Zagazig J. Agric. Res., Vol. 46 No. (6B) 2019 2287-2295

Soil Science and Agricultural Engineering

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

RESPONSE OF CANOLA (*Brassica napus cv.* Global.) TO FOLIAR SPRAYING WITH ASCORBIC AND CITRIC ACIDS

Ashraf M.S. Ebrahim[*1], A.E. El-Sherbieny[1], S.M. Dahdouh[1] and Kh.M. Wahdan[2]

1. Soil Sci. Dept., Fac. Agric., Zagazig Univ., Egypt

2. Biochem. Dept., Fac. Agric., Zagazig Univ., Egypt

Received: 27/08/2019; Accepted: 15/09/2019

ABSTRACT: A field experiment was carried out to study the effect of spraying ascorbic and citric acids on canola grown on a sandy soil in Ismailia Governorate, Egypt, the design was a randomized complete block, factorial. Factor 1: ascorbic acid spray at 4 rates. Factor 2 : Citric acid spray at 4 rates . Rates in each were 0, 144, 192 and 240 g acid ha^{-1} of spray. Thus there were 16 different combinations. Foliar spray was applied three times: 40, 60 and 80 days from sowing, each of 1000 L ha^{-1}. Yields of seeds, pods, shells, oil and oil percentage were increased with increasing the rate of acid addition. Seed yield, No. seeds pod^{-1}, pod yield and pod shelling were increased with addition rates of 240 g solution ascorbic ha^{-1} without citric acid. Shell yield and 1000 seed weight were increased with spraying 240 g ha^{-1} from both of ascorbic and citric acid.

Key words: Canola, ascorbic acid , citric acid foliar spray.

INTRODUCTION

The oil seed industry is one of the most rapidly growing agricultural enterprises globally, in particular, in semi-tropical and tropical agricultural regions, providing highly nutritious human food and animal feed. Several conventional and non conventional oilseed crops are grown including palm, olive, cotton sunflower, peanut, canola, sesame, sunflower, Jojoba, and soybean among others (**Scarisbrick and Daniels1986**).

Oil consumption in Egypt has increased at a very rapid rate in the past decade along with the growing population and higher consumption patterns. Egypt imports more than 95% of its consumption of vegetable oil.

Canola (*Brassica napus* cv. Global) is one of the most important oil crops and an important source of vegetable oil extraction after palm oil and soybean oil. Its cultivation is suitable for newly reclaimed marginal land where there is no competition with traditional crops, with salinity up to 7000-8000 mg kg^{-1} (**Alivand *et al*.**, **2013**).

Canola seeds contain 40-45% oils (6% saturated fatty acids and 94% unsaturated fatty acids). Canola oil is used in human nutrition in many countries of the world such as Canada, Europe, America and Japan. For example, in Canada canola oil accounts for 63% of all vegetable oils, while soybeans account for 24% and sunflower oil only 4% (**Sector Profile, 1988**).

Canola oil is the fifth largest crop in terms of world trade, preceded by rice, wheat, maize, cotton . It is the third export crop in Canada after wheat and barley. Hybrid rapeseed plants are among the crops of ancient civilizations in Asia and the Mediterranean. It was introduced to China and Japan from India (**Hougen and Stefansson, 1983**).

However, its oil may contain high Erucic fatty acid. Erucic acid is a monounsaturated omega-9 fatty acid, produced with other fatty acids in many plants especially Brassica plants genus. For industrial purposes and production of erucic acid, rapeseed is used; for food purposes

***Corresponding author: Tel. :** +201117030011
E-mail address: as342616@gmail.com

a 'low-erucic acid rapeseed' has been developed, which contains fats derived from oleic acid instead of erucic acid (**Dolatabadian *at al*., 2009; Downey, 1983**).

Erucic acid is produced by elongation of oleic acid *via* oleoyl-coenzyme A and malonyl-CoA. It is broken down into shorter-chain fatty acids by the long-chain acyl CoA dehydrogenase enzyme. Oil, (rapeseed canola-equivalent oil) is regulated to a maximum of 2% erucic acid by weight in the USA and 5% in the EU with special regulations for infant food (**FAO, 1987**).

The oil production can be increased horizontally by increasing the allotted area to canola in the new lands and vertically by increasing the productivity per hectare (**Weiss, 1983**).

Ascorbic and citric acid have a simulative effect on plant growth and development. **Givan (1979)** reported that ascorbic acid is a product of D-glucose metabolism which affect nutritional cycles activity in higher plants and plays an important role the in electron transport system.

Miernyk and Trelease (1981) found that citric acid is one of the organic acids presented in tricarboxylic acid cycle. **Malik and Singh (1982) and Nofal (1990)** and **El-Sayed *et al.* (2006)** found that ascorbic acid increases organic acids excreted from the root into the soil and consequently increases the solubility of most nutrients.

MATERIALS AND METHODS

A Field Experiment was Conducted in Abu-Sueir area, Ismaelia Governorate, Egypt. The experiment concerned in evaluation the response of canola (*Brassica napus cv.* Global) to spraying with ascorbic acid and citric acid.

Soil samples were collected from the experimental field at a depths of (0-30 and 30-60) for determining the main physical and chemical properties (Table 1) according to the methods outlined by **Black *et al.* (1965)**. The desing of each experiment was a randomized complete block (3 replicates) factorial with 2 factors. The plot area was 21 m^2. The 1st experiment was carried during 2017 season. The seeds were sown on 15th October 2017 for 1st experiment. Three seeds were planted in each hill 10 cm apart and 30 cm row spacing.

The study inoculated two factors. Factor 1: Ascorbic acid rates of spraying at 0, 144,192 and 240 mgL^{-1} concentration. Factor 2: Citric acid spray at the same concentrations of ascorbic acid. Spraying was done three times, 40, 60 and 80 days after seeding. Total treatment combinations was 16; executed in 3 replicates, plot area was 21 m^2 (3x7). Rate of spray each time was 1000 L ha^{-1}. All plots received N, P and K at 144, 30 and 180kg ha^{-1}, respectively. Sources were ammonium nitrate, triple super phosphate and K. sulphate, respectively. Rates of ascorbic acid are designated as, A_0, A_1, A_2 and A_3 while as those of citric acid are C_0, C_1, C_2 and C_3.

Methods of Analyses

Mechanical analyses of the soil and $CaCO_3$ content were carried out as described by **Piper (1950)**. Soil pH, EC and organic matter were carried out as described by **Jackson (1965)**.

Total nitrogen in plant was determined by the Kjeldahl method, and phosphorus was determined in the extracts or digests using a colorimetric method of the ascorbic acid method (**Murphy and Riley, 1977**). Potassium was measured by flame-photometer. Oil in seeds was determined using the soxhelt apparatus with N-hexane as solvent due to **Deyoe and Shellenberger (1965)** as well as **AOAC (1990)**.

RESULTS AND DISCUSSION

Canola seed yield, shell and pod yields are shown in Table 2. There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 1.87 Mg seed yield ha^{-1}. All other treatments treated with ascorbic acid or citric acid or both, gave increases in seed yield. Other treatment gave increases of 14.97% by A_0 C_1 to 104.3 % by A_0 C_3. This indicates the high efficiency of citric acid at the highest rate applied. Main effects for citric acid shows a pattern of $C_3 > C_2 > C_0 \geq C_1$. Main effect of ascorbic followed the order $A_3 > A_1 > A_0 > A_2$.

The main effect of citric acid and ascorbic acid rate shows progressive increase with the increase in the rate of addition. However the

Table 1. Physical and chemical properties of the studied soil

Partical distribution								Soluble ions (mmolc L^{-1})								Available micronutrient (mg kg^{-1})			
Sand (%)	Silt (%)	Clay (%)	Texture	$CaCO_3$ g kg^{-1}	OM g kg^{-1}	pH*	EC dS m^{-1}**	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	Fe	Zn	Mn	Cu
93.65	2.75	3.6	Sand	26.40	15.50	7.1	1.538	5	5	15	38	0.00	5	15	43	8.4	0.39	0.26	0.13

* pH in (1:2.5) soil :water suspension ; ** EC and soluble ions at (soil paste extract).

effect was more positive with citric acid over ascorbic acid since increases by C_1 to C_3 over C_0 and by A_1 to A_3 over A0 (**Mujahid, 2017**).

Shell Yield

As for shell yield, the non foliar spray A_0 C_0 gave 2.10 Mg shell yield ha^{-1}, at the highest rate of A_3 C_3 the shell yiled was as high as 3.66 Mg ha^{-1}. All other treatments given ascorbic acid or citric acid or both gave increases except A_2C_2 which decreased shell yield by 0. 9%. Other treatment gave increases of 15.71% by A_0 C_1 to 60.48% by A_0 C_3. .Main effects for citric acid shows a pattern of $C_3 > C_1 > C_2 > C_0$ increased shell yield. Main effect of ascorbic asid was as follow: $A_3 > A_1 > A_0 > A_2$ (Table 2).

The main effect of citric acid and ascorbic acid rate shows progressive increase with the increase in the rate of addition. Increases by C_1, C_2 and C_3 were 15.81, 3.56 and 19.76%, respectively. The increases by A_1 to A_3 over A_0 gave an average 0.36 to 5.40%, respectively, except A_2 caused decreasing by 6.47%. These results are agrement with those obtained by **El-Sabagh *et al*. (2017)**.

Pod Yield

The non foliar spray A_0 C_0 treatment gave 3.89 Mg pod yield ha^{-1}, as compared to 7.30 Mg ha^{-1} by A_3 C_3 treatment. Other treatments gave increases of 17.48% by A_0 C_1 to 84.83% by A_0 C_3 (Table 2).

The main effect of citric acid and ascorbic acid rate shows progressive increase with the increase in the rate of addition. The increases by C_1, C_2 and C_3 give an averages of 13.47, 1.98 and 20.00%, respectively, while then increases by A_1 to A_3 over A_0 were gives 4.29 and 11.38% respectively, except for A_2 which cused decreasing by 5.41%.

Shelling (%)

The non foliar spray A_0 C_0 gave 48.07% and at highest rate gave 53.14% by A_0 C_3, while the other treatment given an increases of 9.81% to 10.55%, respectively (Table 3).

The main effect of ascorbic acid rate shows progressive increase in shelling (%) with the increase in the rate of addition. The pattern of increases by A_1 to A_3 over A_0 give an averages increases of 4.33, 1.14 and 5.81%, respectively.

No. of seeds pod^{-1}

Regardling number of seeds pod^{-1} (Table 3) Results show that the non foliar spray A_0 C_0 gave 25 seeds, the highest No. seeds pod^{-1} (31.0) was obtained by A_0 C_3. The effect of foliar spraying with different rates of citric acid gave increases of 4.0% by C_1 and 24% by C_3 while decreased by 4.0% when plants sprayed by C_2. (Table 3).

The main effect of ascorbic acid spraying rate shows progressive decrease with the increase of addition rates. This indicates that the decreases by A_1 to A_3 as compared to A_0 gave an averages 1.89, 3.77 and 3.77%, respectively.

1000 - Seed weight

As for 1000 seed weight the non foliar spray A_0 C_0 gave 3.88 g seeds while, at the highest rate of spraying (A_3C_3), 1000-seed weight vaulted as much as 4.58 g.

Table 2. Seed, shell and pod yields of canola (Mg ha^{-1}) as affected by foliar spraying with ascorbic acid and citric acid

Concentration of citric acid spray solution (C)	Concentration of ascorbic acid spray solution (A)														
	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean
	Seed yield					Shell yield					Pod yield				
C_0	1.87	3.14	2.38	2.79	2.55	2.10	2.91	2.43	2.66	2.53	3.89	6.04	4.81	5.45	5.05
C_1	2.15	3.11	3.30	2.68	2.81	2.43	3.32	3.30	2.66	2.93	4.57	6.43	6.60	5.33	5.73
C_2	2.58	2.43	2.10	3.06	2.55	3.20	2.51	2.00	2.74	2.62	5.78	4.90	4.10	5.81	5.15
C_3	3.82	2.59	2.09	3.64	3.04	3.37	2.41	2.65	3.66	3.03	7.19	5.00	4.75	7.30	6.06
Mean	2.61	2.82	2.47	3.04	2.73	2.78	2.79	2.60	2.93	2.78	5.36	5.59	5.07	5.97	5.50
LSD 5%	A		0.315				0.407					0.711			
	B		0.315				0.407					0.711			
	AB		NS				NS					1.443			

A_0, A_1, A_2, and A_3 are ascorbic acid addition rates *i.e.,* 0.144, 192 and 240mg L^{-1}.

C_0, C_1, C_2 and C_3 are citric acid addition rates *i.e.,* 0.144, 192 and 240mg L^{-1}.

Table 3. Shelling (%), No. of seeds pod^{-1} and 1000– seed weight (g) of canola as affected by foliar spraying with ascorbic acid and citric acid

Concentration of citric acid spray solution (C)	Concentration of ascorbic acid spray solution (A)														
	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean
	Shelling (%)					No. of seeds pod^{-1}					1000 - seed weight				
C_0	48.07	52.01	49.62	51.33	50.26	25	25	24	24	24	3.88	3.97	3.81	4.07	3.93
C_1	47.13	48.38	50.03	50.06	48.90	26	25	25	25	25	3.48	3.61	3.84	2.84	3.68
C_2	44.56	48.89	51.39	52.88	49.43	24	30	28	27	26	4.00	3.97	3.26	4.30	3.88
C_3	53.14	52.05	44.09	49.83	49.78	31	24	25	26	27	3.54	3.93	3.88	4.58	3.65
Mean	48.23	50.32	48.78	51.03	49.59	27	26	26	26	26	3.73	3.87	3.70	3.95	3.79
LSD 5%	A		1.594				2.48					0.157			
	B		1.594				2.48					0.157			
	AB		3.232				5.04					0.318			

A_0, A_1, A_2, and A_3 are ascorbic acid addition rates *i.e.*, 0.144, 192 and 240mg L^{-1}.

C_0, C_1, C_2 and C_3 are citric acid addition rates *i.e.*, 0.144, 192 and 240mg L^{-1}.

Nitrogen Concentration

Canola N concentration (%), uptake and protein are shown in Table 4. There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 10.13 N (%). All other treatments treated with ascorbic acid or citric acid or both gave increases in N (%). Other treatments gave increases of 5.15% by A_0 C_1 to 11.68 % by A_0 C_3. This indicates the high efficiency of citric acid at the highest rate applied. Main effects for citric acid shows a pattern of $C_3 > C_2 > C_1 > C_0$. Main effect of ascorbic followed the order $A_3 > A_0 > A_2 > A_1$.

The main effect of citric acid and ascorbic acid rate shows progressive increase with the increase in the rate of addition. However the effect was more positive with citric acid over ascorbic acid since increases by C_1 to C_3 over C_0 and by A_0 to A_3 over A_1 and A_2.

Nitrogen Uptake

As for N uptake (Table 4). There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 18.94 (kg N uptake ha^{-1}). All other treatments treated with ascorbic acid or citric acid or both gave increases in N uptake. Other treatments gave increases of 17.51% by A_0 C_1 to 56.78 % by A_0 C_3. This indicates the high efficiency of citric acid at the highest rate applied. Main effects for citric acid shows a pattern of $C_3 > C_2 > C_1 > C_0$. Main effect of ascorbic followed the order $A_1 > A_3 > A_2 > A_0$.

The main effect of citric acid and ascorbic acid rates showed progressive increase with the increase in the rate of addition. However the effect was more positive with citric acid over ascorbic acid since increases by C_1 to C_3 over C_0 and by A_1 to A_3 over A_0.

Protein Content in Seed

As for Protein content in seed (Table 4). There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 18.94 (kg N uptake ha^{-1}). All other treatments treated with ascorbic acid or citric acid or both gave increases in protein content in seed. Other treatments gave increases of 4.86% by A_0 C_1 to 11.69 % by A_0 C_3. This indicates the high efficiency of citric acid at the highest rate applied. Main effects for citric acid showed a pattern of $C_3>C_2>C_1>C_0$. Main effect of ascorbic followed the order $A_3>A_0>A_2>A_1$.

The main effect of citric acid and ascorbic acid rates showed progressive increase with the increase in the rate of addition. However the effect was more positive with citric acid over ascorbic acid since increases by C_1 to C_3 over C_0 and by A_0 to A_3 over A_1

The main affect of citric acid addition rates gave a decreases of 10.3 and 8.76% with C_1 and C_3, respectively and gave 3.09% increase by spraying with C_2 (Table 4). The main effect of ascorbic acid addition rate showed progressive increases with the increase in the rate of addition. The increases by A_1 to A_3 over A_0 gave an average increases of 3.75 and 5.9%, respectively, except A_2 given an average decreases of 0.80%.

The effect of foliar spray with ascorbic acid was positive (**Hoseini *et al.*, 2014**).

Oil Yield

Concerning to, oil yield. Results revealed that, the non foliar spray A_0 C_0 treatment gave 0.80 Mg ha^{-1}, while at the highest rate of spraying (A_3C_3) oil yield increased and amounted as much as 1.78 Mg ha^{-1}. The increases obtained by spraying with different rates of citric acid were 17.50% by C_1 to 122.5% by C_3 (Table 5).

The main effect of ascorbic acid rate shows progressive increase with the increase in the rate of addition and followed the pattern of $A_3 > A_1 > A_0 > A_2$, given increases by A_1 to A_3 over A_0 by 7.76 and 10.35%, respectively, except A_2 gave 1.72% decrease.

Oil Percentage

As for oil percentage (Table 5). The non foliar spray A_0 C_0 gave 42.78 % oil and lowest value 41.72% was obtained due to treatment of A_1 C_0. The highest value of oil percentage (52.1%) was obtained when the plants treated with A_3 C_3 which gave an increase of 21.7% as compared with A_0 C_0 treatment. The main effect of spraying with citric acid gave increases of 3.92% by C_1, 6.45% by C_2 and 12.4% by C_3. acid or both gave increases. Other treatments gave increases of 2.36% by A_0 C_1 to 8.86% by A_0 C_3. At the highest rate there was no significant differences between the tow sources (Table 5).

Table 4. Nitrogen concentration (%) and uptake (kg ha^{-1}) and protein (kg ha^{-1}) of canola as affected by ascorbic acid and citric acid foliar spray

Concentration of citric acid spray solution (C)		Concentration of ascorbic acid spray solution (A)													
		(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean
		N (%)					N uptake					protein				
	C_0	10.13	9.48	9.96	10.25	9.96	18.94	29.77	23.71	28.60	25.40	63.31	59.25	62.25	64.06	62.25
	C_1	10.68	9.84	10.08	10.80	10.30	22.96	30.60	33.27	28.95	28.94	66.75	61.5	66.96	67.50	64.38
	C_2	11.21	11.40	11.69	11.91	11.52	28.92	27.70	24.55	36.45	29.38	70.06	71.25	73.07	74.44	72.0
	C_3	11.47	11.76	11.98	11.27	11.88	43.82	30.46	25.04	41.02	36.12	71.69	73.50	74.88	70.44	74.25
Mean		10.87	10.66	11.33	11.16	11.01	28.37	30.06	27.99	33.93	30.06	67.94	66.63	70.81	69.75	68.82
LSD 5%	A	0.315					0.407					0.711				
	B	0.315					0.407					0.711				
	AB	NS					NS					1.443				

A_0, A_1, A_2, and A_3 are ascorbic acid addition rates *i.e.*, 0.144, 192 and 240mg L^{-1}.

C_0, C_1, C_2 and C_3 are citric acid addition rates *i.e.*, 0.144, 192 and 240mg L^{-1}.

Table 5. Oil yield (Mg ha^{-1}) and oil percentage (%) of canola as affected by aapplication of ascorbic acid and citric acid foliar spray

Rate of citric acid g ha^{-1} (C)		Concentration of ascorbic acid spray solution (A)									
		(A_0)	(A_1)	(A_2)	(A_3)	mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean
		Oil yield					Oil percentage				
	C_0	0.80	1.31	1.04	1.26	1.10	42.78	41.72	43.56	45.33	43.35
	C_1	0.94	1.36	1.53	1.24	1.27	43.79	43.87	46.25	46.39	45.08
	C_2	1.14	1.08	0.97	1.53	1.18	44.01	44.65	46.21	50.03	46.23
	C_3	1.78	1.23	1.02	1.09	1.28	46.57	47.67	48.88	52.11	48.81
Mean		1.16	1.25	1.14	1.28	1.21	44.29	44.48	46.23	48.47	45.86

A_0, A_1, A_2, and A_3 are ascorbic acid addition rates *i.e.*, 0.144, 192 and 240 mg L^{-1}.

C_0, C_1, C_2 and C_3 are citric acid addition rates *i.e.*, 0.144, 192 and 240 mg L^{-1}.

The main effect of ascorbic acid rate shows progressive increase with the increase in the rate of ascorbic acid addition and followed the order of $A_3>A_1>A_0>A_2$, given an increases of 0.45, 4.29 and 9.48%, due to A_1, A_2 and A_3. Addition, respectively.

Saponification Number

Canola saponification number, acidity number and esterification number are shown in Table 6. There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 144.20 saponification number. All other treatments treated with ascorbic acid or citric acid or both gave increases in saponification number. Other treatments gave decreases of 9.17% by A_0 C_2 and gave increases 18.81% by A_1 C_2. This indicates the high efficiency of ascorbic acid at the highest rate applied. Main effects for citric acid showed a

pattern of $C_1>C_0>C_3>C_2$. Main effect of ascorbic followed the order $A_2 > A_0 > A_3 > A_0$.

The main effect of citric acid and ascorbic acid rate showed progressive increase with the increase in the rate of addition. However the effect was more positive with ascorbic acid over citric acid since increases by C_1 over C_0 and by A_1 to A_2 over A_0 and A_3.

Acidity Number

As for acidity number (Table 6). There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 0.53 acidity number. All other treatments treated with ascorbic acid or citric acid or both gave increases in acidity number. Other treatments gave increases of 81.91% by A_0 C_1 to 84.73% by A_0 C_2. This indicates the high efficiency of citric acid at the highest rate applied. Main effects for citric acid showed a pattern of $C_2 > C_1 > C_3>C_0$. Main effect of ascorbic followed the order $A_2 > A_3 > A_1 > A_0$.

The main effect of citric acid and ascorbic acid rate showed progressive increase with the increase in the rate of addition. However the effect was more positive with citric acid over ascorbic acid since increases by C_1 to C_3 over C_0 and by A_1 to A_3 over A_0.

Esterification Number

As for esterification number (Table 6). There were positive effects due to foliar spray with each and both acids. The non foliar spray A_0 C_0 gave 143.67 esterification number. All other treatments treated with ascorbic acid or citric acid or both gave increases in esterification number. Other treatments gave decreases of 10.35% by A_0 C_2 to 15.35 % by A_2 C_2. This indicates the high unefficiency of citric acid at the highest rate applied. Main effects for citric acid showed a pattern of $C_1 > C_0 > C_3> C_2$. Main effect of ascorbic followed the order $A_2 > A_1 > A_3 > A_0$.

The main effect of citric acid and ascorbic acid rate showed progressive increase with the increase in the rate of addition. However the effect was more positive with ascorbic acid over citric acid since increases by C_1 to C_3 over C_2 and by A_1 to A_3 over A_3.

Table 6. Oil content of canola as affected by aapplication of ascorbic acid and citric acid foliar spray

Concentration of citric acid spray solution (C)	Concentration of ascorbic acid spray solution (A)														
	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean	(A_0)	(A_1)	(A_2)	(A_3)	Mean
	Saponification number					Acidity number					Esterification number				
C_0	144.20	155.12	165.40	149.13	153.46	0.53	1.33	2.67	2.40	1.73	143.67	153.79	162.73	146.73	151.73
C_1	154.17	169.30	157.18	155.19	158.96	2.93	3.20	1.60	2.40	2.53	151.24	1.66.10	155.58	152.79	156.56
C_2	132.27	171.32	148.57	150.11	150.55	3.47	1.60	1.60	1.87	2.14	128.80	169.72	146.97	148.24	148.41
C_3	142.19	170.62	152.64	143.58	152.26	2.67	2.40	1.60	1.60	2.07	139.52	168.22	151.04	141.98	150.19
Mean	143.21	166.61	155.94	149.52	153.81	2.40	2.13	1.87	2.07	2.12	140.81	164.48	154.07	147.45	151.69

REFERENCES

Alivand, R., R.T. Afshari and F.S. Zadeh (2013). Effects of gibberellin, salicylic acid, and ascorbic acid on improvement of germination characteristics of deteriorated seeds of *Brassica napus*. Iran. J. Field Crop Sci., 43 (4): 561 - 571.

AOAC (1990). Official Methods and Recommended Practices of the American Oil Chemists Sociely. AOCS press, Washington, DC.

Deyoe, C.W. and J.A. Shellenberger (1965). Amino acids and proteins in sorghum grain. J. Agric. and Food Chem., 13 : 446.

Dolatabadian, A., S.A.M.M. Sanavy and M. Sharifi (2009). Effect of ascorbic acid (Vitam. C) leaf feeding on antioxidant enzymes activity, proline accumulation and lipid peroxidation of canola (*Brassica napus* L.) under salt stress condition. [Persian] J. Sci. and Technol. Agric. and Nat. Res., 13 (47 B): 611-621.

Downey, R.K. (1983). The Original Description of the Brassica Oilseed Crops, in High and low Erucic Acid Rapeseed Oils, Kramer, J.K.G. Sauer, F.D. and Pigden, W.J., Ed. Toronto: Academic Press.61-83.

El-Sabagh, A., Kh.A.A. Abdelaal and C. Barutcular (2017). Impact of antioxidants supplementation on growth, yield and quality traits of canola (*Brassica napus* L.) under irrigation intervals in North Nile Delta of Egypt. J. Exp. Biol. and Agric. Sci., 5 (2): 163-172.

El-Sayed, M.A.A., R.E.A. El-Sharayhi and A.N.A Adel-Aal (2006). Response of some canola genotypes to nitrogen fertilizer rates and some foliar, J. Agric. Res., 43 : 123-140.

FAO (1987). Food and Agri. Organization of the Untied Nation, Production Year Book, 161: 2-44.

Givan, G.V. (1979). Metabolic detoxification of ammonia in tissues of higher plants phytochemistry, 18: 375-382.

Hoseini, M., M. Ghadimzadeh, B. Ahmadi and J.A.T. da Silva (2014). Effects of ascorbic acid, alpha-tocopherol, and glutathione on microspore embryogenesis in *Brassica napus* L. *In vitro* Cellular and Dev. Biol.-Plant, 50 (1): 26-35.

Hougen, F.W. and B.R. Stefansson (1983). Rapeseed, in advances in cereal science and technology, St. Paul: Ame. Assoc. Cereal Chem., 5: 261-289.

Jackson, M.L. (1965). Soil Chemical Analysis. Prentice Hall of India., New Delhi.

Malik, R.K. and C. Singh (1982). Influence of organic acids and cycocel on cotton growth Zanco Series A, 8: 59-75.

Miernyk, J.A. and R.N. Trelease (1981). Role of malate synthase in citric acid synthesis by maturing cotton embryos A proposal Plant Physiol., 68: 875-881.

Mujahid, F. (2017). Microwave irradiation and citric acid assisted seed germination and phytoextraction of nickel (Ni) by *Brassica napus* L.: morpho-physiological and biochemical alterations under Ni stress. Environ. Sci. and Poll. Res., 24 (26): 21050-21064.

Murphy, J. and J.R. Riley (1977). A modified single solution method for the determination of phosphate in natural waters. Anal. Chem. 27: 31-36.

Nofal, M.A. (1990). Growth and some micronutrients content of lettuce plants as applied by seed soaking and foliar spray of ascorbic and citric acids. Proc. of soil fertility and foliar fertilization conf., Giza, Egypt, 14-15 Jan. Paper No.3.

Nofal, M.A. (1991). Effect of ascorbic and citric acids applied as seed soaking and or foliar spray on growth and macronutrients composition of lettuce plant Zagazig J. Agric. Res., 18: 1033-1038.

Piper, C.S. (1950). Soil and Plant Analyses. Test cince : puplishers Inc. New York.

Scarisbrick, D.H. and R.W. Daniels (1986). Oil Seed Rape. First Published in Great Britain by Collins Professional and Technical Books.

Sector Profile (1988). Qttawa: Oilseed Div., Grain Marketing Bur., Grains and Oilseeds Branch, Agric. Canada.59.

Weiss, E.A. (1983). Longman, L., 146-158.

استجابة نبات الكانولا للرش الورقي بحمضي الستريك والأسكوربيك

أشرف محمد سعيد إبراهيم [١] – أحمد عفت الشربينى[١]
صلاح محمود دحدوح[١] - خالد محمد وهدان[٢]

١- قسم علوم الأراضي – كلية الزراعة – جامعة الزقازيق - مصر

٢- قسم الكيمياء الحيوية – كلية الزراعة – جامعة الزقازيق - مصر

تم إجراء تجربة حقلية في مدينة أبو صوير، محافظة الإسماعيلية على نبات الكانولالدراسة تأثير معاملة نبات الكانولا بحمضي الستريك والإسكوربيك رشاً ورقياً بمعدل ١٠٠٠ لتر محلول للهكتار وذلك على ثلاث دفعات بعد ٤٠، ٦٠ و٨٠ يوما من الزراعة وكانت تركيزات محاليل الرش صفر، ١٤٤، ١٩٢ و ٢٤٠ ملجم لتر$^{-1}$، أعطت المعاملات أعلى محصول في كل من محصول البذور والقرون والزيت ونسبة التقشير وعدد البذور في القرن الواحد عند إضافة ٢٤٠ ملجم لتر$^{-1}$ من حمض الستريك وبدون معاملة من حمض الإسكوربيك وكذلك كان أعلى معدل من وزن الألف بذرة ومحصول القشر والنسبة المئوية للزيت عند إضافة ٢٤٠ ملجم لتر$^{-1}$ من حمضي الستريك والإسكوربيك، بينما تم الحصول على أقل محصول في جميع الصفات في معاملة الكنترول.

المحكمـــــون:
١- أ.د. علي أحمد عبدالسلام أستاذ الأراضي المتفرغ – كلية الزراعة بمشتهر – جامعة بنها.
٢- أ.د. أيمن محمود حلمـي أستاذ ورئيس قسم الأراضي – كلية الزراعة – جامعة الزقازيق.