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NUTRITIONAL STATUS OF ROSELLE PLANT (Hibiscus sabdariffa L.) UNDER DIFFERENT LEVELS OF POTASSIUM AND PROLINE

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Abstract

A plastic pots experiment was conducted during the period from March, 2nd, till October, 12th, 2012. The aim of this study was to assess the influence of different levels of potassium as K_2SO_4 and different concentrations of proline as well as their interaction on N,P and K status of roselle plant. Three levels of K (0.5, 1.0 and 2.0 g/pot) interacted with four concentrations of proline (0, 50, 100 and 150 mg/l) were used. Results revealed that K treatment (2 gm/pot) gave higher percentage of N, P and K of roselle plant as well as their rates of absorption and transport. There was a significant effect of proline on the above mentioned characteristics where 150 mg/l proline was superior among others. A part from P and K transport rates, the interaction had a marked effect on the rest of N, P, K traits.

Key words: *Potassium, Proline, Roselle plant.*

INTRODUCTION

Roselle plant (*Hibiscus sabdariffa* L.) is an annual plant, cultivated in many countries, recently introduced to Iraq, tropical and subtropical weather are suitable for the growth and production of this plant. Sepals are the important part taken up as a drink after boiling. They are containing acids as citric, malic and tartaric acids, anthocyans including delphinidin -3-xyloglucoside, delphinidin-3-glucoside, cyanidin-3-xyloglucoside as well as flavonoids including gossypetin (Gruenwald *et al*., 1998). More over, it contains salts, calcium oxalate and V. C. Hibiscus tea has a laxative effect due to the high content of poorly absorbable fruit acid, Therefor, Roselle is considered as a medicinal and economical plant.

The growth and productivity of plant could be increased by the application of some chemical fertilizers .Potassium is one of these fertilizers. It plays an important role in plant tolerance against abiotic stresses in general (Awon ,*et al*.,2012) , though its effect on water balance ,regulating the permeability of cell membrane , mechanism of stomata ,translocation of carbohydrates and the activation of a number of enzymes (Mengel and Kirkby,1982).

Proline is one of the important amino acids which alleviates the stresses especially the water stress. It plays an antioxidant against free radicals. Moreover, it plays a major role in the stability of the cell membrane :(Marur, et *al.*, 1994).

The aim of this study was to assess the effects of different levels of potassium and proline as well as their interaction on the nutritional status (i.e.N, P and K percentage as well as their rates of absorption and transport) of Roselle plant.

MATERIALS AND METHODS

Pots experiments were conducted in Karbala province during the period from 2/3/ to 12/10/2012. Pots were filled with soil at a rate of 10 kg. Samples from the soil were taken at depth 0-30 cm and the

chemical and the physical properties were determined (Table 1) .according to the methods described by (Page, *et al*., 1982) .

Factorial experiment within (C.R.D.)was adopted. Three levels of K(i.e. 0.5,1.0,and 2.0) g/pot was added at the time of planting in addition to 1g/pot of Di ammonium phosphate fertilizer (DAP) was also added . Four levels of proline were applied (i.e. 0, 50,100 and 150) mg/l as foliar application at 4-6 leaf stage . Each treatment was repeated 3 times . Means of treatments were compared by using Least Significant Difference test (L.S.D.) at 0.05 probability level (Steel and Torrie,1981) .

At the end of the experiment, plants were removed from the pots ,separated into roots and tops, thoroughly washed by tap water ,acidic and distilled water to remove the soil particles and ovenly dried .Roots and upper leaves were taken and separately digested by using the wet digestion (Gresser and Parsons,1979). Nitrogen ,phosphorus and potassium were determined as follows :

1- Nitrogen was determined by using Microkijldahl according to Chapman and Pratt (1961) .

2- Phosphorus was determined by using Spectrophotometer according to Matt(1970) .

3- Potassium was determined by using Flame photometer according to Shaffelen *et al*.(1961).

The rates of absorption and transport were calculated according to Williams (1948) and Robson, *et al*.,(1970) respectively .

Table (1) :Some chemical and physical properties of the soil

Soil separates (g/kg)			Soil Texture	Ec ds/m	pH	O.M %	$CaCo_3$ %	Available Tons (mg/kg)		
Clay	silt	sand						N	P	K
60	284	656	Sandy loam	1.0	7.2	0.2	36.0	92.0	20.1	231.0

RESULTS

Data in table (2) revealed that ,increasing K caused an increase in N per cent in roots where it increased from 1.05 to 1.31 % as added K increased from 0.5 to 2.0 g/pot giving an increment of 24.8 % . Proline also increased N% when it increased from 0 to 150 mg/l giving 50.5% increase . The interaction between K and proline significantly influenced root's N concentration where 2.0 g/pot K and 150 mg/l proline gave the highest value whereas,0.5 g/pot K and 0 mg/l proline gave the lowest value. The same trend was found in the leaves –N concentration.

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Table (2) :The effect of K and Proline on the percentage of N in roots and leaves of Roselle plant

Proline mg/l	Roots	Leaves

K g/pot \ Proline mg/l	Roots					Leaves				
	0	50	100	150	Mean	0	50	100	150	Mean
0.5	1.05	1.05	1.05	1.05	1.05	1.40	1.80	1.80	2.10	1.78
1.0	1.05	1.05	1.05	1.58	1.18	1.80	1.80	1.80	2.17	1.89
2.0	1.05	1.05	1.05	2.10	1.31	1.80	1.80	2.00	2.53	2.03
Mean	1.05	1.05	1.05	1.58		1.67	1.80	1.87	2.27	
L S $D_{0.05}$	K				0.128					0.075
	Proline				0.148					0.087
	Interaction				0.256					0.151

Leaves' K concentration was increased due to increasing K level from 0.5 to 2.0 g/pot giving values 2.93 , 3.27 and 3.48 % respectively giving per cent increments equal to 11.6 and 18.8 % compared with the control respectively (Table 4) .

Marked effect was found due to proline application Proline concentration at 150 mg/l gave the highest values of K % reached 4.26 % with per cent increases 35.2,64.8 and 97.2 % as compared with the control treatment .No significant effect was found on K% in root due to the interaction between K and proline . Apart from one case (i.e. the interaction effect) leaves' K % showed the same trend with that found in root's K % .

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Table (3) :The effect of K and Proline on the percentage of P in roots and leaves of Roselle plant

Proline mg/l / K g/pot	Roots					Leaves				
	0	50	100	150	Mean	0	50	100	150	Mean
0.5	0.25	0.37	0.38	0.38	0.35	0.36	0.37	0.37	0.38	0.37
1.0	0.36	0.37	0.38	0.38	0.37	0.36	0.37	0.37	0.38	0.37
2.0	0.37	0.38	0.38	0.38	0.38	0.37	0.37	0.38	0.38	0.38
Mean	0.33	0.37	0.38	0.38		0.36	0.37	0.37	0.38	
L S D0.05	K 0.009 Proline 0.011 Interaction 0.019									0.002 0.003 0.004

Table (4) :The effect of K and Proline on the percentage of K in roots and leaves of Roselle plant.

Proline mg/l / K g/pot	Roots					Leaves				
	0	50	100	150	Mean	0	50	100	150	Mean
0.5	1.90	2.63	3.27	3.90	2.93	1.87	2.47	2.70	2.70	2.44
1.0	2.17	3.00	3.36	4.27	3.27	2.23	2.57	2.70	2.80	2.58
2.0	2.40	3.13	3.77	4.60	3.48	2.40	2.70	2.70	2.87	2.67

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Mean	2.16	2.92	3.56	4.26		2.17	2.58	2.70	2.79	
L S $D_{0.05}$	K 0.084 Proline Interaction				0.097 N.S					0.065 0.075 0.131

Apart from two cases (the interaction effect on the transport rate of P and K),Potassium levels increased the rates of absorption and transport ug/g/day of N, P and K .Increasing exogenous proline markedly increased rates of N, P and K absorption and transport (Tables, 5,6 and 7). Increasing K levels from 0.5 to 2.0 (g/pot) caused an increase in the absorption and transport rates values of N which were 16.5 and 57.9 % ; 15.9 and 32.9 %for absorption and transport rates respectively as compared with the control treatment .

Table (5) :The effect of K and Proline on the absorption and transport rates of nitrogen (µg/g/day) in Roselle plant.

Proline mg/l / K g/pot	Absorption Rate (I m)					Transport Rate (V)				
	0	50	100	150	Mean	0	50	100	150	Mean
0.5	269.0	417.0	543.0	702.0	483.0	230.0	317.0	491.7	642.0	434.0
1.0	341.0	531.0	536.0	843.0	563.0	297.0	476.0	488.0	749.0	503.0
2.0	366.0	552.0	632.0	1032.0	645.5	316.0	498.0	583.0	910.0	576.8
	324.0	500.0	570.3	859.0		281.0	448.0	520.9	767.0	
L S $D_{0.05}$	K Proline Interaction				33.20 38.34 66.40					30.12 34.78 60.25

Proline also influenced the absorption and transport rates of N giving percentages increase reaching 54.3 ,76.0 and 165.1 % in the absorption rate for respective proline concentrations compared with the control treatment .Nitrogen transport rate was also influenced by proline concentrations giving per cent increase 172.9 % at the highest concentration of proline (i. e. 150 mg/l) compared with the control treatment .

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Table (6): The effect of K and Proline on the absorption and transport rates of Phosphorus (µg/g/day) in Roselle plant.

Proline mg/l / K g/pot	Absorption Rate (I m)					Transport Rate (V)				
	0	50	100	150	Mean	0	50	100	150	Mean
0.5	68.6	93.0	133.5	139.7	108.7	58.8	76.3	101.3	118.6	88.7
1.0	75.6	117.2	118.0	155.7	116.6	60.1	99,0	100.4	132.2	97.9
2.0	81.0	123.0	125.2	159.4	122.2	65.2	103.5	124.3	136.9	107.5
Mean	75.1	111.1	125.6	151.6		61.4	92.9	108.7	129.2	
LS $D_{0.05}$	K				6.74					14.05
	Proline				7.78					8.43
	Interaction				13.47					N.S.

Same trends were found with P and K . However, the rates of absorption and transport of P were less than that found with N and K . Apart from two cases (i. e. the transport rate of P and K) the interaction between K and proline was profound on the rates of absorption and transport of N, P and K.

DISCUSSION

Increasing K levels in the root media significantly increased N ,P and K percentage in roots and leaves of Roselle plants. Nitrogen was increased by 24.8% and 14.0 % in roots and leaves respectively due to increasing K levels from 0.5 to 2.0 (g/pot) this result could be attributed to the increment of leaf are leading to increase the efficiency of photosynthesis which reflected by increasing of ATP production . Moreover ,it is well known that , K increases the absorption of NO_3 (Mengel and Kirkby,1982). In addition, K plays an important role in the translocation of NO_3 as KNO_3 from roots to shoots leading to increase N percentage in leaves (Barker and Pilbeam, 2007).

Raising K levels from 0.5 to 2.0 (g/pot)also increased P per cent in roots and leaves of Roselle plants . The reason for this finding could be explained by the synergistic effect between K and the phosphate in the absorption of ions via the cell membrane (Barker and Pilbeam,2007), in addition to the reasons mentioned before concerning the relationship between K and N.

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It is well understood that , increasing any ion in the nutrient or soil solution leads to increase the absorption of that ion by plants' roots (Epsteim,1972;Mengle and Kirkby ,1982; Barker and Pilbeam, 2006). Therefore increasing K levels in root media gave an increase of that nutrient.

However, these results were in agreement with (Egilla *et al.*, 2001;Al-Sammak, 2009), with Hibiscus and Maize respectively.

Table (7): The effect of K and Proline on the absorption and transport rates of K (µg/g/day) in Roselle plant

Proline mg/l / K g/pot	Absorption Rate (I m)					Transport Rate (V)				
	0	50	100	150	Mean	0	50		150	Mean
0.5	383.8	627.1	899.5	1059.3	742.0	309.0	510.0	738.0	833.0	598.0
1.0	464.3	827.3	900.1	1238.7	857.0	372.0	688.0	731.0	969.0	690.0
2.0	525.5	909.8	972.0	1303.7	927.8	424.0	757.0	891.0	1029.0	775.0
Mean	457.0	788.0	923.0	1200.6		368.0	652.0	787.0	944.0	
L S D0.05	K 38.34 Proline 44.27 Interaction 76.68									54.5 62.9 N.S

Increasing proline concentration from 0 to 50,100 and 150 mg/l markedly increased N, P and K percentages in both roots and leaves of Roselle plants . Proline at 150 mg/l was the best in terms of increasing the concentration of N, P, K in roots and leaves of Roselle plants . Proline increased N % by 50.5 % and 35.9 % ; P % by 15.2 % and 5.6 % ; K % by 97.2 % and 28.6 % for roots and leaves respectively as compared with the control . The increment in N ,P and K percentages due to the increase in the proline could be due to the role of proline in the balance of osmotic potential ,stability of the cell membrane and the synthesis of protein and due to the proline role against the stress where it plays as antioxidants scavenger of free radicals and osmotic regulation in the cell membrane in addition to its role in the absorption of nutrients by plant's roots .

Again, K and proline increased N, P and K concentration in roots and leaves of Roselle plant .This result could be attributed to the increase in the rates of absorption and transport of N, P and K due to increasing K and proline levels (Tables 5, 6 and 7) .

These results were in accordance with that found by (Egilla *et al.*, 2005) with Hibiscus rosa – sinensis; and (Paksoy,*et al* .,2010) with Okra seedling.

Profound effect was found due to K and proline on the absorption and transport rates of N ,P and K (Tables 5,6 and 7) .

Increasing K levels from 0.5 to 2.0 g/pot increased absorption rate of N, P and K by 52.9 %,12.4 % and 25.0 % respectively. The transport rates of N, P and K were also influenced by K levels where they increased by 32.9 % ,21.2 % and 29.6 % respectively as compared with 0.5 g/pot K.

Proline affected the rates of absorption and transport markedly . Increasing proline levels from 0 to 150 mg/l increased the absorption rates of N,P and K by 165.1 % 101.9 % and 162.6 % respectively .Increasing proline from 0 to 150 mg/l significantly increased rates of transport of N,P and K by 172.9 % ,110.4 % and 156.5 % respectively .

of N,P and K where 2.0 g/pot K and 150 mg/l proline gave the highest values whereas ,0.5 g/pot K and 0 mg/l proline gave the lowest values .These results could be due to the same reasons mentioned so far with the percentages of N ,P and K. Nevertheless, these results agreed with (Abd El-Samad, *et al.*, 2010 with maize plants , Paksoy , *et al.*, 2010 with Okra and Al-sammak ,2009 with maize plants).

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