 and 84.2% in the first season and about 23.36 and 23.98

thousand L.E fed⁻¹ with reduction 83.2 and 83.7 % in the second seasons, respectively comparing to planting method Afir under untreated check, which was 3.95 and 3.92 thousand L.E. fed⁻¹. Results reveal that the highest net benefit was achieved from planting methods improved afir and weed control by (T3 and T4) treatments which was making a Benefit / Costs Ratio (B/C ratio) 1.79 and 1.82, in first season and about 1.66 and 1.71 in the second seasons, respectively While, the lowest B/C ratio was 0.31 and 0.30 which recorded by planting method Afir with no management to weed control in both seasons, respectively.

CONCLUSION

Results of this work, revealed that the best interaction of planting methods and weed control treatments were between improved afir with herbicides (Sencor or Amex or Broadstrike) + hand weeding or combination with Fusilade forti or Select supar. These treatments gave a strong annual weeds control as well as gave the greatest values of lentil seed yield fed^{-1} , accompanied to the total income in both seasons.

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