

EFFECT OF SOME SAFETY NATURAL AND BIO-FERTILIZERS ON THE GROWTH AND PRODUCTION OF CALENDULA PLANT

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ABSTRACT

Recently, the usage of eco-friendly fertilizers instead of the agrochemicals has gained great attention worldwide. In this study, the effects of phosphorus and potassium ore (0, 25, 50 and 100% of the recommended dose) were evaluated individually or in combination with phosphorin as biofertilizer to enhance the growth and flowering of *Calendula officinalis*. The results indicated that the treatment of P25% + K50% + phosphorin or P25%+ k100%+ phosphorin achieved the highest significant ($P \leq 0.05$) increases in plant height and the number of brunches and flowers compared to the control. Meanwhile, the flower diameter was not affected by different treatments. A similar trend was observed in both plant and flowers' fresh and dry weights. Chlorophyll was also significantly improved by the treatment of P25% + K50% + phosphorin or p25%+ K25%+ phosphorin in both seasons respectively. The biochemical attributes of the leaves and the produced flowers confirmed that total carbohydrates, carotenoids, N, P and K were positively responded to the eco-friendly fertilizers compared to the conventional fertilizers. The objective of this study was to evaluate the effect of natural and biofertilizers instead of mineral fertilizers. These procedures can be recommended due to its safe and eco-friendly influences on humans and environment.

Keywords: Pot marigold, *Calendula officinalis* L, NPK Fertilization, Flowering.

INTRODUCTION

Calendula officinalis L. belonging to the family Asteraceae, grows in a winter season. The name of this plant comes from calendus which means 'the first day of each month' because it takes a long time to flower. Moreover, since the flowers of this plant follow the sun, it is regarded as a sign of the sun (Kathi and Kemper,1999).

Calendula is grown as a medical drug in Germany, Australia, Czech, Austria, Switzerland, Hungary and recently in Egypt and Syria (Omidbaigi, 2005).

Calendula officinalis was grown as an ornamental plant for a long time until its medicinal effects were discovered and thus it began to be used as a medicinal plant. In Europe, the growth of this plant began in the 17th century. Its flowers that have no calyces and have been introduced as drugs in some pharmacopoeia and are used to cure stomach and intestine diseases (Stary, 1991).

Chrysanthemum is considered one of the most important medicinal plants because it contains effective medical substances that are used in many pharmaceuticals and has been used for the treatment of sores, tonsillitis, anti-inflammatory and many skin diseases (Safana, 2017).

In further detail, the active substances of the *Calendula officinalis* plant are made and stored in its yellow and orange flowers. The most important ones are flavonoids, carotenoids, volatile oils, and vitamin A. This plant is used to treat diseases of the stomach, intestines, and also the flowers extract is used to dye some types of foods and fats (Ehsan et al., 2012).

Organic fertilizers contain all the necessary elements for the growth and development of the plant, including rare elements, as well as their containment and its various sources of wide ranges of dissolved organic compounds in water, such as proteins, sugars, amino acids, humic and non-humeral acids. All these compounds contribute directly or indirectly to plant growth and its evolution (Taiz and Zeiger 2003). Therefore, safe sources of antiviral fertilizers and bio-fertilizers were used to know their effect on the growth and production of the calendula plant.

Calendula officinalis is used as a natural colorant in foods. It is also used in pharmaceutical and cosmetic products. In further detail, the active substances of the *Calendula officinalis* plant are made and stored in its yellow and orange flowers (Ehsan et al., 2012)

The use of organic fertilizers is very important method for providing plants with their nutritional requirements without having an undesirable impact on the environment by eliminating or reducing chemical input to achieve desirable and sustainable agriculture (Diacono and Montemurro, 2010).

The use of organic fertilizers in medicinal and aromatic plant production has several positive effects on production and quality (Snyman et al., 1998). Use of compost showed an improvement of soil physical and chemical properties in many basic characteristics, such as decreasing the pH of the soil and enhancement of nutrient status. Furthermore, organic fertilization has a positive effect on many vegetative growth parameters of Marigold (Shadanpour et al., 2011).

Conventional NPK chemical fertilization is relatively a fast way of providing plants with essential macro- and micro-nutrients. But excess usage has hazardous environmental effects like runoff, emissions which lead to pollution of aquatic ecosystems and salt accumulation in soil. Phosphorous does not dissolve in water and its overuse causes hardening of soil (Srinivasaro et al., 2021).

Adding inorganic NPK fertilizer replenishes nitrogen, potassium and phosphorus, but it depletes essential soil nutrients that are naturally present in fertile soils and leads to lower soil fertility. Therefore, to avoid environmental pollution, it is required to use the optimal amounts of NPK fertilizer needed by the crop and replace the inorganic fertilizers used with organic ones, if possible.

Mineral fertilization using nitrogen fertilization had a significant impact on number of plant parameters. Results showed that applications of N fertilizer caused in increasing yield of calendula, where that the nitrogen element play an important role as a primary constituent of building proteins, consequently N fertilizers can substantially increase plant yields (Olson and Swallow, 1984)

The economic and environmental sustainability of ornamental plants production can be improved by environmentally friendly organic substances, such as humic acid (HA).

The objective of this study was to evaluate the effect of natural and biofertilizers instead of mineral fertilizers. These procedures can be recommended due to its safe and eco- friendly influences on humans and environment.

MATERIALS AND METHODS

3.1. Plant Material

The seeds of the *Calendula* plant which used in the experiment were purchased from the Orman garden, (Ministry of Agriculture). These plants were known by Madame Therese Labib, a taxonomy consultant in the botanical gardens and the lawn of the Orman Garden. The phosphorus ore was also purchased from Al -Ahram Mining Company in Maadi – Cairo. Finally, the bio fertilized (phosphorin) was purchased from the Ministry of Agriculture, Dokki, Giza.

3.2. Location and Duration

Pots 'study was carried out in the garden of ELFERDOS, Cairo, Egypt; during two successive seasons of 2020-2021 and 2021-2022.

On the 10th of September in both seasons, seeds were sown in a pre-prepared growing medium of peat moss: vermiculite (2:1 by volume). Seedlings were transplanted in the beginning of November. plants were grown in agricultural foam trays (one seedling per pot) filled with clean washed sand, peat moss and vermiculite (2:1:1 by volume) ... The chemical content of sandy soil was shown in Table (1). Meanwhile, the peat moss and vermiculite were displayed in Table 2 & 3 respectively.

Table (1): Chemical analysis of sandy soil

Parameter	Value %
SiO ₂	43.5
Ti O ₂	0.6
Al ₂ O ₃	12.5
Fe ₂ O ₃	6.1
MnO	0.2
CaO	15.8

Na ₂ O	1.0
K ₂ O	1.9
P ₂ O ₅	0.1
MgO	3.0

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Table (2): Product specifications of peat moss

Porosity (vole-%)	90-98
Water volume (vole-%)	40-82
Air volume	16-60
Degree of decomposition(R-value)	Below 55
Degree of decomposition(H)	H2-H5
Organic matter (weight-% in dry matter)	>75
Ash content (weight-% in dry matter)	1-25
pH. Value CaCl ₂	2.5-3.5
pH. Value H ₂ O	3-4
Total nitrogen(N)	approx.1% weight (dry)

Peat moss was obtained from an imported source SAB Company, Germany.

Table (3): Chemical composition of vermiculite utilized.

Substances	Vermiculite composites (%)
SiO ₂	44
Al ₂ O ₃	7.9
F ₂ O ₃	8.5
CaO	3.44
MgO	30.35
Na ₂ O	1
K ₂ O	2.51
SO ₃	0.58
TiO ₂	0.75
P ₂ O ₅	0.09
TOTAL	99.12

Vermiculite was purchased from El Delta Company, Egypt.

Table (4) chemical analysis for potassium ore.

Item	(%) Percentage	
	From	To
SiO ₂	71.40	0.02
TiO ₂	0.02	0.02
Al ₂ O ₃	14.19	14.55
F ₂ O ₃	0.30	0.27
Mno	0.01	<0.01
MgO	<0.01	<0.01
CaO	0.30	<0.01
Na ₂ O	1.36	1.55
K ₂ O	10.11	12.05
P ₂ O ₅	0.09	<0.01
L.O.I	0.83	0.s0
TOTAL	99.4t %	99.90%

Feldspar was purchased from Al Ahram Mining Company, Egypt

Table (5) Chemical analysis for Phosphate Ore

Item	(%) Percentage	
	From	To
SiO ₂	14.50	14.73
TiO ₂	0.08	0.03
Al ₂ O ₃	1.15	0.59
F ₂ O ₃	1.35	1.74
MnO	0.05	o.t4
MgO	2.78	1.39
CaO	43.15	43.50
Na ₂ O	0.35	0.28
K ₂ O	0.18	0.05
P ₂ O ₅	18.20	22.51
L.O.I	15.38	12.66
F	1.09	1.o4
TOTAL	99.16 %	99.91%

Phosphate was purchased from Al Ahram Mining Company, Egypt

Table (6) Fertilizers Requirements For *calendula officinalis* & Aromatic plants (old&New Lands),2015.

Land	New Land			Old Land		
Crop	N	P	K	N	P	K
Klandiola	62	52	41	41	37.5	36

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3.4. Experimental Fertilizer Treatments

Two fertilizer treatments were made up applied as follows:

- 1- Phosphorous treatment included 3 different concentrations of potassium ore. with and without bio fertilizer.
- 2- Control (as standard fertilizers).

Detailed instructions on how to add the fertilizer treatments include:

- a- Phosphorous ore:3concentration of phosphorous ore were added to the soil, and each treatment was 5 replicates 25% - 50%- 100%
- b- Phosphorous with Potassium: A proportion of phosphorous ore was mixed with 3 different concentrations of potassium ore, and each treatment had 5 replicates.25% 50% 100%.
- c- A biological fertilizer is added to the three treatments, which is phosphorin as a biological fertilizer for phosphorus and potassium mag, as a biological fertilizer for potassium, and each treatment has 5 replicates.
- d- Control (as standard fertilizers).

3.5. Results and data recorded:

a- Above-ground vegetative parameters:

- 1- Plant height (cm)
- 2- Branch number/ plant
- 3- Number of flowers/ plants
- 4-Flower diameter (cm)

5- Flowers fresh weight/plant (g/plant)

6-Flowers dry weight/plant (g/plant)

7-plant fresh weight/plant (g/plant)

8-plant dry weight/plant (g/plant)

The vegetative parameters and morphological characteristics were recorded when the vegetative growth of the plant was completed starting from the 1st of April till the end of the month, except for flower fresh and dry weights, which were assessed in the middle of May. The analyses were conducted in the central laboratories of Cairo University and the research laboratories of the Faculty of Agriculture, Cairo University.

b. Chemical analysis.

1- Determination of N, P and K elements:

Nitrogen content (N) was determined by the modified micro-Kjeldahl method as described by FAO (1980). As for phosphorus (P) it was estimated as the technique recommended by Chapman and Parker (1961). Potassium (K) was determined using a flame-photometer (Jenway SN: 20158051101 Japan) according to the procedure prescribed by Brown and Lilleland (1946).

2- Chlorophyll and total carotenoids

Chlorophyll a in addition to total carotenoids contents were all determined calorimetrically in fresh leaf samples (mg/g fresh matter) according to the routine of Saric et al. (1967).

3-Total carbohydrates:

Total carbohydrate was estimated in the above-ground herb according to the method established by Chaplin and Kennedy (1994).

4. Experimental Design and Statistical Analysis

Treatments based on the complete randomized design (CRD) and were subjected to Duncan's Multiple Range with four replicates for each treatment. Each block contained the two fertilizer treatments that were allocated randomly. Each replicate contained five pots, each pot containing one plant.

The experiment was designed from three concentrations of phosphorous ore, 25%, 50%, 100% of the recommended quantities for fertilization by replacing fertilization with natural and vital fertilizers instead of chemical fertilizers, and each treatment is five pots, in addition to control (as standard fertilizers). The above method tests were applied for the comparison between means according to Waller and Duncan (1969).

RESULTS AND DISCUSSION

1- Plant height (cm)

Results in table (7) indicate that fertilization of phosphate ore potassium ore showed significant effect on plant height compared to the control. The highest significant results (69.40, 64.60) were obtained by the treatment of P25 % + K50% with bio in both seasons respectively. However, the control without bio showed the lowest values in both seasons respectively. These findings are in harmony with those obtained by Sharma (1973), Hussein et al. (2011) and Sakr (2017).

2- Branch number / plant:

The data presented in table (7) showed that use of P25%+K50% with bio gave the highest significant number of branches (6.00, 5.60) in 1st and 2nd season respectively, while the treatment P25% + K25%+without bio at 1st season gave the lowest number of branders (3.8) and so nearly like control (4.00-4.60) in both seasons respectively. These results are in agreement with Shadanpour et al. (2011) and Azzaz et al. (2007).

3- Number of flowers / plants:

Results in table (7) revealed that fertilization of natural and bio fertilizers showed significant effect on the amount of flowers/ plant. The highest number of flowers was showed by the treatment of P25 % + k 50 % with bio (54.00 and 58.00) in both seasons respectively. These results are similar to those reported by Beata (2012) and El-Gamal (2015). Conversely, the lowest number of Flower was showed without bio and with bio 41.40 and 42.000 respectively in both seasons. These results also are in agreement with those reported by Arab et al. (2015).

Table (7): Effect of some safety natural fertilizers with and without Bio-fertilizer on the plant height, branch number, flower number and flower diameter of *Calendula officinalis* in the two seasons 2020-2021 and 2021-2022.

Values within the same column followed by the same letters are not significantly different, using Duncan's Multiple Range Test at 5% level.

4- Flowers diameter (cm):

Results in table (7) show that P25 % + K100% + with bio clearly indicate significant increase in flower diameter (4.62) in 1st Season, while; using P25%+k50% +with bio gave a similar trend in the 2nd season (4.78) compared to the other treatments. On the other hand, the lowest diameter of flower was explored in the control treatment without bio for 1st and 2nd season respectively. These results are in consent with Leite et al. (2005), Valadares et al. (2010) and Shadanpour et al. (2011).

5- Flowers Fresh weight (g/ plant)

As shown in table (8) the use of, P25% + K100% + with bio gave the highest fresh weight of flowers (54.40) and (46-20) in both seasons respectively Compared to the control without and with bio (36.00) and (34.40) respectively, and these results are in agreement with those of Mukesh *et al.* (2007) and Khalid *et al.* (2006).

Treatments	Plant height(cm)		Branch number		Flower number		Flower diameter	
	2020-2021	2021-2022	2020-2021	2021-2022	2020-2021	2021-2022	2021	2022
p25 %+ k25% without	59.0 C	60.00B	5.00A	4.80A	52.2 D	50.60D	4.01	4.10
p25%+ k25%+with	67.40AB	68.2 A	3.80D	5.00ABC	56.80BC	55.20BC	4.51	4.72
P25% + K50% without	64.20B	54.80C	5.00B	4.80BCD	55.20C	49.00D	4.04	4.20
P25% + K50%+ with	69.40A	64.60A	6.00A	5.60A	59.20AB	60.60A	4.38	4.78
P25%+ k100% without	60.40C	57.00BC	4.80BC	4.40CD	56.00C	52.60CD	4.07	3.97
P25%+ k100%+ with	68.80A	65.60A	5.40AB	5.40CD	60.40A	58.40AB	4.62	4.44
Control without	43.00D	44.00D	4.00CD	4.60CD	41.40E	44.60E	3.30	3.51
Control with	45.60D	44.00D	4.00CD	4.20D	43.0E	42.00E	3.23	3.71
Means	59.73	57.28	4.75	4.85	53.02	51.63	4.01	4.18

6- Flowers dry weight (g/plant)

Results presented in Table (8) clearly indicated that the use of P 25% + K 100% + with bio and P25% +50% + with bio show the highest dry weight of flowers (26.80) and (25-20) for 1st and 2nd compared to the control (15.40) and (16.20) in

both seasons respectively. These results are in harmony with those reported By Ganjali et al. (2010) and Mili & Sable (2003).

Treatments	Flowers fresh weight (g/plant)		Flowers dry weight (g/plant)		Plant fresh weight (g/plant)		Plant dry weight (g/plant)		Chlorophyll (gm)	
	2020-2021	2021-2022	2020-2021	2021-2022	2020-2021	2021-2022	2020-2021	2021-2022	2020-2021	2021-2022
p25 %+ k25% without	44.80 D	38.20 D	24.20 C	17.40 D	335.40 B	339.0 0 B	147.6 0 A	146.4 0 CD	46.40 BC	44.74 C
p25%+ k25%+with	49.80 C	46.40 B	24.80 BC	23.20 B	357.60 AB	349.4 0 B	125.6 0 CD	156.4 0 AB	48.14 AB	49.48 A
P25% + K50% without	50.60 C	42.00 C	23.00 C	20.80 C	336.40 B	338.8 0 B	143.2 0 AB	150.4 0 DC	46.34 BC	45.30 BC
P25% + K50%+ with	52.80 AB	53.20 A	26.20 AB	25.20 A	357.60 AB	352.0 0 B	133.4 0 C	154.6 0 ABC	48.50 A	46.70 B
P25%+k100 % without	51.80 ABC	45.60 B	23.60 C	22.20 BC	348.40 B	341.6 0 B	135.2 0 BC	142.2 0 DE	45.80 C	45.64 BC
P25%+ k100%+ with	54.40 A	46.20 B	26.80 A	23.00 B	378.80 A	370.4 0 A	148.0 0 A	159.8 0 A	48.44 AB	45.68 BC
Control without	36.00 E	37.40 DE	16.20 D	17.40 D	262.60 D	270.4 0 C	121.6 0 D	128.0 0 F	41.20 D	41.60 D
Control with	36.20 E	34.40 E	15.40 D	16.20 D	289.40 C	265.0 0 C	131.4 0 C	136.4 0 E	41.00 D	41.48 D
Means	47.05	42.93	22.52	20.68	335.40	328.3 3	147.6 0	146.7 8	46.40	45.08

Table (8): Effect of some safety Natural fertilizers with and without Bio fertilizer ratios on *Calendula officinalis* on Flowers fresh weight (g/plant) Flowers dry, weight, plant fresh weight and plant dry weight (g/plant) Chlorophyll (gm) in two Seasons 2020-2021 and 2021 – 2022

Values within the same column followed by the same letters are not significantly different, using Duncan's Multiple Range Test at 5% level.

7- Plant weight (gm)

Data in Table (8) show that the treatment of P25%+K 100% + with bio gave the highest value of fresh and dry weight for 1st (378.8, 148) and 2nd (370.4, 159.8) seasons respectively; while the lowest value in the same order with control without bio recorded 121.6 and 128.00 for the 1st and 2nd season respectively. These results are in agreement with the previous studies of Khalid et al. (2007) and Khalid (2014).

8- Total chlorophyll:

Data in table (8) show that the treatment of P25% +K50% + with bio gave the highest value of chlorophyll in 1st season (48.50) while the use of P25% + K25% + with bio in 2nd season gave the highest value. (49,48) comparing to the control without bio in 1st and 2nd season respectively, these results are in agreement with these finding and reported by El-hindi et al. (2009) and in the same trend with results recorded by El-Sayed et al. (2009) and Ali (2001).

9- Total carbohydrates in plant (mg/g):

Results in table (9) indicated that the highest values (29.3 and 28.5) of total carbohydrates were obtained by the treatment of P25% + K100% with bio for both seasons respectively. Meanwhile, the lowest total carbohydrates were showed in the control plants without bio (16.7and 17.0) in 1st and 2nd season respectively, while those data are in consent with these reported by Abd El-Fatah et al. (2019), and Hashem (2016).

10- Total Carotenoids:

Data in table (9) revealed that the highest value of carotenoids in flowers are by treatment (P25% + K 100% + with bio) are (11.0.and 11.4) for 1st and 2nd seasons respectively, while the lowest value with (P25%+ K25%) without bio are

(5.88 and 5.16) for 1st and 2nd season respectively compared to control without bio (6-8 and 6.4) in both seasons respectively. These results are in agreement with those reported by Abd El-Fatah *et al.* (2019) and Abou-Sreya *et al.* (2017).

Table (9): Effect of some safety Natural and Bio fertilizer ratios on content total carbohydrates in plant and carotenoids in flowers in two season 2020-2021 and 2021-2022

Treatment	Total Carbohydrates (mg/g dw)				Total Carotenoids (mg/g dw)			
	2020	2021	2021	2022	2020	2021	2021	2022
1	p25%+k25%+without	26.9	27.5	27.5	5.88	5.16	5.16	5.16
2	p25%+k25%+with	35.7	36	36	7.7	8.57	8.57	8.57
3	p25%+k50%+without	24.1	24.4	24.4	7.15	6.23	6.23	6.23
4	p25%+k50%+with	30.9	31.7	31.7	8.2	9.81	9.81	9.81
5	p25%+k100%+without	25.3	25.9	25.9	9.9	7.26	7.26	7.26
6	p25%+k100%+with	29.3	28.5	28.5	11	11.14	11.14	11.14
7	Control+without	16.7	17	17	6.8	6.4	6.4	6.4
8	Control+with	18.7	20.03	20.03	7.1	7.79	7.79	7.79

11- Nitrogen%:

The data displayed in Table (10) clearly indicate that the use of P25% + K25% with and without treatment gave the highest percentage of nitrogen in flowers for 1st and 2nd seasons. However, the same trend was observed in the leaves in by the treatment of P25 % +K 25% with bio. As well as the treatment of P25%+ K50% without bio gave the lowest N% in flowers (2-1 and 2-24) in both seasons respectively. These results are in harmony with the study recorded by. Khalid *et al.* (2007) and EL-Hindi *et al.* (2009).

12- Phosphorous %

Data in Table (10) show that the treatments of P25% +K 100% with and without bio gave the highest P%. in flowers (0.19 and 0.18) in 1st and 2nd Seasons respectively, compared to the lowest value of P% in (P25% + K25% without bio) are (0.15. and 0.16) in both seasons respectively, whereas in leaves the treatment (P25% +K 100% with bio) show the highest P%. in 1st season (0.19) and the same value presented in 2nd season by treatment. (P25%+ K25% with bio). Compared to the lowest P% in leaves (0,15) with Control without bio for both seasons. These results are in agreement with that recorded by Naguib (2011) and Abou-Sreea and Yassein (2016).

13- Potassium%

The data in table (10) indicated that the use of P25%. + K25% with biotreatment gave the highest K% in Flowers (0.97) for 1st season but in 2nd season. While the lowest values with P25%+ K25% without bio were 0.53 and 0.64 in both seasons respectively compared to Control .

Data show that in leaves the highest K% with (P25%+K100 with bio) (0.82.and 0.91) in both seasons respectively and lowest K% by (P25%+ K25% without bio) (0.66 and 0.60) respectively. These results were in harmony with those reported by Hussein et al. (2011).

Table (10): Effect of natural fertilization with and without bio fertilizer ratios on nitrogen, phosphorus, and potassium as percentages in Flowers and Leaves of *Calendula officinalis* plants during two seasons 2020-2021 and 2021-2022.

Treatments	N (Flowers) %		N (Leaves) %		P(Flowers) %		P(Leaves) %		K(Flowers) %		K(Leaves) %	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Out p25%+ k25% with	2.52	2.94	1.86	2.8	0.15	.016	0.17	0.17	0.53	0.64	0.66	0.60
p25%+ k25% with	2.94	2.38	3.08	3.08	0.20	0.16	0.22	0.19	0.97	0.84	0.74	0.81
P25% + K50% without	2.1	2.24	1.65	1.96	0.17	0.17	0.18	0.17	0.62	0.77	0.71	0.73
P25% + K50% with	2.80	2.66	2.94	3.08	3.08	0.17	0.20	0.20	0.92	0.92	0.82	0.88
P25%+ k100% without	2.38	2.66	2.5	2.8	0.17	0.18	0.18	0.18	0.70	0.75	0.76	0.80
P25%+ k100% with	2.66	2.66	3.08	2.94	0.19	0.15	0.19	0.17	0.92	0.95	0.82	0.91
Control without	2.22	2.25	2.1	2.1	0.16	0.16	0.15	0.15	0.80	0.82	0.69	0.71
Control with	2.55	2.52	2.60	2.94	0.16	0.17	0.18	0.18	0.86	0.88	0.73	0.75

CONCLUSIONS

The aim of this study is to determine the potential effectiveness of natural fertilizers (phosphorous ore, potassium ore, with and without bio-fertilizers) to reduce the use of mineral fertilizers, and to evaluate the effect of these treatments on growth, development, yield and flowering. Application of (p25% + K 100%) with bio-fertilizer, as well as (p25% + k50%) with bio-fertilizer yielded the best results. It can be concluded that the use of natural fertilizers with bio-fertilizers not

only leads to the reduction of minerals in the fertilizer but also improves the natural condition and parameters of the flowers. This study opens the way for further study to evaluate the medicinal components and natural pigments of the calendula plant.

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تأثير بعض الأسمدة الطبيعية والحيوية الأمانة على نمو وإنتاجية نبات الأقحوان

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المستخلص

يعتبر نبات الأقحوان *calendula officinalis* والذي يتبع العائلة المركبة *Asteraceae* من نباتات الزينة الهامة والتي لها استخدامات طبية وغذائية متميزة. لذا أجريت هذه التجارب البحثية لدراسة تأثير استخدام مصادر من الأسمدة الطبيعية مع أو بدون تسميد حيوي في أصص وذلك بحديقة الفردوس التابعة لحدائق محافظة القاهرة. وتمت التجربة في أصص تم ملؤها بالرمل مع البيت موس والفرميوكولايت لموسمين متتاليين 2020-2021، 2021-2022. حيث استخدمت 6 معاملات سمادية لمصدر فوسفور... طبيعي "خام" تم الحصول عليه من شركة الأهرام للأسمدة الطبيعية بالقاهرة. تلخصت المعاملات في استخدام الفسفور الخام بنسبة 25% مع ثلاث تركيزات من البوتاسيوم الخام (25%، 50%، 100%) مع أو بدون التسميد الحيوي. وقد أكدت النتائج أن المعاملة (تسميد حيوي + 100%K + 25%P) أعطت أفضل النتائج خلال الموسمين سواء القياسات الخضرية أو الكيميائية والمحصولية.. هذا وأشادت نتائج المعاملة (مع التسميد الحيوي 50%K + 25%P) الي نتائج متميزة عن الكنترول (المقارنة). مما يوضح أنه يمكن استخدام الأسمدة الخام الأمانة مع التسميد الحيوي لتعطي نتائج أفضل عن استخدام الأسمدة المعدنية "الكنترول" بالتركيزات الموصى بها.

الكلمات المفتاحية: (نبات الأقحوان *calendula officinalis* -سماد NPK - التزهير)