Effect of Ascorbic acid spraying and planting date on the medically active compounds of three varieties of Roselle crop

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Abstract:

A field experiment was conducted at the location of Al-Suwaira District, Al-Shahimiya District (60) km north of Wasit Governorate during the summer season of 2024 in a sandy clay soil, for the purpose of determining the best cultivar that gives the best response to the medically active compounds with the effect of ascorbic acid at three concentrations (200, 100, 0) mg L-1 - and different planting dates on (1/4/2024, 15/4/2024, 30/4/2024) for several cultivars of Roselle plant (red, white and black). A complete randomized block design was used with a split-plot arrangement, and the cultivars occupied the main plots, the planting dates the secondary plots, and ascorbic acid the sub-secondary plots. The results showed the superiority of the black cultivar plants and the third planting date of 4/1/2024 and spraying ascorbic acid at a concentration of 200 mg L-1 in the studied traits, as well as the presence of bi and triple interactions between the factors through significant effect on the medically active compounds.

Introduction

The Hibiscus sabdariffa L. plant, which belongs to the Malvaceae family, is one of the important medical plants [1] and its medical importance is concentrated in its calyx leaves as a source of the glycoside Hibiscin, as it is rich in vitamin C and citric tartaric and malic acids, and it also contains the compound PCA (Protocatehenic acid), which is an important antioxidant in addition to its role in treating some cancerous tumors [8] a source of many powerful antioxidants. Among the benefits of Hibiscus is that it contains very powerful antioxidants that help the body in the following: Fighting free radicals and strengthening immunity. Prevention of many problems, such as: arthritis and bone infections, cancers, heart disease, Alzheimer's, and many other diseases, in addition to its secondary uses as a refreshing drink to moderate high temperatures. Its industrially produced red formula is used as natural food colorants to give it flavor. It is used in the manufacture of jams, jelly, candy making, food preservation, and its seeds contain a high percentage of oil, reaching 20-25% [9] Due to the annual increase in population, it is necessary to expand the cultivation of this crop. Many studies have indicated the importance of spraying ascorbic acid according to the critical stage of the plant. It is important in enhancing the growth of leaves and stems, as well as enhancing the strength of the plant and its resistance to harsh environmental conditions [5]. Studying cultivars according to the environmental adaptation of the region is very important, as the response varies according to the medically active substances they contain, due to the difference in the genes responsible for the synthesis of these substances. Therefore, the aim of the research was to determine the best

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cultivar adapted to the region, the best planting date for these cultivars, the best concentration for spraying ascorbic acid, and the best treatment for interaction between the factors that give the best response to the medically active compounds for the Roselle crop .

Materials and methods

A field experiment was conducted at a location in Al-Suwaira District, Al-Shihimiya Sub-district (60) km north of Wasit Governorate during the summer season of 2024 in a sandy clay silty soil, for the purpose of determining the best cultivar that gives the best response to the seed content of medically active compounds under the influence of ascorbic acid at three concentrations (200, 100, 0) mg L-1 - and different planting dates on (4/1/2024, 4/15/2024, 4/30/2024) for several cultivars of Roselle plant (red, white and black)

The randomized complete block design was used with split-plot arrangement, and the cultivars occupied the main plots, planting dates sub plots, and ascorbic acid the sub-sub plots. The experimental land was plowed by a rotary plough twice perpendicularly, then it was smoothed and leveled. It was then divided into three sectors, each sector included 27 experimental units with an area of (12) m. The experimental unit included 4 3-m-long ridges, with a distance between one ridge and the next of 75 cm. Random samples were taken from the experimental field at a depth of (0-30) cm to conduct analyses of the physical and chemical properties of the soil in the laboratories of the Technical Institute / Al-Musayyab, the specifications of which are shown. The soil was fertilized with phosphate fertilizer in the form of triple superphosphate at a rate of 140 kg. ha-1 in one batch before planting, then 80 kg. ha-1 of nitrogen fertilizer was added in the form of urea in two batches, the first after thinning and the second before flowering [13] The seeds were planted on (04/01/2024, 04/15 and 04/30), the seeds were planted in pit in the upper third of the yard, the distance between holes is 50 cm and alternately on both sides of the yard, . The crop was irrigated without flooding until germination was complete, and when it reached a height of (10-15) cm, the thinning and patching processes were coundected, after which the plants were irrigated as needed, with all crop service operations carried out, such as weeding, weeding and pest control, etc. The following characteristics were studied- :

The percentage of nitrogen in the seeds was estimated using the Microkjedhal device according to [3] mentioned.

-2Estimation of Vitamin C

-3Estimation of Anthocyanin Pigment%

-4Estimation of Gossypetine Compound

-5Estimation of Hibsceetine Compound

-6Estimation of Sabdaretine Compound

The data were analyzed using the Genstat program under a significance level of 0.05

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Table 1. Physical and chemical properties of the field soil for the location

First location	uints	traits	
7.14	-	PH	
2.4	$DS.m^{-2}$	Ec	
38.11	$mg.kg^{-1}$	N	
11.27	$mg.kg^{-1}$	P	
120	$mg.kg^{-1}$	K	
1.33	(%)	Organic matter	
445	$g.kg^{-1}$	Sand	Soil separators
403	$g.kg^{-1}$	silt	
150	$g.kg^{-1}$	Clay	
Silty loam clay	-	texture	

Results and Discussion

-1Nitrogen%

It is clear from the results of Table (2) that the Roselle cultivars differed significantly in the percentage of nitrogen in the green leaves, where the C3 cultivar plants excelled by giving the highest average of (1.48)% and the lowest average was (1.13)% for the C1 cultivar plants. The difference in the nitrogen content of the leaves of the cultivars is due to their variation in genotype and the resulting differences in the nature of their growth and the difference in their ability to absorb nutrients The percentage of nitrogen in the green Roselle leaves increased significantly with the increase in planting dates, reaching the highest average of (1.33)% at the third date D2, while the comparison plants D0 gave the lowest average of (1.28)% for the location, respectively. This may be due to the role of this acid in improving the vital and physiological processes inside the plant cell by stimulating the antioxidant system and reducing the oxidative action in addition to its role in improving the permeability of cell membranes and stimulating the production of hormones and reducing the intake of sodium, and these together contribute positively to increasing the absorption of major nutrients, including nitrogen [6] Spraying ascorbic acid caused an increase in the percentage of nitrogen in green leaves. The plants sprayed with concentration A2 excelled by giving them the highest average (1.30)%, and the lowest average (1.30)% was reached in the plants of control treatment A0. This may be due to the amino acids and nitrogen contained in the composition of this acid, as the nitrogen entering into the composition of amino acids is ready for direct absorption by the plant (Al-Sahaf, 1989), which led to an increase in its concentration in the leaves sprayed with this extract by increasing chlorophyll, and thus the process of carbon metabolism and protein building increased. The results of the study agreed with what was reached by [14]when they studied okra that spraying different concentrations of ascorbic acid increased the nitrogen content of green leaves.As for the interaction of the cultivar with planting dates, statistical differences appeared in the two locations only, represented by the superiority of the C3D2 combination plants, which gave the highest average of (1.49)%, while the lowest nitrogen percentage appeared with the C1D0 cultivar plants at concentration 50, reaching (1.12)% for the location. As for the bi-interaction between the cultivar and ascorbic acid, the C3A2 treatment excelled the bi-interaction between ascorbic acid 100 g L-1 with the black cultivar, as it gave the highest percentage (1.49)% for the location in succession, which appeared in the C3A2 combination plants, while the lowest average for this trait reached (1.12)%, which appeared with the C1A0 combination and for both locations .The bi-interaction between planting dates and Ascorbic acid to a significant increase in the percentage of nitrogen, the treatment was superior when spraying ascorbic acid at a concentration of 100 g L-1 with the third date, as the plants of the combination D2A0 gave the highest average for this trait, which was (1.33)% for the location , while the plants of the combination D0A0 gave the lowest average, which was (1.27)%, the experimental location .The interaction of the three factors was significant in the location in succession, as the plants of the combination C3D2A2, which represents the black cultivar, excelled with the third planting dates and the second concentration of ascorbic acid 100 g L-1 and gave the highest average, which was (1.50)%, while the plants of the combination C1D0A0 gave the lowest average, which was (1.11)%, in the experimental location.

Table (2) Effect of ascorbic acid, planting dates, cultivars and their interaction on the percentage of nitrogen

average D*C	Ascorbic acid) A(			Planting dates)D(	cultivars
	A2	A1	A0		
1.12	1.12	1.12	1.11	D0	C1
1.13	1.13	1.13	1.13	D1	
1.13	1.13	1.13	1.13	D2	
1.24	1.24	1.24	1.24	D0	C2
1.35	1.35	1.35	1.34	D1	
1.35	1.36	1.35	1.35	D2	
1.47	1.48	1.47	1.46	D0	C3
1.48	1.49	1.48	1.48	D1	
1.49	1.50	1.50	1.49	D2	

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0.15	**0.24**			**L.S.D (0.05)**
average C	**A2**	**A1**	**A0**	**Ascorbic acid / cultivars**
1.13	**1.13**	**1.13**	**1.12**	**C1**
1.31	**1.32**	**1.31**	**1.31**	**C2**
1.48	**1.49**	**1.48**	**1.48**	**C3**
0.9	**0.12**			**L.S.D (0.05)**
average D	**A2**	**A1**	**A0**	**Ascorbic acid / Planting dates**
1.28	**1.28**	**1.28**	**1.27**	**D0**
1.32	**1.32**	**1.32**	**1.32**	**D1**
1.33	**1.33**	**1.33**	**1.32**	**D2**
0.8	**0.12**			**L.S.D (0.05)**
	1.31	**1.31**	**1.30**	**average A**
	0.09			**L.S.D (0.05)**

Quercetin Vitamin (mg L-1(

Table (3) shows significant differences between treatments. The black cultivar C3 excelled the vitamin C trait by giving the highest value (7.78), while the cultivar C1 gave the lowest vitamin value (1.33). As for planting dates, they had a significant effect on vitamin C by giving the highest value in the third date D2, which amounted to (5.31 and 2.79) for both locations, respectively. While D0 gave the lowest value, which amounted to (3.65) for the two experimental locations.

As for spraying ascorbic acid, it increased vitamin C, as plants treated with level A2 excelled the rest of the treatments by giving them the highest value of vitamin (4.46), while control treatment A0 gave the lowest value (4.36) in succession for the two experimental locations (Al-Tahfi, 2015). The results of the same table indicate a bi- interaction between the cultivars and planting dates, where the C3D2 cultivar excelled by giving the highest value (9.39) for the two experimental locations in succession, while the C1D0 cultivar gave the lowest value (1.26) for the experimental location in succession. This is due to the availability of suitable moisture for growth, which encouraged an increase in the concentration of vitamin C. These results are consistent with what was found by [2, 4]The results also showed a bi interaction between

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ascorbic acid and cultivars. Treatment (C3 A1) excelled the bi interaction between ascorbic acid 100 g L-1 with the black cultivar by giving the highest rate of (7.85), while treatment (A0C1) gave the lowest rate of (1.30) for the location in succession.The results showed a bi interaction between ascorbic acid and planting dates. The treatment excelled when spraying ascorbic acid at a concentration of 100 g L-1 with the third date (A1 D2) by giving the highest rate of (5.36), while treatment (A0 D0) gave the lowest rate of (3.60) for the location in succession.As for the triple interaction between the factors, a significant interaction was observed between them. Treatment (C3 D2 A1), which represents the black cultivar, excelled the third planting date and the second ascorbic acid concentration of 100 g L-1 and gave the highest rate of (9.50). Treatment (C1 D0 A0) gave the lowest rate of (1.22) for the location, respectively.

Table (3) The effect of ascorbic acid, planting dates, cultivars and the interaction between them in the estimation of vitamin C

average D*C	**Ascorbic acid) A(**			**Planting dates)D(**	**cultivars**
	A2	**A1**	**A0**		
1.26	**1.29**	**1.28**	**1.22**	**D0**	**C1**
1.34	**1.37**	**1.35**	**1.31**	**D1**	
1.40	**1.42**	**1.40**	**1.38**	**D2**	
3.13	**3.18**	**3.15**	**3.07**	**D0**	**C2**
4.16	**4.18**	**4.16**	**4.13**	**D1**	
5.13	**5.15**	**5.13**	**5.12**	**D2**	
6.56	**6.59**	**6.57**	**6.52**	**D0**	**C3**
7.39	**7.46**	**7.39**	**7.30**	**D1**	
9.39	**9.50**	**9.46**	**9.20**	**D2**	
0.05	**0.07**			**L.S.D (0.05)**	
average C	**A2**	**A1**	**A0**	**Ascorbic acid / cultivars**	
1.33	**1.36**	**1.34**	**1.30**	**C1**	
4.14	**4.17**	**4.15**	**4.10**	**C2**	
7.78	**7.85**	**7.81**	**7.67**	**C3**	
0.05	**0.05**			**L.S.D (0.05)**	
average	**A2**	**A1**	**A0**	**Ascorbic acid**	

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D				Planting dates
3.65	3.69	3.67	3.60	D0
4.30	4.34	4.30	4.25	D1
5.31	5.36	5.33	5.23	D2
0.02	0.04			L.S.D (0.05)
	4.46	4.43	4.36	average A
	0.02			L.S.D (0.05)

Anthocyanin

It is clear from the results of Tables (4) that the concentration of Anthocyanin in the calyx leaves varied according to the difference in cultivars and ascorbic acid in the location, as the C3 cultivar plants showed the highest average of (0.39) mg L-1 for the location. While the C1 cultivar gave the lowest average (0.16) mg L-1 for the location. The difference in the concentration of Anthocyani between the cultivars may be due to the difference in genetic factors between the cultivars, which distinguished the plants of the black cultivar from the other two cultivars. This is consistent with what was reached by [7] the difference between the Iraqi and Iranian cultivars of Kajrat in the content of active substances in the anther leaves, including Anthocyan. There are no significant differences in planting dates as well as in ascorbic acid.The bi interactions between the cultivar and planting dates indicate significant differences in the concentration of Anthocyanin, as the plants of the combination C3D2 gave the highest average (0.45) mg L-1, while the plants of the combination C1D0 gave the lowest average (0.12) mg L-1 for the location, respectively. As for the interaction of the cultivars with ascorbic acid, statistical differences appeared for the bi interaction of ascorbic acid 100 g L-1 with the black cultivar, as the plants of the combination C3A2 excelled the rest, as they gave the highest The average concentration of Anthocyanin in the sepals was (0.41) mg L-1 for the location. While the plants of the combination C1A0 gave the lowest average (0.15) mg L-1 for the location. The bi-interaction between ascorbic acid and planting dates was significant, as the treatment plants excelled when spraying ascorbic acid at a concentration of 100 g L-1 with the third date D2A2 and gave the highest average (0.29) mg L-1 for the location, while the plants of the combination D0A0 gave the lowest average (0.21) mg L-1 for the location.The triple interaction of the study factors showed significant differences between the combinations, that the plants of the combination C3D2A2, which represents the black cultivar with the third planting dates and the second ascorbic acid concentration of 100 g/L-1, excelled the plants of the rest of the combinations by giving them the highest average Anthocyanin concentration of (0.47) mg/L for the location, while the concentration decreased to its lowest value of (0.11) mg/m for the plants of the combination C3D0A0 for the location, respectively .

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Table (4) Effect of ascorbic acid, planting dates, cultivars and their interaction in the estimation of anthocyanin pigment

average D*C	Ascorbic acid) A(			Planting dates)D(	cultivars
	A2	A1	A0		
0.12	0.14	0.13	0.11	D0	C1
0.17	0.17	0.17	0.16	D1	
0.19	0.19	0.19	0.18	D2	
0.15	0.14	0.13	0.17	D0	C2
0.17	0.18	0.18	0.17	D1	
0.21	0.21	0.21	0.20	D2	
0.35	0.36	0.35	0.34	D0	C3
0.38	0.39	0.38	0.37	D1	
0.45	0.47	0.45	0.42	D2	
0.01	0.01			L.S.D (0.05)	
average C	A2	A1	A0	Ascorbic acid / cultivars	
0.16	0.17	0.16	0.15	C1	
0.18	0.18	0.17	0.18	C2	
0.39	0.41	0.39	0.38	C3	
0.01	0.01			L.S.D (0.05)	
average D	A2	A1	A0	Ascorbic acid / Planting dates	
0.21	0.21	0.20	0.21	D0	
0.24	0.25	0.24	0.23	D1	
0.28	0.29	0.28	0.27	D2	

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n.s	**0.01**			**L.S.D (0.05)**
	0.25	**0.24**	**0.24**	**average A**
	n.s			**L.S.D (0.05)**

Content of the anther leaves of the compound Gossypotin mg L-1

The results of Table (5) show that there are significant differences between the study factors for the Gossypotin trait of the Roselle plant, as the C3 cultivar plants excelled by giving the highest value of (0.84) mg L-1. While the C1 cultivar plants gave the lowest average of (0.37) mg L-1 for the experimental location. The planting dates had a significant effect on the Gossypotin ratio, as the third date D2 excelled by giving the highest value of (0.67) mg L-1 for the location. While the first date D0 gave the lowest value of (0.53) mg L-1 (Ahanger et al., 2014), the percentage of Gossypotin increased with increasing the level of ascorbic acid, the plants treated at level A2 significantly excelled the rest of the treatments and gave the highest average of (0.62) mg L-1, while control treatment A0 gave the lowest average for this trait of (0.59) mg L-1 for the location. (Abbas and Ali, 2015) The results of the same table showed the presence of a bi-interaction between the cultivars and planting dates, as treatment (C3D2) excelled by giving the highest percentage of (0.96) mg L-1, while treatment (C1D0) gave the lowest value of (0.34) mg L-1 for the total percentage of Gossypetin in the plant. The bi-interaction between the cultivars and ascorbic acid was shown. Treatment (C3A2) excelled the bi-interaction in ascorbic acid 100 g/L-1 with the black cultivar by giving the highest rate of Gossypetin, reaching (0.69) mg L-1, while treatment (C3A0) gave the lowest rate, reaching (0.52) mg L-1 for the experimental location. As for the bi-interaction of ascorbic acid and planting dates, the treatment excelled when spraying ascorbic acid at a concentration of 100 g L-1 with the third date if it gave (D2A2) by giving the highest average of (0.62) mg L-1 while the ((D0A0 treatment gave the lowest average of (0.59) mg L-1 for the location.The results showed the presence of a triple interaction between the factors. The combination C3D2A2, which represents the black cultivar, excelled with the third planting dates and the second ascorbic acid concentration of 100 g / L-1 by giving the highest percentage of Gossypetin of (0.99) mg L-1 while the combination C1D0A0 gave the lowest percentage of (0.33) mg L-1 of the total Gossypetin percentage in the plant for the location in sequence.

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Table (5) Effect of ascorbic acid, planting dates, cultivars and their interaction in Gosypetine

average D*C	Ascorbic acid) A(			Planting dates)D(	cultivars
	A2	A1	A0		
0.34	0.35	0.34	0.33	D0	C1
0.37	0.38	0.37	0.36	D1	
0.41	0.42	0.40	0.39	D2	
0.54	0.56	0.54	0.52	D0	C2
0.59	0.60	0.59	0.58	D1	
0.64	0.65	0.64	0.62	D2	
0.73	0.77	0.69	0.73	D0	C3
0.85	0.87	0.85	0.82	D1	
0.96	0.99	0.96	0.93	D2	
0.02	0.03			L.S.D (0.05)	
average C	A2	A1	A0	Ascorbic acid / cultivars	
0.37	0.38	0.37	0.36	C1	
0.59	0.60	0.59	0.57	C2	
0.84	0.88	0.83	0.82	C3	
0.01	0.02			L.S.D (0.05)	
average D	A2	A1	A0	Ascorbic acid / Planting dates	
0.53	0.56	0.52	0.52	D0	
0.60	0.62	0.60	0.59	D1	
0.67	0.69	0.67	0.65	D2	
0.01	0.02			L.S.D (0.05)	
	0.62	0.60	0.59	average A	
	0.01			L.S.D (0.05)	

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Hibiscetine-

The results of Table (6) indicate that there is no significant effect of the cultivars on the concentration of Hibiscetine in the anther leaves, as the C3 cultivar plants excelled the rest of the cultivars significantly and gave the highest average of (0.46) mg L-1 for the location, while the C1 cultivar plants gave the lowest average of (0.16) mg L-1 for the location. The difference in the cultivars in the concentration of Hibisctine may be due to the differences between the cultivars that distinguish the black cultivar from the other two cultivars. This is consistent with what was reached by [7]regarding the difference between the Iraqi and Iranian Roselle cultivars in the content of the anther leaves of active substances, as well as what was found by [10] Planting dates had a significant effect on this trait for the two experimental locations, respectively, as the high concentration D2 achieved the highest average concentration of Hibiscetine in the anther leaves, reaching (0.35) mg L-1 for the experimental location, while the comparison plants D0 gave the lowest average, reaching (0.26) mg L-1 for the location. This may be due to the fact that ascorbic acid has a hormonal effect that can increase the growth of the plant cell, as it greatly affects a number of physiological processes, so it is considered one of the regulating factors. It is also an internal regulator in cell division, plant growth, and cell differentiation to a wide extent, and protects cells from oxidation resulting from the irregular photosynthesis process. It also regulates the photosynthesis process, which leads to an increase in secondary metabolite products in the plant, including Hibisctine. The increase in the concentration of ascorbic acid had a significant effect on increasing the concentration of Hibiscetine in the anther leaves in both locations, as the effect increased with the increase in the spray concentration and reached its highest average of (0.32) mg L-1 at concentration A2 and the lowest average of (0.30) mg L-1 in the first location at concentration A0. This may be due to the fact that the increase in leaf area as a result of planting dates is directly proportional to the increase in the concentration of secondary compounds that the plant can produce by increasing the plant's efficiency in carbon manufacturing with an increase in the formation of enzymes responsible for their synthesis or formation, as the extract provides many elements that are basically involved in the composition of these compounds [3] The increase in the growth of the plant's vegetative group is directly reflected in the performance of many physiological processes that the plant performs during its growth, as the extract works to supply the plant medium with many nutrients that enter into the construction of its tissues, in addition to its role in raising the efficiency of carbon metabolism, which causes an increase in the concentration of active substances, or perhaps good lighting during the growth period is a contributing and positive factor in the coloration of the anther leaves [13] This study was consistent with [11] and (Hussein et al. 2013).As for the interaction of the cultivar with planting dates, there is no interaction, and there is no bi-interaction between the cultivar and ascorbic acid, as well as between planting dates and ascorbic acid for the two experimental locations.The interaction of the three factors was significant in two locations in succession, as the plants of the combination C3D2A2, which represents the black cultivar, excelled the third planting dates and the second ascorbic acid concentration of 100 g/L-1 and gave the highest average of (0.50) mg L-1, while the plants of the combination C1D0A0 gave the lowest average of (0.13) mg L-1 in the experimental location in succession.

Table (6) Effect of ascorbic acid, planting dates, cultivars and their interaction in Hibiscetine

average D*C	Ascorbic acid) A(			Planting dates)D(	cultivars
	A2	A1	A0		
0.14	0.15	0.14	0.13	D0	C1
0.16	0.16	0.16	0.15	D1	
0.18	0.18	0.18	0.17	D2	
0.21	0.22	0.20	0.19	D0	C2
0.34	0.36	0.35	0.32	D1	
0.39	0.40	0.39	0.38	D2	
0.42	0.44	0.43	0.41	D0	C3
0.46	0.47	0.46	0.45	D1	
0.49	0.50	0.49	0.48	D2	
n.s	0.01			L.S.D (0.05)	
average C	A2	A1	A0	Ascorbic acid / cultivars	
0.16	0.16	0.16	0.15	C1	
0.31	0.33	0.31	0.30	C2	
0.46	0.47	0.46	0.45	C3	
n.s	n.s			L.S.D (0.05)	
average D	A2	A1	A0	Ascorbic acid / Planting dates	
0.26	0.27	0.26	0.24	D0	
0.32	0.33	0.32	0.31	D1	
0.35	0.36	0.35	0.34	D2	
n.s	n.s			L.S.D (0.05)	
	0.32	0.31	0.30	average A	

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n.s	L.S.D (0.05)

Sabdaretine

The results of Table (7) show that there are no significant differences in the experimental factors and their bi-interactions in Sabdaretine.

Table (7) Effect of ascorbic acid, planting dates, cultivars and their interaction in Sabdaretine

average D*C	Ascorbic acid) A(			Planting dates)D(	cultivars
	A2	A1	A0		
0.12	0.13	0.12	0.12	D0	C1
0.14	0.14	0.14	0.13	D1	
0.15	0.15	0.15	0.15	D2	
0.17	0.17	0.17	0.16	D0	C2
0.18	0.19	0.18	0.18	D1	
0.20	0.21	0.20	0.19	D2	
0.23	0.24	0.23	0.22	D0	C3
0.27	0.28	0.27	0.25	D1	
0.33	0.35	0.34	0.31	D2	
n.s	n.s			L.S.D (0.05)	

average C	A2	A1	A0	Ascorbic acid / cultivars
0.14	0.14	0.14	0.13	C1
0.18	0.19	0.18	0.18	C2
0.28	0.29	0.28	0.26	C3
n.s	n.s			L.S.D (0.05)

average D	A2	A1	A0	Ascorbic acid / Planting dates
0.17	0.18	0.17	0.17	D0

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0.20	**0.20**	**0.20**	**0.19**	**D1**
0.23	**0.24**	**0.23**	**0.22**	**D2**
n.s	**n.s**			**L.S.D (0.05)**
	0.21	**0.20**	**0.19**	**average A**
	n.s			**L.S.D (0.05)**

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