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IMPACT OF POTASSIUM FERTILIZER AND LITHOVIT ON GROWTH, FLOWERING AND CHEMICAL CONSTITUENTS OF ARABIAN JASMINE VAR. DOUBLE PETALS PLANT

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ABSTRACT

Pot experiment was carried out during the two summer consecutive seasons of 2020 and 2021 at Ornamental Nursery of EL-Quassasin Horticultural Research Station, Ismailia Governorate, Egypt. This study aimed to investigate the impact of different potassium fertilizer rates (0.0, 1.5, 3.0 and 4.5 g/pot) as potassium sulfate (48% K_2O), lithovit concentrations (0.0, 0.5, 1.0 and 1.5 gl^{-1}) and their combinations on vegetative growth, flowering characters and chemical contents of *Jasminum sambac* plant. The achieved results revealed that maximum plant height, No. of branches and leaves/ plant as well as fresh and dry weights of plant were recorded when plants were fertilized with potassium sulfate at 4.5 g/pot compared to the other rates under study and control. Also, the vegetative growth traits were increased gradually as lithovit concentrations increased to reach the maximum values with 1.5gl^{-1}. Using of any potassium fertilizer rates or lithovit concentrations individually, significantly increased flower number per plant, flower diameter and petal number per flower compared to control. In general, fertilizing Arabian jasmine plants with 4.5 g/pot potassium sulfate and spraying with 1.5 gl^{-1} lithovit recorded higher values of growth traits and flowering parameters as well as chemical constituents of leaves compared to the other combination treatments. Therefore, this treatment can be recommended to apply it to the Arabian jasmine plant under the same conditions.

INTRODUCTION

Arabian jasmine or sambac jasmine (*Jasminum sambac* Ait.) is a tropical evergreen shrub which produces a persistent show of fragrant flowers everywhere during the warmer months on well-established flower plants (**Zhang *et al.*, 1995**). It belongs to the family Oleaceae (the olive family). Sambac jasmine plants are used in landscaping private and public gardens and it is also used in interior landscaping in large and sunny places (**Lokhande *et al.*, 2015**). Arabian jasmine oils are utilized extensively in the manufacture of confectionary perfumes, soaps, cosmetics, perfumed tobacco, ointments, syrups, disinfectants, detergents and aerated water. Flowers are utilized for hair adornment of women religious and social functions as well as making garlands (**Chopde *et al.*, 2017**). Moreover, there are several varieties of Arabian jasmine plant relying on the petals size and number of flower, whereas, the numerous petals of flowers in double variety looks such as a small white rose (**Thakor *et al.*, 2017**). In addition, the pharmacological studies pointed out that the plant extracts touched antipyretic, antimicrobial, antioxidant, insecticidal, analgesic, anticancer, anti-inflammatory, anti-diabetic, dermatological, cardiovascular,

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anti-obesity, and gastro protective effects (**Al-Snafi, 2018**).

Potassium (K) be worthy of private attention as a nutrient of plant in flowering plants, for its function in production and flower quality, although it is not a constituent of each plant section, it affects the metabolism of carbohydrates, nitrogen and the synthesis of starch, protein and lipid (**Marschner, 1995**). Fertilization is one of the eventual crucial factors that enhance plant growth and development. Fertilizers as potassium element are given of plant nutrient that can be increased to the soil to outfit its naturalist productivity. The utilization of adequate fertilizers is necessary as a conclusive management practices that able to enhance the plant growth and flowering in plants qualitatively and quantitatively (**Mohammed *et al*., 2016**).

Lithovit (nano-$CaCO_3$) is a natural calcium carbonate and it is applied as foliar fertilizer which turns fine particles (<10 μm) that can readily be adsorbed directly through the plant leaves stomata. Lithovit particles break down then it release gaseous CO_2 improving the CO_2 rate at the photo-synthetically active area within the leaves of plant (**Shallan *et al*., 2016**). Furthermore, the highest values of stevia growth parameters (plant height, branch number/ plant and leaf number /plant as well as dry weight of leaves/plant) were recorded with lithovit at 4 or 6 gl^{-1} as foliar spray without significant differences between them (**Soliman *et al*., 2018**). Also, **Mostafa (2019)** on stevia plant reported that, the maximum values of total N, P and K percentages and total chlorophyll content (SPAD unit) were obtained when plants were sprayed with 1gl^{-1} of lithovit compared to control. Moreover, **Mohammed *et al*. (2021)** indicated that the highest values of plant height, number of leaves per plant and total dry weight per plant as well as total chlorophyll content of roselle and cluster bean were achieved by 4 gl^{-1} of lithovit compared to the other rates under study.

In order to obtain acceptable growth and flowering under summer season, this study was aimed to evaluate the advantageous impacts of fertilization with potassium sulfate and foliar spraying with lithovit as nano particles on quality improvement of Arabian jasmine plant.

MATERIALS AND METHODS

In order to enhance Arabian jasmine plant growth and flowering, the current study was carried out at Ornamental Nursery of EL-Quassasin Horticultural Research Station, Ismailia Governorate, Egypt, during the two consecutive summer seasons of 2020 and 2021. This experiment was conducted in pots. The experimental design was completely randomized design (CRD) arranged in split-plot design with three replicates. There were sixteen combination treatments. Factor I which was potassium fertilizer rate was arranged in main plot. It was consisted of four rates (0.0, 1.5, 3.0 and 4.5 g/pot) of potassium sulfate (48% K_2O). Factor II which was lithovit concentration was distributed in sub-plot. It was consisted of four concentrations (0.0, 0.5, 1.0 and 1.5 gl^{-1}).

Seedlings of Arabian jasmine (*Jasminum sambac* var Double petals Ait.) were obtained from a private nursery in Belbas District, Sharkia Governorate, Egypt and were planted in plastic pots 40 cm diameter filled with 8 kg soil mixture of farm soil and sand (1/1, *V/V*), on the 20th February during both seasons. The experimental unit contained 12 pots. Each pot contained one seedling. The physical and chemical properties of the utilized soil mixture are shown in Table 1. This analysis was done according to **Chapman and Pratt (1978)**.

Potassium fertilization was applied four times during season; *i. e.*, after 30, 60, 90 and 120 days from transplanting. Lithovit

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

Physical analysis			Soil texture
Clay (%)	Silt (%)	Sand (%)	Sandy
22.65	9.03	68.32	

Chemical analysis												
pH	E.C. (dsm^{-1})	Soluble cations (m.mol/l)					Soluble anions (m.mol/l)			Available (ppm)		
		Ca^{++}	Mg^{++}	Na^{+}	Zn^{++}	Mo^{++}	Cl^{-}	HCO_3^{-}	SO_4^{--}	N	P	K
7.86	0.68	1.82	0.96	0.33	1.11	1.30	3.05	1.14	0.86	118	54	62

was obtained from German company (Agrolink) in powder form. It was contained 5.0% $MgCO_3$, 75.0% $CaCO_3$, 0.02% Mn and 0.25% Fe. Lithovit was foliar sprayed at monthly interval starting from 20th March until 20th August). All recommended agricultural practices for growing Arabian jasmine plants were done whenever needed.

Sampling and Collecting Data

During both consecutive seasons, at the end of the current study (20th September), the following parameters were recorded:

Vegetative growth parameters

Random samples of three plants of Arabian jasmine were taken from each experimental unit during 2020 and 2021 seasons, and the following data were recorded: Plant height (cm), branch and leaf numbers /plant, total fresh and dry weights (aerial part) of plant (g) as well as area of mature leaf (cm^2). Also leaf area was calculated as reported by **Keller (1972)** using the following formula: Leaf area (cm^2)=10 leaves fresh weight /fresh weight of 10 disks × Disk area ($2\pi r2$).

Flowering characters

At flowering stage, the following data were recorded: Number of flowers/plant and number of days to flowering (day). The duration of flowering period was noticed as number of days from the beginning of flowering until the end of flowering period for each treatment. In addition, flower diameter (cm) and number of petals/flower were recorded as average of 30 flowers per plant during both seasons.

Chemical constituents

After two weeks from the application of the second potassium sulphate dose, total nitrogen, phosphorus and potassium percentages were determined in Arabian jasmine leaves according to the methods of **AOAC (1990)**. Leaf green color degree (total chlorophyll content as SPAD unit) was determined in Arabian jasmine fresh mature leaves by using SPAD- 502 meter as reported by **Markwell *et al.* (1995)**.

Statistical Analysis

All collected data were analyzed with analysis of variance (ANOVA) procedure using Statistix version 9 computer program (**Analytical Software, 2008**). Differences between means were compared by using least significance difference (LSD) at 5% level of probability **(Gomez and Gomez 1984)**.

RESULTS AND DISCUSSION

Vegetative Growth

Impact of potassium fertilizer rate:

Results presented in Tables 2, 3 and 4 indicate that, all potassium rates (1.5, 3 and 4.5 g/pot) significantly increased plant height, number of branches per plant, number of leaves per plant, area of mature leaves as well as total fresh and dry weights of plant compared to control (unfertilized plants) in both seasons. In general, increasing potassium fertilization rate gradually increased sambac jasmine vegetative growth traits. Furthermore, higher significant values in this connection were obtained when plants were fertilized by the highest potassium rate (4.5 g/pot) compard with the other rates under study. The enhancement of jasmine growth traits may be a reflection to the fact that potassium is a remarkable element for plant nutrition and it have the ability to affect water status, meristem growth, photosynthesis, enhance many enzyme actions, long distance transport of assimilates, increase protein content, control ionic balance helps as well as translocate sugars and starches (**Mengel and Kirkby, 2001**). In addition, **El-Naggar and El-Nasharty (2016)** pointed out that applying 2% K_2O foliar combined with 100% potassium soil dressing (2 g/pot) recorded the highest significant values of gladiolus plant height, leaf number per plant and fresh and dry weights of leaves per plant compared to the control.

Impact of lithovit concentration

Regarding the impact of lithovit on vegetative growth traits of Arabian jasmine, results listed in Tables 2, 3 and 4 reveal that, using any concentration of lithovit significantly increased plant height, branch and leaf number per plant, area of mature leaves and total fresh and dry weights per plant compared with control (sprayed with tap water) in 1st and 2nd seasons. Likewise, utilizing of lithovit at 1.5 gl^{-1} concentration gave higher values in this concern compared to control and the other ones under study with significant difference between them. This beneficial effect of lithovit may be attributed to it is component since it contains $CaCO_3$ which decomposes to carbon dioxide (CO_2) in stomata of leaves, and this increases photosynthesis process leading to enhance plant growth traits (**Carmen *et al.*, 2014**). In the same time, it was found that spraying *Echinacea purpurea* (L.) plants with 2gl^{-1} lithovit three times/ season at 30 days interval led to enhance plant growth compared to the other rates (0.0 and 1.0 gl^{-1}) under study (**Abd El-Baset, 2018**).

Impact of combination between potassium fertilization and lithovit

Results recorded in Tables 2, 3 and 4 demonstrate that, combination between different potassium fertilization rates and lithovit concentrations significantly increased plant height, number of branches and leaves /plant and area of mature leaf compared to the control in both seasons. However, the best combination treatment in this connection was that of 4.5 g/pot of potassium fertilizer combined with lithovit at 1.5 gl^{-1}. In addition, all combination treatments were higher than individual potassium rates or individual lithovit concentrations. Generally, as mentioned above, both potassium fertilizer rate and lithovit concentrations (each alone) increased growth parameters of Arabian jasmine plant, in turn; they together might maximize their impacts leading to achieve taller, more branches and leaves and the heaviest plants. These results are in line with those found by **Attia *et al*. (2016)** on Egyptian cotton plant and **Ghatas and Mohamed (2018)** on *Cymbopogon citruts* plant.

Table 2. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) on plant height (cm) and number of branches per plant of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Plant height (cm)									
0.0	42.97	42.80	43.53	44.07	**43.34**	43.70	44.97	45.23	45.73	**44.91**
1.5	42.47	45.10	47.07	48.03	**45.67**	44.63	46.73	48.83	49.37	**47.39**
3.0	45.23	47.63	49.77	52.70	**48.83**	46.93	51.27	52.97	55.93	**51.78**
4.5	46.70	50.13	49.70	53.03	**49.89**	50.00	53.17	56.57	60.07	**54.95**
Mean (B)	**44.34**	**46.42**	**47.52**	**49.46**		**46.32**	**49.03**	**50.90**	**52.78**	
LSD at 5 %	**(A) = 0.63**		**(B) =0.48**		**(A×B) = 1.03**	**(A) = 0.62**		**(B) = 0.53**		**(A×B) = 1.10**
	Number of branches / plant									
0.0	4.83	5.17	5.37	6.53	**5.48**	5.40	5.67	6.43	7.33	**6.75**
1.5	5.10	6.13	7.07	8.13	**6.61**	6.17	7.63	8.30	9.10	**7.80**
3.0	6.87	7.60	10.43	11.77	**9.17**	7.33	8.27	9.27	10.73	**8.90**
4.5	8.73	10.17	11.20	13.20	**10.83**	8.10	9.77	10.67	12.80	**10.33**
Mean (B)	**6.38**	**7.27**	**8.52**	**9.91**		**6.75**	**7.83**	**8.67**	**9.99**	
LSD at 5 %	**(A) = 0.33**		**(B) = 0.18**		**(A×B) = 0.45**	**(A) = 0.29**		**(B) = 0.27**		**(A×B) = 0.55**

Table 3. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) treatments on number of leaves per plant and area of mature leaf (cm^2) of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Number of leaves / plant									
0.0	29.10	30.47	32.50	32.70	**31.19**	25.53	27.67	29.70	30.57	**28.37**
1.5	31.37	33.13	35.23	37.50	**34.63**	31.57	39.13	39.43	42.70	**38.21**
3.0	33.67	37.83	44.33	47.30	**40.78**	34.77	39.83	41.77	45.47	**40.46**
4.5	37.40	45.10	47.53	50.60	**45.16**	39.77	43.40	47.53	49.23	**44.98**
Mean (B)	**32.88**	**36.63**	**39.90**	**42.03**		**32.91**	**37.51**	**39.61**	**41.99**	
LSD at 5 %	**(A) = 0.54**	**(B) = 0.63**		**(A×B) = 1.22**		**(A) = 0.53**	**(B) = 2.53**		**(A×B) = 1.05**	
	Area of mature leaf (cm^2)									
0.0	19.72	20.70	22.27	22.69	**21.34**	20.73	21.56	23.75	25.08	**22.78**
1.5	20.37	21.58	23.01	23.68	**22.16**	21.19	22.96	24.19	25.60	**23.49**
3.0	21.84	23.49	25.36	25.92	**24.15**	22.74	23.98	26.44	27.36	**25.13**
4.5	22.04	23.41	26.56	27.06	**24.77**	24.40	26.31	27.86	28.99	**26.89**
Mean (B)	**20.99**	**22.30**	**24.30**	**24.84**		**22.27**	**23.70**	**25.56**	**26.76**	
LSD at 5 %	**(A) = 0.25**	**(B) = 0.27**		**(A×B) = 0.53**		**(A)= 0.19**	**(B)= 0.26**		**(A×B)= 0.49**	

Table 4. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) on total fresh and dry weights (leaves+ branches) per plant (g) of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Total fresh weight per plant (g)									
0.0	83.80	85.43	86.60	88.70	**86.13**	77.07	82.53	87.77	91.93	**84.82**
1.5	82.27	87.70	94.33	101.97	**91.57**	79.80	84.73	96.13	98.77	**89.86**
3.0	91.63	93.67	107.17	113.73	**101.55**	92.33	104.07	116.37	119.30	**108.02**
4.5	96.83	104.13	113.57	120.90	**108.86**	95.00	111.00	120.17	123.97	**112.53**
Mean (B)	**88.63**	**92.73**	**100.42**	**106.32**		**86.05**	**95.58**	**105.11**	**108.49**	
LSD at 5 %	**(A) =0.90**		**(B) = 0.86**		**(A×B) =1.74**	**(A) =1.73**		**(B) =1.30**		**(A×B) = 2.83**
	Total dry weight per plant (g)									
0.0	12.33	12.60	12.90	13.43	**12.82**	11.30	11.87	13.03	14.37	**12.64**
1.5	11.90	13.30	14.40	15.43	**13.76**	11.77	12.17	14.57	14.67	**13.29**
3.0	12.73	14.03	17.80	19.73	**16.08**	14.20	16.73	19.63	21.07	**17.91**
4.5	15.00	16.83	18.83	20.30	**17.74**	14.60	18.50	21.00	22.63	**19.18**
Mean (B)	**12.99**	**14.19**	**15.98**	**17.22**		**12.97**	**14.82**	**17.06**	**18.18**	
LSD at 5 %	**(A) = 0.24**		**(B) = 0.26**		**(A×B) = 0.50**	**(A) = 0.16**		**(B) = 0.32**		**(A×B) = 0.58**

Flowering Characters

Impact of potassium fertilizer rate:

Results of both seasons in Tables 5 and 6 reveal that, number of flowers per Arabian jasmine plant as well as flower diameter and petal number per flower significantly increased by using any applied potassium fertilizer rate compared to control in the two consecutive seasons. In other words, all rates of potassium significantly delayed formation of flowers in Arabian jasmine when compared to control treatment to reach the maximum delaying with 4.5 g/pot. Increasing potassium fertilization rate from 1.5, 3.0 to 4.5 gradually increased flower number per plant, flower diameter and number of petals per flower in both seasons. Potassium activates some enzymatic reactions, promotes the meristematic tissue growth, aids in the synthesis of proteins and nitrogen metabolism, catalyzes activities of some mineral elements as well as aids in carbohydrate translocation and metabolism which reflected in enhance flowering characters of plant (**Zörb *et al*., 2014**). These results are in accordance with those found by **Kwon *et al*. (2019)** on bellflower, **Abou El-Ghait *et al.* (2020)** on *Jasminum sambac*, Single petals cultivar and **Hamza *et al*. (2021)** on Arabian jasmine (*Jasminum sambac* Ait.) var. double petals.

Impact of lithovit concentration:

It is evident from the obtained results in Tables 5 and 6 that, higher flower number per plant and petals number per flower as well as flower diameter of Arabian jasmine were detected when plants were sprayed with lithovit at 1.5 gl^{-1} compared to control and the other ones under study in both seasons. Moreover, the earliest flowering date was achieved without lithovit application in the two consecutive seasons. Since, the improving impacts of lithovit mode of action are to enhance CO_2 levels within the leaf structure of plant and by implication increase photosynthetic efficiency which reflected in

Table 5. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) on number of flowers per plant and number of days to flowering (day) of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Number of flowers per plant									
0.0	42.23	47.33	49.00	53.57	**48.03**	45.70	46.13	51.83	56.30	**49.99**
1.5	47.37	55.13	57.43	60.60	**55.13**	49.20	53.70	60.00	62.13	**56.26**
3.0	52.50	66.90	71.57	74.23	**66.30**	53.90	61.80	64.83	72.13	**63.17**
4.5	56.77	72.93	75.67	77.53	**70.73**	62.93	68.97	72.40	77.17	**70.37**
Mean (B)	**49.72**	**60.58**	**63.42**	**66.48**		**52.93**	**57.65**	**62.27**	**66.93**	
LSD at 5 %	**(A) = 0.85**		**(B) =1.20**		**(A×B) =2.24**	**(A) = 1.02**		**(B) = 1.09**		**(A×B) =2.13**
	Number of days to flowering (day)									
0.0	60.93	61.47	64.73	62.60	**62.43**	63.90	64.47	66.43	62.07	**64.22**
1.5	65.27	68.53	70.80	67.70	**68.08**	64.73	68.07	72.10	69.93	**68.71**
3.0	65.97	69.87	74.20	72.30	**70.58**	67.77	75.13	76.40	72.47	**72.94**
4.5	69.70	71.93	77.07	73.93	**73.16**	70.63	75.63	78.20	77.13	**75.40**
Mean (B)	**65.47**	**67.95**	**71.70**	**69.13**		**66.76**	**70.83**	**73.28**	**70.40**	
LSD at 5 %	**(A) =1.12**		**(B) =0.61**		**(A×B) =1.54**	**(A) =0.93**		**(B) = 0.72**		**(A×B) = 1.55**

Table 6. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) on flower diameter (cm) and number of petals per flower of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Flower diameter (cm)									
0.0	2.13	2.15	2.18	2.20	**2.17**	2.10	2.17	2.20	2.23	**2.18**
1.5	2.14	2.20	2.23	2.30	**2.22**	2.13	2.21	2.26	2.29	**2.22**
3.0	2.18	2.24	2.28	2.40	**2.28**	2.21	2.26	2.30	2.35	**2.28**
4.5	2.26	2.38	2.43	2.47	**2.38**	2.23	2.41	2.45	2.49	**2.40**
Mean (B)	**2.18**	**2.24**	**2.28**	**2.34**		**2.17**	**2.22**	**2.28**	**2.34**	
LSD at 5 %	**(A) =0.001**	**(B) =0.001**		**(A×B) =0.002**		**(A) =0.001**	**(B) =0.001**		**(A×B) =0.002**	
	Number of petals per flower									
0.0	12.22	12.56	13.22	13.78	**12.95**	12.67	13.00	13.11	13.45	**13.06**
1.5	12.67	13.11	14.11	14.67	**13.64**	12.78	13.33	13.67	14.44	**13.56**
3.0	12.33	13.11	14.33	15.11	**13.72**	13.66	14.78	14.89	15.89	**14.81**
4.5	12.89	13.89	15.33	15.67	**14.45**	14.55	14.89	16.00	16.56	**15.50**
Mean (B)	**12.53**	**13.17**	**14.25**	**14.81**		**13.42**	**14.00**	**14.42**	**15.09**	
LSD at 5 %	**(A) =0.35**		**(B) =0.27**		**(A×B) =0.58**	**(A) =0.22**		**(B) =0.29**		**(A×B) = 0.54**

flowering improvement. Similarly, **Abd El-Baset (2018)** noticed that flower number / plant of *Echinacea purpurea* was significantly affected by 2 gl^{-1} lithovit comparing with 1gl^{-1} treatment during both seasons.

Impact of combination between potassium fertilizer and lithovit

The results illustrated in Tables 5 and 6 show that, increasing potassium fertilizer rates from 1.5 or 3.0 to 4.5 gl^{-1} resulted in significant increases in Arabian jasmine flowering characteristics under different lithovit concentrations in both seasons. In addition, the highest significant values of flower number per plant, flower diameter and number of petals per flower were obtained under the impact of combination treatments between potassium fertilization rate (4.5 g/pot) and lithovit at 1.5 gl^{-1} in 1st and 2nd seasons. This enhancement of Arabian flowering characters may be due to its carbon dioxide (CO_2) supplying for the plants in much higher efficiency than that in the atmosphere and so enabling the photosynthesis to have place with higher concentration leading to a stronger natural vegetative growth and increasing flower number per plant and flower diameter. Furthermore, supplementation with potassium nutrient probably increased the enzymatic activity which may be played a role in this regard. Likewise, **Anuburani *et al*. (2018)** on gundumalli (*Jasminum sambac* Ait.), **Bellubbi *et al*. (2015)** on gerbera plant and **Diwivedi *et al.* (2018)** on jasmine (*Jasminum grandiflorum* L.) also proved similar results concerning a positive impact of chemical fertilization on flowering characters. Also, **Abd El-baset (2018)** recommended to treat *Echinacea purpurea* plants by lithovit at the concentration of 2 gl^{-1} three times as foliar spray to obtain the best results concerning flowering characters.

Chemical Constituents

Impact of potassium fertilizer rate

It is quite clear from the results in Tables 7 and 8 that, using any potassium rate (1.5, 3 and 4.5 g/pot) significantly increased total nitrogen, total phosphorus and potassium percentages as well as leaf green color degree of Arabia jasmine leaves compared to control (without potassium fertilization) in two tested seasons. The chemical constituents of plant leaves were increased with increasing K fertilizer rate in both seasons. Furthermore, the highest significant values in this regard were obtained when plants fertilized by the highest potassium rate (4.5 g/pot). In this ragard, **Solimandarabi *et al*. (2017)** pointed out that chlorophyll a of periwinkle (*Catharanthus roseus* Cv. 'Acillata') leaves was increased with chemical potassium fertilization.

Impact of lithovit concentration

The results illustrated in Tables 7 and 8 indicate that, the highest significant values of N, P and K percentages and leaf green color degree were achieved when Arabian jasmine plants were sprayed with lithovit at 1.5 gl^{-1} concentration six times per season. Increasing of lithovit concentration was concomitant with gradual increase in determined chemical constituents of plant leaves in the two tested seasons. In this connection, **Attia *et al*. (2016)** demonstrated that leaves total chlorophyll content as well as N, P and K contents of Egyptian cotton leaves were significantly increased with increasing nano-fertilizer (Lithovit) concentration. Also, **Abd El-baset (2018)** found that chemical constituents of N, P and K % and photosynthetic pigments (total chlorophyll) content of *Echinacea purpurea* significantly increased with application of lithovit at 2gl^{-1} compared to control. **Mohammed *et al*. (2021)** reported that using 4 gl^{-1} of lithovit significantly increased roselle and cluster bean plants total chlorophyll content of leaves compared to control.

Impact of combination between potassium fertilizer and lithovit

The results given in Tables 7 and 8 suggest that, the combination treatment between potassium fertilizer at 4.5 g/pot rate and lithovit at 1.5 gl^{-1} significantly increased

Table 7. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) on total nitrogen and total phosphorus percentages of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Total nitrogen percentage in leaves									
0.0	1.981	2.030	2.047	2.070	**2.032**	2.025	2.058	2.095	2.105	**2.071**
1.5	2.015	2.057	2.087	2.098	**2.064**	2.011	2.065	2.091	2.121	**2.072**
3.0	2.047	2.053	2.102	2.114	**2.079**	2.055	2.068	2.110	2.131	**2.091**
4.5	2.043	2.084	2.108	2.138	**2.093**	2.081	2.101	2.130	2.155	**2.117**
Mean (B)	**2.022**	**2.056**	**2.086**	**2.105**		**2.043**	**2.073**	**2.106**	**2.128**	
LSD at 5 %	**(A) =0.007**		**(B) =0.007**		**(A×B) =0.014**	**(A) =0.008**		**(B) =0.006**		**(A×B) =0.013**
	Total phosphorus percentage in leaves									
0.0	0.278	0.301	0.309	0.317	**0.301**	0.262	0.269	0.285	0.308	**0.281**
1.5	0.301	0.319	0.331	0.336	**0.322**	0.268	0.297	0.306	0.316	**0.297**
3.0	0.322	0.325	0.342	0.343	**0.333**	0.292	0.308	0.316	0.322	**0.310**
4.5	0.328	0.345	0.351	0.358	**0.346**	0.314	0.321	0.340	0.358	**0.333**
Mean (B)	**0.307**	**0.323**	**0.334**	**0.338**		**0.284**	**0.299**	**0.312**	**0.326**	
LSD at 5 %	**(A) =0.008**		**(B) =0.006**		**(A×B) =0.013**	**(A) =0.006**		**(B) =0.004**		**(A×B) =0.009**

Table 8. Impact of potassium fertilizer rate (A), lithovit concentration (B) and their interaction (A×B) on potassium percentage and total green color degree (SPAD) of *Jasminum sambac* plant during 2020 and 2021 seasons

Potassium fertilizer rate (g/pot)	Lithovit concentration (gl^{-1})									
	0.0	0.5	1.0	1.5	Mean (A)	0.0	0.5	1.0	1.5	Mean (A)
	First season					Second season				
	Potassium percentage in leaves									
0.0	1.829	1.872	1.926	1.952	**1.895**	1.833	1.860	1.866	1.890	**1.862**
1.5	1.852	1.899	1.932	1.946	**1.907**	1.830	1.876	1.890	1.900	**1.874**
3.0	1.876	1.916	1.939	1.962	**1.923**	1.856	1.903	1.920	1.936	**1.904**
4.5	1.909	1.936	1.956	1.992	**1.948**	1.870	1.906	1.936	1.966	**1.920**
Mean (B)	**1.867**	**1.906**	**1.938**	**1.963**		**1.847**	**1.886**	**1.903**	**1.923**	
LSD at 5 %	**(A)=0.011**		**(B)=0.007**		**(A×B) =0.016**	**(A) =0.006**		**(B)=0.006**		**(A×B) =0.012**
	Green color degree (SPAD)									
0.0	46.89	47.89	48.67	48.89	**48.08**	47.89	48.00	49.11	49.56	**48.64**
1.5	48.89	48.78	48.89	49.11	**48.67**	48.56	49.11	49.56	49.56	**49.20**
3.0	48.66	49.22	50.11	50.66	**49.67**	48.89	49.56	50.44	51.00	**49.97**
4.5	49.89	50.33	50.55	51.56	**50.58**	49.89	50.22	51.44	52.11	**50.52**
Mean (B)	**48.33**	**49.06**	**49.56**	**50.06**		**48.81**	**49.22**	**50.14**	**50.56**	
LSD at 5 %	**(A) = 0.29**		**(B) =0.31**		**(A×B) =0.61**	**(A) =0.34**		**(B) =0.27**		**(A×B) =0.58**

Arabian jasmine N, P and K percentages as well as leaf green color degree compared to control and the other ones under study in the two seasons. In addition, increasing lithovit rate up to 1.5gl^{-1} under each K fertilization rate significantly increased leaves chemical constituents of sambac jasmine. Moreover, as mentioned just before, both potassium fertilization and lithovit treatments (each alone) increased chemical constituents, in turn, they together might maximize their impacts leading to more N, P and K percentages and darker leaves green color. Likewise, **Helaly and Hegazy (2016)** indicated that the combined treatment of fertilization with potassium plus spraying with lithovit at the rate of 1.5 gl^{-1} gave the highest value for each of N, P and K percentage and total chlorophyll content of *Lavandula officinalis* plant.

Conclusion

From above mentioned results, it is preferable to fertilize Arabian jasmine (*Jasminum sambac* Ait.) plants with potassium at 4.5 g /pot as well as spraying with lithovit at 1.5 gl^{-1} six times per season to enhance the vegetative growth and flowering characters of this important ornamental and aromatic plant.

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الملخص العربي

تأثير السماد البوتاسي والليثوفيت على النمو والإزهار والمحتوي الكيميائي لنبات الفل صنف المجوز

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اجريت تجربة أصص خلال موسمي الصيف المتتاليين لأعوام 2020 و 2021 في مشتل الزينة بمحطة أبحاث القصاصين بمحافظة الإسماعيلية، مصر بهدف دراسة تأثير معدلات السماد البوتاسي (0.0 ، 1.5 ، 3.0 ، 4.5 جرام/أصيص في صورة كبريتات بوتاسيوم 48٪ K_2O)، تركيزات الليثوفيت (0.0 ، 0.5 ، 1.0 و 1.5 جم/لتر) والتداخل بينهما على النمو الخضري، التزهير و المكونات الكيميائية لنبات الفل المجوز. أظهرت النتائج المتحصل عليها أن أقصي طول للنباتات، عدد أفرع وأوراق النبات ووزن طازج أو جاف للنبات تم الحصول عليها عند تسميد النباتات بكبريتات البوتاسيوم بمعدل 4.5 جرام/أصيص مقارنة بالمعدلات الأخرى تحت الدراسة والكنترول. أيضا، ارتفعت قيم صفات النمو الخضري تدريجياً مع زيادة تركيز الليثوفيت لتصل إلى أعلى القيم عند معدل 1.5 جم / لتر. أدى استخدام أي معدل من السماد بوتاسي أو أى تركيز من الليثوفيت كل على حدة إلى زيادة معنوية في عدد الأزهار لكل نبات وقطر الزهرة وعدد البتلات لكل زهرة مقارنة بالكنترول. بشكل عام، سجلت نباتات الفل المجوز المسمدة بمعدل 4.5 جم/أصيص كبريتات البوتاسيوم والتي تم رشها بـ 1.5 جم/لتر ليثوفيت أعلى القيم لصفات النمو الخضري و التزهير و المكونات الكيميائية مقارنة بمعاملات التداخل الأخرى. لذلك، يمكن التوصية بهذه المعاملة لتطبيقها على نبات الفل المجوز تحت نفس الظروف.

الكلمات الإسترشادية: الفل الصنف المجوز، بوتاسيوم، الليثوفيت، نمو، التزهير، الكلوروفيل الكلي.

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