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Effect of Weed Control Treatments on Yield and Seed Quality of Some Canola Cultivars and Associated Weeds in Newly Reclaimed Sandy Soils

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Abstract: Effect of Butralin herbicide at the rate of 2.4 and 3.6 L/ha, hand hoeing and uncontrolled weeds on three canola cultivars (AD 201/Gi., Pactol and Serw 4) and associated weeds were investigated under newly reclaimed sandy soils in winter seasons of 2007/08 and 2008/09 at the Agricultural Experimental Station of National Research Center, Nobaryia, Egypt. Plant height, dry weight of canola plant at 60 DAP as well as the fresh and dry weight of broad and grassy weeds were significantly affected in response to weed control treatments. Controlling weeds with hoeing twice and Butralin herbicide resulted in an increase in plant height compared with the unweeded check. However, the treatment received Butralin at 3.6L/ha caused a significant decrease of canola plant height relative to hoeing and Butralin at low rate. The plots treated with hand hoeing twice and that received Butralin 2.4L/ha resulted in an increase in number of pods/plant, number of seeds/pod, 1000-seed weight and seed yield/plant compared with the Butralin at 3.6 L/ha or unweeded check. In addition, seed and oil yields (t/ha) were significantly increased with the two superiority treatments as compared with Butralin 3.6 L/ha or unweeded check. Seed oil content was also significantly increased with the hand hoeing compared with the unweeded check or high rate of Butralin, however, the differences between the treatment received hand hoeing twice and the treatment treated by Butralin 2.4 L/ha were insignificant. The highest values of Palmitic (4.0%) and Oleic (64.2%) were obtained with Butralin 2.4 L/ha, while applying of hand hoeing twice resulted in the highest Lenoleic acid (24.6%) as compared with unweeded check. Data also cleared that application of hand hoeing twice resulted in the lowest Linolenic acid (10.3%), while the highest (11.5%) was recorded with unweeded check. Also applying hand hoeing twice resulted in the lowest Erucic acid (0.4 %), while the highest (1.1%) with unweeded check.

Key words: Butralin · Canola cultivars · Fatty acids · Yield · Weed control

INTRODUCTION

Canola (*Brassica napus* L.) is the third most important source of oil in the world after soybean and palm oil. In Egypt, it is revealed that canola (spring types) could be grown successfully in the winter season [1, 2]. The cultivated area of canola in Egypt is relatively small in this decade. This is due to the strong competition between canola and other strategic crops such as wheat and Egyptian clover on the limited arable land in Nile valley and Delta. There are agricultural opportunities to increase canola production but the expansion of canola in Egypt is almost limited. Weeds are considered one of the most important obstructed factors in canola fields. They compete with crop plants on light, water, nutrients, space and allelochemicals. Canola as a slowly growing crop and thereby exposed to severe competition by weeds. However, at the early stage of growth, the canopy of canola leaves grew up over the rows and covered the field, hence, shading might suppress weed growth beneath. In addition, weeds with branched, vigorous root system inhibit the development of canola plants through severe nutrients depression, hence the growth, yield and its quality will be reduced [3]. According to the mentioned reasons, a linear decline was observed in seed yield of Indian mustard with increasing the weed population and biomass [4]. Gill *et al*. [5] reported that weeds cause enormous damage to the mustard crop and the magnitude of loss ranges from 30-50% depending on the growth and persistence of weed population in standing crop. Weed competition not only decreases canola crop yield, but also reduces its quality and market value. Rose and Bell [6] pointed out that growing some weed species such as wild mustard (*Sinapis arvensis*) and stinkweed

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(*Thlaspi arvensis*) in canola fields reduced canola seed quality by increasing the level of Erucic acid in the extracted oil and increasing the glucosinolates content of the remaining meal. Hand hoeing is still the conventional weed control practice in canola and in other row spacing field crops in Egypt. In recent years, the hand labour is becoming noneconomic because its wages have been increased. This in turn presents to view the needs for another reasonable alternative. Herbicide treatment alone surpassed some hand hoeing treatments in this respect [7]. While the studies of Yadav [8] and Chauhan *et al*. [9] revealed that hand hoeing twice increased seed and oil yields, pods/plant and 1000 seed weight. Use of aggressive cultivars can be effective cultural investigate the effect of cultivars and weed control practice for weed growth suppression [10, 11].

Therefore, this study aims to investigate the effect of Butralin herbicide at two rates and hand hoeing treatments on yield and seed quality of some canola cultivars grown in newly reclaimed sandy soils.

MATERIALS AND METHODS

Two field experiments were carried out at the Agricultural Experimental Station of the National Research Center at Nobaryia, Egypt, during the two successive winter seasons 2007/8 and 2008/9 to study the effect of weed control treatments on yield and its components as well as seed quality of some canola (*Brassica napus* L.) cultivars. The experimental design was split- plot with four replications. The main plots were devoted to the canola cultivars (AD 201/Gi, Pactol and Serw 4) and the weed control treatments [Unweeded check, hand hoeing twice at 21 and 35 DAP (days after planting), Butralin at 2.4 L/ha or at 3.6 L/ha] were randomly distributed in the sub plots. The herbicide Butralin (Amex 48% EC N-sec-butyl-4-tert-butyl-2, 6-dinitroaniline) is produced by SFBI Co., France and introduced by Wadi El Nil Co. for Agricultural and Development, Giza, Egypt. The experimental unit area was 10.5 square meters consisting of ten rows (3.5 m long and 30 cm between rows). Canola seeds were sown at a rate of 7.5 kg/ha in November 20th in the two seasons. Phosphorus and potassium fertilizers were added before sowing at a rate of 500 and 250 kg/ha as super phosphate (15.5 % P_2O_5) and potassium sulphate (48% K_2O), respectively, while nitrogen fertilizer was added at a rate of 150kg N/ha as ammonium nitrate (33.5%N) in two equal doses at 21 and 35 DAP. The experimental soil is sandy soil in texture, pH 8.43, E.C 0.22 dSm^{-1}, OM 0.92%, Ca CO_3 5.85%, total N 392 ppm and available P 5.8 ppm. At 60 DAP weeds were hand pulled from one square meter area of the middle of each plot, fresh broad, grassy and total weeds were weighed before oven dried at 105°C for 4 hours, then the its dry weight were estimated. At the same time, five guarded plants were taken at random from the 2nd row of each plot for determining the plant height and dry weight/plant. At harvest, a random sample of ten plants from each plot were taken to determine some yield attributes such as number of pods/plant, number of seeds/pod, seed yield/plant and 1000-seed weight. Plants of two square meter from the middle rows of each plot were harvested, dried under sunshine for one week and seeds were cleaned after separated from the pods, then the seed yield and oil yield (kg/ha) were estimated. Crude oil percentage in the seeds was determined according to AOCS [12] using Soxhelt apparatus and petroleum ether 40-60°C as a solvent. Fatty acids composition of oil was determined using Gas Liquid Chromatography, the methyl esters were prepared according to Stahl [13] using Benzene: Methanol: Sulphuric acid (conc.) as a ratio of 10:86: 4.

Statistical Analysis: The analysis of variance procedure of split- plot design according to Snedecor and Cochran [14], a combined analysis of two seasons was done according to Steel and Torrie [15] and treatment means were compared using LSD test at 5% of probability.

RESULTS

Effect of Treatments on Weeds: The dominant weeds in the unweeded plot at 60 days after canola sowing (Table 1) were prickly dock (*Emex spinosa* (L.) Campd), black mustard (*Brassica nigra* L (Koch)), scorlet pimpernel (*Anagallis arvensis* L.) and lambsquarters (*Chenopodium album* L.) as broad leaved weeds and wild oats (*Avena fatu*a L.) as grass. Fresh and dry weight of broad and grassy weeds recorded at 60 DAP were significantly affected by weed control treatments (Table1). High rate of Butralin (3.6 L/ha) reduced fresh weight of broad leaved, grassy and total weeds over hand hoeing twice by 44.4, 38.3 and 42.5%, respectively than hand hoeing treatment. Butralin at low rate significant surpassed hand hoeing on dry weight of broad leaved weeds, while the differences between them were not significant on dry weight of grassy weed (Table 1).

Hand hoeing twice and Butralin at 2.4L/ha resulted in an increase in plant height compared to Butralin at 3.6L/ha. Dry weight/ plant at 60 DAP was significantly increased in treatments received low or high Butralin rates in comparison with the plants treated with hand hoeing twice or with unweeded check.

Table 1: Effect of weed control treatments on fresh and dry weight of weeds, plant height and dry weight of canola plants at 60 days after planting (Combined analysis of the two seasons)

	Fresh weight of weeds (g/m^2)			Dry weight of weeds (g/m^2)				
Weed control treatments	Broad leaved	Grasses	Total	Broad leaved	Grasses	Total	Plant height (cm)	Dry weight (g/plant)
Unweeded check	308.8	113.7	422.5	41.84	22.76	64.60	40.33	4.02
Two hand hoeing	155.9	70.8	226.7	24.51	12.14	36.65	51.89	5.33
Butralin 2.4L/ha	161.9	64.0	225.9	19.22	12.58	31.80	52.33	7.78
Butralin 3.6 L/ha	86.7	43.7	130.4	14.31	9.40	23.71	45.11	6.81
LSD 5%	20.2	18.9	24.8	6.20	2.73	7.52	3.17	1.60

Table 2: Growth of some canola cultivars and associated weeds in response to weeds control treatments at 60 days after planting (Combined analysis of the two seasons)

				Fresh weight of weeds (g/m^2)			Dry weight of weeds (g/m^2)		
Cultivars	Weed control treatments	Plant height (cm)	Dry weight/ plant (g)	Broad leaved	Grasses	Total	Broad leaved	Grasses	Total
AD 201	Unweeded check	52.7	5.10	293.8	113.2	407.0	38.9	24.4	63.3
	Hand hoeing	56.7	7.12	156.8	80.2	237.0	21.5	14.8	36.3
	Butralin 2.4L/ha	51.7	10.67	153.1	67.8	220.9	12.5	13.4	25.9
	Butralin 3.6L/ha	51.3	7.96	76.7	35.2	111.9	12.9	7.4	20.3
Mean		53.1	7.70	169.9	74.1	244.0	21.5	14.8	36.3
Pactol	Unweeded check	33.0	3.90	285.1	122.5	407.6	47.3	23.1	70.4
	Hand hoeing	51.7	4.70	178.2	78.4	256.6	29.6	12.6	42.2
	Butralin 2.4L/ha	49.3	7.20	188.8	68.9	257.7	26.0	14.4	40.4
	Butralin 3.6L/ha	50.0	7.70	100.3	55.6	155.9	17.4	11.2	28.6
Mean		46.0	5.90	188.1	81.3	269.4	30.0	15.3	45.4
Serw 4	Unweeded check	35.3	3.00	348.1	105.2	453.3	39.3	20.7	60.0
	Hand hoeing	47.3	4.20	132.7	53.8	186.5	22.5	9.0	31.5
	Butralin2.4L/ha	56.0	5.50	143.4	55.5	198.9	19.2	9.8	29.0
	Butralin3.6L/ha	34.0	4.70	83.1	40.4	123.5	12.6	9.7	22.3
Mean		43.2	4.40	176.8	63.7	240.5	23.4	12.3	35.7
LSD 5%	Cultivars	3.0	0.90	NS	NS	NS	NS	NS	NS
	Cultivars x weeds control treatments	5.5	NS	35.0	NS	43.0	NS	NS	NS

Table 3: Yield and yield components of canola in response to weed control treatments (Combined analysis of the two seasons)

		Number of					
Weed control treatments	Seed yield / plant (g)	Pods / plant	seeds / pod	1000- seed weight (g)	Seed yield (t/ha)	Seed oil (%)	Oil yield (t /ha)
Unweeded check	7.21	99.90	17.00	3.14	1.419	36.99	0.525
Two hand hoeing	10.13	118.20	24.67	3.32	2.266	41.28	0.935
Butralin 2.4L/ha	9.37	119.30	21.22	3.21	2.044	41.48	0.848
Butralin 3.6 L/ha	8.40	96.90	21.62	3.02	1.881	39.90	0.751
LSD 5%	0.90	9.90	1.11	0.21	0.190	1.24	0.070

Table 4: Yield and yield components of some canola cultivars in response to weed control treatments (Combined analysis of the two seasons)

Cultivars	Weed control treatments	Seed yield (g/plant)	Pods number /plant	Seeds number / pod	1000- seed weight (g)	Seed yield (t/ha)	Seed oil (%)	Oil yield (t/ha)
AD 201	Unweeded check	7.51	133.92	18.55	3.28	1.607	37.08	0.596
	Two hand hoeing	10.98	148.40	23.43	3.53	2.531	41.13	1.041
	Butralin 2.4L/ha	9.61	112.43	21.63	3.10	2.398	41.71	1.000
	Butralin 3.6 L/ha	8.65	91.52	22.18	3.07	2.445	40.77	0.997
Mean		9.19	119.07	21.40	3.24	2.245	40.17	0.982
Pactol	Unweeded check	6.73	86.85	15.79	3.01	1.462	37.81	0.523
	Two hand hoeing	10.50	101.48	25.53	3.07	1.803	41.92	0.756
	Butralin 2.4L/ha	9.04	134.93	20.75	3.23	1.820	41.15	0.749
	Butralin 3.6 L/ha	8.38	104.71	21.86	2.99	1.609	39.52	0.636
Mean		8.66	106.99	20.98	3.08	1.674	40.10	0.671
Serw 4	Unweeded check	7.38	88.90	16.66	3.12	1.188	36.09	0.429
	Two hand hoeing	8.91	104.77	25.25	3.37	2.463	40.80	1.005
	Butralin 2.4L/ha	9.46	110.67	21.28	3.30	1.914	40.68	0.779
	Butralin 3.6 L/ha	8.17	94.49	20.81	3.02	1.588	39.42	0.626
Mean		8.48	99.89	21.00	3.20	1.788	39.25	0.711
LSD 5%	Cultivars	NS	8.87	NS	NS	0.180	NS	0.080
	Cultivars x weeds control treatments	NS	17.13	1.92	NS	0.320	NS	0.120

Table 5: Fatty acids composition of canola oil seeds in response to weed control treatments

	Fatty acids %				
Weed control treatments	Palmitic	Oleic	Linoleic	Linolenic	Erucic
Unweeded check	3.77	59.32	23.98	11.47	1.07
Hand hoeing (twice)	3.42	59.59	24.58	10.25	0.42
Butralin at 2.4L/ha	4.01	64.15	20.33	10.35	0.59
Butralin at 3.6 L/ha	3.91	62.52	21.64	10.94	0.57

Table 6: Fatty acids composition of some canola cultivars in response to weed control treatments

		Fatty acids %				
Cultivars	Weed control treatments	Palmitic	Oleic	Linoleic	Linolenic	Erucic
AD 201	Unweeded check	3.79	60.47	23.13	10.97	0.75
	Two hand hoeing	3.58	61.78	21.62	10.13	0.38
	Butralin 2.4L/ha	3.84	62.65	20.53	11.03	0.40
	Butralin 3.6 L/ha	3.87	63.98	20.69	10.21	0.38
Mean		3.77	62.27	21.49	10.59	0.48
Pactol	Unweeded check	3.57	56.16	27.83	11.22	1.00
	Two hand hoeing	2.98	60.13	25.27	10.62	0.38
	Butralin 2.4L/ha	3.91	63.36	21.09	10.83	0.64
	Butralin 3.6 L/ha	3.91	61.28	22.32	11.73	0.76
Mean		3.59	60.23	24.13	11.10	0.70
Serw 4	Unweeded check	3.96	61.34	20.99	12.23	1.48
	Two hand hoeing	3.69	56.86	26.85	10.00	0.49
	Butralin 2.4L/ha	4.29	66.44	19.36	9.18	0.74
	Butralin 3.6 L/ha	3.96	62.31	21.91	10.87	0.53
Mean		3.98	61.74	22.28	10.57	0.89

Table 2 indicated that there are significant differences between the three cultivars on height and dry weight of canola plants. On the other hand, weed associated with canola plants were not significantly affected by cultivars as well as by the interaction between canola cultivars and weed control treatments. However the canola plant height and fresh of broad leaved weeds and dry weight of grassy weed were significantly affected by the interaction. The highest plant height was recorded in Serw 4 received 2.4 L/ha Butralin and the greatest dry weight/plant was recorded in AD201 treated by 2.4 L/ha Butralin. Data in Table 2 showed that in all canola cultivars, application of 3.6 L/ha Butralin decreased the fresh broad leaved weeds in comparison with other weed control treatments, however, the lowest fresh broad leaved weeds was recorded in AD201x 2.4L/ha Butralin followed by Serw 4 at the same Butralin rate.

Data presented in Table 3 revealed that seed yield and yield components were significantly affected by different weed control treatments. The plants treated with hand hoeing twice and that received Butralin 2.4L/ha resulted in an increase in seed yield/plant, number of pods/plant, number of seeds/pod as well as 1000-seed weight as compared with the treatment received Butralin 3.6 L/ha or unweeded check. Such increases in seed yield/plant due to application of hand hoeing twice, Butralin 2.4 and 3.6 L/ha were estimated by 40.5, 30.0 and 16.5 % compared with unweeded check, respectively. Number of seeds/pod and 1000-seed weight were also significantly increased with hand hoeing twice resulted in the highest seeds/pod (24.7) and 1000-seed weight (3.3 g). Seed and oil yields (ton/ha) were significantly increased with the plants received hand hoeing twice or treated with Butralin 2.4 L/ha as compared with Butralin 3.6 L/ha or unweeded check. Seed oil content was also significantly increased with the treatment received hand hoeing twice compared with the unweeded check or high rate of Butralin application, however, the differences between the treatment received hand hoeing twice and the treatment treated by Butralin 2.4 L/ha were insignificant. The unweeded check produced the lowest oil percentage (36.99 %), while the highest (41.48 %) was obtained by Butralin 2.4 L/ha.

Data presented in Table 4 indicated that seed yield/plant was not significantly affected by the interaction between weed control treatments and canola cultivars. Data also showed that AD 201 and Serw 4 cultivars surpassed Pactol cultivar in most yield components. The number of pods/plant and number of seeds/pod were significantly affected by the interaction treatments, where under hand hoeing treatment the highest number of pods/plant (148.4) and seeds/pod (25.5) were obtained from AD201 and Pactol cultivars, respectively. Also application of hand hoeing twice in the three canola cultivars insignificantly affected 1000-seed weight, however the highest 1000-seed weight (3.5 g) was recorded with AD201, while the lowest (3.0 g) was recorded with Pactol at high rate of herbicide Butralin. In this regard, data in Table 4 cleared that seed and oil yields (t/ha) were significantly increased up to 2.531 and 1.041 t/ha in AD201 received hand hoeing twice as compared with unweeded check, respectively.

Data in Table 5 showed that the fatty acids percentages were affected by using different weed control treatments. The highest values of Palmitic (4.01%) and Oleic (64.15%) acids were obtained with Butralin 2.4 L/ha, while applying of hand hoeing twice resulted in the highest Lenoleic acid (24.58%) as compared with unweeded check. Data also cleared that application of hand hoeing twice resulted in the lowest Linolenic acid (10.25%), while the highest (11.47%) was recorded with unweeded check. Also applying hand hoeing twice resulted in the lowest Erucic acid (0.42 %), while the highest (1.07%) with unweeded check.

Table 6 illustrated the interaction between canola cultivars and weed control treatments on fatty acids contents, Palmitic acid was less affected, however the treatment received Butralin 2.4 L/ha in Serw 4 resulted in the highest value (4.29%), while the lowest (2.98%) was obtained in Pactol treated with hand hoeing twice. The highest Oleic acid (66.44) was obtained with Serw 4 x 2.4 L/ha, while Pactol produced the lowest (56.16 %) with unweeded check. Also Serw 4 produced the lowest Linoleic (19.36%) and Linolenic acids (9.18%) with the same Butralin rate. Data in Table 6 indicated that the Erucic acid was decreased up to 0.38 % in AD 201 and Pactol cultivars with the treatment received hand hoeing twice, while the highest Erucic acid (1.07%) was observed in AD 201cultivar under unweeded check.

DISCUSSION

It is well known that weeds interfere with crop plants causing serious impacts either in the competition for light, water, nutrients and space or in the allelopathy. Canola as a slowly growing crop is particularly exposed to severe competition from weeds. Weed suppression by shading only begins after the canopy of canola leaves grown over the rows and early covered the field. Faster growth of weeds is disadvantageous for light and hence photosynthesis needed for canola plants. Through this light deprivation less energy is available to crop plant for metabolic production and hence growth of canola plant will be reduced. In addition, weeds with branched, vigorous root systems inhibit the development of canola plant through severe nutrition deprivation. Two hand hoeing and also herbicide Butralin at a rate of 2.4L/ha resulted in an increase in plant height compared with the unweeded check. This means that the least competition between growing weeds and canola plants due to the weed control management may encourage canola plants to grow well. Martin *et al.* [16] reported that canola must be kept weed-free in most cases until the four-leaf stage of the crop (17-38 days after crop emergence and, in one early-seeded experiment, until the six-leaf stage of the crop (41 DAE), in order to prevent > 10% yield loss. After the four- to six-leaf stage of the canola crop, few weeds emerged, and late-emerging weeds accumulated little shoot biomass. Therefore hand hoeing twice at 21 and 35 DAP is sufficient to controlling weeds (Table 1). In this respect, Roushdy *et al.* [3] and El-Bastawesy *et al.* [17] showed that all growth characters of rapeseed plant were improved by weed control treatments. Similar findings were obtained by Sharma and Jain [18], who pointed that, hand weeding twice at 30 and 45 DAP recorded the highest plant height. On contrary the reduction in plant height with the unweeded treatment may be due to that weeds growing with a crop have been shown to reduce soil moisture, although the depth of additional water extraction depends on the specific combination of crop and weeds present [19].

Data also indicated that the dry weight of canola plant was increased using hand hoeing twice or application of herbicide Butralin as pre emergence. Singh *et al.* [4] mentioned that *Brassica juncea* varieties and weed control treatments showed an increase in dry matter accumulation when plants treated with two hand hoeing at 25 and 45 DAP as well as by using pendimethalin at a rate of 1kg/ha. The superiority of herbicide Butralin might be due to the fact that herbicide persisted in the soil for longer duration and gave a longer weed control. In this regard, Roushdy *et al*. [3], Fayed *et al*. [20], and Elewa [21], reported that application of herbicide significantly decreased the fresh weight of total winter weeds in comparison with unweeded treatments. Also, Rajput *et al*. [22] concluded that, application of hand hoeing twice at 30 and 45 days after sowing resulted in a decrease in dry weight of weeds associated with Indian mustard plants. Singh *et al*. [4] reported that while the weed management methods significantly reduced the intensity of weeds and dry matter, two manual weeding at 25 and 45 days after sowing were found the most effective in reducing the intensity and dry matter accumulation of weeds over the other methods of the weed control. Similar results were obtained by Sharma and Jain [17], who declared that weed management treatments decreased the weed population and weed dry weight and consequently increased the weed control efficiency.

Concerning the seed yield and yield components, the plants treated with hand hoeing twice and also received Butralin 2.4L/ha resulted in an increase in seed yield/plant, number of pods/plant, number of seeds/pod as well as 1000-seed weight in comparison with the treatment received Butralin 3.6 L/ha or the unweeded check. Such increases in seed yield/ plant due to application hand hoeing twice estimated by 20.6 and 40.5 % in comparison with the treatment 3.6 L/ha Butralin or unweeded check, respectively. The highest yield with hand hoeing twice may be attributed to lower dry matter accumulation by weeds and decrease in their population that helped in increasing the yield attributes which ultimately led to higher yield. Weiner *et al.* [23] reported that there was a linear relationship between above-ground weed biomass and crop yield, so weed suppression translocated directly into yield. Whytok *et al*. [24] stated that the highest cost of weed control in relation to the often small effects of weed competition on yield suggest that herbicides are a good target for reducing the cost of inputs in oilseed rape, while, Jat and Giri [25] concluded that the maximum increase in seed and biomass yields was recorded with pendimethalin, whereas hand-weeding proved to be equally effective. All the weed control methods significantly increased seed yield over unweeded (control) method is believed to be a direct or indirect expression of a reduction in weed-crop competition which significantly helped to increase seed yield Singh *et al*. [4]. Generally effective weed control of weeds increased the capacity of canola plants to utilizing the availability of soil moisture, light, nutrients and carbon dioxide in building new tissues and that might account for improving growth and yield of canola plants.

Concerning the response of canola cultivars to the weed control treatments, data cleared that controlling weeds by hand hoeing twice in AD201 cultivar resulted in the highest seed and oil yields (2.531 and 1.041 ton/ha), respectively. Such increases in seed yield attributed to the increase in other yield components such as number of pods, seeds/pod, 1000-seed weight and also seed yield/plant. The positive relationship between number of pods and 1000-seed weight with seeds per plant and consequently with seed yield were reported by Mekki [2] and Ozer *et al.* [26]. Similar finding was reported by Yadav [8] and Chauhan *et al*. [9] who revealed that two hand hoeing increased seed and oil yields and their components. Gill *et al*. [5] reported that weeds cause enormous damage to the mustard crop and the magnitude of loss ranges from 30-50 % depending on the growth and persistence of weed population in standing crop. On the other hand, application of 2.4 L/ha Butralin increased seed and oil yields over 3.6 L/ha by 0.163and 0.097 t/ha and by 0.625 and 0.325 t/ha over the unweeded check, respectively (Table 3). The seed oil content was also significantly increased with the treatment received two hand hoeing compared with the unweeded check or high rate of Butralin application, this means that the superiority of herbicide Butralin might be due to the fact that this herbicide gave highest efficiency on weeds for longer duration. The present results are in accordance with the findings of Kaneria and Patel [27], Nair *et al*. [28] and Miri and Rahimi [29]. The differences between hand hoeing and Butralin at low rate treatments was insignificant that is accordance with the finding of Sharma and Jain [18], who pointed that oil content did not significantly affected by using cultural as well as chemical weed control.

Concerning the canola cultivars, AD 201 cv. produced the largest seed yield per plant and per hectare, followed by Pactol cv. and the lowest one is Serw4 cultivars (Table 4). The differences between cultivars in grain and biological yields might be due to the genetically differences among cultivars and different genotypes concerning dry matter partitioning, where canola cultivars might differ in carbon equivalent, yield energy [30].

Fatty acids composition was affected by the interaction between weed control treatments and cultivars, where the obtained data indicated that the highest Oleic acid (66.44 %) was obtained with Serw 4 x 2.4L/ha Butralin, while Pactol produced the lowest (56.16%) with unweeded check. Davik and Heneen [31] stated that the concentrations of Oleic and Erucic acids were negatively correlated and a high Oleic acid concentration (<50%) was always associated with a low Erucic acid concentration (> 4%). On the other hand, the content of Lenoleic acid was increased with Pactol or Serw 4 and unweeded check or hand hoeing twice, respectively. Linolenic acid was only increased in Serw 4 x unweeded check, while the lowest Linolenic acid (9.18 %) was recorded with Serw 4 x 2.4L/ha Butralin. Lower Linolenic acid is desired to improve the storage characteristics of the oil, while higher Linolenic acid content may be nutritionally desirable. Similar observations were reported by Farag *et al*. [32] and Getinet *et al*. [33]. The second oil quality breeding objective is to reduce the percentage of Linolenic acid from the percent 8-10% to less than 3%, while maintaining or increasing the level of Linoleic acid [34].

Lower Linolenic acid is desired to improve the storage characteristics of the oil, while higher Linolenic acid content may be nutritionally desirable.

Applying hand hoeing twice in AD 201 or Pactol cultivars produced the lowest Erucic acid (0.38%), while the highest content (1.48 %) was observed with Serw 4 x unweeded check (Table 6). The reduction in Erucic acid in canola plants my be due the direct effect to mechanical or herbicide control treatments, resulted in a reduction of weeds density accompanied with canola plants. These results were accordance with finding of Elewa [21]. In this concern, Rose and Bell [6] pointed out that growing some weed species such as wild mustard (*Sinapis arvensis*) and stinkweed (*Thlaspi arvensis*) in canola fields reduced canola seed quality by increasing the level of Erucic acid in the extracted oil and increasing the glucosinolates content of the remaining meal.

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