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Influence of Foliar Application of Potassium on Growth and Chemical Composition of *Bauhinia variegata* Seedlings under Different Irrigation Intervals

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Abstract: A pot experiment was executed during two successive seasons of 2004 and 2005 carried out under greenhouse conditions at the National Research Centre, Dokki, Cairo, Egypt. The purpose of this study is to investigate the influence of foliar spraying with potassium (0.25 and 50 ppm) on growth and chemical composition under four irrigation intervals (3, 4, 5 and 6 days) on *Bauhinia variegata*. Irrigation intervals treatments have a depressing effect on different growth characters (stem length, stem diameter, root length, number of branches, leaves number/plant, leaf area, fresh and dry weight of stem and leaves by increasing irrigation intervals. The same manner was observed concerning three pigments content, sugar and N, P and K percentage in root and N, P and K uptake in all plant organs. On the contrary, root length and fresh and dry weight of roots induced as irrigation intervals increased. Data also, showed that all growth characters except root parameters, pigments content, sugar and N, P and K percentage and uptake in all plant organs tended to increase by increasing the concentration of potassium up to 50 ppm as compared with the untreated one. This application may be recommended for decreasing the hazard effect on growth of *Bauhinia variegata* under different irrigation intervals.

Key words: Foliar potassium · *Bauhinia variegata* · irrigation intervals · vegetative growth · chemical composition

INTRODUCTION

Bauhinia variegata is a species of flowering plant in the family Fabaceae, native to southeastern Asia from southern china west to India. Common names include Orchidtree and Mountain - ebony. It is a very popular ornamental tree in subtropical and tropical climates, grown for its scented flowers. In some areas it has become naturalized and invasive.

Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts it use. Research on the response of plant to water stress is there for necessary for improving plant growth and tree production in these regions. Farahat [1] in study on *Schinus molle*, *Schinus terbinthifolius* and *Myoporum ocuminatum* and Metwally *et al.* [2] on roselle, found that plant height, stem diameter and fresh and dry weigh of leaves, stem and root decreased with prolonging the water intervals. Uday *et al.* [3] studied the effect of irrigation at (field capacity 10.4%w/w) 0.2 F.C. 0.5 F.C. and 1.0 F.C. levels on growth of *Simmondsia chinensis* seedling and reported that growth was increased with increasing irrigation levels. Sayed [4] on *Khaya senegalensis* and Soad [5] on *Simmondsia chinensis*, irrigated seedlings with different soil moisture content. She found that chlorophyll a, b and carotenoids content were increased as soil moisture content decreased. In addition to that total sugar, N, P and K concentrations in the leaves were also, stimulated gradually by decreasing water supply. While, leaf content of nitrogen, phosphorus and potassium increased by increasing water supply.

Potassium is multifunctional versatile nutrient indispensable for plants. In plants, the function of K has several roles, such as enzyme activation, stimulation of assimilation and transport of assimilate anion/cation balance as well as water regulation through control of stomata [6]. Dutta *et al.* [7] and Ali and Mowafy [8] indicated that adding potassium fertilizer significantly increased each of number of branches.

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Foliar potassium fertilization has been successful for citrus and other fruits [9, 10]. Thalooth *et al.* [11] reported that K was superior in the features of area, number and weigh of leaves/plant. Marschner [12] indicated that potassium make a major contribution to the osmotic pressure of glycophytic plant species and to play an important role in the carbohydrate migration. Also, Hartt and Quick [13] found that promotes translocation of newly synthesized to different rates.

Therefore, the aim of this study is to investigate the effect of spray with potassium application on growth and chemical constituents of *Bauhinia variegata* seedlings under different irrigation intervals.

MATERIALS AND METHODS

The experiment trials were carried out under greenhouse conditions at the National Research Centre, Dokki, Cairo, Egypt during two successive seasons of 2004 and 2005. It intended to find out the individual and combined effects of different irrigation intervals and foliar application of potassium on growth and chemical composition of *Bauhinia variegata*.

One year - old seedlings of *Bauhinia variegata* were obtained nursery of Forestry Department Horticulture Research Institute, Agriculture Research Centre. The seedlings were planted on 15th March in plastic pots 30 cm (one plant/pot, the average height of seedlings were 15-20 cm) filled with 10 kg soil. The investigated soil of the experimental of the following characteristics 38.15 sand, 9.48% silt, 52.37% clay, pH 7.2, EC 0.5 dS m^{-1}, $CaCO_3$ 2.3%, OM 0.15%, Ca 2.7, Mg 0.3, Na 2.4, K 1.2, Cl 2.4, HCO_3 1.3 SO_4 2.8 meq l^{-1}. Each pot received 400 cm^3 irrigation water. The field capacity was 1300 cm^3/pot. The irrigation schedule was four treatments (every 3, 4, 5 or 6 days). After one month from transplanting, the irrigation regime was started and was terminated in 15th November. Three concentrations of foliar spray of potassium fertilizer (0, 25 and 50 ppm) as potassium nitrate (KNO_3) was used. the plants treated with potassium three times of 30 days intervals starting on the 15th May in both seasons. The available commercially fertilizer used through this experimental work was Kristalon (NPK 19:19:19) produced Phayzen Campany, Holland. The fertilizer rates 5.0 g/pot in four doses after 4, 8, 16 and 20 weeks from transplanting.

The following data were recorded: Stem length (cm), stem diameter (mm), root length (cm), number of branches, leaves number/plant, leaf area, fresh and dry weight of all plant organs (g). The experiment was sitting in Completely Randomized in factorial experiment Design with four irrigation intervals and sprayed with three concentrations of K to give 12 treatments with 6 replicates. Obtained results were subjected to statistical analysis of variance according to the method described by Snedecor and Cochran [14] and the combined analysis of the two seasons was calculated according to the method of Steel and Torrie [15]. The following chemical analysis was determined soluble, non soluble and total sugar percentages were determined according to the method by Dubios *et al.* [16]. Chlorophyll (a, b and carotenoids content) were determined according to Saric *et al.* [17]. Nitrogen, phosphorus, potassium and sodium were determined according to the method described by Cottenie *et al.* [18]. The physical and chemical properties of the soil were determined according to Chapman and Pratt [19].

RESULTS AND DISCUSSION

Vegetative growth: Results recorded in the two seasons Tables 1-3 show that significant decrease was detected in all above-ground vegetative growth including, stem length, stem diameter, number of branches/plants, leaves number/plant, leaf area, fresh and dry weight of stem and leaves as a result of increasing intervals between irrigation. The highest values for all these parameters were obtained due to the use of irrigation every 6 days. According to the previous results, El-Monayeri *et al.* [20] reported that, this may be due to the vital roles of water supply at adequate amount for different physiological processes such as photosynthesis respiration, transpiration, translocation, enzyme reaction and cells turgidity occurs simultaneously. Such reduction could be attributed to a decrease in the activity of meristemic tissues responsible for elongation. As well as the inhibition photosynthetic efficiency under insufficient water condition [21]. On the other hand, root length and fresh and dry weights of roots gave an opposite manner as they gradually increased with irrigation intervals increase. These results were on line with those reported by Burman *et al.* [22] found that lower water supply causes the root system to penetrate deeper and expending wider in the soil with higher root system researching for moisture in lower.

According to the different K levels values of the above - ground vegetative growth parameters increased by increasing K concentrations. In this context, Marschner and Cakmak [23] found that, when K is

Table 1: Effect of foliar application of potassium on vegetative growth of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

(a)

Characters	Potassium (ppm)											
	Stem length (cm)				Stem diameter (mm)				Number of branches			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	38.21	44.13	48.61	43.65	13.10	14.20	14.60	14.00	4.21	4.37	4.76	4.45
4	36.71	41.67	45.41	41.26	12.50	12.90	13.30	12.90	3.61	3.87	4.11	3.86
5	33.51	37.11	49.08	36.57	12.10	12.50	13.00	12.50	3.21	3.45	3.83	3.50
6	30.61	33.41	35.54	33.19	11.20	11.80	12.40	11.80	2.72	3.08	3.25	3.02
Mean	34.76	39.08	42.16		12.20	12.90	13.30		3.44	3.69	3.99	
L.S.D. 0.05												
A				2.04				0.50				0.24
B				1.67				0.41				0.28
A x B				2.79				0.70				0.34

(b)

Characters	Potassium (ppm)											
	Root length (cm)				Leaves number/plant				Leaf area			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	13.17	13.11	12.31	12.86	8.31	9.51	10.17	9.33	5.73	6.21	6.67	6.20
4	14.61	13.73	13.17	13.84	8.11	8.53	8.97	8.54	5.31	5.67	5.96	5.65
5	16.71	14.11	14.46	15.09	7.37	7.81	8.13	7.77	4.76	4.96	5.13	4.95
6	18.35	15.67	14.91	16.31	6.51	6.97	7.53	7.00	3.83	4.12	4.67	4.20
Mean	15.71	14.16	13.71		7.58	8.21	8.70		4.91	5.24	5.61	
L.S.D. 0.05												
A				0.76				0.51				0.33
B				0.63				0.42				0.27
A x B				1.08				0.73				0.47

A: potassium B: irrigation

Table 2: Effect of foliar application of potassium on fresh weight of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

Characters	Potassium (ppm)											
	Stem (g)				Leaves (g)				Roots (g)			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	13.28	16.05	25.28	18.20	11.36	15.71	22.19	16.42	6.00	5.54	4.39	5.31
4	11.12	13.31	23.37	15.93	10.11	13.74	15.79	13.21	7.61	6.83	6.11	6.85
5	8.00	10.75	16.71	11.82	7.31	9.71	11.44	9.49	8.11	7.37	6.53	7.34
6	5.49	8.11	12.74	8.78	5.31	7.66	9.17	7.38	10.30	8.66	7.21	8.72
Mean	9.47	12.06	19.53		8.52	11.71	14.65		8.01	7.10	6.06	
L.S.D. 0.05												
A				1.66				1.91				2.02
B				1.35				1.56				1.65
A x B				2.34				2.70				2.86

A: potassium B: irrigation

Table 3: Effect of foliar application of potassium on dry weight of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

Characters	Potassium (ppm)											
	Stem (g)				Leaves (g)				Roots (g)			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	5.22	5.87	9.76	6.95	4.71	6.71	10.11	7.18	4.16	3.81	2.34	3.44
4	3.78	5.06	7.88	5.57	3.15	5.40	7.16	5.24	4.76	4.12	2.53	3.80
5	3.12	4.23	5.86	4.40	2.51	3.64	5.16	3.77	5.71	4.71	3.07	4.50
6	2.08	3.00	4.64	3.24	2.00	2.75	3.46	2.74	6.27	5.13	3.58	4.99
Mean	3.55	4.54	7.04		3.09	4.63	6.47		5.23	4.44	2.88	
L.S.D. 0.05												
A				2.91				0.97				0.44
B				2.38				0.79				0.25
A x B				4.12				1.37				0.44

A: potassium B: irrigation

Table 4: Effect of foliar application of potassium on Chlorophyll a, b and carotenoids (mg g^{-1} F.W.) of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

Characters	Potassium (ppm)											
	Chlorophyll (a)				Chlorophyll (b)				Carotenoids			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	1.73	1.81	1.87	1.80	0.67	0.73	0.79	0.73	0.71	0.78	0.31	0.77
4	1.67	1.77	1.80	1.75	0.62	0.66	0.72	0.67	0.69	0.75	0.79	0.74
5	1.35	1.44	1.49	1.43	0.43	0.52	0.61	0.52	0.61	0.68	0.73	0.67
6	1.21	1.36	1.42	1.33	0.31	0.37	0.46	0.38	0.45	0.53	0.64	0.54
Mean	1.49	1.60	1.65		0.51	0.57	0.65		0.62	0.69	0.74	

deficient, growth is retarded and net retransloction of K is enhanced from mature leaves and stems and under sever deficiency these organs become chloroic and necrotic, depending on the light intensity to which the leaves are exposed.

The interaction between different factors (irrigation and potassium) was almost significant for all vegetative growth parameters. The highest values due to the irrigation regime and potassium were obtained due to irrigated every 3 days and 50 ppm K for stem length, stem diameter, number of branches/plant, leaves number/plant, leaf area, fresh and dry weight of stem and leaves. While, the same treatment gave the lowest values of root length and fresh and dry weight of roots. The lowest sensitivity of potassium - sufficient plants to drought stress is related to several factors [24]: (a) the role of K in stomatal regulation, which is major mechanism controlling the water regime of higher plants and (b) the importance of K for the osmotic potential in the vacuoles, maintaining a high tissue water content even under drought conditions.

Chemical composition:

***Pigments content*:** From the given data in Table 4 it can be concluded that, increasing irrigation intervals caused an increase in the content of photosynthetic pigments (chlorophyll a, b and carotenoids). Accordingly it can be stated that irrigation every 6 days was the most effective irrigation treatment for promoting the synthesis and accumulation of the three photosynthetic pigments. In harmony with these results were those obtained by Sayed [4] and Soad [5].

Table 5: Effect of foliar application of potassium on soluble, non soluble and total sugar percentage of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

	Potassium (ppm)											
Characters	Soluble sugar %				Non soluble sugar %				Total sugar %			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	5.17	5.37	5.67	5.40	19.31	19.83	21.11	20.08	24.48	25.20	26.78	25.49
4	5.03	5.12	5.35	5.17	18.07	18.31	19.41	16.60	23.10	23.43	24.76	23.76
5	4.71	4.91	5.22	4.95	16.71	17.11	17.76	17.19	21.42	22.02	22.98	22.14
6	3.43	3.93	4.37	3.91	14.74	15.15	15.43	15.11	18.17	19.08	19.80	19.02
Mean	4.59	4.83	5.15		17.21	17.60	18.43		21.79	22.43	23.58	

The three photosynthetic pigments took similar trend in response to K levels. The two concentrations used of potassium caused an increase in the contents of chlorophyll a, b and carotenoids in regard to those of untreated seedlings. In harmony with these results were those revealed by Bottrill *et al.* [25] mentioned that, in deficient plants various parameters of CO_2 exchange are affected. An increase in potassium contents in the leaves increase the rate of photosynthesis and carboxylase activity, as well as photorespiration, probably due to a stronger depletion of CO_2 at the catalytic sites of the enzyme. With increase in potassium content dark respiration decreases. Higher respiration rates are a typical feature of potassium deficiency. Marschner [26] reported that potassium nutritional status may also affect photosynthesis in leaves via its function in stomatal regulation.

In this respect, interaction between irrigation intervals and potassium applications, the data revealed that the combination of both factors on chlorophyll a, b and carotenoids was more effective than the effect of each factor when tested alone. Similar results were reported by Pier and Berkowitz [27] stated that during dehydration isolated chloroplasts lose large amounts of their K and photosynthesis decrease; this decrease can be overcome by high concentrations of extrachloroplastic K. Also in intact plants the decrease in photosynthesis under drought stress in much less severe at high K supply.

***Sugar percentage*:** Data recorded in Table 5 indicated that soluble, non soluble and total sugar percentage as affected by different irrigation intervals treatments, followed the same manner obtained previously on photosynthetic pigments, were gradually decreased by increasing the intervals of irrigation. These results were in accordance with those recorded by Azza and Sahar [28].

Potassium at both used concentration caused an increase in soluble, non soluble and total sugar percentage as compared with untreated seedlings. These results were on line with those reported by lauchli and Pfluger [29] found that, these changes in sugar metabolism are presumably related to the high K requirement of certain regulatory enzymes, particularly pyruvate kinase and phosphfructokinase. As for the interaction between irrigation intervals and potassium applications the higher values were provided when adding 50 ppm K and irrigation every 3 days.

***Mineral content*:** Data of nitrogen, phosphorus, potassium and sodium content and uptake in the various rates of potassium foliar application treatments in the two successive seasons are presented in Tables 6-9. Generally, the present results indicated that, increasing irrigation intervals increased the content of N, P and K in stem and leaves. Moreover, these increases were enhanced gradually by increasing irrigation intervals. On the other hand, the adverse results were obtained in root. Nitrogen, phosphorus and potassium content decreased by increasing irrigation intervals. This may be due to the leaching of the mineral from soil. Similar suggestion was also reported by Sayed [4], Soad [5] and Azza and Sahar [28]. Furthermore, sodium content increased by increasing irrigation intervals in all plant organs (stem, leaves and root) these results run parallel with those obtained by Farahat [1] and El-Tantawy *et al.* [30].

Concerning the effect of potassium foliar application on nitrogen, phosphorus and potassium, it is evident from data that the previous minerals in all plant organs in the

Table 6: Effect of foliar application of potassium on nitrogen, phosphorus and potassium percentage of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

(a) Stem

Characters	Potassium (ppm)											
	N %				P %				K %			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	1.52	1.65	2.31	1.83	0.19	0.23	0.35	0.26	0.97	1.21	1.76	1.31
4	1.79	1.86	2.71	2.12	0.25	0.26	0.43	0.31	1.10	1.33	2.00	1.48
5	2.11	2.18	3.13	2.47	0.28	0.30	0.50	0.36	1.32	1.58	2.39	1.76
6	2.51	2.78	3.45	2.94	0.36	0.40	0.57	0.44	1.77	1.89	2.74	2.13
Mean	1.98	2.14	2.9		0.27	0.30	0.46		1.29	1.50	2.22	

(b) Leaves

Characters	Potassium (ppm)											
	N %				P %				K %			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	2.27	2.78	3.33	2.79	0.32	0.40	0.45	0.39	2.67	2.88	3.11	2.89
4	2.81	3.38	3.90	3.36	0.36	0.44	0.49	0.43	2.99	3.23	3.48	3.23
5	3.12	3.95	4.33	3.80	0.41	0.48	0.55	0.48	3.29	4.03	4.39	3.90
6	3.46	3.99	4.55	3.95	0.44	0.53	0.61	0.53	3.49	4.39	4.76	4.21
Mean	2.92	3.53	4.03		0.38	0.46	0.53		3.11	3.63	3.94	

(c) Roots

Characters	Potassium (ppm)											
	N %				P %				K %			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	2.28	2.52	4.13	2.98	0.45	0.53	0.87	0.62	0.28	0.35	0.55	0.39
4	1.87	2.27	3.75	2.63	0.33	0.45	0.79	0.52	0.22	0.29	0.34	0.28
5	1.54	1.96	3.02	2.17	0.26	0.38	0.63	0.42	0.16	0.23	0.29	0.23
6	1.33	1.68	2.57	1.86	0.22	0.29	0.50	0.34	0.12	0.18	0.20	0.17
Mean	1.76	2.11	3.15		0.32	0.41	0.70		0.20	0.26	0.35	

tow growing seasons, were increased by using potassium foliar application, especially by using high level of potassium (50 ppm). But, sodium content took an opposite manner, it decreased by increasing potassium concentration.

The interaction between applied 50 ppm K and irrigation every 6 days showed the maximum percentage of each element; expect Na percentage in all plant organs. Interaction between 50 ppm K application and irrigated every 3 days showed the lowest values of Na percentage. On the contrary of all plant organs percentage of N, P and K by irrigation intervals treatments, all plant organs content of such three nutrients was gradually increased by decreasing irrigation intervals. These results could be

Table 7: Effect of foliar application of potassium on nitrogen, phosphorus and potassium uptake mg/plant of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

(a) Stem

	Potassium (ppm)											
Characters	N - uptake mg/plant				P - uptake mg/plant				K - uptake mg/plant			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	79.34	96.86	225.56	133.92	9.92	13.50	34.16	19.19	50.53	71.03	171.78	97.78
4	67.66	94.12	213.55	125.11	9.45	13.16	33.88	18.83	41.58	67.30	157.60	88.83
5	65.83	92.21	183.42	113.82	8.74	12.69	29.30	16.91	41.18	66.83	140.05	82.69
6	52.21	81.10	160.08	99.46	7.49	12.00	26.45	15.31	36.82	56.70	127.14	73.55
Mean	66.26	92.32	195.65		8.90	12.84	30.95		42.53	65.47	149.14	

(b) Leaves

	Potassium (ppm)											
Characters	N - uptake mg/plant				P - uptake mg/plant				K - uptake mg/plant			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	106.92	186.54	336.66	210.04	15.07	26.84	45.50	29.14	125.76	193.25	314.42	211.14
4	88.52	182.52	279.24	183.43	11.34	23.76	35.08	23.39	94.19	174.42	249.17	172.59
5	78.31	143.78	223.43	148.51	10.29	17.47	28.38	18.71	82.33	146.69	226.52	151.85
6	69.20	109.33	157.43	111.99	8.80	14.58	21.11	14.83	69.80	120.73	164.70	118.41
Mean	85.74	155.54	249.19		11.38	20.66	32.52		93.02	158.77	238.70	

(c) Roots

	Potassium (ppm)											
Characters	N - uptake mg/plant				P - uptake mg/plant				K - uptake mg/plant			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	94.85	96.01	96.64	95.83	18.72	20.19	20.36	19.76	11.65	13.34	13.81	12.93
4	89.01	93.52	94.88	92.47	15.71	18.54	19.99	18.08	10.48	10.95	11.95	11.13
5	87.93	92.32	92.71	90.99	14.85	17.90	19.34	17.36	10.03	10.28	10.83	10.38
6	83.39	86.18	92.01	87.19	13.79	14.88	17.90	15.52	7.52	8.15	9.23	8.30
Mean	88.80	92.01	94.06		15.77	17.88	19.40		9.92	10.68	11.46	

explained in the light the considerable decrease in leaves and stem dry weight by the increase in irrigation intervals. In accordance with the obtained results were the finding of Farahat [1] and Soad [5]. On the other hand, Na uptake increased by increasing irrigation intervals.

All plant organs contents of each of N, P and K were increased in both seasons, due to the use of the two potassium concentrations than those of untreated seedlings. But, application at both concentrations 25 and 50 ppm caused considerable reduction in sodium uptake

Table 8: Effect of foliar application of potassium on sodium percentage (%) of *Bauhinia variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

	Potassium (ppm)											
Characters	Stem				Leaves				Roots			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	0.27	0.15	0.06	0.16	0.39	0.23	0.15	0.24	0.43	0.40	0.32	0.38
4	0.43	0.21	0.11	0.25	0.55	0.31	0.22	0.36	0.51	0.48	0.38	0.46
5	0.55	0.27	0.17	0.33	0.71	0.47	0.31	0.50	0.83	0.71	0.52	0.69
6	0.85	0.40	0.23	0.49	0.92	0.64	0.49	0.68	0.97	0.68	0.71	0.85
Mean	0.53	0.26	0.14		0.63	0.41	0.29		0.69	0.61	0.48	

Table 9: Effect of foliar application of potassium on sodium uptake mg/plant of *Bauhina variegata* under different irrigation intervals (Average values of 2004 and 2005 seasons)

	Potassium (ppm)											
Characters	Stem				Leaves				Roots			
Irrigation Intervals days	0	25	50	Mean	0	25	50	Mean	0	25	50	Mean
3	14.09	8.81	5.86	9.59	16.01	15.43	15.17	15.54	17.89	15.24	7.49	13.54
4	16.25	10.63	8.67	11.85	17.33	16.74	15.75	16.61	24.28	19.78	9.61	17.89
5	17.16	11.42	9.96	12.85	17.82	17.10	16.00	16.97	47.39	33.44	15.96	32.26
6	17.68	12.00	10.67	13.45	18.40	17.60	16.95	17.65	60.82	44.12	25.42	43.45
Mean	16.30	10.72	8.79		17.39	16.72	15.97		37.60	28.15	14.62	

in all plant organs. In respect to the interaction between two involved factors (irrigation and potassium) they were increased for nitrogen, phosphorus and potassium contents in all plant organs. The highest values in both seasons due to such various interactions were obtained from irrigation every 3 days with 50 ppm potassium. Moreover, the highest values of sodium uptake was obtained due to irrigation every 6 days with 0 ppm potassium.

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