EFFECT OF SOME ANTIOXIDATS (ASCORBIC ACID, PROLINE, AND SALIC ACID) ON JOJOBA PLANTS UNDER CIRCUMSTANCE OF SINAI

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ABSTRACT

Two field experiments of jojoba plants were carried out in Almaghara Research and Production Station followed to Desert Research Center, Agriculture Ministry, North Sinai Governorate, Egypt, at 2016/2017 and 2017/2018, Respectively. Therefor to study the influence yield of five clones (S-L, S-610, S- 700, S-B and S-G) under foliar spray of salicylic acid, ascorbic acid and proline [(50:50:50(conc. 1); 100:100:100 (conc. 2) and 200:200:200 ppm (conic. 3)] on jojoba plants at four and fourteen years old from planting. The experiment was conducted as split plot design, were varieties order in the main plots and treatments in sub plots, uisg three replicates. Results showed that the foliar application of salicylic acid, ascorbic acid and proline led to increase of all growth characters, yield characters and some chemical contents in leaves and seeds on all of clones. Clones S-700 recoded the highest values for all traits studied followed by clones S-B, while, studied traits, clones S-L recorded the lowest values. Foliar spray application with salicylic acid, ascorbic acid and proline had the highest data with all clones with aged fourteen years compear aged four years. All characters increased with increase in salicylic acid, ascorbic acid and proline on varieties, especially clone S-700. Jojoba plants appearance response to plant nutrition.

Keywords*:* yield of oil, jojoba clones, Sinai. foliar, growth regulatars, yield, clones.

تأثير بعض مضادات الأكسدة (حمض الأسكوربيك، البرولين، وحمض الساليسيليك) على نبات الجوجوبا تحت ظروف سيناء

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المستخلص

تم إجراء تجربتين حقليتين لنبات الجوجوبا في محطة المغارة للأبحاث والإنتاج، التابعه لمركز بحوث الصحراء، وزارة الزراعة، بمحافظة شمال سيناء، مصر، عامى 2017/2016 و 2018/2017 بالتتابع. وذلك لدراسة تأثر محصول زيت الجوجوبا لخمسة سلالات (S–L، S–610 ، S– 700 ، S–B, SG) بالرش الورقي بحامض الساليسيليك وحامض الأسكوربيك والبرولين [(50:50:50 conc. 1) ؛ (100: 100 : 100 conc. 2) و(200: 200: 200 conc3 جزء في المليون)] في عمر أربعة وأربعة عشر عامًا من الزراعة ، وقد أجريت التجربة بتصميم الالواح المنشقة، وتم ترتيب الأصناف في الالواح الرئيسية والمعاملات في الالواح الثانوية، باستعمال ثلاث مكررات. أظهرت النتائج أن الرش الورقي بحامض الساليسيليك وحامض الأسكوربيك والبرولين أدى إلى زيادة جميع صفات النمو وصفات المحصول وبعض المكونات الكيميائية في الأوراق والبذور فى جميع السلالات. ووجد أن السلالالة S– 700 سجلت أعلى القيم لجميع الصفات التي المدروسة، ثم تبعتها السلالة SB ، في حين سجلت السلالة SL أدنى القيم، حيث أعطى الرش الورقي بحامض الساليسيليك وحمض الأسكوربيك والبرولين أعلى البيانات مع جميع السلالات التي يبلغ عمرها أربعة عشر عامًا مقارنة بالنباتا الصغيرة فى العمر. زادت قيم الصفات المدروسة مع زيادة في حامض السالسيليك وحامض الاسكوربيك والبرولين على السلالات، وخاصة السلالة S– 700. أظهرت الدراسة استجابة نبات الجوجوبا الرش بمضادات الاكسدة تحت تأثير الملوحة.

كلمات مفتاحية: محصول الزيت، سلالات الجوجوبا، سيناء، النمو الخضري، منظمات النمو.

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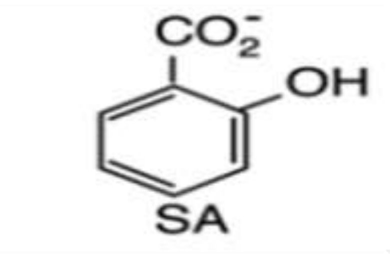
INTRODUCTION

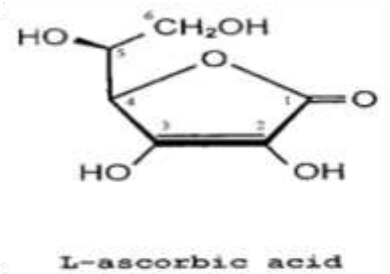
Jojoba (*Simmondsia chinensis* Link Schneider) is an evergreen shrub that is native to northern México and the southwestern United States. The jojoba plant has economic value because its seeds contain about 50% of a light yellow, odorless wax ester commonly referred to as jojoba oil, which is extensively used in the cosmetic industry due to dermatological properties. As occurs in other crops, the jojoba industry faces the challenge of finding ways to improve productivity and quality of the products. Jojoba is a difficult species to domesticate because it is highly variable as a result of its being dioecious and an obligatory cross-pollinated species. Only a small proportion (less than 1%) of the plant population originating from seeds of native plants has the potential of yielding economically acceptable yields (40). Hence, the best method for jojoba improvement, in the short term, is the selection of plants with desirable characteristics and propagating them asexually, (28). Salicylic acid (SA), a plant phenolic is now considered as a hormone-like endogenous regulator, and its role in the defence mechanisms against biotic and abiotic stressors has been well documented (45, 47). It was found that inhibition of catalase, a H_2O_2 scavenging enzyme, by SA plays an essential role in the generation of reactive oxygen species (21). By increasing H_2 O_2 concentration of the tissues, moderate doses of SA may activate the antioxidative mechanisms. Ascorbic acid is an antioxidant molecule that acts as a primary substrate in the cyclical pathway for detoxification and neutralization of superoxide radicals and singlet oxygen (35). Ascorbate has been shown to play multiple roles in plant growth, such as in cell division, cell wall expansion, and other developmental processes (37). It requirements for growth and differentiation of some plant species have been reported (39). Although roots of some plant species are capable of vitamin B synthesis, roots of other plants cannot synthesize this vitamin (34) and are dependent on transport from the shoot. Absorption by plant roots has been reported (31). It is an essential cofactor for numerous metabolic enzymes including amino acid metabolism and antibiotic biosynthesis. Most interestingly, it has recently been found that the vitamin is a potent antioxidant with a particular ability to quench reactive oxygen species such as superoxide and singlet oxygen, (16). Proline, and its metabolism, is distinguished from other amino acids in several ways. The most fundamental is that proline is the only one of the proteogenic amino acids where the a-amino group is present as a secondary amine. While this may seem like a distinction more important to chemists than plant biologists, the unique properties of proline are highly relevant to understanding its role in plants. Although the developmental accumulation of proline in reproductive organs has been repeatedly reported, and seems to be a widespread phenomenon among plant species, its functional meaning is still matter of debate. An obvious function of proline in development may be the protection of developing cells from osmotic damages, especially in those developmental processes, such as pollen development and embryogenesis, in which tissues undergo spontaneous dehydratation. Accordingly, higher levels of proline have been measured in tissues with low water content as compared as to tissues with high water content, (14). Since the oxidation of one molecule of proline yields 30 ATP equivalents, (6, 12) this amino acid seems well suited to sustain high energy-requiring processes. The upregulation of the proline catabolic genes typically observed in flowers, siliques and seed is consistent with the need to provide the plant with energy throughout the whole reproductive phase. which confirms a specific role of proline in the rapid elongation of the inflorescence stem. Because in higher plants the proline synthesis pathway proceeding from glutamate is regarded as the main, if not the only, biochemical route to synthesize proline, (18) and P5CS is the rate limiting enzyme of this pathway, mutants of either P5CS1 or P5CS2, two paralog genes present in the Arabidopsis genome that encode P5CS, were mainly used in these works. Proline has been proposed to act as a compatible solute that adjusts the osmotic potential in the cytoplasm, (5, 7, 9, 33, 38). hus proline can be used as a metabolic marker in relation to stress, (8). Proline produces immediately protects the plasma membrane and proteins against stress, (42). Understanding of plant ability in fight to stresses open a way for crops manipulations for their ability in tolerance, adaptation or resistant to stresses, (20).

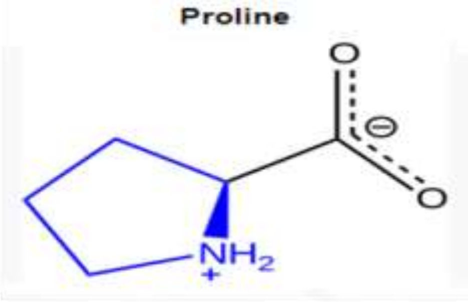
The aim of this study was to evaluate the effects of salicylic acid, ascorbic acid and proline on five clones' jojoba plants cultivated in Sinai and the effect on variation study between them.

MATERIALS AND METHODS

Jojoba plants were cultivated in Almaghara Research and Production Station (latitude: 30,717993"N, longitude: 33, 329103 E) followed to Desert Research Center, Agriculture Ministry, Egypt. Two field experiments were carried out for five clones (S-L, S-610, S- 700, S-B and S-G), to study the effect of spray salicylic acid, ascorbic acid and proline [(50:50:50(conc. 1); 100:100:100 (conc. 2) and 200:200:200 ppm (conic. 3)] on jojoba plants at aged three years from planting to investigation content seed from oil and other contents.







The experimental rows (5 plants each) were assigned for each clone in each replication. Distances between rows and plants within rows were 4 and 2 m. respectively. Plants (mixed males and female seedlings) derived from the open population, as a source of pollen, were repeated one row every six female (clone) rows. Additional border mixed seedling rows were planted around each replication and no free space was left between rows within each replication to ensure homogeneity within each replication. Before sowing the field was ploughed and appropriate planting holes prepared and a drip irrigation system was installed in the experimental areas. Weed control and irrigation were done as necessary but no fertilizers were applied in the course of this study. All clones were treated at three times during October, March and April. The plants were collected at 22nd April to determine the growth, yield characters and some chemical content. Leaf area (cm^2) was estimated from the following equation: Leaf area = 0.717 X – 0.095, which X is the product of length by width. (13).

RESULTS AND DISCUSSION

All data in Tables 1, 2 and 3 shows that the foliar application of salicylic acid, ascorbic acid and proline led to increase of all growth characters as plant height (cm), number of main branches/plant, stem diameter (cm), number of nodes/stem, length of node (mm), leaf number of leaves/plant, leaf width (mm), leaf length (mm) and leaf area (cm^2) and so, yield characters as total number of branches, number of leaves, weight of seeds/plant (kg), weight of seed (gm), weight 100 seeds (gm) and oil content of the seeds %. And also, some chemical contents in leaves as Chlorophyll content (chl. A, Chl. B and carotene); total Carbohydrates, nitrogen%, phosphorus%, Potassium%, Fe ppm, Zn ppm, Cu ppm and Mg ppm. All characters affected by increase in SA, AsA and proline under clone S-700. Data presented in Table 1 and 2 show that, the foliar application of different concentrations of conc. Three (200ppm) had significantly stimulatory effect on growth parameters of jojoba plants in term of plant height, number of branches, and leaves/plant and leaf area compared with the untreated plants, as this respect (2).

Table 1. Effect of rates of salicylic acid, ascorbic acid and proline and clones of jojoba plants on growth characters

Clones / Treatments		shoot characters: plant height (cm)	shoot characters: number of main branches/plant	shoot characters: stem diameter (cm)	shoot characters: n umber of nodes/stem	shoot characters: Length of node (mm)	leaves characters: leaf number of leaves/plant	leaves characters: leaf width (mm)	leaves characters: length (mm)	leaves characters: leaf area (cm^2)
S-L	0	69.31	2.317	1.214	14.24	10.60	82.80	26.20	36.08	7.263
	Conc. 1	72.68	2.432	1.273	15.55	11.65	87.67	27.19	36.32	7.568
	Conc. 2	73.98	2.817	1.474	15.78	11.76	94.26	26.70	36.96	7.712
	Conic. 3	75.49	2.874	1.505	16.13	12.00	96.22	27.24	37.71	7.873
S-610	0	70.80	2.386	1.249	14.71	10.98	85.23	26.25	36.15	7.301
	Conc. 1	74.19	2.505	1.311	15.89	11.86	96.19	27.24	36.38	7.624
	Conc. 2	75.46	2.901	1.517	16.02	11.97	102.62	27.88	36.54	7.998
	Conic. 3	76.99	2.960	1.550	16.46	12.22	104.71	28.44	37.29	8.155
S-700	0	72.19	2.459	1.287	14.96	11.18	87.86	26.31	36.22	7.371
	Conc. 1	75.71	2.580	1.349	15.89	11.86	98.90	28.51	36.46	8.038
	Conc. 2	77.04	2.988	1.563	16.85	12.63	105.92	27.92	36.61	8.073
	Conic. 3	78.61	3.050	1.596	17.30	12.89	108.08	28.51	37.36	8.242
S-B	0	71.51	2.435	1.274	14.83	11.05	86.61	26.28	36.18	7.333
	Conc. 1	74.96	2.555	1.336	16.01	11.93	94.97	27.27	36.42	7.660
	Conc. 2	76.20	2.959	1.549	16.49	12.28	100.78	27.97	36.57	8.031
	Conic. 3	77.76	3.019	1.580	16.94	12.58	102.84	28.47	37.33	8.206
S-G	0	70.07	2.364	1.237	14.47	10.82	84.02	26.22	36.12	7.271
	Conc. 1	73.50	2.481	1.298	15.77	11.76	92.54	27.22	36.35	7.593
	Conc. 2	74.76	2.872	1.504	15.99	11.86	97.84	27.84	36.51	7.962
	Conic. 3	76.29	2.931	1.534	16.26	12.12	99.84	28.41	37.26	8.125
LSD C		13.103	11.51754	0.7088	0.07260	1.77109	2.49732	13.8215	6.48253	7.65934
LSD T		11.313	9.941754	0.4013	0.04228	3.74937	2.40450	11.7632	4.11442	7.02496
LSD C x T		8.0251	7.054063	0.2401	0.03252	3.63396	1.58079	8.78059	2.48792	5.57277

Antioxidant is very effective in improving the plant biomass (16, 17, 27). Foliar-applied SA, AsA and proline were effective in improving the plant growth of both cucumber cultivars. Previously, while working on okra plants Amin et al (4) found that external treatment of antioxidant significantly improved the growth of okra plants and they attributed this growth improvement to AsA-induced stimulation in amino acids, protein contents and photosynthetic pigments.

Table 2. Effect of rates of salicylic acid, ascorbic acid and proline and clones of jojoba plants on yield

Clones / Treatments		total number of branches,	No. leaves	W, Seeds harvest (kg)	Weight of seed gm	Weight (100 seed gm)	oil content of the seeds %
S-L	0	7.451	118.9	63.086	0.640	63.982	37.918
	Conc. 1	7.820	125.9	64.372	0.677	67.742	43.002
	Conc. 2	8.966	134.0	63.739	0.767	76.654	45.086
	Conic. 3	9.240	138.1	65.716	0.790	79.030	46.479
S-610	0	7.678	122.4	66.826	0.658	65.901	39.233
	Conc. 1	8.057	138.1	68.199	0.696	69.777	43.937
	Conc. 2	9.231	145.5	67.547	0.794	78.972	46.733
	Conic. 3	9.515	150.0	69.631	0.818	81.417	48.174
S- 700	0	7.905	126.4	70.761	0.658	65.969	40.178
	Conc. 1	8.294	142.8	72.057	0.696	69.846	45.535
	Conc. 2	9.505	150.8	71.346	0.794	79.050	47.736
	Conic. 3	9.798	155.4	73.556	0.818	81.495	49.206
S-B	0	7.829	124.9	68.706	0.650	65.316	39.418
	Conc. 1	8.218	136.6	70.128	0.696	69.154	44.317
	Conc. 2	9.420	143.4	69.456	0.785	78.271	47.093
	Conic. 3	9.704	147.8	71.599	0.809	80.696	48.544
S-G	0	7.602	120.6	64.021	0.650	65.258	38.678
	Conc. 1	7.971	132.8	65.326	0.687	69.096	43.460
	Conc. 2	9.146	139.1	64.703	0.785	78.193	45.905
	Conic. 3	9.420	143.4	66.700	0.809	80.618	47.327
	LSD C	2.0789	1.827353	27.01448	8.100161	0.2775	8.579567
	LSD T	1.9343	1.70025	20.01237	7.608448	0.008702	7.254914
	LSD C x T	1.5349	1.349177	14.98001	6.217079	0.001934	6.545737

All data showed that the effect of salicylic acid, ascorbic acid, proline and increase concertation led to increases all variation. All results could be due to the role of antioxidants in enhancing some physiological and biochemical aspects (30) or activity in antioxidant enzymes content (26). It could be concluded that, many of these phytochemicals may help to protect cells against oxidative damage caused by free radicals (46). Antioxidants intercept free radicals and protect cells from the oxidative damage that leads to aging (25). Active oxygen scavengers (antioxidants) could be beneficial in the protection of the structure and function of the photosystems against excess light (41). Antioxidants play role in the reduction or prevention of enzymatic browning by inhibiting polyphenol oxidase (32). These results were in agreement with these which obtained by foliar spraying of antioxident (10, 29, 36) and foliar spraying of VE (3, 43. 44).

Table 3. Effect of rates of salicylic acid, ascorbic acid and proline and clones of jojoba plants on content of leaves from chemical content.

Clones		Chlorophyll 51Content			Total Carbohydrates	Nitrogen%	phosphorus%	Potassium%	Fe ppm	Zn ppm	Cu ppm	Mg ppm
Treatments		Chl.A	Chl. B	Carot.								
S-L	0	1.899	1.423	2.705	9.458	2.352	0.222	1.432	1153.3	4047.6	1143.0	0.708
	Conc. 1	2.883	1.582	3.108	11.328	2.987	0.231	1.845	1360.1	4458.7	1152.3	0.841
	Conc. 2	3.173	1.742	3.420	12.467	3.289	0.254	2.032	1497.5	4909.0	1269.4	0.926
	Conic. 3	3.632	1.603	3.792	12.545	3.017	0.261	1.914	1548.3	4879.1	1162.7	0.908
S-610	0	2.798	1.480	2.911	10.110	2.585	0.247	1.777	1167.1	4062.9	1154.4	0.741
	Conc. 1	3.257	1.645	3.145	12.448	3.043	0.258	2.066	1376.4	4476.6	1163.8	0.882
	Conc. 2	3.585	1.812	3.467	13.704	3.350	0.283	2.274	1515.4	4928.6	1281.7	0.971
	Conic. 3	4.231	1.705	4.624	12.730	3.129	0.280	2.103	1566.9	4898.4	1174.3	0.952
S-700	0	2.798	1.480	2.911	10.110	2.585	0.247	1.777	1167.1	4062.9	1154.4	0.741
	Conc. 1	3.257	1.645	3.145	12.448	3.043	0.258	2.066	1376.4	4476.6	1163.8	0.882
	Conc. 2	3.585	1.812	3.467	13.704	3.350	0.283	2.274	1515.4	4928.6	1281.8	0.971
	Conic. 3	4.231	1.705	4.624	12.730	3.129	0.280	2.103	1566.9	4898.4	1174.3	0.952
S-B	0	2.705	1.510	2.921	10.578	2.549	0.258	1.799	1461.8	4917.3	1145.9	0.746
	Conc. 1	2.958	1.679	3.229	12.643	3.065	0.269	1.980	1390.2	4489.9	1156.2	0.886
	Conc. 2	3.256	1.848	3.551	13.918	3.377	0.295	2.179	1530.5	4943.4	1273.0	0.984
	Conic. 3	4.072	1.737	4.213	12.828	3.141	0.289	2.097	1582.6	4913.2	1183.7	0.957
S-G	0	2.676	1.451	2.883	9.828	2.500	0.227	1.746	1444.3	4897.8	1134.5	0.725
	Conc. 1	2.929	1.614	3.201	12.360	3.007	0.257	1.922	1373.8	4472.1	1145.1	0.861
	Conc. 2	3.225	1.777	3.523	13.607	3.309	0.282	2.116	1513.3	4923.9	1260.4	0.948
	Conic. 3	4.034	1.670	4.174	12.643	3.081	0.269	2.036	1563.8	4893.7	1172.0	0.959
LSD C		0.0860	0.0755	0.0198	0.05221	4.17753	0.09809	0.00896	0.1087	134.025	804.15	2.0186
LSD T		0.0775	0.0681	0.0192	0.08201	3.96982	0.08781	0.00835	0.0979	120.668	724.04	0.1650
LSD C x T		0.0027	0.0023	0.0029	0.11295	3.69637	0.08842	0.00483	0.0934	114.981	689.94	0.1658

This study clearly shows that the compound of salicylic acid, ascorbic acid and proline has a significant effect in stimulating different growth characters in Jojoba plants. Antioxidants as salicylic acid, ascorbic acid and proline could be used successfully to increase seed yield and yield components of jojoba. Increase oil content by application of salicylic acid, ascorbic acid and proline on jojoba. The salt stress has a significant impact on the productivity of jojoba but to enhancing the harmful effect by application of salicylic acid, ascorbic acid and proline. The treatment of growing Jojibe plants under the influence of Sinai salinity with salicylic acid, ascorbic acid and proline used as induces the accumulation of substances such as growth regulator and photosynthesis products which reduces the effect of salinity, especially with S-700 clone.

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