

Effect of different sources of potassium fertilizers on growth yield, and chemical composition of *Calendula Officinalis*

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ABSTRACT: A field experiments were carried out during the two successive seasons of 2007/2008 and 2008/2009, in Qualubia Governorate, Egypt, to study the effect of different sources of potassium fertilizer (banana residue and potassium sulphate) on yield, and chemical composition of herbs and flowers of *Calendula Officinalis*. It had been deduced that application of potassium fertilizer from different sources; potassium sulphate and banana residue were effective in increasing all tested growth yields compared with unfertilized treatment. Data also, showed that mixing potassium sulphate or/ and banana residue led to a marked increase in fresh and dry weight of herbs and flowers as compared with application of potassium sulphate or/ and banana residue solely in both seasons. Data also, showed that mixing potassium sulphate or/ and banana residue increased N and P and K content and uptake as compared with the control, potassium sulphate and banana residue alone.

[Yassen, A.A.; Habib, A. M.; Sahar, M. Zaghoul, and Khaled, S.M. Effect of different sources of potassium fertilizers on growth yield, and chemical composition of *Calendula Officinalis*. Journal of American Science 2010;6(12):1044-1048]. (ISSN: 1545-1003). <http://www.americanscience.org>.

Key words: *Calendula Officinalis* - potassium fertilizer - banana residue - growth – yield - NPK.

INTRODUCTION

Calendula Officinalis (Pot Marigold) is a plant in the genus *Calendula* (marigolds), in the family Asteraceae. It is probably native to southern Europe through its long history of cultivation makes its precise origin unknown, and may be of garden origin. It is also widely naturalized further north in Europe (north to southern England) and elsewhere in warm temperate regions of the world.

Calendula Officinalis is used for the treatment of skin disorders and pain, and as a bactericide, antiseptic and anti-inflammatory Fuchs *et al.*, and (2005) Bolderston *et al.*, (2006). The petals and pollen contain triterpenoid esters (an anti-inflammatory) and the carotenoids flavoxanthin and auroxanthin (antioxidants, and the source of the yellow-orange coloration) Hamburger *et al.*, (2003) and Bashir *et al.*, (2006).

Potassium is a 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 Krauss and Jin Jiyun (2000) Zhou *et al.*, (2006) and TAN De-shui (2007). Dutta *et al.*, (2001) Balliu and Ibro, (2002) and Ali and Mowafy (2003) and Gent, (2004) and Liu, *et al.*,

(2008) indicated that adding potassium fertilizer significantly increased number of branches and yield in crops.

Singh *et al.*, (2005 and 2007) and Munnu Singh and Ganesha Raoa (2009) found that application of N and K produced significant higher patchouli herbage and compared with controls. Similarly, N and K uptake were also higher compared with controls.

This field experiment was, therefore, conducted to investigate the influence of different sources of potassium fertilizer on yield and chemical composition of herbs and flowers of *Calendula Officinalis*.

MATERIALS AND METHODS

Two field experiments were carried out during two successive seasons of 2007/2008 and 2008/2009, in Qualubia Governorate, Egypt, to study the effect of potassium fertilizer on yield, and chemical composition of herbs and flowers of *Calendula Officinalis*.

Prior to any practices, a composite soil sample was taken from the soil surface (0-30 cm) of the experimental site, air dried, sieved by 2 mm sieve and analyzed (table 1). The physical and chemical

properties of soil were determined according to Chapman and Pratt (1961).

Table (1) some characteristics of the experimental site in two seasons

seasons	Physical properties				Chemical properties						
	Sand	Silt	Clay	Texture	pH	EC dSm ⁻¹	CaCO ₃ %	OM %	N	P	K
	%								(ppm)		
07/08	14.1	26.9	59.0	Clay	8.20	0.66	2.80	1.40	115	2.11	26.3
08/09	13.2	27.8	59.0	Clay	7.97	0.59	3.11	1.60	120	2.20	25.4

Potassium fertilizer at a rate of (50kg K/ fed) and two sources of potassium, one type of organic material (Banana residues) and the other inorganic potassium (potassium sulphate) were added. Application rate of organic matter used to depend on its content of potassium and the total required K (50 kg K/ fed), which added by organic material only and / or by complete the rest by K fertilizer as follows:

- Control (recommended doses)
- 50 kg K / fed (K₂SO₄)
- 10 kg K / fed (Banana residues) + 40 kg K / fed (K₂SO₄)
- 20 kg K / fed (Banana residues) + 30 kg K / fed (K₂SO₄)
- 30 kg K / fed (Banana residues) + 20 kg K / fed (K₂SO₄)
- 40 kg K / fed (Banana residues) + 10 kg K / fed (K₂SO₄)

- 50 kg K / fed (Banana residues)

From the above mentioned treatments that increasing K fertilizer associated with decreasing in the amount of organic material applications.

The seeds of *Calendula Officinalis* L. plants were kindly provided by the Department of Medicinal and Aromatic Plants, Ministry of Agriculture, Egypt.

Seeds were sown on October 1st during both seasons. The experimental design was complete randomized blocks with five replicates. The experimental area (plot) was 2m² (2m x 1m) containing 4 rows; and the distance between the hills was 25cm and 50 cm apart. Thinning for one plant/hill was done 45days after sowing. The irrigation was carried out whenever plants needed.

All agricultural operations other than experimental treatments were done according to the recommendations of Ministry of Agriculture; Egypt Chemical analysis of used organic fertilizer (Banana residues) is presented in table, 2.

Table (2): Chemical analysis of Banana residues used in this study.

Contents	pH 1:20)	EC dSm ⁻¹ 1:20)	OM %	O.C %	N %	P %	K %
Banana residues	8.72	3.38	76.16	44.18	1.34	0.59	5.92

Plant samples and analysis

Fresh and dry weights (g/plant) of herbs and flowers of *Calendula Officinalis* which dried at 70 °C. were recorded. The following chemical analyses were determined: nitrogen, phosphorus, and potassium according to the methods described by Cottenie *et al.*, (1982). Collected data was subjected to statistical analysis of variance according to Snedecor and Cochran (1980). Physical and chemical properties of the soil were determined according to Chapman and Pratt (1961)

RESULTS AND DISCUSSION

Effect of potassium fertilizer on vegetative growth:

It is quite clear from the data presented in table (3) that application of potassium fertilizer from different sources; inorganic (potassium sulphate) and organic (banana residue), affected herbs and flowers of *Calendula Officinalis*. Fresh and dry weights were significantly increased in first and second seasons when compared with the control Singh, *et al.*, 2007 and Munnu Singh, and Ganesha Raoa, 2009) found that potassium application increased growth parameters (fresh and dry plant weight) as compared with control (no K fertilizer).

Results mentioned above indicate that superiority of fresh and dry weight of herbs and flowers under K application might be due to the role of K in the enhancement and development of plant tissues through the synthesis of simple sugars and starch and also, the translocation of carbohydrates and protein synthesis.

Comparing application of potassium fertilizer, as potassium sulphate and as compost (banana residue), data showed that mixing potassium sulphate or/ and banana residue led to marked increase in fresh and dry weight of herbs and flowers as compared with application of potassium sulphate or/ and banana residue solely in both seasons (El- Ghadban 1989), investigating *Mentha viridis*, showed that K and

organic fertilizer were generally more effective in increasing fresh and dry weight of herb. The data of dry weight followed a nearly similar trend of fresh weight in herbs and flowers in both seasons.

The maximum recorded values were 14.9 and 13.2g / plant dry weight in flowers and 24.2 and 24.6g / plant in herbs in first and second seasons respectively. Similar trend noticed with fresh weight in herbs and flowers in both seasons.

From the data presented in table (3) clearly the high value of fresh and dry weight of herbs and flowers was obtained when K was added at a rate of 20kg K/ fed as potassium sulphate + 30kg K / fed as an organic source (banana compost) in both seasons.

Table (3) effect of potassium fertilizer on fresh and dry weight (g / plant) on herbs and flowers of *Calendula Officinalis*. (in both seasons)

Treatments		Flowers				Herbs			
		Fresh weight (g / plant)		Dry weight (g / plant)		Fresh weight (g / plant)		Dry weight (g / plant)	
Org.	Inorg.	1 st season	2 nd season	1 st season	2 nd season	1 st season	2 nd season	1 st season	2 nd season
Control		18.7	18.7	3.2	3.0	47.8	43.2	8.8	8.3
0	+ 50	30.5	31.3	8.8	8.0	68.1	68.5	16.4	16.5
10	+ 40	35.3	33.6	7.8	7.6	74.2	76.0	18.7	17.3
20	+ 30	56.3	54.7	14.9	13.2	90.7	90.4	24.2	24.6
30	+ 20	51.2	49.6	13.0	12.7	82.1	80.7	21.1	20.7
40	+ 10	30.1	30.3	6.9	7.3	70.3	72.5	13.7	15.1
50	+ 0	23.8	22.2	6.4	6.1	53.2	57.1	11.7	13.3
L.S.D	0.05								
		3.48	3.31	0.57	0.83	5.66	5.64	0.99	1.41

Org: banana residue Inorg : potassium sulphate

Chemical composition:

Data of nitrogen and phosphorus, content and uptake in the various sources of potassium fertilizers application treatments on herbs and flowers of *Calendula Officinalis* in the two successive seasons are presented in tables (4 and 5). Generally, the present results indicate that, nitrogen and phosphorus, content and uptake increased as compared with the control treatment. These results were on line with those reported by Liu *et al.*, (2008) and Munnu Singh and Ganesha Raoa (2009)

Data also, showed that application of potassium fertilizer in different sources inorganic (potassium sulphate) and organic material (banana residue)

increased N and P content and uptake as compared with potassium sulphate and banana residue alone. The highest values of N and P were recorded at 30 kg K / fed as an organic source (banana residue) + 20kg K/ fed as potassium sulphate application (2.00 and 2.12% N) and(0.41 and 0.44% P) in flowers and (1.54and 1.58% N) and (0.28 and 0.26% P) in herbs in the two successive seasons, respectively.

Concerning the effect of potassium application on potassium content and uptake it is evident to data that the previous mineral in all plant organs, in the tow growing seasons, were increased by using potassium, especially by using the mixture potassium sulphate with banana residue. Similar conclusion was also reported by Singh *et al.*, 2005 and 2007.

Table (4): effect of potassium fertilizer on N, P and K content (%) on herbs and flowers of *Calendula Officinalis*. (in both seasons)

treatments	N%				P%				K%				
	Flowers		Herbs		Flowers		Herbs		Flowers		Herbs		
	1 st season	2 nd season											
Org. Inorg.													
Control	0.97	0.95	0.67	0.70	0.18	0.20	0.11	0.09	1.10	1.07	1.45	1.53	
0 + 50	1.54	1.50	1.14	1.20	0.31	0.28	0.17	0.16	1.46	1.39	2.40	2.37	
10 + 40	1.78	1.80	1.35	1.30	0.33	0.35	0.21	0.20	1.55	1.50	2.53	2.46	
20 + 30	1.84	1.90	1.50	1.48	0.38	0.40	0.25	0.23	1.84	1.88	2.64	2.73	
30 + 20	2.00	2.10	1.54	1.58	0.41	0.44	0.28	0.26	1.93	1.88	2.89	2.94	
40 + 10	1.73	1.76	1.30	1.33	0.33	0.36	0.20	0.23	1.49	1.52	2.43	2.37	
50 + 0	1.49	1.50	1.20	1.27	0.35	0.31	0.18	0.20	1.35	1.40	2.38	2.31	
L.S.D 0.05													
	0.14	0.15	0.11	0.11	0.04	0.03	0.02	0.02	0.13	0.12	0.20	0.22	

Table (5): effect of potassium fertilizer on N,P and K uptake (%) on herbs and flowers of *Calendula Officinalis*.(in both season)

treatments	N%				P%				K%				
	Flowers		Herbs		Flowers		Herbs		Flowers		Herbs		
	1 st season	2 nd season											
Org. Inorg.													
Control	31.04	28.50	58.96	58.10	5.76	8.20	9.68	7.47	35.20	43.87	127.60	126.99	
0 + 50	135.52	120.00	186.96	198.00	27.28	22.40	27.88	26.40	128.48	111.20	393.60	391.05	
10 + 40	138.84	136.80	252.45	224.90	25.74	26.60	39.27	34.60	120.90	114.00	473.11	425.58	
20 + 30	274.16	250.80	363.00	364.08	56.62	52.80	60.50	56.58	274.16	248.16	638.88	671.58	
30 + 20	260.00	266.70	324.94	327.06	53.30	55.88	59.08	53.82	250.90	238.76	609.79	608.58	
40 + 10	119.37	128.48	178.10	200.83	22.77	26.28	27.40	34.73	102.81	110.96	332.91	357.87	
50 + 0	95.36	91.50	140.40	168.91	22.40	18.91	21.06	26.60	86.40	85.40	278.46	307.23	
L.S.D 0.05													
	18.98	19.26	24.98	23.64	3.88	4.03	4.47	3.95	11.85	16.81	45.82	43.46	

REFERENCE

1. Ali, A.A.G. and S.A.E. Mowafy (2003) Effect of different levels of potassium and phosphorus fertilizer with the foliar application of zinc and boron on peanut in sandy soil. *Zigzag J. Agric. Res.*, 30: 2: 335 – 358.
2. Balliu and V. Ibro, (2002), Influence of different levels of potassium fertilizers on growth, yield and ascorbic acid content of tomato fruit grown in non-heated greenhouse, *Acta Horticulturae*. 579 pp. 385 –388.
3. Bashir S, Janbaz KH, Jabeen Q (2006) Studies on spasmogenic and spasmolytic activities of *Calendula Officinalis* flowers. *Phytother Res*. 20:906-910.
4. Bolderston A, LLoyd NS, Wong RK et al. (2006). The prevention and management of acute skin reactions related to radiation therapy: a systematic review and practice guideline. *Support Care Cancer*. 14:802-817.
5. Chapman H.D., and Pratt P.F., (1961) *Methods of Analysis for Soils, Plant and Waters*. Univ. of California, Dept of Agric. Sci., USA: 5-6 and 56-58.
6. Cottenie A.M., Verloo L., Kiekens G Velghe and Camerlynck R.,(1982)*Chemical Analysis of Plant and Soil*. PP. 100 – 129. Laboratory of Analytical and Agrochemistry, State Univ. Ghent. Belgium.
7. Dutta, R;P.K. Gogoi, R. Lalramhluni,A.C. Thakur and N.C. Deka (2001) Effect of levels of lime and potash on production of groundnut . *Crop Res. Hisar*. 26:3:420 -423.

8. El- Ghadban, E.A.F. (1989)effect of some organic and in organic fertilizers on growth, oil yield and chemical composition of spearmint and majoram plants. Ph.D.Thesis, Fac., Agric., Cairo Univ. Egypt
9. Fuchs SM, Schliemann-Willers S, Fischer TW, (2005) Protective effects of different marigold (*Calendula Officinalis* L.) and rosemary cream preparations against sodium-lauryl-sulfate-induced irritant contact dermatitis. *Skin Pharmacol Physiol* 18(4):195-200.
10. Gent, M.P.N (2004) Yield of greenhouse tomato in response to supplemental nitrogen and potassium, *Acta Horticulturae*. 633 pp. 341–348.
11. Hamburger M, Adler S, Baumann D, (2003) Preparative purification of the major anti-inflammatory triterpenoid esters from Marigold (*Calendula Officinalis*). *Fitoterapia* 2003;74(4):328-338.
12. Krauss, A. and Jin Jiyun (2000) Strategies for improving balanced fertilization. International Potash Institute, Basel Switzerland.
13. Liu, Z. H., Jiang, L. H., Li, X. L., Härdter, R., Zhang, W. J., Zhang, Y. L. and Zheng, D. F. (2008) Effect of N and K fertilizers on yield and quality of greenhouse vegetable crops. *Pedosphere*. 18(4): 496–502
14. Munnu Singh, a, and R.S. Ganesha Raoa(2009) influence of sources and doses of N and K on herbage, oil yield and nutrient uptake of patchouli [*Pogostemon cablin* (Blanco) Benth.] in semi-arid tropics. *Industrial Crops and Products* 29, Issue 1- 229-234.
15. Singh, M. R.S. Ganesha Rao and S. Ramesh, (2005) Effects of nitrogen, phosphorous and potassium herbage, oil yield, oil quality and soil fertility status of lemongrass in a semi-arid tropical region of India, *J. Hortic. Sci. Biotechnol.* 80 pp. 493–497.
16. Singh, M. R.S. Ganesha Rao and S. Ramesh, (2007) Effects of N and K on growth, herbage, oil yield and nutrient uptake patterns of rosemary under semi-arid tropical conditions, *J. Hortic. Sci. Biotechnol.* 82 pp. 414–419
17. Snedecor, G.W. and W.G. Cochran., (1990) *Statistical Methods*. pp: 369-375. 11th Ed. Iowa State College Press. Ames, Iowa, U.S
18. TAN De-shui, JIN Ji-yun, a, HUANG Shao-wena, LI Shu-tiana and HE Pinga(2007) effect of long-term application of k fertilizer and wheat straw to soil on crop yield and soil k under different planting systems. *Agricultural Sciences in China* 6: 2:200-207
19. Zhou, TH. HP Zhang and L Liu, (2006) Studies on effect of potassium fertilizer applied on yield of Bt cotton, *Chin. Agric Sci Bull* 22 (8) 292–296.

10/27/2010