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EFFECT OF SALINE WATER AND CYCOCEL LEVELS ON CANOLA OIL OF PLANTS GROWN IN WADI SUDR

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ABSTRACT

Two field experiments were carried out during two seasons in Agricultural Experimental Station of Desert Research Center at Wadi Sudr, to study the effects of salinity levels ((3607 and 4602 ppm) and cycocel application (00, 250, 500 and 1000 ppm) on physical, chemical properties and fatty acids composition of oil extracted from seeds of two canola cultivars (Pactol and Serw4) grown under salt-affected calcareous soils.

The data indicated clearly that, acid, peroxide and saponification values were increased in oil of Pactol and serw4 cultivars under high level of salinity at 0 and 6 month of storage. While, the iodine value was significantly decreased in oil of two cultivars under high level of salinity at 0 and 6 month of storage. Acid value was increased by spraying dose of 500 and 1000 ppm CCC for Pactol and Serw4 cultivars, respectively. Also, Pactol and Serw4 cultivars gave the maximum values of peroxide value by spraying dose of 500 ppm CCC. While iodine value took the reverse effect for two canola cultivars after treatment with 500 ppm CCC. After 6 month of storage at room temperature, acid and peroxide values for Pactol cultivar were increased by spraying dose of 500 ppm CCC. While, acid and peroxide values for serw4 cultivar were decreased by spraying of 250 and 1000 ppm CCC, respectively. In this regard, the spraying of CCC tended to increase iodine value for two canola cultivars.

Caproic, lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic, arachidic, Cis-11-eicosenoic and behenic acids were detected in most samples of canola oil under study. The predominant saturated fatty acid in two canola cultivars (Pactol and Serw4) is palmitic acid. The major constituents of unsaturated fatty acids in oil extracted from two canola cultivars were oleic, linoleic and linolenic acids. Concerning the erucic acid content (which is the main limiting factor for canola oil use) in oil of two canola cultivars, it was increased under high level of salinity. Spraying of Cycocel under low level of salinity tended to increase the erucic acid in oil of serw4 cultivar, when applied at rate 1000 ppm CCC. Under high level of salinity, erucic acid for Pactol was increased with increasing cycocel levels. While, Serw4 cultivar took the reverse effect for such content, when applied at rates 250 and 1000 ppm CCC.

Keywords: Canola, saline conditions, Cycocel, Chemical constituents, Fatty acids.

INTRODUCTION

Egypt is facing acute shortage of edible oils. There is a wide gap between the production of vegetable oil and its consumption. The average production was 144,000 tons in 2002, whereas the consumption amounted to 1,097,000 tons, in the same year (FAS 2003). The wide gap between the production and consumption of vegetable oil reached to 86.8%, which has created a need for importation from other countries.

Since it is difficult to increase the cultivated area of oil crops through the Nile Valley, cultivating new non-traditional oil crops such as Canola in the newly reclaimed soils (such as Wadi Sudr in south of Sinai) seems to be one of the most promising solution for this acute problem.

Canola (Brassica napus) is a major oil crop in USA, Canada, UK and many other countries in the world. Canola has many advantages in comparison with the other oil crops, e.g., sunflower, cotton, corn and peanuts. It is cultivated in winter in contrast with oil crops, which are grown in summer. Therefore, no competition would occur with the major summer crops. So it can cover the oil gap in oil production in Egypt.

Canola seeds is a major world source of vegetable oil, which contains about 40 to 45 % of oil. The production of canola oil has grown much faster than any other source of edible vegetable oil in the last years. After oil extraction, a meal containing about 25% proteins is obtained.

Some canola genotypes produce oil with a high amount of erucic acid, which has a lead effect on public health. This obstacle made several countries refuse to utilize rapeseed oil in human feeding. The name canola was adapted in 1979 in Canada for any genetically modified rapeseed variety that contained less than 2% erucic acid in its oil. This definition was revised in 1997 to less than 1 % erucic acid in the oil (Amarowicz *et al.*, 2000).

The most new lands in Egypt are subjected to salinity stress such as Wadi Sudr in south of Sinai. The rainfall or the existing fresh water in this region is limited. So, irrigation in this region depends mostly on underground water. Also, the soil of Wadi Sudr showed to be saline and highly calcareous.

The major inhibitory effect of soil and irrigation water salinity on plant growth and development has been attributed to osmotic inhibition of water availability, toxic effect of salt ions and nutritional imbalance caused by such ions. Under these conditions salinity has a great role in the definition of the absorption feature of plant roots which could be reflected on the behavior of any particular crop with respect to physiological and metabolic activities.

In recent years, some growth regulators e.g. Cycocel (Chloromequat or CCC) are described to increase the ability of some plants to withstand stress conditions, such as salinity, water stress and other stresses. The conspicuous effect of CCC is growth retardation by shortening of the upper internodes. This may be leading to enhance the accumulation of free assimilate for additional floret differentiation, grain filling and/or for more branching.

Therefore, the present work was carried out to study the effects of salinity levels and cycocel application on physical, chemical properties and fatty acids composition of oil extracted from seeds of two canola cultivars (Pactol and Serw4) grown under salt-affected calcareous soils.

MATERIAL AND METHODS

Two field experiments were conduced under calcareous of Ras Suder Agricultural Experiment Station of Desert Research center, South Sinai Governorate, Egypt during 2000/2001 and 2001/2002 seasons to study the effects of saline water irrigation (3607 and 4602 ppm) and foliar application of Cycocel (00, 250, 500 and 1000 ppm). The seeds of Canola cultivars (Pactol and Serw4) were obtained from the Field Crop Institute, Agriculture Research Center, Ministry of Agriculture, Giza, Cairo, Egypt. Planting was carried out on 1 st November during the both seasons at rate of 2.5 Kg seeds per feddan. The experiment included 16 treatments (two Canola cultivars, two salinity levels of irrigated water and four levels of Cycocel) were arranged on split split plot design with three replicates. The plot area was 6 m ^{2}(2 X 3 m^2). Organic manure and calcium superphosphate fertilizers were added during soil preparation at rates of 20 m^2 and 30 Kg P_2O_3 per feddan, respectively. Three doses of ammonium nitrate (33.5 % N) were added at rate 45 Kg N/fed. The chemical analysis of saline irrigation water and soils are presented in Tables (1& 2). The growth regulator used in this experiment is Cycocel (2-chloroethyl trimethyl ammonium chloride). It was applied with four levels [00 (as control using tap water), 250, 500 and 1000 ppm]. Plants were spraying with CCC ***as follows***:

1-Spraying at prebranching stage (30 day after sowing).

2-Spraying at preflowering stage (75 day after sowing).

Chemical analysis

Canola seeds under investigation were cleaned, fred from foreign matter and milled into a small particles. Oil was extracted from the grounded canola seeds with n-hexane (b.p. 60-70) using Soxhlet apparatus according to the procedure described by A.O.A.C. (1995). The solvent was distilled off by rotatory evaporator at 40-50 °C. The oil was dried over anhydrous sodium sulfate, filtered and kept in dark bottles in the refrigerator for analytical purposes.

Refractive index, acid value, peroxide value, saponification value and iodine value were estimated according to A.O.A.C. (1995). The fatty acids of the oil were converted to methyl esters using method according to Chman *et al.*, (1973). Methyl esters of fatty acids were separated by using Varian 3700 GC, with column 200 cm glass, 4% OV-101 +OV-210 on 80/100 mesh and chromosorb W.HP. Both of injector and flame ionization detector (FID) temperature were 150 and 250°C , respectively. Carrier gas was nitrogen, 20 ml/ min flow rate. The program beginning with 100°C for 2 min, then increase to 200°C with rate of 10°C/min and isothermally for 25 min.

Statistical analysis:

The data were analyzed statistically according to the procedure outline by Snedecor and Cochran (1967). Means followed by the same alphabetical letter (s) are not statistically different at the 0.05 level of significance according to **Duncan's** multiple range test (1955).

RESULTS AND DISCUSSION

Physical and chemical properties of canola oil: -

1.Effect of salinity levels:

The effect of salinity on physical and chemical properties of canola oil can be deduced from data presented in table (3).

Table (1) Chemical composition of the well water used for irrigation in Ras Sudr experimental station.

Salinity Levels	E.C (ds/m)	ppm	pH	Soluble cations meq/L				Soluble anions meq/L			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
Well 1	5.64	3607	7.58	3.00	3.50	72.34	0.61	------	2.75	27.37	49.33
Well 2	7.19	4602	7.48	5.25	4.75	79.02	0.62	------	3.50	38.62	47.52

Table (2) Chemical properties of the soil in Ras Sudr experimental station.

Salinity levels	E.C (ds/m)	ppm	pH	Soluble cations meq/L				Soluble anions meq/L			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
Soil 1	5.72	3663	7.74	3.75	3.75	52.25	0.26	------	2.25	29.89	27.87
Soil 2	8.24	5276	7.77	14.00	9.50	58.25	0.23	------	2.85	41.22	37.91

Data showed that acid value, peroxide value and saponification number were significantly increased under high level of salinity as compared with the low level at 0 and 6 month of storage. In this regard, Noureldin *et al* (1994) showed that acid value was higher for rapeseed plants grown under saline soil conditions than those of plants grown under sandy soil conditions. Also, Zeitoun (1999) found that refractive index was 1.467, peroxide value 0.50, saponification number 194 and iodine value 118 in the Egyptian canola seeds of Pactol cultivar (Brassica napus) grown and yielded at Noubaria area. While, the iodine value was significantly decreased under high level of salinity at 0 and 6 month of storage.

The obtained data can be attributed to the fact that the oxidation of vegetable oils takes place in a series of steps, and is often referred to as a free radical type oxidation because the initiation step is the formation of a fatty free radical. This occurs when a proton is lost from the alpha methylenic carbon in the fatty acid chain. The fatty free radical is readily susceptible to attack by atmospheric oxygen, resulting in the formation of peroxides and hydroperoxides. The final steps in the autoxidation , hydroperoxides may split into smaller organic compounds such as aldehydes, ketones, alcohols and acids, which give the obnoxious odor of rancid oil (Sherwin, 1978).

2.Effect of Cycocel application:

Data presented in table (4) show the variation in physical and chemical properties in oil of canola seeds cultivars due to effect of CCC at zero time. Results indicated that acid and peroxide values were significantly increased with spraying dose of 500 ppm CCC as compared with the control. Also, the saponification value took the same trend by spraying of 500 and 1000 ppm CCC. While, the minimum value of iodine number was obtained by spraying dose of 500 ppm CCC. The obtained data were within the range reported by El-Samanody (1998) and Atta (2000).

After 6 month of storage at room temperature, the same table shows that acid and peroxide values were decreased by spraying dose of 1000 ppm CCC as compared with the control. Sawan *et al* (2001) reported that the application of growth retardant (Cycocel) decreased the acid value in oil of cotton. Also, the saponification and iodine values were increased with spraying dose of 1000 ppm CCC as compared with the control. In this respect, El-Shahat (2000) and Farag (2004) found that increase in the acid value and peroxide value had accrued with storage. Also, there was a decrease in the iodine value of all oils from zero time to final time.

3.Varietal differences:

Results in table (5) show the response of physical and chemical properties in oil of canola cultivars under salinity stress. It is quite clear from these results that Serw4 cultivar significantly higher than Pactol cultivar in peroxide value at 0 and 6 month of storage. In this regard, Noureldin *et al* (1994) and El-Samanody (1998) found difference of chemical properties in oil between varieties of rapeseed (Brassica napus) grown and yielded under Egyptian conditions.

Table (3): Physical and chemical properties of oil extracted by hexane from seeds of Canola cultivars grown under different salinity levels.

Water salinity levels (ppm)	Physical and chemical properties									
	O month					6 month				
	Refractive index	Acid Value	Peroxide Value	*Sap* Value	Iodine Value	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value
3607	1.471 a	0.397 b	1.668 b	185.64 b	106.9 a	1.469a	1.526 b	9.16 b	193.86 b	93.65 a
4602	1.471 a	0.558 a	2.077 a	188.74 a	103.5 b	1.470a	1.744 a	16.29 a	196.78 a	89.45 b

Table (4): Physical and chemical properties of oil extracted by hexane from seeds of Canola cultivars treated with different levels of Cycocel.

Cycocel levels (ppm)	Physical and chemical properties									
	O month					6 month				
	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value
00	1.471 a	0.467 b	1.781 b	187.27 b	107.2 a	1.469a	1.657 ab	13.92 a	195.08 b	89.97 d
250	1.470 a	0.473 b	1.862 b	185.41 c	105.0 b	1.470a	1.602 ab	13.95 a	195.79 ab	92.24 b
500	1.470 a	0.514 a	2.237 a	187.74 ab	103.7 c	1.470a	1.703 a	14.58 a	193.91 c	90.99 c
1000	1.472 a	0.456 b	1.609 c	188.33 a	104.8 b	1.469a	1.577 b	8.45 b	196.49 a	93.02 a

Table (5): Physical and chemical properties of oil extracted by hexane from seeds of two Canola cultivars.

Canola Cultivars	Physical and chemical properties									
	O month					6 month				
	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value
Pactol	1.472 a	0.488 a	1.204 b	187.16 a	106.5 a	1.470a	1.791 a	4.81 b	195.81 a	93.60 a
Serw4	1.470 a	0.467 b	2.540 a	187.22 a	103.9 b	1.469 a	1.479 b	20.64 a	194.82 a	89.50 b

-Values followed by the same letter in columns are not different at $P< 0.05$ by Duncan's multiple range test.

4.Effect of interaction between salinity and cycocel levels:

Data in table (6) illustrate the interaction between salinity and cycocel levels on physical and chemical properties of oil of canola cultivars at zero time. Acid value was significantly decreased by spraying dose of 500 ppm CCC as compared with the control under low level of salinity. While, the spraying dose of 500 and 1000 ppm CCC had increased the peroxide value. The reverse effect was true for iodine value under the same salinity level. However, the saponification value was increased by spraying dose of 1000 ppm CCC as compared with the control. Under high level of salinity, the acid and peroxide values were increased by spraying dose of 500 ppm CCC as compared with the control. While, the reverse was true for iodine value under the same salinity level.

Also data in table (6) showed that after 6 month of storage at room temperature, acid value decreased when cycocel was applied at rate 500 ppm CCC under low level of salinity. Also, peroxide value took the same trend by spraying of 1000 ppm CCC. While, the reverse was true for saponification and iodine values under the same salinity level. Under high level of salinity, acid value was increased after treatment with 500 ppm CCC as compared with the control. While, the spraying dose of 250 and 1000 ppm CCC decreased the peroxide value as compared with the control. The reverse was true for iodine value under the same salinity level. In other words, the continuity of the period of storage led to the increase in peroxide formation and consequently decrease in the iodine value due to the attack of the double bond in fatty acids molecules (De and Alyar, 1978).

5. Effect of interaction between salinity levels and Canola cultivars:

Results shown in table (7), indicate the interaction between salinity levels and canola cultivars. Acid, peroxide and saponification values were increased in oil of Pactol and serw4 cultivars under high level of salinity as compared with the low level at 0 and 6 month of storage. Noureldin *et al* (1994) showed that acid value was higher for rapeseed plants grown under saline soil conditions than those of plants grown under sandy soil conditions. While, the iodine value was significantly decreased in oil of two cultivars under high level of salinity as compared with low level at 0 and 6 month of storage.

6. Effect of interaction between cycocel levels and Canola cultivars

The interaction between CCC and canola cultivars at zero time can be followed from the data in table (8). Results indicated that acid value was increased by spraying dose of 500 and 1000 ppm CCC for Pactol and Serw4 cultivars, respectively as compared with the control. Also, Pactol and Serw4 cultivars gave the maximum value of peroxide value by spraying of 500 ppm CCC as compared with the control. While iodine value took the reverse effect for two canola cultivars after treatment with 500 ppm CCC.

Also data in table (8) showed that after 6 month of storage at room temperature, acid and peroxide values for Pactol cultivar were increased by spraying of 500 ppm CCC as compared with the control.

Table (6): Variation in physical and chemical properties of oil extracted by hexane from seeds of Canola cultivars due to interaction between salinity and Cycocel levels.

Treatments		Physical and chemical properties									
		O month					6 month				
Water salinity levels (ppm)	Cycocel levels (ppm)	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value
3607	00	1.471 a	0.420 ef	1.583 e	186.11 cd	107.6 a	1.469a	1.580 bc	8.09 e	193.68 cd	92.85 bc
	250	1.470 a	0.386 f	1.454 f	183.30 e	107.5 a	1.470a	1.510 cd	12.38 c	193.68 cd	92.56 c
	500	1.470 a	0.339g	1.721 d	185.87 d	106.0 b	1.469a	1.420 d	9.44 d	192.63 d	93.54 b
	1000	1.474 a	0.444 de	1.914 c	187.28 b	106.6 ab	1.470a	1.595 bc	6.75 f	195.43 b	95.67 a
4602	00	1.470 a	0.514 c	1.979 c	188.44 ab	106.9 ab	1.470a	1.735 b	19.75a	196.49 ab	87.10 f
	250	1.471 a	0.561 b	2.270 b	187.51 b	102.6 c	1.470a	1.695 b	15.52 b	197.89 a	91.92 c
	500	1.471 a	0.690 a	2.754 a	189.61 a	101.4 d	1.470a	1.985 a	19.72 a	195.19 bc	88.43 e
	1000	1.470 a	0.467 d	1.304 g	189.38 a	102.9 c	1.469a	1.560 b-d	10.15 d	197.54 a	90.37 d

Table (7): Variation in physical and chemical properties of oil extracted by hexane from seeds of Canola cultivars due to interaction between salinity levels and Canola cultivars.

Treatments		Physical and chemical properties									
		O month					6 month				
Water salinity levels (ppm)	Cultivars	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value
3607	Pactol	1.473 a	0.403 c	1.088 d	185.75 b	108.2 a	1.470a	1.620 b	4.14 d	194.21 b	95.06 a
	Serw4	1.470 a	0.391 c	2.248 b	185.52 b	105.7 b	1.469a	1.432 d	14.19 b	193.50 b	92.25 b
4602	Pactol	1.470 a	0.573 a	1.320 c	188.56 a	104.8 c	1.470a	1.963 a	5.48 c	197.42 a	92.15 b
	Serw4	1.471 a	0.543 b	2.833 a	188.91 a	102.1 d	1.469a	1.525 c	27.09 a	196.13 a	86.76 c

-Values followed by the same letter in columns are not different at $P< 0.05$ by Duncan's multiple range test.

While, acid and peroxide values for serw4 cultivar were decreased by spraying of 250 and 1000 ppm CCC, respectively. Sawan *et al* (2001) reported that the application of growth retardant (Cycocel) decreased the acid value in oil of cotton seed. However, Serw4 cultivar gave the maximum value of saponification after treatment with 250 and 1000 ppm CCC. The reverse was true for such content in oil of Pactol cultivar by spraying dose of 500 ppm CCC. In this regard, the spraying of CCC tended to increase iodine value for two canola cultivars. Sawan *et al* (1993) showed that application of Chlormequat increased iodine value in oil of cottonseed compared with the control.

In this regard, Keskinel *et al* (1964) stated that the decrease of acid value at the beginning and the increase which took place during storage might be due to oxidation of unsaturated centers in fatty acids which is followed by breaking down to acids of lower molecular weights. On the other side, an increase in free fatty acids must occur, but when hydroperoxides and peroxides are formed in the first step of oxidation of certain fatty acids, they have higher weight than the autoxidized fatty acids.

Fatty acids composition of Canola seeds oil: -

The fatty acids composition of Canola oil extracted by hexane method from seeds of canola plants grown under salinity levels and treated by doses of cycocel are given in table (9) & Fig (1). Caproic, lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic, arachidic, Cis-11-eicosenoic and behenic acids were detected in most samples of canola oil under study.

The predominant saturated fatty acid in two canola cultivars (Pactol and Serw4) is palmitic acid. It was decreased by about 41.11% in oil of Pactol cultivar under high level of salinity as compared with the low level of salinity. While, such content for Serw4 was increased by about 44.15% under high level of salinity. As to the effect of foliar application of cycocel on palmitic acid in oil of canola cultivars, it was found that palmitic acid was decreased in oil of Pactol with spraying dose of 250 and 1000 ppm CCC as compared with the control under low level of salinity. This decrease was 4.44% and 45.55% after treatment with 250 and 1000 ppm CCC, respectively. These results are in agreement with results of Raheja *et al* (1982) on peanut. Such content for serw4 took the same trend by spraying dose of 250 ppm CCC under the same salinity level. In this regard, plants sprayed with 1000 ppm CCC showed an increase of palmitic acid in oil of Pactol cultivar under high level of salinity. This increase was 32.91% , while such content for serw4 cultivar under high level of salinity was decreased by about 12.98% and 5.19% after treatment with 250 and 1000 ppm CCC, respectively. In this respect, Noureldin *et al* (1994) found that the predominant saturated fatty acid in rapeseed varieties was palmitic, its percentage varied being 5.9, 6.3 and 8.3 % in Cresor, Brutor and Liraspa varieties grown under saline soil. Also, Zeitoun (1999) found that palmitic acid was 5.6% in oil of Egyptian seeds of Pactol cultivar (Brassica napus) grown at Noubaria area. Whereas, Afiah *et al* (1999) noticed that the predominant saturated fatty acid was palmitic, its percentage was reached 4.10 and 3.93 % for Global and Canola 103, respectively under salinity stress.

Table (8): Variation in physical and chemical properties of oil extracted by hexane from seeds of Canola cultivars due to interaction between Cycocel levels and Canola cultivars.

Treatments		Physical and chemical properties									
		O month					6 month				
Cycocel levels (ppm)	Cultivars	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value	Refractive index	Acid Value	Peroxide Value	Sap Value	Iodine Value
00	Pactol	1 471 a	0.444 d	1.00 f	187.27 ab	108.5 a	1.470a	1.805 b	3.91 d	196.84 a	91.24 c
	Serw4	1 470 a	0 491 c	2.56 b	187.27 ab	106.0 b	1.469a	1.510 cd	23.94 a	193.33 c	88.71 e
250	Pactol	1.470 a	0 514 bc	1.08 f	184.71 c	106.0 b	1.470a	1.805 b	4.14 cd	195.79 ab	93.72 b
	Serw4	1.470 a	0.432 d	2.64 b	186.11 b	104.1 c	1 470a	1.400 e	23.75 a	195.79 ab	90.75 cd
500	Pactol	1.470 a	0.620 a	1 49 d	187.98 a	104.9 c	1.470a	1.980 a	6.09 c	194.14 bc	93.58 b
	Serw4	1 470 a	0.409 de	2 98 a	187.51 ab	102.6 d	1.470 a	1.425 de	23.06a	193.68 bc	88.39 e
1000	Pactol	1.475 a	0.374 e	1.24 e	188.68 a	106.6 b	1.470 a	1.575 c	5.09 cd	196.49 a	95.87 a
	Serw4	1 470 a	0.537 b	1.97 c	187.98 a	103.0 d	1 468a	1.580 c	11.81 b	196.48 a	90.17 d

-Values followed by the same letter in columns are not different at $P < 0.05$ by Duncan's multiple range test.

Table (9): Fatty acids composition of Canola oil extracted by hexane for two Canola cultivars grown under different salinity and Cycocel levels.

Treatments			Fatty acids composition (%)											
Water salinity levels (ppm)	Cycocel levels (ppm)	Cultivars	Caproic $C_{10:0}$	Lauric $C_{12:0}$	Myristic $C_{14:0}$	Palmitic $C_{16:0}$	Stearic $C_{18:0}$	Oleic $C_{18:1}$	Linoleic $C_{18:2}$	Linolenic $C_{18:3}$	Arachidic $C_{20:0}$	Cis-11-Eicosenoic $C_{20:1}$	Behenic $C_{22:0}$	Erucic $C_{22:1}$
3607	00	Pactol	0 20	0.30	1.10	9.00	1.80	68.9	1.10	0.70	0.90	7.30	8.90	0.00
		Serw4	0.10	0.10	0.10	4.30	1.00	42.2	19 0	21.60	11.70	n.d	n.d	0.00
	250	Pactol	0 10	0.80	0.90	8.60	1.20	77.8	1.70	0.70	0.60	4.50	6.20	0.00
		Serw4	0.10	0.90	1.00	1.20	1.10	60.1	14.50	13.80	n.d	3.10	4.60	0.00
	1000	Pactol	0.10	0.10	0.10	4.90	0.60	58.4	23.60	12.10	n.d	n.d	n.d	0.00
		Serw4	0.10	0.50	0.40	5.10	0.80	65.6	10.40	9.70	n.d	2.10	3.50	2.20
4602	00	Pactol	0.10	1.10	0.90	5.30	1.10	55.5	24.80	12.30	n.d	n.d	n.d	0.10
		Serw4	0.10	0.90	1.10	7.70	1.50	51.8	11.70	6.90	2.90	4.60	6.10	4.50
	250	Pactol	0.10	0.10	0.10	5.30	0.40	59.7	21.40	11.30	0.50	0.40	0.20	0.50
		Serw4	0 10	1.00	0.10	6.70	1.10	47.4	13.80	16.00	n.d	4.90	4.60	3.30
	1000	Pactol	0.20	0.70	0.90	7.90	1.10	71.6	2.30	0.80	0.60	4.20	5.60	3.70
		Serw4	0.10	0.90	0.90	7.30	1.20	54.6	12.80	10.80	n.d	3.30	5.40	3.00

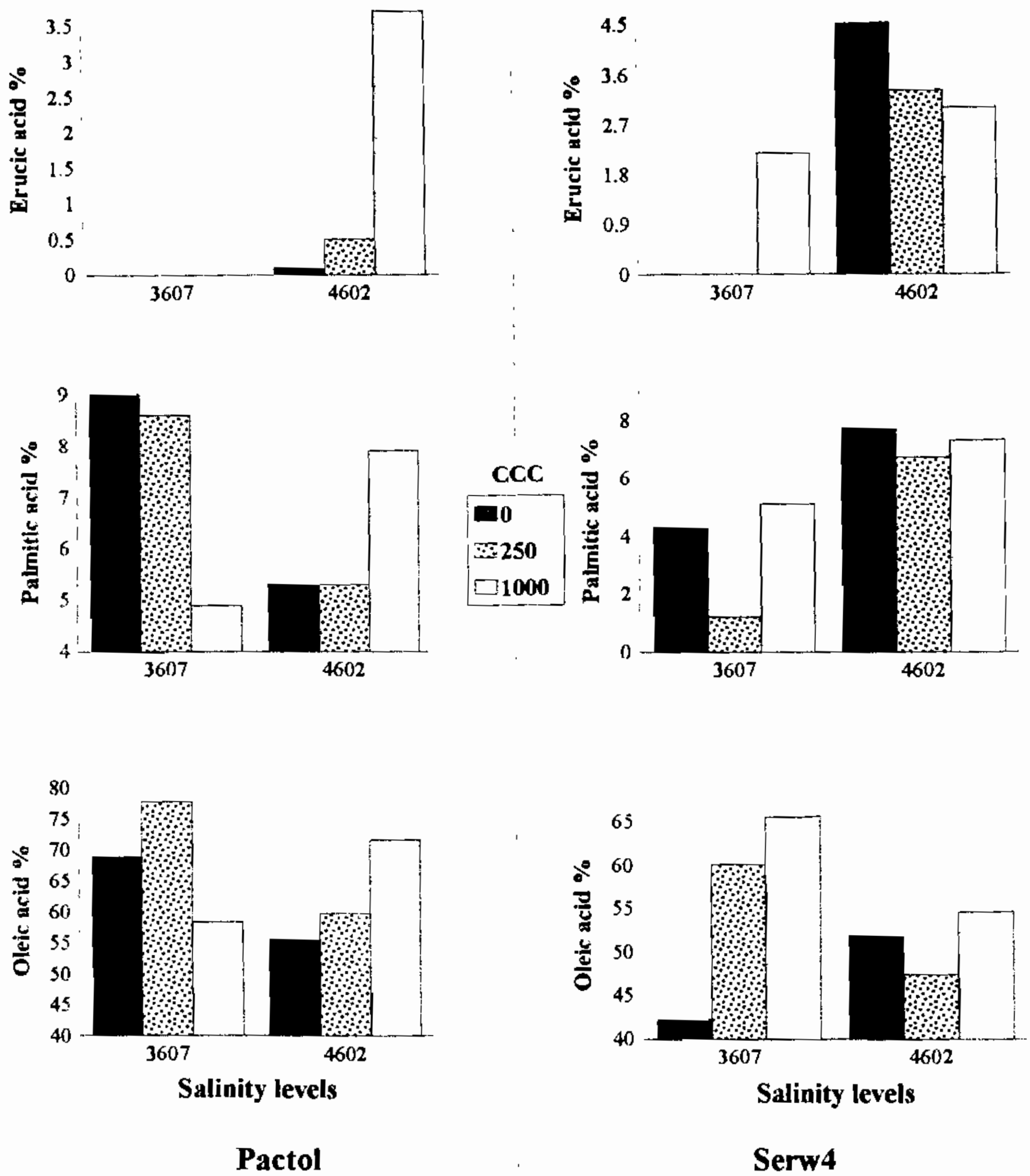

Fig.(1): Effect of salinity and cycocel levels on fatty acids composition of Canola oil extracted by hexane for two Canola cultivars.

Behenic acid is the second major saturated fatty acid in the tested samples and decreased in oil of Pactol cultivar under high level of salinity as compared with the low level of salinity. The reverse effect was true for Serw4 cultivar under the same condition. The effect of interaction between foliar application of CCC and canola cultivars under low level of salinity showed that, the spraying of cycocel decreased behenic acid in oil of Pactol, when applied at rate 250 and 1000 ppm CCC as compared with the control. The reverse effect was true for Serw4 cultivar under the same level of salinity. Such content was increased by foliar application with 250 and 1000 ppm CCC as compared with the control under high level of salinity for Pactol cultivar. While, Serw4 took the reverse effect for such content, when applied at rates 250 and 1000 ppm CCC by 24.59% and 11.47%, respectively under high level of salinity. In this regard, Pritchard *et al* (2000) showed that fatty acid composition in oil of Canola (Brassica napus) varied with region.

Concerning stearic acid in oil of Pactol cultivar, it was decreased by about 38.88% under high level of salinity as compared with low level. While, such content for Serw4 cultivar was increased by about 33.33% under high level of salinity. As to the effect of foliar application of CCC on stearic acid in oil of canola cultivars, it was found that stearic acid in oil of Pactol was decreased with increasing cycocel levels under low level of salinity. This decrease was 33.33% and 66.66% after treatment with 250 and 1000 ppm CCC, respectively. Also, such content for Serw4 cultivar was decreased by about 20%, when applied at rate 1000 ppm CCC as compared with the control. In this respect, Pactol and Serw4 cultivar gave the minimum value of stearic acid by spraying dose of 250 ppm CCC under high level of salinity. Afiah *et al* (1999) showed that stearic acid had recorded the high values in oil seeds of varieties Canola 103, Tower and Duplo under salinity stress. Also, Zeitoun (1999) found that stearic acid was 1.43 % in oil of Egyptian seeds of Pactol cultivar (Brassica napus) grown at Noubaria area.

In this connection, the saturated fatty acids.e.g. caproic, lauric and myristic acids were found in lower amounts.

The obtained results showed that the major constituents of unsaturated fatty acids in oil extracted from two canola cultivars were oleic, linoleic and linolenic acids. It is clear that oleic acid for Pactol cultivar was decreased by about 19.44% under high level of salinity as compared with the low level. The reverse effect was true in such content of Serw4 cultivar under the same condition. This increase was 18.53% for Serw4 cultivar. The effect of interaction between foliar application of cycocel and canola cultivar under low level of salinity showed that, oleic acid in oil of Pactol cultivar increased by adding cycocel foliarly at rate of 250ppm CCC as compared with the control. This increase was 11.43%. Also, the spraying of CCC tended to increase oleic acid in oil of Serw4 cultivar, when applied at rates 250 and 1000 ppm CCC by 29.78% and 35.67% respectively, as compared with the control under the same salinity level. Raheja *et al* (1982) in their study on peanut and Osman and Abu-Lila (1985) on flax, showed that cycocel increased oleic acid content of seed. In this regard, oleic acid in oil of Pactol cultivar under high level of salinity was decreased with increasing cycocel levels. The rate of increment reached 7.03% and 22.48% after treatment with

250 and 1000, respectively as compared with the control. Also, spraying dose of 1000 ppm CCC under the same salinity level increased such content by 5.12% for serw4 cultivar. According to Munshi *et al* (1986), salinity decreased oleic acid content in seeds of Brassica campestris var. toria and B.Juncea. Also, Noureldin *et al* (1994) showed that oleic acid in rapeseed varieties was the most prevalent acid in all studied rapeseed oils grown under saline and sandy soils. Its highest amount was in Brutor and Liraspa i.e, 87.5 and 86.5 % under the respective soils. While in Cresor, Liraspa and Linetta it reached 79.3, 79.6 and 83.6 %, respectively. Also, Afiah *et al* (1999) found that oleic acid was the most prevalent unsaturated acid in oil seeds of varieties grown under saline conditions. Its high amount was in Silvo and Canola 103 by 70.13 and 70.30 % respectively. In this connection, El-Azezy (2000) found that the most majority of the determined fatty acids of Brassica napus (Global) were in the unsaturated form under saline condition.

The essential fatty acid (linoleic acid) was the second major unsaturated fatty acid in the tested samples, it was increased by about 95.56% under high level of salinity as compared with the low level. However, such content for serw4 cultivar was decreased by about 38.42% under high level of salinity. As to the effect of foliar application of CCC on linoleic acid in oil of canola cultivars, it was found that linoleic acid in oil of Pactol cultivar was increased with increasing cycocel levels under low level of salinity. The magnitude of such increment reached 35.29% and 95.33% upon spraying by 250 and 1000 ppm CCC, respectively. While, Serw4 cultivar took the reverse effect under the same salinity level, when applied at rates 250 and 1000 ppm CCC by 26.31% and 45.26%, respectively. Under high level of salinity, there was decrease in linoleic acid for Pactol cultivar, when applied CCC at rates 250 and 1000 ppm by 13.70% and 90.72% respectively. In this regard, Raheja *et al* (1982) showed that cycocel decreased linoleic acid in seeds of peanut and Osman and Abu-Lila (1985) found that cycocel had little effect on linoleic acid content in oil seeds of flax. While, it was increased in oil of serw4 cultivar by about 15.21% and 8.59% after treatment with 250 and 1000 ppm CCC, respectively under the same salinity level. In this regard, Munshi *et al* (1986) showed that salinity decreased linoleic acid content in seeds of Brassica campestris var. toria and B.Juncea. Also, Sureena *et al* (1999) showed that linoleic acid content in some species of Brassica was increased with increasing salinity. Sureena *et al* (2001) indicated that salinity affected fatty acid composition considerably by increasing levels of essential fatty acids of Brassica species.

Concerning the erucic acid content in oil of two canola cultivars, the obtained data showed that it was increased under high level of salinity as compared with the low level. Regarding the effect of salinity levels and foliar application with cycocel on erucic acid (which is the main limiting factor of canola oil use), the data indicate that spraying of Cycocel under low level of salinity tended to increase the erucic acid in oil of serw4 cultivar, when applied at rate 1000 ppm CCC as compared with the control. Under high level of salinity, erucic acid for Pactol was increased with increasing cycocel levels. The magnitude of such increment reached 80% and 97.29% upon spraying by 250 and 1000 ppm CCC, respectively. While, Serw4 cultivar took the reverse effect for such content, when applied at rates 250 and 1000 ppm CCC by 26.66% and 17.7%, respectively. In this connection, the increase of erucic acid as a result of salinity is in agreement with those recorded by Munshi *et al* (1986) on Brassica species, Sureena *et al* (2001) on three species of Brassica and El-Azezy (2000) on *Brassica napus* (Global) at the experimental station on Desert Research Center, at Wadi Sudr, South Sina, Governorate, Egypt. Also, Bhardwaj and Hamama (2000) showed that the erucic acid content was higher in *Brassica. rapa* than *Brassica napus*.

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تأثير مستويات من ملوحة مياه الرى والسيكوسيل على زيت الكانولا للنباتات المزروعة بوادى سدر

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تم إجراء تجربتين حقليتين خلال موسمين بمحطة مركز بحوث الصحراء بوادى سدر وذلك لدراسة تأثير الرى بمياه مالحة (٣٦٠٧، ٤٦٠٢ جزء فى المليون) والرش بالسيكوسيل (٢٥٠ ، ٥٠٠ ،١٠٠٠ جزء فى المليون) على الخواص الطبيعية والكيميائية للزيت وتركيب الأحماض الدهنية لصنفين من الكانولا (باكتول ، سرو٤) النامى تحت ظروف الأراضي الكلسية والملحية.

أوضحت النتائج المتحصل عليها من وجود زيادة فى رقم الحامض والبيروكسيد والتصبن فى زيت الصنف باكتول وسرو٤ تحت مستوى الملوحة العالى وذلك فى البداية وبعد ٦ أشهر من التخزين. بينما أخذ الرقم اليودى لصنفى الكانولا الاتجاه العكسى تحت مستوى الملوحة العالى.

وقد أدى الرش بالسيكوسيل للصنف باكتول بتركيز ٥٠٠ جزء فى المليون، صنف سرو٤ بتركيز ١٠٠٠ جزء فى المليون إلى زيادة رقم الحامض مقارنة بالكنترول (بدون سيكوسيل). كما أن معاملة صنفي الكانولا بمعدل ٥٠٠ جزء فى المليون أعطى قيم عالية من رقم البيروكسيد. بينما أخذ الرقم اليودى الاتجاه العكسي وذلك عند نفس المعاملة بالسيكوسيل. وبعد ٦ أشهر من التخزين، وجد زيادة فى رقم الحامض والبيروكسيد لصنف باكتول وذلك عند الرش بمعدل ٥٠٠ جزء فى المليون. بينما أدى رش الصنف سرو٤ بمعدل ٢٥٠ جزء فى المليون إلى انخفاض رقم الحامض، كما انخفض رقم البيروكسيد عند رشه بمعدل ١٠٠٠ جزء فى المليون. كما أوضحت النتائج أن الرش بالسيكوسيل يميل إلى زيادة الرقم اليودى لصنفى الكانولا.

أوضحت النتائج أن محتوى الزيت من الأحماض الدهنية للصنف باكتول ،سرو٤ هو كابرويك، لوريك، ميرستيك، استياريك، أوليك، لينوليك، لينولينيك، اراشيديك، ايكوسينوك، بهنيك فى معظم العينات المستخلصة. وقد وجد أن حامض البالمتيك هو الحامض الدهنى المشبع السائد لصنفى الكانولا . كما وجد أن حامض الأوليك هو الحامض الدهنى الغير مشبع السائد فى زيت الصنفين. وقد حدث زيادة فى محتوى حامض الايروسيك (الحامض الدهنى المحدد لاستهلاك الزيت) فى زيت الصنف باكتول، سرو٤ تحت مستوى الملوحة العالى وذلك مقارنة بمستوى الملوحة المنخفض. كما وجد زيادة فى حامض الايروسيك تحت مستوى الملوحة المنخفض وذلك عند رش الصنف سرو٤ بالسيكوسيل بمعدل ١٠٠٠ جزء فى المليون مقارنة بالكنترول (بدون سيكوسيل). كذلك وجد زيادة فى محتوى حامض الايروسيك فى صنف باكتول وذلك مع زيادة مستويات السيكوسيل تحت مستوى الملوحة العالى. ولكن حدث العكس عند معاملة صنف سرو٤ بتركيز ٢٥٠، ١٠٠٠ جزء فى المليون تحت مستوى الملوحة العالى.