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IMPROVING GROWTH AND YIELD OF ROSELLE (*Hibiscus sabdariffa* L.) PLANTS BY USING TYROSINE AND GLUTAMINE ACIDS UNDER DIFFERENT SOWING DATES

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ABSTRACT: In order to improve the growth and yield of the roselle plant under Sharkia Governorate conditions, a split-plot experiment was conducted during the two consecutive summer seasons 2018 and 2019. The two experiments included two main factors where the first factor was sowing date (15th April, 1st May, 15th May and 1st June), the second factor was amino acid concentrations (tyrosine and glutamine acids at 100 and 200 ppm) and control (Sprayed with tap water) as well as their interaction treatments. Following data were recorded: plant height, number of branches per plant, number of leaves per plant, dry weight of leaves per plant and root length as plant growth parameters as well as number of fruits per plant, fresh and dry sepal's yield per plant and dry sepal's yield per faddan as yield components. Results revealed that roselle planted on 15th April produced taller plants and more branches and leaves as well as heavier leaf dry weight per plant compared to the other dates. Also, the early sowing date (April 15) recorded higher values of roselle yield components with significant differences than the other dates under study. Moreover, glutamine acid at 200 ppm concentration significantly increased plant growth and yield components compared to the other concentrations in both seasons. In conclusion, sowing roselle seeds on 15th April and sprayed with 200 ppm glutamine four times per season appears to support growth and is adequate for achieving the highest roselle yielding under Sharkia Governorate conditions.

Key words: Roselle, sowing date, amino acids, growth parameters, yield components.

INTRODUCTION

Roselle or karkadeh (*Hibiscus sabdariffa*, L.) is an important medicinal plant of the Malvaceae family together with *Hibiscus rosa-sinensis*. It is an annual or biennial medicinal plant cultivated in tropical and subtropical regions for its edible sepals; leaves stem fibers and seeds (**El-Bakhshwan and El-Kouny, 2018**). Cultivation of the roselle plant has been reported throughout some parts of Asia, America, Australia and throughout Africa (**Cobley, 1968**). Roselle extracts acts as sexual stimulator, cathartic, appetizer, anti-cough, cancer-protective and refrigerant. It initial relevant constituents are anthocyanins, organic acids, flavonoids and polysaccharides (**Müller and Franz, 1992**). Roselle is an ideal multi-function model for food, feed, medicine and fiber (**Dutt *et al*., 2009**).

The maximum yield can be obtained by selecting proper environmental parameters, appropriate cultivar and on time sowing. Sowing date is an important agent in crop growth and productivity as it can positively or negatively influence plant performance and yield (**Futuless *et al*., 2010**). Timely sowing dates get about proper development and growth of plants fulfilling in maximum yield of the crop and economic utilize of land (**Islam *et al*., 2010**). Early sowing date increased plant height, stem diameter, number of leaves/plant, number of calyces/plant, calyces fresh and dry weight and calyces yield of roselle while this traits decreased with delayed sowing (**Khattak *et al*., 2016**)

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Growth regulating substances were shown to promote the biosynthesis of several chemical constituents in plants. In this regard the amino acids which have a high integrity with various metabolic pools in plants were utilized to encourage plant growth and development (**Coruzzi and Last, 2000**). **Davies (1982)** pointed out that amino acids as nitrogenous compounds are the constructing blocks in the synthesis of proteins. However, the regulatory effect of amino acids on plant outgrowth could be announced by the concept that some amino acids *e.g.* tyrosine and glutamine are hydroxyl phenyl amino acids that are utilized to build neurotransmitters and hormones **(Walter and Nawacki, 1978)**.

The main goal of this work was to achieve best sowing date and concentration of tyrosine or glutamine acids to enhance plant growth and yield components of *Hibiscus sabdariffa* plants grown in clay soil under Sharkia Governorate conditions.

MATERIALS AND METHODS

Two field experiments were conducted at Experimental Farm (Ghazala), Faculty of Agriculture, Zagazig University, Egypt during the two consecutive summer seasons of 2018 and 2019. The aim of this work was to improving the vegetative growth and yield components of roselle (*Hibiscus sabdariffa*, L.) plants by using different amino acid concentrations (tyrosine and glutamine acids each at 100 and 200 ppm) and control plant which sprayed with tap water) under different sowing dates (15th April, 1st May, 15th May and 1st June) and their interactions. The layout of these experiments was split-plot design with three replicates. Sowing dates were assigned in the main plots and amino acids concentrations treatments were arranged in the sub plots. The interaction treatments between main factor and sub factor were 20 treatments. Seed of roselle (dark variety) were sown at the previously mentioned sowing dates during the two seasons and immediately irrigated. After 20 days from sowing, seedlings were thinned to be one plant/hill. The physical and chemical properties of the used experimental soil are presented in Table 1, according to **Chapman and Pratt (1978)**.

The plot area was 7.2 m^2 (2×3.6 m) included six ridges. Each ridge was 60 cm wide and 2 meter in length. The seeds were sown in hills on one side of the ridge, and hills were spaced 50 cm, a part. Amino acid treatments were applied as foliar application at 30, 50, 70 and 90 days after sowing. Each experimental unit received five letters solution using spreading agent (Super Film at a rate of 1ml /l). The untreated control plants were sprayed with tap water.

The source of tyrosine acid ($C_9H_{11}NO_3$) and glutamine acid ($C_5H_{10}N_2O_3$) were Techno Gene Company (TGC), Dokky, Giza, Egypt. All treatments were fertilized with 200 kg calcium superphosphate (15.5% P_2O_5), 200 kg ammonium sulphate (20.5% N) and 100 kg potassium sulphate (50% K_2O) per faddan. Phosphorus fertilizer was applied during soil preparation. While, nitrogen and potassium fertilizers were divided into three equal doses and were added to the soil at 50, 70 and 90 days after sowing. All recommended agricultural practices of growing roselle plants were done whenever needed.

Data Recorded

Plant growth

Plant height (cm), number of both branches and leaves/plant, leaf dry weight /plant (g) and root length (cm) were estimated at 98 days after sowing by taking nine random guarded plants from each experimental unit.

Yield components

At harvesting stage (150-180 days after sowing), number of fruits /plant, fresh and dry sepals yield per plant (g/plant) were determined, then total dry sepals yield per faddan (kg) was calculated.

Statistical Analysis

Collected data were analyzed according to **Gomez and Gomez (1984)**. Least significance difference (LSD) was used to differentiate means at 5% level of probability. The means were compared using computer program of Statistix version 9 (**Analytical Software, 2008**).

RESULTS AND DISCUSSION

Plant Growth

Effect of sowing date

Results presented in Tables 2, 3 and 4 shows that plant height, number of both branches and leaves/plant, dry weight of leaves/plant and root

Table 1. Physical and chemical properties of experimental soil (average of the two seasons)

Physical properties				Soil texture
Clay (%)	Silt (%)	Fine sand (%)	Coarse sand (%)	Clay
41.39	19.26	15.62	23.73	

Chemical properties												
pH	E C m.mohs /cm	Organic mater (%)	Soluble cations (meq./ L)				Soluble anions (meq. /L)			Available (ppm)		
			Mg^{++}	Ca^{++}	K^{+}	Na^{+}	Cl^{-}	HCO_3^{-}	SO_4^{--}	N	P	K
7.82	0.98	0.58	2.7	1.5	1.6	3.9	4.5	1.7	3.5	17	8.3	71

Table 2. Effect of sowing date (S), amino acid concentration (A) and their interaction (S×A) treatments on *Hibiscus sabdariffa* plant height (cm) and number of branches/plant during 2018 and 2019 seasons

Sowing date	Amino acid concentration (ppm)					
	Tap water	Tyrosine		Glutamine		Mean (S)
		100	200	100	200	
Plant height (cm)						
2018 season						
15th April	169.33	181.00	188.00	192.00	195.00	**185.07**
1st May	167.00	174.67	193.00	182.67	197.67	**183.00**
15th May	168.33	174.67	187.33	176.33	192.67	**179.87**
1st June	158.67	168.00	178.00	172.00	185.67	**172.47**
Mean (A)	**165.83**	**174.58**	**186.58**	**180.75**	**192.75**	
LSD at 5%	**(S)= 2.66**		**(A)= 2.34**		**(S×A)= 4.94**	
2019 season						
15th April	173.67	177.00	183.33	187.33	191.00	**182.47**
1st May	169.33	176.67	185.67	178.33	191.67	**180.33**
15th May	169.67	176.33	190.33	182.33	189.67	**181.67**
1st June	152.67	165.00	175.00	167.67	177.67	**167.60**
Mean (A)	**166.33**	**173.75**	**183.58**	**178.92**	**187.50**	
LSD at 5%	**(S)= 1.86**		**(A)= 1.90**		**(S×A)= 3.87**	
Number of branches/plant						
2018 season						
15th April	8.67	10.33	11.67	12.33	13.00	**11.20**
1st May	7.67	9.67	11.33	9.67	12.33	**10.13**
15th May	7.33	8.33	9.67	8.67	10.33	**8.87**
1st June	6.33	7.00	8.33	8.33	9.00	**7.80**
Mean (A)	**7.50**	**8.83**	**10.25**	**9.75**	**11.17**	
LSD at 5 %	**(S)= 0.39**		**(A)= 0.61**		**(S×A)= 1.17**	
2019 season						
15th April	7.67	11.33	12.33	13.00	13.67	**11.60**
1st May	8.33	10.00	12.00	10.33	11.67	**10.47**
15th May	6.67	8.33	9.33	9.00	11.33	**8.93**
1st June	6.67	7.67	8.67	9.33	9.67	**8.40**
Mean (A)	**7.33**	**9.33**	**10.58**	**10.42**	**11.58**	
LSD at 5 %	**(S)= 0.76**		**(A)= 0.53**		**(S×A)= 1.22**	

Table 3. Effect of sowing date (S), amino acid concentration (A) and their interaction (S×A) treatments on *Hibiscus sabdariffa* number of leaves/plant and dry weight of leaves/ plant (g) during 2018 and 2019 seasons

Sowing date	Amino acid concentration (ppm)					
	Tap water	Tyrosine		Glutamine		Mean (S)
		100	200	100	200	
Number of leaves/plant						
2018 season						
15th April	246.67	261.00	267.00	261.67	277.67	**262.80**
1st May	236.00	257.00	274.00	264.67	277.67	**261.87**
15th May	230.00	238.00	257.00	247.33	267.33	**247.93**
1st June	224.33	233.33	243.00	247.00	247.33	**239.00**
Mean (A)	**234.25**	**247.33**	**260.25**	**255.17**	**267.50**	
LSD at 5%	**(S)= 5.26**		**(A)= 4.17**		**(S×A)= 9.10**	
2019 season						
15th April	237.67	267.33	268.00	276.00	284.67	**266.73**
1st May	241.67	257.33	268.00	261.33	279.33	**261.53**
15th May	222.00	238.00	258.33	250.33	278.00	**249.33**
1st June	211.00	222.00	246.33	250.33	257.33	**237.40**
Mean (A)	**228.08**	**246.17**	**260.17**	**259.50**	**274.83**	
LSD at 5%	**(S)= 7.47**		**(A)= 4.56**		**(S×A)= 11.02**	
Dry weight of leaves/plant (g)						
2018 season						
15th April	51.48	53.59	61.52	56.07	64.60	**57.45**
1st May	49.04	50.60	52.68	50.85	55.41	**52.72**
15th May	44.04	47.68	50.02	48.92	50.75	**48.28**
1st June	37.62	42.29	46.27	44.36	46.81	**43.47**
Mean (A)	**45.54**	**48.54**	**52.62**	**50.05**	**54.39**	
LSD at 5%	**(S)= 0.94**		**(A)= 0.61**		**(S×A)= 1.44**	
2019 season						
15th April	53.62	57.91	67.95	57.59	69.79	**61.37**
1st May	50.44	51.19	67.03	54.49	67.90	**58.21**
15th May	42.10	48.67	51.63	50.13	52.16	**48.94**
1st June	38.93	41.85	50.20	42.41	49.78	**44.63**
Mean (A)	**46.27**	**49.90**	**59.20**	**51.15**	**59.91**	
LSD at 5%	**(S)= 1.57**		**(A)= 0.76**		**(S×A)= 2.07**	

Table 4. Effect of sowing date (S), amino acid concentration (A) and their interaction (S×A) treatments on *Hibiscus sabdariffa* root length (cm) 2018 and 2019 seasons

Sowing date	Amino acid concentration (ppm)					
	Tap water	Tyrosine		Glutamine		Mean (S)
		100	200	100	200	
			Root length (cm)			
			2018 season			
15th April	21.67	24.33	23.50	23.33	26.17	**23.80**
1st May	21.33	23.00	27.00	24.33	27.00	**24.63**
15th May	19.17	24.17	23.50	23.67	28.17	**23.73**
1st June	19.33	22.83	24.50	22.67	26.67	**23.20**
Mean (A)	**20.37**	**23.58**	**24.75**	**23.50**	**27.00**	
LSD at 5%	**(S)= 1.40**		**(A)= 0.61**		**(S×A)= 1.77**	
			2019 season			
15th April	23.50	24.67	28.67	23.67	29.33	**25.97**
1st May	20.17	22.17	26.50	26.00	27.67	**24.50**
15th May	20.17	21.33	25.33	23.33	25.83	**23.20**
1st June	18.00	21.50	25.17	21.80	25.17	**22.27**
Mean (A)	**20.46**	**22.42**	**26.42**	**23.63**	**27.00**	
LSD at 5%	**(S)= 1.08**		**(A)= 0.71**		**(S×A)= 1.66**	

length of roselle plant were gradually decreased with delaying sowing date in both seasons (except that of plant height during second season). However, maximum plant growth values were observed at the earliest sowing (15th April), while minimum values were recorded in roselle plants sown on 1st June. The increases in leaves dry weight/plant were about 32.16 and 37.51% for sowing on 15th April, 21.28 and 30.43% for sowing on 1st May over sowing on 1st June in 1st and 2nd seasons, respectively.

The prospective cause for the differences in plant growth due to sowing dates is that early sown roselle plants had a longer period for vegetative growth, which produced taller plants, more branches and leaves as well as heavier leaves and longer roots. These results are in accordance with those found by **Okosun *et al*. (2006)**, **Ado *et al*. (2015)**, **Khattak *et al*. (2016)** and **El Sherif and Khattab (2016)** on roselle.

Effect of amino acids

From results recorded in Tables 2, 3 and 4 it is obvious that spraying with tyrosine and glutamine acids at any concentration (100 or 200 ppm) significantly increased roselle growth parameters compared to control (sprayed with tap water) in both seasons. Furthermore, plant height, number of branches and leaves/plant, dry weight of leaves /plant and root length of roselle plant were gradually increased with increasing tyrosine and glutamine acids concentrations. Moreover, the highest values in this connection were obtained with foliar spray with glutamine acid at 200 ppm compared to tap water and the other ones under study. The increases in number of branches/plant were about 48.93 and 57.98% for glutamine acid at 200 ppm as well as 36.67 and 44.34% for tyrosine acid at 200 ppm over the control in 1st and 2nd seasons, respectively.

Many researchers pointed out that those amino acids have various roles in plant metabolism, and exogenous application of amino acids may have benefits and stimulation effects on plant growth. Furthermore, **El-Sherbeny and Da Silva (2013)** reported that tyrosine at 100 and 200 mg/l increased plant height, number of leaves, dry weight of leaves and root length of beetroot compared to a

higher concentration (400 mg/1). Also, **Hegazi *et al*. (2016)** found that foliar spray to garlic plants with glutamine at 200 ppm gave the highest values of plant growth criteria *i.e.* plant length and number of leaves/ plant as compared to the other treatments (50 and 100 ppm) and control.

Effect of the interaction

Results listed in Tables 2, 3 and 4 suggest that the best interaction treatment in roselle growth parameters was that of sowing on 15th April interacted with glutamine at 200 ppm. However, interaction between sowing dates and amino acid concentrations significantly increased plant height, number of branches and leaves per plant and leaves dry weight per plant as well as root length compared to the control (planted on 1st June with tap water spraying) in the two seasons, in most cases. In the mean time, as mentioned above, both sowing date and tyrosine or glutamine concentrations (at 200 ppm) increased plant growth of roselle plant, in turn; they together might maximize their effects leading to taller, more branches and leaves as well as heavier weight of leaves per plant. Moreover, **El-Gamal and Ahmed (2016)** on *Anethum graveolens* demonstrated that interaction between sowing on 1st November and seaweed at 0.5 ml/l foliar application resulted in the highest values of the studied vegetative characters.

Yield Components

Effect of sowing date

As shown in Tables 5 and 6, number of fruits per plant, fresh and dry sepals yield per plant (g) and dry sepals yield per faddan (kg) of roselle were significantly increased when planted on 15th April compared to the others sowing dates. Also, the values of roselle yield components were decreased with late sowing dates. Since, the increases in dry sepals yield per faddan were about 67.81 and 91.41% for showing on 15th April, 27.80 and 52.61% for showing on 1st May over showing on 1st June in first and second seasons, respectively. The effect of sowing dates on flowering might be due to the longer duration of growth period, which resulted in a greater canopy and more assimilated available for the plat to produce more flowers per plant. These results are in agreed with those reported by **Seghatoleslami *et al*. (2013)**, **Nnebue *et al*. (2014)** and **Motlagh *et al*. (2018)** on roselle plant. In addition, **Hashem (2016)** suggested that, sowing dates had significant influences on herb dry weight (g/plant), flower number/plant as well as flowers fresh and dry weights (g/plant and kg/fad.) in pot marigold flowers compared to control.

Effect of amino acids

The obtained results in Tables 5 and 6 indicate that, higher values of roselle yield components (number of fruits per plant, fresh and dry sepals yield per plant and dry sepals yield per faddan) were obtained from the treatment of glutamine acid at 200 ppm compared to control in two tested seasons. Likewise, increasing tyrosine or glutamine acids concentrations from 100 to 200 ppm, gradually increased yield components of roselle plant. The application of amino acids can stimulate the performance of plant (**Abdel-Mawgoud *et al*., 2011**). Similarly, **Shafeek *et al*. (2012)** on onion plant, stated that amino acid concentration of 150 ppm was the most favorable concentrations for number and weight of bulbs/m^2, total yield (ton/fed.) and average weight of bulb (g).

Effect of the interaction

The data illustrated in Tables 5 and 6 reveal that interaction between sowing dates and amino acid concentrations significantly increased number of fruits per plant, fresh and dry sepals yield per plant (g) and dry sepals yield per faddan (kg) of roselle compared to the control (sprayed with tap water and planted in 1st June) in both seasons. However, the best interaction treatment in roselle yield components was that of sowing at 15th April interacted with glutamine at 200 ppm. In the mean time, as mentioned above, both sowing date and amino acids concentrations (each at 200 ppm) increased yield of roselle plant, in turn; they together might maximize their effects leading to more fruits as well as higher sepals yield.

Moreover, **Badawy *et al*. (2013)** revealed that October sowing date to *Lallemantia iberica* plant had a pronounced effect on seeds yield/ plant, mucilage contents and essential and fixed oil yield/plant. Furthermore, **Radkowski and Radkowska (2018)** noticed that the highest application rate of amino acids caused a significant increase in seed yield of timothy plant compared with the control.

Table 5. Effect of sowing date (S), amino acid concentration (A) and their interaction (S×A) treatments on *Hibiscus sabdariffa* number of fruits/plant and fresh sepals weight /plant (g) during 2018 and 2019 seasons

Sowing date	Amino acids concentration (ppm)					
	Tap water	Tyrosine		Glutamine		Mean (S)
		100	200	100	200	
Number of fruits/plant						
2018 season						
15th April	97.00	130.33	150.33	144.67	157.67	**136.00**
1st May	96.00	111.67	129.33	118.33	136.33	**118.33**
15th May	91.33	99.67	126.67	117.67	130.67	**113.20**
1st June	78.67	96.33	124.00	113.33	127.00	**107.87**
Mean (A)	**90.75**	**109.50**	**132.58**	**123.50**	**137.92**	
LSD at 5%	**(S)= 2.61**		**(A)= 2.72**		**(S×A)= 5.51**	
2019 season						
15th April	105.00	139.00	153.67	142.33	162.33	**140.47**
1st May	102.67	119.33	141.00	127.33	143.67	**126.80**
15th May	96.00	103.67	132.00	129.00	134.33	**119.00**
1st June	78.33	97.00	126.67	109.67	129.33	**108.20**
Mean (A)	**95.50**	**114.75**	**138.33**	**127.08**	**142.42**	
LSD at 5%	**(S)= 2.67**		**(A)= 2.60**		**(S×A)= 4.45**	
Fresh sepals weight/plant (g)						
2018 season						
15th April	380.35	472.94	575.43	501.97	608.68	**507.87**
1st May	371.67	433.96	473.90	470.81	514.64	**452.99**
15th May	340.23	376.75	437.25	417.73	480.13	**410.42**
1st June	295.92	374.18	429.86	412.62	449.04	**392.33**
Mean (A)	**347.04**	**414.46**	**479.11**	**450.78**	**513.12**	
LSD at 5%	**(S)= 5.74**		**(A)= 10.37**		**(S×A)= 19.39**	
2019 season						
15th April	434.02	492.34	608.62	522.62	641.75	**539.87**
1st May	391.65	452.89	545.98	495.75	564.35	**490.12**
15th May	358.00	383.89	478.75	421.33	488.06	**426.01**
1st June	295.11	363.80	426.10	383.61	425.65	**378.85**
Mean (A)	**369.70**	**423.23**	**514.86**	**455.83**	**529.95**	
LSD at 5%	**(S)= 7.27**		**(A)= 6.60**		**(S×A)= 13.83**	

Table 6. Effect of sowing date (S), amino acid concentration (A) and their interaction (S×A) treatments on *Hibiscus sabdariffa* dry sepals yield/plant (g) and/faddan (kg) during 2018 and 2019 seasons

Sowing date	Amino acid concentration (ppm)					
	Tap water	Tyrosine		Glutamine		Mean (S)
		100	200	100	200	
		Dry sepals yield/plant (g)				
		2018 season				
15th April	37.08	49.72	68.18	51.67	70.68	**55.47**
1st May	35.02	38.51	42.70	40.66	54.31	**42.24**
15th May	31.52	34.13	39.14	36.72	44.27	**37.16**
1st June	27.81	31.40	35.29	34.58	36.19	**33.05**
Mean (A)	**32.86**	**38.44**	**46.33**	**40.91**	**51.36**	
LSD at 5%	**(S)= 0.85**		**(A)= 1.10**		**(S×A)= 2.14**	
		2019 season				
15th April	40.07	56.32	70.23	67.83	71.67	**61.23**
1st May	36.89	40.20	55.94	43.49	67.54	**48.81**
15th May	30.91	34.15	42.88	33.95	43.80	**37.14**
1st June	26.89	30.89	33.77	33.25	35.11	**31.99**
Mean (A)	**33.69**	**40.39**	**50.71**	**44.63**	**54.53**	
LSD at 5%	**(S)= 0.71**		**(A)= 0.59**		**(S×A)= 1.27**	
		Dry sepals yield/faddan (kg)				
		2018 season				
15th April	519.17	696.13	954.47	723.43	989.47	**776.53**
1st May	490.33	539.09	597.75	569.92	760.39	**591.37**
15th May	441.28	477.87	548.01	514.08	619.73	**520.37**
1st June	389.29	439.55	494.01	484.12	506.71	**462.74**
Mean (A)	**460.02**	**538.16**	**648.56**	**572.73**	**719.07**	
LSD at 5%	**(S)= 11.94**		**(A)= 15.41**		**(S×A)= 29.98**	
		2019 season				
15th April	561.00	788.50	983.30	949.60	1003.40	**857.15**
1st May	516.50	562.80	783.20	608.90	945.60	**683.38**
15th May	432.80	478.10	6000.30	475.30	613.20	**519.92**
1st June	376.50	432.80	472.70	465.50	491.50	**447.81**
Mean (A)	**471.70**	**565.52**	**709.87**	**624.83**	**763.42**	
LSD at 5%	**(S)= 10.00**		**(A)= 8.26**		**(S×A)= 17.79**	

Conclusion

From above mentioned results, it could be concluded that, the sowing date of 15th April and spraying roselle plants with glutamine acid at 200 ppm was suitable for increasing the growth and yield of *Hibiscus sabdariffa* L. plant grown in clay soil under Sharkia Governorate conditions.

REFERENCES

Abdel-Mawgoud, A.M.R., A.M. El-Bassiouny, A. Ghoname and S.D. Abou-Hussein (2011). Foliar application of amino acids and micronutrients enhance performance of green bean crop under newly reclaimed land conditions. Aust. J. Basic. Appl. Sci., 5 (6): 51-55.

Ado, G., I.I. Indabawa and K.D. Sani (2015). Effect of sowing date and seed density on the growth and yield of roselle *Hibiscus Sabdariffa* (Linn). Int. Conf. Chem., Environ. and Biol. Sci., (CEBS-2015) March, 18-19.

Analytical Software (2008). Statistix Version 9, Analytical Software, Tallahassee, Florida, USA.

Badawy, E.M., S.E. El-Sherbeny, A.F.Y. El-Kady and H.M.S. Amer (2013). Influence of sowing dates and distances on growth, yield and chemical constituents of *Lallemantia iberica* (Bieb.) Fisch. and Mey. Plant. J. Appl. Sci. Res., 9 (3): 2093-2103.

Chapman, H. and P. Pratt (1978). Methods of Analysis for Soils, Plants and Waters. Div. Agric., Sci. Univ. Calif. USA, 16-38.

Cobley, L. S. (1968). An Introduction to Botany of Tropical Crops. Longman, London, 95-98.

Coruzzi, G. and R. Last (2000). Amino acids. In: Biochemistry and Molecular Biology of Plants. B. Buchanan, W. Gruissem, R. Jones (eds.). Ame. Soc. Plant Biol., Rockville, MD, USA (pub.): 358-410.

Davies, D.D. (1982). Physiological aspects of protein turn over. Encycl. Plant Physiology. New Series, 14 A (Nucleic acids and proteins: structure biochemistry and physiology of proteins). 190-288–Ed., Boulter, D. and Par.

Dutt, D., J.S. Upadhyay, B. Singh and C.H. Tyagi (2009). Studies on *Hibiscus cannabinus* and *Hibiscus sabdariffa* as an alternative pulp blend for softwood: An optimization of kraft delignification process. Industrial Crops and Prod., 29 (1): 16- 26.

El-Bakhshwan, M.H. and H.M. El-Kouny (2018). Impact of irrigation intervals, sowing time and density on hibiscus yield. Misr J. Ag. Eng., 35 (2): 485 – 500.

El-Gamal, S.M.A. and H.M.I. Ahmed (2016). Response of dill (*Anethum graveloens* Linn.) to seaweed and moringa leaf extracts foliar application under different sowing dates. Alex. J. Agric. Sci., 61 (5): 469-485.

El-Sherbeny, M.R. and J.A.T. Da Silva (2013). Foliar treatment with proline and tyrosine affect the growth and yield of beetroot and some pigments in beetroot leaves. J. Hort. Res., 21 (2): 95-99.

El Sherif, F. and S. Khattab (2016). Effect of seed vernalization temperature, duration and sowing date on growth and yield of *Hibiscus sabdariffa* plants. Life Sci. J., 13 (6): 52-60.

Futuless, K.N., Y.M. Kwaga and T. Clement (2010). Effect of sowing date on calyx yield and yield components of roselle (*Hibiscus Sabdariffa* L.) in Northern Guinea Savanna. New York Sci. J., 3 (11): 1-4.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons Inc., Singapore 680.

Hashem, H.A.E.A. (2016). Effect of sowing date and fertilization treatments on growth and chemical constituents of *Calendula officinalis* plants under North Sinai conditions. Mid. East J. Agric. Res., 5 (4): 761-774.

Hegazi, A.Z., S.Kh.H. Hasan and N.A.M. El-Said (2016). Response of garlic plants to foliar application of moringa leaves extract, glutamine and cysteine. J. Plant Prod., Mansoura Univ., 7 (1): 1 - 6.

Islam, M., S. Saha, H. Akand and A. Rahim (2010). Efffect of sowing date on the growth

and yield of sweet pepper (*Capsicum annuum* L.). Agronomski Glasnik, 1: 3-14.

Khattak, A.M., M. Sajid, H.Z. Sarwar, A. Rab, M. Ahmad and M.A. Khan, (2016). Effect of sowing time and plant density on the growth and production of roselle (*Hibiscus sabdariffa*). Int. J. Agric. Biol., 18: 1219-1224.

Motlagh, B.P., P.R. Moghaddam and Z.A. Sardooei (2018). Responses of calyx phytochemical characteristic, yield and yield components of roselle (*Hibiscus sabdariffa* L.) to different sowing dates and densities. Int. J. Hort. Sci. and Technol., 5 (2): 241-251.

Müller, B.M. and G. Franz (1992). Chemical structure and biological activity of polysaccharides from *Hibiscus sabdariffa*. Plantamedica, 58 (1): 60-67.

Nnebue, O.M., I.J. Ogoke, O.P. Obilo, C.M. Agu, G.O. Ihejirika and F.O. Ojiako (2014). Estimation of sowing dates for roselle (*Hibiscus sabdariffa* L.) in the humid tropical environment of Owerri, Southeastern Nigeria. Agrosearch, 14 (2):168-178.

Okosun, L.A., M.D. Magaji and A.I. Yakubu (2006). Effect of sowing date and sowing disrance on growth and yield of two cultivars of roselle (*Hibiscus Sabdariffa* var. *Sabdariffa*). J. Plant Sci., 1 (4): 297-305.

Radkowski, A. and I. Radkowska (2018). Influence of foliar fertilization with amino acid preparations on morphological traits and seed yield of timothy. Plant Soil Environ., 64 (5): 209-213.

Seghatoleslami, M.J., S.G. Mousavi and T. Barzgaran (2013). Effect of irrigation and sowing date on morpho-physiological traits and yield of roselle (*Hibiscus sabdariffa*). J. Anim. and Plant Sci., 23(1): 256-260.

Shafeek, M.R., Y.I. Helmy, M.A.F. Shalaby and N.M. Omer (2012). Response of onion plants to foliar application of sources and levels of some amino acid under sandy soil conditions. J. Appl. Sci. Res., 8(11): 5521-5527.

Walter, G.R. and E. Nawacki (1978). Alkaloid biolog and metabolism in plants. Planum, press, NY, 152.

تحسين نمو ومحصول نباتات الكركدية باستخدام أحماض التيروزين والجلوتامين تحت مواعيد زراعة مختلفة

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أجريت تجربة القطع المنشقة مرة واحدة خلال موسمي الصيف المتتاليين لأعوام ٢٠١٨ و٢٠١٩، حيث تضمنت التجربتان عاملين رئيسيين وكان العامل الأول هو ميعاد الزراعة (١٥ أبريل، ١ مايو، ١٥ مايو و١ يونيو)، وكان العامل الثاني عبارة عن تركيزات الأحماض الأمينية حيث اشتملت على كل من حمضي التيروزين والجلوتامين بتركيزات (١٠٠ و ٢٠٠ جزء في المليون)، بجانب معاملة الكنترول (الرش بماء الصنبور) بالإضافة إلى معاملات التفاعل بينهما وذلك لتحسين نمو وإنتاجية نبات الكركديه تحت ظروف محافظة الشرقية. تم تسجيل البيانات التالية: ارتفاع النبات، عدد الأفرع لكل نبات، عدد الأوراق لكل نبات، الوزن الجاف للأوراق لكل نبات وطول الجذر كصفات نمو النبات وكذلك عدد الثمار لكل نبات، محصول السبلات الطازج والجاف لكل نبات ومحصول السبلات الكلي فدان كمساهمات محصولية، أوضحت النتائج المتحصل عليها أن الكركديه المزروع في ١٥ أبريل أنتج نباتات أطول أدى إلى زيادة عدد الأفرع والأوراق وكذلك زاد الوزن الجاف للأوراق مقارنة بالمواعيد الأخرى، كما سجل تاريخ الزراعة المبكر (١٥ أبريل) أعلى القيم لمساهمات محصول الكركديه مع وجود فروق معنوية مع مواعيد الزراعة الأخرى قيد الدراسة، علاوة على ذلك، أدى تركيز استخدام حمض الجلوتامين بتركيز ٢٠٠ جزء في المليون إلى زيادة معنوية في نمو النبات والمساهمات المحصولية مقارنة بالتركيزات الأخرى في الموسمين، في الختام، أدى زراعة بذور الكركديه في ١٥ أبريل ورشها بـ ٢٠٠ جزء في المليون جلوتامين أربع مرات في الموسم إلى تحسن النمو وإعطاء أعلى إنتاجية للكركديه تحت ظروف محافظة الشرقية.

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