J. of Plant Production, Mansoura Univ.,Vol 11 (10): 893-898, 2020

Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

Enhancing Growth and Productivity of Roselle (*Hibiscus sabdariffa*, L.) Plant by Using Ascorbic Acid under Different Potassium Fertilization Levels

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Asmaa A. Fahmy[1*] and H. M. S. Hassan[2]

[1]Department of Horticulture, Faculty of Agriculture, Zagazig University, Egypt.
[2]Department of Plant Production, Fac. Environ. Agric. Sci., Arish Univ., Egypt.

ABSTRACT

Two experimental fields were conducted during the two consecutive summer seasons of 2018 and 2019 at the Experimental Farm of Fac. Agric., Zagazig Univ., Egypt, to study the effect of potassium fertilization levels (0.0, 24, 48 and 72 kg K_2O/feddan), ascorbic acid concentrations (0.0, 150 and 300 ppm as foliar spray) and their interaction treatments on vegetative growth parameters, yield components and chemical constituents in calyxes of roselle plants. The obtained results indicated that the highest level of potassium fertilization (72 kg K_2O/feddan) gave the highest values of plant height and branch number per plant and total dry weight per plant compared to the other two levels and control. In addition, the yield components of roselle plants (number of fruits per plant as well as sepals and seed yield per plant and per feddan) and chemical constituents (total chlorophyll content in leaves, anthocyanin content, total soluble solids, nitrogen, phosphorus and potassium percentages in calyxes) Moreover, foliar spray with 150 and 300 ppm of ascorbic acid recorded the highest values of abovementioned parameters with significant difference between them compared to control (unsprayed plants). In conclusion, it could recommend that 72 kg K_2O/feddan level interacted with 300 ppm ascorbic acid, reveals a uniform effect in enhancing of growth and yielding of roselle plants compared to the other interaction treatments under study.

Keywords: *Hibiscus sabdariffa*, potassium fertilization, ascorbic acid, Growth, yield and Chemical constituents.

INTRODUCTION

Roselle (*Hibiscus sabdariffa*, L.) is a member of the family Malvaceae. Roselle is declared commonly as "karkade" in Egypt and the most Arab nations. Mohamed *et al.* (2007) pointed out that the dried and fleshly calyxes obtained from roselle fruits have a great amount of organic acids (malic, oxalic, tartaric and citric acids). The calyxes (sepals) have also the possessions of diuretic and therapeutic and ascorbic acids as well as anthocyanin (red pigment) as a one of the glycosides medicinal group (Peng-Kong *et al.*, 2002). Roselle has been wealthy medicinal sources for a much long-term time and has held a special position in health interest from both prohibition remedy and aspects. A Roselle calyx kills various species of microorganisms and decreases cause's reposes of the survival parts of the body (Aziz *et al.*, 2007). The red beverage is also used in tea pies, jams, and deserts. It is utilized for controlling blood pressure, restorative, sexual stimulator, cancer-protective and anti-cough (Islam, 2019).

Potassium (K) is a soil commutable cation and is actively take in by roots of plant. K is a prime component of numerous soils and is in the end derived from the weathering of soil origin materials such as K-Al-Si in the soil. Due to plants and other organisms occupancy K as free ions in plant cells, once an organism dies, its K speedily re enters the soil solution (Boroomand and Grouh, 2015). It may affect the growth, yield and active ingredients synthesis in medicinal and aromatic plants and are utilized by plants to build many processes, since it impact on enzymes involved in the carbohydrates biosynthesis (Hafsi *et al.*, 2015). Lately, potassium fertilizer application has obtained to the plant scientist's awareness to enhance the production of many medicinal plants as indicated by Arab *et al.* (2015) on marigold, Helaly and Hegazy (2016) on lavender and El-Shayeb *et al.* (2020) on fenugreek.

Ascorbic acid (AsA) is a small water-soluble antioxidant molecule which doing as a main substrate in the periodic pathway of hydrogen peroxide enzymatic detoxification. AsA is the first material in super oxide radicals neutralizing (Noctor and Foyer, 1998). In addition, latest has serious function in vital procedures in plant growth such as cell's division and wall expansion (Pignocchi and Foyer, 2003). In this regard, Abdelkader and Hamad (2014) revealed that the better growth characters and higher yield components as well as chemical constituents of roselle sepals could be obtained by spraying ascorbic acid at 300 ppm compared to control.

Also, El-Gamal (2005) and Nassar *et al.* (2019) reported that AsA at 300 ppm concentration have a good effect on plant growth, photosynthetic pigments and herb productivity of sweet basil plants compared to control.

The main goal of the present work was to enhancing growth, yield and some chemical constituents of *Hibiscus sabdariffa* under the effect of different levels of potassium fertilization and concentrations of ascorbic acid under Sharkia Governorate conditions.

*** Corresponding author.**
E-mail address: galal_dr@yahoo.com
DOI: 10.21608/jpp.2020.123966

MATERIALS AND METHODS

In order to enhancing growth and productivity of roselle plants, two field experiments were done during the two consecutive summer seasons of 2018 and 2019 at Experimental Farm, Fac. Agric., Zagazig Univ., Sharkia Governorate, Egypt. Therefore, four rates of potassium fertilizer (0.0, 24, 48 and 72 kg K_2O /feddan) and three concentrations of ascorbic acid (0.0, 150 and 300 ppm) were tested, separately or in interaction to formed twelve treatments. These treatments were distributed in a split-plot design with three replicates. The levels of potassium fertilization (K) were randomly distributed in the main plots, while ascorbic acid (AsA) concentrations were randomly distributed in the sub plots.

The experimental soil was clay in texture (54.48% clay, 10.98% silt and 34.54% sand) and chemical properties were 7.68 and 7.82 pH, 0.58 and 0.56% organic matter, 0.98 and 1.07 ds/m for E.C., 18 and 25 ppm available N, 20 and 27 ppm available P and 71.2 and 84.2 ppm available K in the 1st and 2nd seasons, respectively.

Roselle Seeds were obtained from Research Centre of Medicinal and Aromatic Plants, Dokky, Giza. Seeds of roselle were sown, on 15th and 21th May during 1st and 2nd seasons, respectively, at space of 50 cm in one side of the ridge just after irrigation. After 15 days from sowing date, plants were thinned to one plant/ hill. Experimental plot was 14.40 m^2 (3 × 4.80 m) included 8 ridges; each ridge was 60 cm apart and 3 m in length.

All roselle plants were given ordinary agricultural practices whenever they necessary. All roselle plants were fertilized with 300 kg ammonium sulphate (20.5%N) and 200 calcium super phosphate (15.5% P_2O_5). Potassium source was potassium sulphate (48 % K_2O). However, the ascorbic acid ($C_6H_8O_6$) source was Techno Gene Company (TGC), Dokky, Giza, Egypt. Phosphorus fertilizer was added during soil preparation. While, nitrogen and potassium fertilizers were divided into four equal portions and were added to the soil after 35, 55, 75 and 95 days from sowing date. The plants were sprayed with ascorbic acid rates at 40, 55, 70 and 85 days after sowing date.

Data Recorded:

A random sample of three roselle plants from each sub plot was randomly taken at 120 to 180 days after sowing date and the following data were listed:

Vegetative growth parameters:

Roselle plant height (cm), branch number/plant and total dry weight/ plant (g) were recorded after 120 days after sowing.

Yield and its components:

After 150 to 180 days from sowing date, number of fruits /plant and dry sepals and seeds yield /plant (g) then total yield (kg/feddan) was determined.

Chemical constituents:

After 120 days from sowing date, total chlorophyll (SPAD unit) was determined in fresh leaves of roselle by using SPAD- 502 meter as suggested by Markwell *et al*. (1995). Furthermore, at harvest time, dry calyxes were randomly taken from each treatment and oven dried at 70°C till constant weight and anthocyanin content (mg/100g as calyxes dry weight) was determined cholorimetrically according to the method described by (Abou-Arab *et al*., 2011) and came by Francis (2000) for *Hibiscus sabdariffa*. Total soluble solids as Brix° of roselle fresh calyxes were determined by utilizing a hand refractometer. In addition, total nitrogen, total phosphorus and potassium percentages of calyxes as methods stated by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively, were determined.

Experimental design and statistical analysis:

The statistical layout of this experiment was a split-plot experiment in completely randomized block design. Where, main plots with randomly distributed contained four potassium fertilization levels, while ascorbic acid rates were randomly arranged in sub-plots. Each treatment was included 3 replicates. Collected data were analyzed according to Gomez and Gomez (1984). Least significance difference (L.S.D.) at 5 % level was utilized to differentiate means of probability. The means were compared utilizing computer program of Statistix version 9 (Analytical software, 2008).

RESULTS AND DISCUSSIONS

Vegetative growth parameters:

From data recorded in Table 1 it is obvious those vegetative growth parameters of roselle gradually increased by increasing potassium fertilization levels with significant difference between them and control in 2018 and 2019 seasons. Moreover, the tallest plants, more branches number per plant and heaviest dry weight per plant of roselle were obtained by 72 kg K_2O/feddan compared to control and the other levels under study.

Furthermore, the vegetative roselle growth parameters were significantly increased by using ascorbic acid as foliar spray four times per season compared to control in both seasons. Generally, plant height and branch number per plant and total dry weight per plant were significantly increased by ascorbic acid (AsA) concentration at 300 ppm compared to the other ones under study. In conclusion, the interaction between the different potassium fertilization levels and ascorbic acid concentrations significantly increased plant height and branch number per plant and total dry weight per roselle plant compared to control in both seasons. These results pointed out that the prevalence of applying the different interactions in enhancing roselle vegetative growth parameters compared to individual effect of K fertilization and AsA treatments in the two consecutive seasons.

These results may be attributed to the role of K element in metabolism and many processes wanted to sustain and encourage plant growth and development. In addition, it plays a remarkable role in numerous physiological and biochemical procedures such as metabolism of carbohydrates and cell division (Marschner, 1995). Also, Jiku *et al.* (2020) demonstrated that plant height, number of leaves/plant and dry weight of leaves/plant (g). In addition, potassium at 200 kg/ha produced the highest dry weight leaves and number of cloves of garlic compared to the other treatments.

However, Blokhina *et al.* (2003) indicated that, ascorbic acid is the extreme abundant antioxidant which save cell, ascorbic acid is actually looked to be a regulator on plant development and growth overdue to its influence on each of cell division and differentiation. Likewise, Azoz *et al*. (2016) reported that spraying sweet basil plants with ascorbic acid at 300 ppm concentration proved to be the most positive effective with enhancing vegetative growth (plant height and number of primary branches/plant).

Generally, as mentioned just before, both potassium fertilization levels and ascorbic acid treatments (each alone) increased vegetative plant growth of roselle plant, in turn, they together might increasing their influences leading to better results in this connection.

Table 1. Effect of potassium fertilization level (K) and ascorbic acid concentration (A) and their interaction (K×A) treatments on plant height, number of branches and plant dry weight of *Hibiscus sabdariffa* plant during the two seasons of 2018 and 2019

K_2O level (kg/fed.)	Ascorbic acid concentration (ppm)							
	0.0	150	300	Mean (K)	0.0	150	300	Mean (K)
	2018 season				2019 season			
				Plant height (cm)				
0.0	134.67	134.67	137.00	135.44	140.67	140.00	143.00	141.22
24	136.00	138.67	139.67	138.11	141.00	143.33	145.00	143.11
48	137.67	142.00	147.00	142.22	142.00	146.67	148.33	145.67
72	139.00	144.47	148.00	143.89	147.00	152.00	155.33	151.44
Mean (A)	136.83	140.00	142.92		142.67	145.50	147.92	
LSD at 5%	K=2.07	A= 1.39	K×A= 3.05		K=1.15	A= 1.13	K×A= 2.17	
				Number of branches/plant				
0.0	8.33	10.00	12.67	10.33	7.33	7.67	10.33	8.44
24	10.00	12.67	13.33	12.00	8.33	10.00	11.67	10.00
48	10.33	14.00	15.33	13.22	9.33	11.67	13.67	11.56
72	11.00	14.67	16.00	13.89	9.67	13.67	14.67	12.67
Mean (A)	9.92	12.83	14.33		8.67	10.75	12.58	
LSD at 5%	K=0.70	A=0.62	K×A=1.23		K=0.63	A=0.48	K×A=1.00	
				Plant dry weight (g)				
0.0	285.95	309.46	330.47	308.63	297.74	311.71	338.31	315.92
24	310.69	331.39	362.83	334.97	315.82	323.44	365.59	334.95
48	323.03	361.29	382.69	355.67	324.96	342.69	389.91	352.52
72	335.16	362.73	396.19	364.69	332.92	352.11	413.07	366.03
Mean (A)	313.71	341.22	368.05		317.86	332.49	376.72	
LSD at 5%	K= 8.15	A= 5.49	K×A=12.09		K=12.47	A=3.62	K×A=13.78	

Yield and its components:

Data listed in Tables 2 and 3 suggest that, all potassium fertilization levels increased number of fruits per roselle plant, calyxes as well as seeds yield per plant and per feddan compared to control in both seasons. In general, the best treatment in this regard was that 72 kg K_2O/feddan compared to the other levels under study. In the same time, roselle sepals yield components as well as seed yield components significantly increased by using ascorbic acid treatment at 300 ppm followed by 150 ppm concentrations during both seasons compared to control. In addition, yield and its components of roselle were gradually increased as ascorbic acid concentrations increased in the two seasons.

Table 2. Effect of potassium fertilization level (K) and ascorbic acid concentration (A) and their interaction (K×A) treatments on fruit number/plant, calyex yield/plant (g) and /feddan (kg) of *Hibiscus sabdariffa* plant during the two seasons of 2018 and 2019

K_2O level (kg/fed.)	Ascorbic acid concentration (ppm)							
	0.0	150	300	Mean (K)	0.0	150	300	Mean (K)
	2018 season				2019 season			
				Fruit number /plant				
0.0	79.00	85.00	91.33	85.11	83.00	90.33	96.00	89.78
24	85.67	102.67	118.00	102.11	88.00	112.67	125.00	108.56
48	106.33	128.67	141.67	125.56	115.33	138.00	150.00	134.44
72	114.00	135.00	167.00	138.67	125.00	145.33	178.67	149.67
Mean (A)	96.25	112.83	129.50		102.83	121.58	137.42	
LSD at 5%	K=3.57	A=2.61	K×A=5.55		K=1.52	A=2.33	K×A=4.09	
				Calyx yield /plant (g)				
0.0	38.66	41.16	45.78	41.87	41.58	44.07	48.56	44.74
24	40.74	43.31	52.31	45.45	46.27	51.71	55.66	51.22
48	47.88	54.81	57.01	53.23	53.23	56.53	58.46	56.07
72	52.06	58.99	63.86	58.30	54.68	61.45	69.86	62.00
Mean (A)	44.84	49.57	54.74		48.94	53.44	58.14	
LSD at 5%	K=0.81	A=0.83	K×A=1.58		K=0.77	A=1.10	K×A= 1.95	
				Calyx yield /feddan (kg)				
0.0	541.24	576.24	640.97	586.15	582.07	617.03	679.84	626.31
24	570.36	606.39	732.34	636.36	627.78	723.99	779.29	717.02
48	670.27	767.39	798.14	745.27	745.17	791.47	818.49	785.04
72	728.89	825.86	894.04	816.26	765.52	860.35	978.09	867.98
Mean (A)	627.69	693.97	766.37		685.14	748.21	813.92	
LSD at 5%	K=11.32	A=11.64	K×A=22.09		K=10.76	A=15.41	K×A=27.34	

Concerning to the interaction effect between potassium fertilization levels with foliar application of ascorbic acid on yield components, the obtained data in Tables 2 and 3 showed a significant and positive impact in all plant yield parameters with roselle plants fertilized with 72 kg K_2O/feddan and sprayed four times per season with 300 ppm AsA in comparison with the other interactions.

Under each ascorbic acid concentration yield components of roselle gradually increased with increasing potassium fertilization levels. In addition, the highest values of roselle sepals' yield and its components were achieved with 48 kg K_2O /feddan rate in 1st and 2nd seasons compared to the other rates under study (Khatab, 2016).

Also, Ali *et al*. (2017) indicated that using ascorbic acid at 200 ppm increased number of umbels/plant, fruit yield/plant and yield/fed of fennel plant compared to control. Touching the interaction effect, El-Tarawy *et al*. (2012) revealed that 75% NPK +200 ppm of ascorbic acid recorded the best values of fennel fruit yield components in comparison to the other treatments.

Table 3. Effect of potassium fertilization level (K) and ascorbic acid concentration (A) and their interaction (K×A) treatments on seed yield per plant (g) and seed yield per feddan (kg) of *Hibiscus sabdariffa* plant during the two seasons of 2018 and 2019

K_2O level (kg/fed.)	Ascorbic acid concentration (ppm)							
	2018 season				2019 season			
	0.0	150	300	Mean (K)	0.0	150	300	Mean (K)
	Seed yield/plant (g)							
0.0	12.73	16.23	18.19	15.72	15.35	17.84	21.18	18.13
24	16.08	17.82	21.27	18.39	16.59	20.54	24.46	20.53
48	19.06	22.47	25.47	22.33	19.01	24.53	27.34	23.63
72	20.13	26.84	34.75	27.24	25.22	33.13	39.10	32.49
Mean (A)	17.00	20.84	24.92		19.04	24.01	28.02	
LSD at 5%	K=0.84	A= 0.53	K×A=1.20		K= 0.53	A=0.59	K×A= 1.09	
	Seed yield /feddan (kg)							
0.0	178.13	227.22	254.66	220.00	214.95	249.81	296.57	253.77
24	225.17	249.43	297.83	257.48	232.26	287.51	342.49	287.42
48	266.79	314.53	356.63	312.65	266.14	343.47	382.71	330.77
72	281.87	375.81	486.45	381.38	353.13	463.87	547.45	454.81
Mean (A)	237.99	291.75	348.89		266.62	336.16	392.30	
LSD at 5%	K=11.73	A=7.46	K×A=16.87		K=7.35	A=8.20	K×A=15.26	

Chemical constituents:

Total chlorophyll (SPAD) in roselle leaves, anthocyanin content (mg/100g as dry weight) and total soluble solids (Brix°) in calyxes significantly increased by using all potassium fertilization levels compared to control in both seasons (Table 4). Also, N, P and K percentages in roselle calyxes were gradually enhancing by increasing potassium fertilization levels from 24 to 72 kg K_2O/feddan (Table 5). Also, the highest values in this connection in the 1st and 2nd seasons were obtained from the potassium fertilization level of 48 kg K_2O/feddan followed by 72 kg K_2O/feddan with no significant differences between them, in most cases in the two seasons.

Moreover, using ascorbic acid concentrations at 300 ppm significantly increased total chlorophyll content, anthocyanin content and total soluble solids as well as nitrogen, phosphorus and potassium percentages of roselle plants compared to control in both seasons. Also, the different interaction treatments recorded a significant enhances in total chlorophyll content, anthocyanin content and total soluble solids as well as total nitrogen, total phosphorus and potassium percentages compared to control in both seasons, in most cases. Likewise, the highest values in this connection were obtained from the interaction treatment between ascorbic acid concentration (300 ppm) under 72 kg K_2O/feddan fertilization in both seasons, in most cases.

Table 4. Effect of potassium fertilization level (K) and ascorbic acid concentration (A) and their interaction (K×A) treatments on total chlorophyll content (SPAD), anthocyanin content (mg/100 g as dry weight) and total soluble solids (Brix°) of *Hibiscus sabdariffa* plant during the two seasons of 2018 and 2019

K_2O level (kg/fed.)	Ascorbic acid concentration (liter/feddan)							
	2018 season				2019 season			
	0.0	150	300	Mean (K)	0.0	150	300	Mean (K)
	Total chlorophyll content (SPAD) in leaves							
0.0	37.33	39.33	40.67	39.11	39.33	40.33	42.33	40.67
24	39.33	41.00	42.67	41.00	41.00	43.00	44.33	42.78
48	42.00	44.67	45.67	44.11	42.33	44.67	48.33	45.11
72	41.67	42.67	47.00	43.78	42.33	45.00	49.00	45.44
Mean (A)	40.08	41.92	44.00		41.25	43.25	46.00	
LSD at 5%	K= 0.75	A=0.59	K×A=1.21		K= 0.58	A=0.66	K×A=1.22	
	Anthocyanin content (mg/100 g as calyxes dry weight)							
0.0	12.32	12.54	13.48	12.78	13.54	14.05	14.68	14.09
24	12.50	13.23	14.36	13.36	13.90	14.66	15.70	14.75
48	13.35	14.69	15.78	14.61	14.62	16.24	16.87	15.91
72	13.26	14.64	15.01	14.30	14.44	15.75	16.47	15.55
Mean (A)	12.86	13.77	14.66		14.13	15.18	15.93	
LSD at 5%	K=0.48	A=0.26	K×A=0.64		K=0.33	A=0.22	K×A=0.49	
	Total soluble solids (Brix°) in calyxes							
0.0	6.38	6.42	6.44	6.41	6.39	6.42	6.46	6.42
24	6.42	6.45	6.51	6.46	6.43	6.47	6.51	6.47
48	6.43	7.41	7.53	7.12	6.43	7.52	7.69	7.21
72	6.59	7.36	7.61	7.19	6.73	7.55	7.79	7.36
Mean (A)	6.46	6.91	7.02		6.49	6.99	7.11	
LSD at 5%	K=0.05	A=0.04	K×A=0.08		K=0.01	A=0.01	K×A=0.02	

Table 5. Effect of potassium fertilization level (K) and ascorbic acid concentration (A) and their interaction (K×A) treatments on total nitrogen, total phosphorus and potassium percentages of *Hibiscus sabdariffa* plant during the two seasons of 2018 and 2019

K_2O level (kg/fed.)	Ascorbic acid concentration (liter/feddan)							
	0.0	150	300	Mean (K)	0.0	150	300	Mean (K)
	2018 season				2019 season			
	Nitrogen % in calyxes							
0.0	2.480	2.623	3.170	2.758	2.437	2.617	3.137	2.730
24	2.600	2.797	3.240	2.879	2.517	2.720	3.240	2.826
48	2.777	3.317	3.363	3.152	2.777	3.233	3.353	3.121
72	2.803	3.290	3.387	3.160	2.717	3.283	3.317	3.106
Mean (A)	2.665	3.001	3.290		2.612	2.963	3.262	
LSD at 5%	K=0.029	A=0.038	K×A=0.078		K=0.015	A=0.014	K×A=0.027	
	Phosphorus % in calyxes							
0.0	0.342	0.347	0.352	0.347	0.344	0.353	0.355	0.351
24	0.349	0.357	0.365	0.357	0.352	0.359	0.366	0.359
48	0.358	0.368	0.379	0.368	0.359	0.368	0.385	0.371
72	0.367	0.387	0.391	0.382	0.365	0.386	0.396	0.383
Mean (A)	0.354	0.365	0.372		0.355	0.367	0.376	
LSD at 5%	K=0.002	A=0.001	K×A=0.003		K=0.002	A=0.002	K×A=0.004	
	Potassium % in calyxes							
0.0	2.543	2.610	2.653	2.602	2.617	2.653	2.680	2.650
24	2.627	2.677	2.710	2.671	2.623	2.713	2.727	2.688
48	2.683	2.750	2.803	2.746	2.747	2.807	2.837	2.797
72	2.873	2.917	3.000	2.930	2.817	2.900	2.943	2.887
Mean (A)	2.682	2.738	2.792		2.701	2.768	2.797	
LSD at 5%	K=0.015	A=0.016	K×A=0.030		K=0.011	A=0.010	K×A=0.020	

However, Abdelkader and Mostafa (2019) found that total chlorophyll content as well as total nitrogen, total phosphorus and potassium percentages increased by the highest rate of potassium under study (50 kg K_2O/faddan).

Also, Hassan *et al*. (2019) stated that ascorbic acid significantly increased dill leaf content of total chlorophyll, carbohydrate and potassium. Generally, Mostafa *et al.* (2019) demonstrated that the interaction treatment of either 100 or 75 % NPK recommended rate and 200 ppm ascorbic acid recorded the highest values of chlorophyll a and b of dragonhead plants in comparison with the other ones under study.

CONCLUSION

From obtaining results under the same conditions, it can be concluded that, foliar spray roselle (*Hibiscus sabdariffa*) plants with ascorbic acid at 300 ppm and fertilization with K_2O at 72 kg/feddan enhanced vegetative plant growth and produced the highest dry calyxes yield per feddan as well as anthocyanin content.

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تحسين نمو وإنتاجية نبات الكركديه باستخدام الرش الورقي بحمض الأسكوربيك تحت مستويات مختلفة من التسميد البوتاسى

أسماء أحمد فهمي[1] وهاني محمد سامي حسن[2]
[1]قسم البساتين ـ كلية الزراعة ـ جامعة الزقازيق ، مصر
[2]قسم الإنتاج النباتي ـ كلية العلوم البيئية الزراعية ـ جامعة العريش ، مصر

أجريت تجربتان حقليتان خلال موسمي الصيف المتتاليين لعامي 2018 و2019 في المزرعة التجريبية، كلية الزراعة، جامعة الزقازيق، مصر، لدراسة تأثير مستويات التسميد بالبوتاسيوم (صفر ، 24 ، 48 و72 كجم / فدان) ، تركيزات من حامض الأسكوربيك (صفر ، 150 و300 جزء/المليون كرش ورقي) ومعاملات التفاعل بينهما على صفات النمو الخضري والمكونات المحصولية والمحتوى الكيميائي في الكؤوس الثمرية لنباتات الكركديه. أشارت النتائج المتحصل عليها إلى أن أعلى مستوى من التسميد البوتاسي أعطى أعلى قيم لإرتفاع النبات وعدد الفرع لكل نبات وكذلك الوزن الجاف الكلي للنبات مقارنة بالمستويين الآخرين والكنترول. بالإضافة إلى ذلك، مكونات محصول نباتات الكركديه (عدد الثمار لكل نبات وكذلك محصول الكؤوس والبذور لكل نبات وللفدان) والمكونات الكيميائية (محتوى الكلوروفيل الكلي في الأوراق، محتوى الأنثوسيانين والمواد الصلبة الذائبة الكلية في الكؤوس الثمرية وكذلك النسب المئوية لكل من النيتروجين، الفوسفور والبوتاسيوم في الكؤوس) أعطت أفضل النتائج مع المعدل الأعلى من التسميد بالبوتاسيوم. علاوة على ذلك، سجلت المعاملة بحامض الأسكوربيك بتركيزات 150 و300 جزء/ المليون من أعلى قيم للفات المذكورة أعلاه مع وجود فرق معنوي بينهما مقارنة بالكنترول (النباتات الغير معاملة). ختاماً، يمكن التوصية بتسميد نباتات الكركدية بمستوى 72 كجم من أكسيد البوتاسيوم/فدان والرش الورقي بحمض الأسكوربيك بتركيز 300 جزء في المليون أدي إلى تحسين نمو وإنتاجية نبات الكركديه مقارنة بمعاملات التفاعل الأخرى تحت الدراسة.