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INFLUENCE OF PHOSPHORUS, POTASSIUM AND YEAST NUTRITION ON GROWTH, FLOWERING AND CHEMICAL COMPOSITION OF TUBEROSE.

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ABSTRACT

Two field experiments were carried out at the Vegetable and Ornamental Plants Dept., Faculty of Agriculture, Mansoura Univ., Egypt, during the two successive seasons of 2008/2009 and 2009/2010 to study the influence of calcium superphosphate at 1.05 and 2.10 g / plant, potassium sulphate at 0.70 and1.40 g / plant, and yeast extract at 1, 2 and 3 g/L as foliar sprays once monthly for three months on growth, flowering and chemical composition of tuberose plant.

Yeast extract at 3 g / L was very effective in stimulating vegetative growth and flower as well as mineral content, the use of calcium superphosphate at 1.05 g / plant has led to increase the leaf area, dry weight of leaves, and increase the length and number of flowers. While, the use of concentration 2.10 g / plant led to the shortest period from planting to flowering and harvest in both seasons. The use of potassium sulfate at 0.70 g / plant has led to increase dry weight of leaves and decreased period from planting to flowering and harvest. Besides, the length of spike and the number of flowers / spike and total chlorophyll in the leaves were increased. While, the use of concentration 1.40 g / plant has led to increase the mineral content in the leaves.

Application of yeast extract at 3g/L combined with calcium superphosphate at 2.10g, potassium sulphate at 1.40g in addition to yeast extract at 3g/L, calcium superphosphate 2.10g and potassium sulphate 0.70 g induced higher values concerning (leaf area and dry weight) over all the other treatments. Moreover, least number of days until harvesting was achieved. Flower quality had higher values and flower number were increased. In addition photosynthetic pigments studied (chlorophyll a+b) when compared with other treatments.

Thus, it could be concluded that spraying tuberose plants with yeast extract (3g/L), calcium superphosphate (1.05g) and potassium sulphate (0.70g / plant) once monthly for three months induced the best vegetative growth and flower quality and economically save about half doses of phosphorus and potassium fertilizer.

Yeast nutrition is considered as a potent, safety and costless natural stimulator.

INTRODUCTION

Polianthes tuberosa L. (Tuberose), Fam:Agavaceae (Amaryllidaceae) is one of the most important flowering bulbs(corm in fact). It is a perennial herb native to Mexico with usually elongate bulb like bases, grass like leaves to 45 cm tall, 1.25 cm. wide, stem leaves clasping and successively smaller. Inflorescence is a terminal raceme or spike, flowers waxy-white, very fragrant, 6.5 cm. long, mostly in pairs. A double-flowered form is most frequently grown (Hogan, 1991).

It is worthy to mention that, obtaining tuberose flowers with height quality needs several agricultural treatments. In this respect soil media, chemical fertilization, irrigation and shading may be factors affecting plant behaviour through increasing the vegetative growth.

Phosphorus is considered as second nutrient element in both plants and microorganisms. The finely tuned homeostasis of phosphorus on chloroplasts is reason for a higher various enzymes activity of carbohydrate metabolism (Rao *et al.,* 1990). The promotive effect of P-fertilizer on growth of plants may be due to the phosphate, which regulates enzymatic processes, the phosphorylation of adenosine diphosphate (ADP)to adenosine triphosphate (ATP). Also, phosphate acts as an activator for some enzymes, leading to enhancement of the metabolism processes and formation of new cells (Dhillon, 1978).

Potassium have several functions such as respiration and transpiration, synthesis of protein and fats, cell division, besides potassium regulates the activities of many enzymes and ferment and also exerts a favorable effect on root development.

Human health has received a great attention nowadays. It was documented that chemical fertilizers have a pollutant effect on the soil and plant, and in turn, on the human health. Recently, great attention has focused on the possibility of natural and safety substitution, i.e., yeast in order to improve plant growth, flowering, fruit setting and total yield of horticultural plant. Yeast as a natural bio-stimulant appeared to induce astonishment influence on growth and yield of many crops (Martinez-Anoya *et al.,* 1990)

The importance of yeast in some physiological properties may be due to that it contains after the composition a wide group of amino acids, and vitamins. In addition, yeast is a natural source of many growth substances as a protective agent, and most of nutritional elements (Na, Ca, Fe, K, P, S, Mg, Zn and Si) and contained cytokinin as well as some organic compounds (Nagodawithana, 1991). It was also investigated for improving growth and flowering of some crops (Fathy and Farid, 1996 and 2000; Ahmed, 1998; El-Mogy *et al.,* 1998; and Fathy *et al.,*2000).

The aim of this study was to study the effect of phosphorus, potassium and yeast nutrition on growth, flowering and chemical constituents of tuberose.

MATERIALS AND METHODS

The present study was conducted during the two successive seasons of 2008/2009 and 2009/2010 in the Experimental Station and Laboratory of the Vegetable and Ornamental Plants Dept., Faculty of Agriculture, Mansoura Univ., Egypt, to study the influence of phosphorus, potassium and yeast extract on growth, flowering, bulb production and chemical constituents of tuberose.

The bulbs of *Polianthes tuberosa* L. cv. Double, were obtained from a well known commercial orchard at El-Kanater El-Khyrea.The diameter of the bulb ranged between 1.87- 2.72 cm with an average of 2.30 cm and the circumference of the bulb ranged between 5.87 and 8.54 cm with an average of 7.21cm.

On May first in the two seasons the bulbs were dipped for 15 minutes in rizolex solution at the rate of 3 g / 1 liter of tap water to control possible fungal infections. The bulbs of *Polianthes tuberosa* were planted in polyethylene bags perforated (25x30 cm.) filled with 7kg a mixture of sand

and clay at 1:2. Samples of the experimented soil were examined for chemical and physical analysis. Relevant data of the soil analysis are presented in Table (1). Ammonium sulphate (20% N) was applied as base dressings (300 kg/feddan) correspond to 2.10 g ammonium sulphate / plant for all plants of the experiment.

Table (1): Chemical and physical analysis of the soil used in the experiment.

Mechanical analysis		Chemical analysis		Soluble cations and anions	
Coarse sand (%)	1.96	Available N (ppm)	42	**Cations (meq/100 g soil)**	
Fine sand (%)	29.33	Available P (ppm)	6.3	Ca++	1.83
Silt (%)	37.03	Available K (ppm)	330	Mg++	1.27
Clay (%)	31.68	Organic matter (%)	2.13	Na+	0.97
Texture	Clay loamy	E.C.* %	0.26	K+	0.08
		pH**	8.14	**Anions (meq/100 g soil)**	
		CaCO3	1.95	CO3=	0.00
				HCO3-	2.53
				SO4=	0.74
				Cl-	0.88

*** 1 : 5 soil : water extraction**
**** 1:2.5 soil suspension**

Factors experimented were as followed:-

A-Phosphorus fertilizer:-

Calcium superphosphate (16% P_2O_5) was added at a half of the recommended dose (150 kg/feddan) and at the recommended dose (300 kg/feddan). This was corresponding to 1.05 and 2.10g/plant calcium super phosphate/ plant, respectively.

B-Potassium fertilizer:-

Potassium fertilizer was used as potassium sulphate (48% K2O) at a half of the recommended dose (100 kg/feddan) and at the recommended dose (200 kg/feddan). This was corresponding to 0.70 and 1.40 g/plant potassium sulphate/ plant, respectively.

In both seasons fertilizing application began after one month from planting date. One third from the fertilizers dose examined was added once monthly at the beginning of the second, third and fourth months.

C- Yeast extract:-

Baker's yeast was mixed with sugar at a ratio of 1:1 and left for 3 hours at room temperature (25± 1Ċ).Then it was frozen for disruption of yeast tissue and releasing its content. Preparation of yeast solution was done according to EL-Ghamriny *et al.* (1999).Data of yeast extract analysis for different bio-constituents are shown in Table (2).

The plants were treated with three doses of active dry yeast (1, 2 and 3 g/L).Foliar sprays of these doses were done after 30, 60 and 90 days from planting.

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The experimental design and treatment:-

Treatments were twelve fertilization treatments. Each treatment was replicated three times (6plants/replicate).

1. Yeast (1g/L) + P (1.05 g / plant) + K (0.70 g / plant).
2. Yeast (1g/L) + P (1.05 g / plant) + K (1.40 g / plant).
3. Yeast (1g/L) + P (2.10 g / plant) + K (0.70 g / plant).
4. Yeast (1g/L) + P (2.10 g / plant) + K (1.40 g / plant).
5. Yeast (2g/L) + P (1.05 g / plant) + K (0.70 g / plant).
6. Yeast (2g/L) + P (1.05 g / plant) + K (1.40 g / plant).
7. Yeast (2g/L) + P (2.10 g / plant) + K (0.70 g / plant).
8. Yeast (2g/L) + P (2.10 g / plant) + K (1.40 g / plant).
9. Yeast (3g/L) + P (1.05 g / plant) + K (0.70 g / plant).
10. Yeast (3g/L) + P (1.05 g/ plant) + K (1.40 g / plant).
11. Yeast (3g/L) + P (2.10 g / plant) + K (0.70 g / plant).
12. Yeast (3g/L) + P (2.10 g / plant) + K (1.40 g / plant).

All treatments received 2.10 g ammonium sulphate / plant.

Data recorded:

Vegetative growth:

- Leaf area (cm2). according to Stickler (1964)
- Leaf dry weight (g).

Flowering stage:

- Number of days from planting until flowering (emergence of flower spikes).
- Number of days from planting until harvesting (anthesis of four basal florets on the spike)
- Spike length (cm).
- Number of florets/spike.

Chemical determinations:

1-pigments content (mg / g FW):

Chlorophyll (a+b) was determined in leaf samples (mg / g fresh matter) according to Mackinney (1941).

2-Nutrient elements determination:

- **Nitrogen %:**

Was determined in leaf dry samples by modified Micro Kjeldahl method as described by Pregl (1945).

- **Phosphorus %:**

Was determined in leaf dry samples according to Jackson (1967).

- **Potassium %:**

Was determined in leaf dry samples according to Black (1965).

Statistical analysis:

The experimental design was a factorial experiment in randomize complete block design according to Steel and Torrie (1980). The treatment means were compared using the least significant difference (LSD) test at the 0.05 level, as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of yeast extract, phosphorus and potassium and there interaction on vegetative growth of Polianthes tuberosa L.plants:

1. Leaf area (cm2):

Data in Table (3) showed that treating plants with 3g/L yeast extract significantly increased leaf area (cm^2) values in both seasons than the two relatively lower used doses of yeast extract.

Data presented in Table (3) revealed that using 2.10g/plant of phosphorus nutrition resulted widest leaf area (cm^2) in both seasons than 1.05 g/plant nutrition without significant difference.

Data in Table (3) revealed that using 0.70g/plant of potassium nutrition resulted widest leaf area (cm^2) in the first season than 1.40 g/plant potassium without significant difference. But in the second season those treated with1.40 g/plant potassium resulted widest leaf area (cm^2) than 0.70g /plant without significant difference.

Data in Table (3) revealed that plants treated with yeast at 3g/L, calcium superphosphate 2.10 g / plant and potassium sulphate 1.40 g or 0.70g / plant, significantly resulted the highest values of leaf area (cm^2) in the first season, as it were (51.30 and 49.30) respectively and no significant difference was observed between them. There were no significant differences between them and those plants treated with yeast at 3g/L, half of the recommended dose of calcium superphosphate with potassium sulphate, yeast at 2g/L, the recommended dose of calcium superphosphate with potassium sulphate 0.70g / plant as it were (46.50, 43.80 and 41. 70) respectively.

Data in the second season, clearly indicated that it is nearly followed the same trend in the first season.

Table (3): Effect of yeast extract, phosphorus, potassium and their interactions on leaf area (cm^2) of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Leaf area (cm^2)									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)
1	1.05	36.00	35.00	35.20	39.10	50.90	54.40	53.20	58.00
	2.10	35.20	34.70			51.80	55.70		
2	1.05	36.80	36.80	37.60		56.40	59.00	59.00	
	2.10	41.70	35.20		41.20	60.00	60.40		61.70
3	1.05	43.80	46.50	47.70		62.70	64.70	67.30	
	2.10	49.30	51.30			70.90	71.10		
Mean of (K)		40.50	39.90			58.80	60.90		
LSD 5%		Y 7.27	P 14.65	K 4.27	YPK 12.62	Y 3.29	P 9.90	K 15.94	YPK 15.84

2. Leaf dry weight (g):

In this concern data in Table (4) showed that plants with 2 and 3g/L yeast extract significantly increased leaf dry weight (g) values in the first season than 1g/L yeast extract, but in the second season there were no

significant differences between them. This may be related to changes in the environmental conditions.

Data in Table (4) revealed that using 2.10g/plant of phosphorus nutrition resulted in heaviest leaf dry weight (g) in both seasons than 1.05 g/plant phosphorus without significant difference. The increasing effect may be due to the relationship between this element and carbohydrate metabolism.

Data in Table (4) revealed that using 1.40g /plant of potassium nutrition induced heaviest leaf dry weight (g) in both seasons than 0.70g/plant potassium but without significant difference between the two levels. The increase in weight may be due to the promoting effect of potassium known on cell division.

Data presented in Table (4) indicated that plants treated with yeast at 3g/L, calcium superphosphate 2.10g/ plant and potassium sulphate 1.40g or 0.70g/ plant interaction significantly resulted the highest values of leaf dry weight as it were (5.09 and 4.19g) respectively and there were no significant differences between them compared with the other treatments.

The result of the second season was better than the first one. The same Table clearly defined that plants fertilized with yeast 3g/L, calcium superphosphate 2.10g and 1.40g or 0.70g potassium sulphate significantly resulted the highest values of leaf dry weight as it were (5.50 and 4.88g) respectively and there was no significant differences between them.

There were no significant differences between all plants treated with yeast at 3g/L and all plants treated with yeast at 2g/L except plants treated with a half of the recommended dose of calcium superphosphate and potassium sulphate.

Generally, in both seasons Table (3 and 4), were clear that the best values of leaf area (cm^2) and leaf dry weight (g) were found in those plants treated with yeast at 3g/L, a half of the recommended dose of calcium superphosphate and potassium sulphate.

These results are in agreement with those found by many workers. Abd-El-Wahid (1995), Patil *et al.* (1999) on tuberose and Gangadharan and Gopinath (2000) on gladiolus mentioned that leaf area increased as a result of NPK fertilization.

The effect of active dry yeast on vegetative growth was reported by many investigators. Ahmed *et al*. (1998) on roselle plant, Ahmed (2001) and Attia *et al.* (2003) on *Calendula officinalis* L., Hassanein *et al.* (2003) and El-Hindi & El-Boraie (2004) on pot marigold reported that the best vegetative growth was observed as a result of using the highest concentration of active dry yeast.

The response of active dry yeast and chemical fertilization combination on vegetative growth was studied by many workers. Ali (2001) on pot marigold plants, Massoud (2006) on sage plants and Manoly & Nasr (2008) on gladiolus cv. Eurovision and El-Hindi *et al.* (2009) on pot marigold plants found that the best vegetative growth was achieved when the plants were fertilized with active dry yeast plus chemical fertilization.

Table (4): Effect of yeast extract, phosphorus, potassium and their interactions on leaf dry weight (g) of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Leaf dry weight (g)									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$(K) 0.70	$K_{g/plant}$(K) 1.40	Mean of (Y)	Mean of (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)
1	1.05	3.14	2.99	3.13	3.32	3.06	3.07	3.21	3.73
	2.10	3.18	3.22			3.49	3.24		
2	1.05	3.22	3.35	3.38		3.70	3.91	3.87	
	2.10	3.45	3.51		3.77	3.92	3.96		4.16
3	1.05	3.55	3.64	4.12		4.33	4.31	4.76	
	2.10	4.19	5.09			4.88	5.50		
Mean of (K)		3.46	3.63			3.89	4.00		
LSD 5%		Y 0.75	P 0.48	K 0.99	YPK 1.27	Y 1.73	P 0.63	K 1.07	YPK 1.86

Table (5): Effect of yeast extract, phosphorus, potassium nutrition on day from planting to flowering of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Day from planting to flowering									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)
1	**1.05**	90.00	82.00	80.25	77.50	94.00	90.00	88.75	83.33
	2.10	75.00	74.00			86.00	85.00		
2	**1.05**	75.00	74.00	74.33		80.00	80.00	79.25	
	2.10	79.33	69.00		71.22	79.00	78.00		79.50
3	**1.05**	72.00	72.00	68.50		79.00	77.00	76.25	
	2.10	67.00	63.00			75.00	74.00		
Mean of (K)		76.39	72.33			82.17	80.67		
LSD 5%		Y 3.60	P 4.56	K 2.94	YBK 5.43	Y 4.53	P 0.67	K 6.62	YBK 5.91

Effect of yeast extract, phosphorus and potassium and their interactions on flowering stage of *Polianthes tuberosa* L.plants:

1. Number of days from planting to flowering:

Plants treated with 3g/L yeast extract had significant shortest period between planting and flowering in the first season than 1and 2g/L yeast extract, but in the second season there were no significant difference between 2 and 3g/L yeast extract Table (5).

In this condition data in Table (5) revealed that using 2.10 g/plant of phosphorus nutrition resulted the shortest period between planting and flowering in both seasons than 1.05 g/plant phosphorus with significant difference between them. One of the many promoting growth factors of phosphorus is the enhancement of root growth matter may be reflected on plant behavior.

The previous Table (5) revealed that using 1.40g /plant of potassium resulted the shortest period between planting and flowering in the first season than 0.70g/plant potassium with significant difference between them. But in

the second season there were no significant differences between them observed.

It is obvious that in Table (5) in the first season, plants treated with the combination of yeast at 3g/L, calcium superphosphate 2.10g and potassium sulphate 1.40g or 0.70g / plant resulted the shortest period between planting and flowering (63.00 and 67.00 days) respectively, and there were significant differences between them when compared with other treatments which gave the longest period between planting and flowering. Since reached in some cases (90 days)

Data in the second season, in the same Table followed a similar trend as in the first season.

2. Number of days from planting to harvesting:

Data in Table (6) showed that treated plants with 3g/L yeast extract induced the least number of days between planting to harvesting in both seasons than the applied two other doses.

Regarding data in Table (6) revealed that using 2.10g/plant of phosphorus nutrition resulted the least number of days between planting to harvesting in the first season than 1.05g/plant phosphorus nutrition without significant difference. But in the second season those treated with 2.10g/plant phosphorus resulted least number of days between planting to harvesting than 1.05 g /plant with significant difference.

Data in Table (6) devoted that using 0.70 and1.40 g/plant of potassium resulted the least number of days between planting to harvesting in both seasons without significant difference.

The results in Table (6) demonstrated that plants treated with yeast at 3g/L, calcium superphosphate 2.10 g and potassium sulphate 1.40 g or 0.70g / plant produced least number of days between planting to harvesting (92.00 and 93.00 days) respectively, in the first season and there were no significant difference between them.

Data in the second season, clearly indicated that it is nearly as the same as in the first season.

Generally, in both seasons Table (6) was clear that plants treated with yeast at 3g/L, the recommended dose of calcium superphosphate and a half of the recommended dose of potassium sulphate led to achieving the shortest period between planting and harvesting of tuberose plants.

These results are in agreement with Gangadharan and Gopinath (2000) on *Gladiolus grandiflorus* cv. White prosperity who mentioned that an increase in number of days taken for emergence of spike was when plants fertilized with organic and inorganic fertilizers. Badawy *et al.* (2002) on *Ornithogalum thrysoides* reported that applying chemical fertilization delayed flower date. Abd El-Wahid (2004) on *Cosmos sulphureus* stated that the least flowering characters were of the plants supplied with chemical fertilization alone.

Concerning the effect of active dry yeast and chemical fertilization, Manoly and Nasr (2008) on Gladiolus cv. Eurovision plants concluded that this fertilization gave better results of producing earlier gladiolus.

Table (6): Effect of yeast extract, phosphorus, potassium and their interactions on day from planting to harvesting of *Polianthes tuberosa* L. during the two seasons of 2008/2009 -2009/2010.

Day from planting to harvesting									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$ (K) 0.70	1.40	Mean of (Y)	Mean of (P)	$K_{g/plant}$ (K) 0.70	1.40	Mean of (Y)	Mean of (P)
1	1.05	106.00	104.00	104.50	100.33	119.00	105.00	109.00	105.17
	2.10	104.00	104.00			103.00	109.00		
2	1.05	98.0	102.0	100.25		104.33	104.00	106.08	
	2.10	99.00	102.00		99.00	113.00	103.00		103.78
3	1.05	97.00	95.00	94.25		99.67	99.00	98.33	
	2.10	93.00	92.00			97.00	97.67		
Mean of (K)		99.50	99.83			106.00	102.94		
LSD 5%		Y 0.65	P 1.49	K 0.96	YPK 1.36	Y 2.73	P 0.54	K 7.27	YPK 5.56

3. Spike length (cm):

Data in Table (7) showed that plants treated with 3g/L yeast extract resulted an increase in spike length in the first season than the two other examined doses of yeast extract. But in the second season in the same Table it was clearly indicated that plants treated with 2 and 3g/L yeast extract, resulted an increase in spike length without significant difference than the lower dose 1g/L of yeast extract.

Dealing with phosphorus data in Table (7) revealed that using 2.10g/plant resulted an increase in spike length in the first season than 1.05 g/plant with significant difference. This may be related to the fact that P enhances metabolism processes. But in the second season there was no significant difference between them.

Data in Table (7) revealed that using 1.40 g/plant of potassium nutrition resulted an increase in spike length in the first season than 0.70 g/plant potassium with significant difference. The observed increase may be related to the several functions of thus element concerning waters relations and protein and fats synthesis. While, in the second season there was no significant difference between them.

These results are in accordance with those obtained by Gangadharan and Gopinath (2000) on *Gladiolus grandiflorus* cv. White prosperity indicated a significant increase in the length of spike in the plot treated with chemical fertilization. Badawy *et al.* (2002) on *Ornithogalum thrysoides* reported that applying chemical fertilization at growing vegetative stage increased length of spike.

In the first season, data in Table (7) presented that plants treated with yeast at 3g/L, calcium superphosphate 2.10 g and potassium sulphate 1.40 g or 0.70g / plant combination resulted an increase in spike length (72.33 and 69.67 cm.) respectively. However, there were no significant differences between them when compared with other plants.

Table (7): Effect of yeast extract, phosphorus and potassium and their interactions on spike length (cm). of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Spike length (cm).									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$(K) 0.70	$K_{g/plant}$(K) 1.40	Mean of (Y)	Mean of (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)
1	1.05	53.50	60.00	59.88	61.58	50.33	52.83	54.38	56.42
	2.10	61.33	64.67			58.67	55.67		
2	1.05	62.67	63.33	63.25		57.67	58.33	57.25	
	2.10	63.33	63.67		65.83	54.00	59.00		58.58
3	1.05	62.00	68.00	68.00		59.33	60.00	60.88	
	2.10	69.67	72.33			60.00	64.17		
Mean of (K)		62.08	65.33			56.67	58.33		
LSD 5%		Y 3.37	P 1.79	K 1.24	YPK 4.03	Y 6.44	P 2.73	K 2.71	YPK 7.34

Data in the second season, in the same Table clearly indicated that plants treated with yeast at 3g/L, calcium superphosphate 2.10 g and potassium sulphate 1.40 g or 0.70g / plant and yeast at 3g/L, calcium superphosphate 1.05 g and potassium sulphate 1.40 g / plant resulted an increase in spike length (64.17, 60.00 and 60.00cm.) respectively and there were no significant differences between them.

There were no significant differences between the last treatments and those plants treated with yeast at 3g/L, calcium superphosphate 1.05 g and potassium sulphate 0.70 g, yeast at 2g/L, calcium superphosphate 2.10 g and potassium sulphate 1.40 g , yeast at 2g/L, calcium superphosphate 1.05 g and potassium sulphate 1.40 g or 0.70g / plant and yeast at 1g/L, calcium superphosphate 2.10 g and potassium sulphate 0.70g / plant as it were (59.33, 59.00, 58.33, 57.67 and 58.67), respectively when compared with other plants.

Regarding the effect of active dry yeast and chemical fertilization on spike length. Abd El-kafie *et al.* (2001) on chrysanthemum plant mentioned that yeast extract at 5 g/L., ATP 1g/L., Vit. B complex 3g/L. Hydrogel 5g/pot. and their combination increased the flowering parameters. Manoly and Nasr (2008) on Gladiolus cv. Eurovision indicated that fertilizing the plants with active dry yeast plus Abou-Tartour rock phosphate resulted in the highest spike length.

4. Number of florets/spike:

Data in Table (8) showed that a wonderful increase in number of florets was achieved with 3g/L yeast (20.7) when compared with 1 and 2g/L (9.5 and 15.2 florets), respectively. It was a matter of interest to note the increase with 3g yeast raced more than the double than with 1g yeast.

Data in Table (8) revealed that there was no significant difference on number of florets/spike by using 1.05 and 2.10 g/plant of phosphorus in both seasons.

Data in Table (8) revealed that there was no significant difference on number of florets/spike when using 0.70 and 1.40 g/plant of potassium in both seasons.

Data recorded in Table (8) revealed that plants treated with yeast at 3g/L and all plants treated with yeast at 2g/L and yeast at 1g/L, calcium superphosphate 2.10 g and potassium sulphate 1.40 g / plant gave no significant differences between them when compared with other treatments.

Data in the second season, coincided with the in the first season.

Generally, in both seasons, it was obvious that the best values of number of florets/ spikes was found in those plants treated with yeast at 2g/L, combined with the recommended dose of calcium superphosphate and potassium sulphate.

The present results are in line with those obtained by Abd-El-Wahid (1995) on *Polianthes tuberosa* who reported that the largst number of flowers/spike was found on the plants fertilized with chemical fertilization. Also, John *et al.* (1997) on Gladiolus cv. Oscar and Gangadharan and Gopinath (2000) on gladiolus (*Gladiolus grandiflorus cv. White*) prosperity demonstrated that applying chemical fertilizers led to an increase in the number of florets per spike. Abd El-Wahid (2004) on *Cosmos sulphureus* investigated that the least flowering characters were of plants supplied with chemical fertilization alone.

Regarding the effect of active dry yeast and chemical fertilization Manoly and Nasr (2008) on gladiolus cv. Eurovision mentioned that applying with active dry yeast plus Abou-Tartour rock phosphate an increased number of florets was achieved.

Table (8): Effect of yeast extract, phosphorus and potassium nutrition on number of flowers (florets/ spike) of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Number of flowers (florets/ spike)									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g\ /plant}$ (K) 0.70	$K_{g\ /plant}$ (K) 1.40	Mean of (Y)	Mean of (P)	$K_{g\ /plant}$ (K) 0.70	$K_{g\ /plant}$ (K) 1.40	Mean of (Y)	Mean of (P)
1	1.05	7.30	10.30	9.50	14.40	7.67	10.00	9.75	12.72
	2.10	8.00	12.30			10.33	11.00		
2	1.05	15.30	13.30	15.20		11.00	11.33	12.75	
	2.10	15.00	17.30		15.80	14.33	14.33		14.61
3	1.05	20.00	20.30	20.70		17.67	18.67	18.50	
	2.10	21.00	21.30			18.67	19.00		
Mean of (K)		14.40	15.80			13.28	14.06		
LSD 5%		Y 8.20	P 5.18	K 3.74	YBK 10.33	Y 4.10	P 2.87	K 7.24	YBK 7.81

Effect of yeast extract, phosphorus, potassium and their interaction on main constituents of Polianthes tuberosa L.plants:

1. Total chlorophyll (mg /g FW):

Data in Table (9) showed that plants treated with the higher level at 3g/l yeast extract significantly induced the highest amount of total chlorophyll (mg/g.) in the first season than the two other used doses of yeast extract. But in the second season there were no significant differences between them.

Data in Table (9) revealed that there was no significant difference between using 1.05 and 2.10g/plant of phosphorus in the first season. But in

the second season 2.10g /plant phosphorus had no significant difference when compared with 1.05g/plant of phosphorus nutrition.

Data in Table (9) devoted that there was no significant difference in both seasons when using 0.70 and1.40 g/plant of potassium.

Apparently data in Table (9) revealed that plants treated with yeast at 3g/L, calcium superphosphate 2.10 g and potassium sulphate 1.40 g or 0.70g / plant. Yeast at 3g/L, calcium superphosphate 1.05 g and potassium sulphate 1.40 g significantly resulted the highest amount of total chlorophyll (mg/g.). in the first season, as it were(0.92,0.89 and 0.76 mg/g.) respectively and no significant differences between them. When compared with other treatments.

Data in the second season, in the same table clearly indicated that plants treated with yeast at 2g/L, calcium superphosphate 2.10 g and potassium sulphate 0.70g / plant and yeast at 3g/L, calcium superphosphate 2.10 g and potassium sulphate 0.70g / plant significantly resulted the highest amount of total chlorophyll (mg/g.) as it were (0.62 and 0.58 mg/g.) respectively and no significant differences between them.

There were no significant differences between all plants treated with yeast at 3g/L and all plants treated with yeast at 2g/L except plants treated with the recommended dose of calcium superphosphate and potassium sulphate when compared with other treatments.

This result was in harmony with those reported by many workers. Abdel-Wahid (1995) on *Polianthes tuberosa* and sterlitzia plant using NPK fertilization that caused an increase in total chlorophylls content in leaves. Habib (1997) noticed that NPK at 3:1:3 produced the highest content of total chlorophylls in dahlia plants. Sakr (2001) stated that NPK fertilizers increased total chlorophylls content in leaves of *Mentha piperita*.

As regards to the effect of active dry yeast and chemical fertilization on photosynthetic pigments. Manoly and Nasr (2008) on Gladiolus cv. Eurovision plants, mentioned that with high rate (6 g /l) active dry yeast+300 kg/fed. of Abou-Tartour gave significantly increased total chlorophyll contents in the leaves.

Table (9): Effect of yeast extract, phosphorus, a potassium nutrition in leaves content of total chlorophyll (mg \ g FW) of *Polianthes tuberosa* L. during the two seasons of 2008/2009 -2009/2010.

Total Chl. in leaves mg \ g FW									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$ (K) 0.70	$K_{g/plant}$ (K) 1.40	Mean of (Y)	Mean of (P)	$K_{g/plant}$(K) 0.70	$K_{g/plant}$(K) 1.40	Mean of (Y)	Mean of (P)
1	1.05	0.59	0.42	0.45	0.55	0.38	0.36	0.42	0.48
	2.10	0.37	0.42			0.46	0.47		
2	1.05	0.46	0.48	0.46		0.46	0.54	0.54	
	2.10	0.54	0.37		0.59	0.62	0.53		0.52
3	1.05	0.59	0.76	0.79		0.54	0.57	0.54	
	2.10	0.89	0.92			0.58	0.48		
Mean of (K)		0.57	0.56			0.51	0.49		
LSD 5%		Y 0.22	P 0.30	K 0.15	YPK 0.28	Y 0.15	P 0.05	K 0.0	YPK 0.16

1. Nitrogen % in leaves:

Data in Table (10) showed that plants treated with the higher level 3g/l yeast extract gave the highest nitrogen % in both seasons than the two other relatively lower doses of yeast extract.

In this respect data in Table (10) revealed that using 2.10g/plant of phosphorus nutrition gave the highest nitrogen % in both seasons than 1.05g/plant of phosphorus dose.

Data in Table (10) revealed that using 1.40 g/plant of potassium nutrition gave the highest nitrogen % in both seasons than 0.70 g/plant of potassium nutrition.

Data in Table (10) revealed that the highest nitrogen % in the first season (2.75 %) resulted from yeast at 3g/L, calcium superphosphate 2.10g and potassium sulphate 1.40g / plant, when compared with other treatments.

In the second season, the leaves contained the highest percentage of nitrogen when the plants treated with yeast at 2g/L, calcium superphosphate 2.10g and potassium sulphate 1.40g / plant and yeast at 3g/L, calcium superphosphate 2.10g and potassium sulphate 1.40g / plant (2.85 %and 2.79 %) respectively. when compared with other treatments.

Table (10): Effect of yeast extract, phosphorus and potassium and their interactions on N% in leaves of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Nitrogen % in leaves									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$ (C)		Mean of (Y)	Mean of (P)	$K_{g/plant}$(K)		Mean of (Y)	Mean of (P)
		0.70	1.40			0.70	1.40		
1	**1.05**	2.17	2.00	**2.30**	**2.16**	2.23	1.99	**2.35**	**2.20**
	2.10	2.42	2.63			2.48	2.68		
2	**1.05**	2.04	2.27	**2.37**		2.10	2.32	**2.45**	
	2.10	2.49	2.68			2.54	2.85		
3	**1.05**	2.13	2.34	**2.44**	**2.58**	2.15	2.39	**2.48**	**2.66**
	2.10	2.54	2.75			2.59	2.79		
Mean of (K)		**2.30**	**2.45**			**2.35**	**2.51**		

2. Phosphorus % in leaves:

Data in Table (11) showed that treated plants with 3g/L yeast extract gave the highest phosphorus % in both seasons than the two other used doses of yeast extract.

Data in Table (11) revealed that using 2.10g/plant of phosphorus nutrition gave the highest phosphorus % in both seasons than 1.05g/plant of phosphorus nutrition.

Data in Table (11) revealed that using 1.40 g/plant of potassium nutrition gave the highest phosphorus % in both seasons than 0.70 g/plant of potassium nutrition.

In the first season, the leaves of the plants treated with yeast at 3g/L, calcium superphosphate 2.10g and potassium sulphate 1.40g / plant contained the highest percentage of phosphorus (0.41%). However, yeast at 1g/L, calcium superphosphate 1.05g and potassium sulphate 0.70g / plant had the least percentage of phosphorus (0.30%) Table (11).

Data in the second season, in the same table clearly indicated that it is nearly as the same as the first season.

Table (11): Effect of yeast extract, phosphorus, potassium and their interactions on P% in leaves of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Phosphorus % in leaves									
First season						Second season			
Y g/L (A)	P g/plant (B)	Kg/plant (C)		Mean of (A)	Mean of (B)	Kg/plant (C)		Mean of (A)	Mean of (B)
		0.70	1.40			0.70	1.40		
1	1.05	0.30	0.32	0.34	0.33	0.31	0.32	0.34	0.33
	2.10	0.36	0.37			0.36	0.37		
2	1.05	0.32	0.33	0.35		0.33	0.34	0.36	
	2.10	0.38	0.39		0.38	0.38	0.39		0.39
3	1.05	0.34	0.35	0.37		0.35	0.35	0.38	
	2.10	0.39	0.41			0.40	0.41		
Mean of (C)		0.35	0.36			0.35	0.36		

2. Potassium % in leaves:

Data in Table (12) showed that treated plants with 3g/l yeast extract exerted the highest potassium % in both seasons (3.27 and 3.35) respectively than the two other used doses of yeast extract.

Recorded data in Table (12) revealed that using 2.10g/plant of phosphorus also included the highest potassium % in both seasons than 1.05g/plant of phosphorus nutrition.

Treating with 1.40 g/plant of potassium nutrition gave the highest potassium % in both seasons than 0.70 g/plant of potassium nutrition Table (12).

Data in Table (12), it was in the first season, that applying yeast at 3g/L, calcium superphosphate 2.10g and potassium sulphate 1.40g / plant led to the presence of the highest potassium percentage in leaves (3.55%), while yeast at 1g/L, calcium superphosphate 1.05g and potassium sulphate 0.70g / plant combination resulted in the least potassium percentage (2.48%).

In the second season data, in the same table was similarly to that detected in the first season.

Generally, in both seasons in Tables (10, 11 and 12), it was clear that the highest percentage of (n, p and k) exert in those plants treated with yeast at 3g/L, the recommended dose of calcium superphosphate and potassium sulphate.

The effect of active dry yeast on mineral elements content was studied by many investigators. Ahmed (2001) showed that, *Calendula officinalis.* L. plants, were sprayed with high rate (4.5 g /l) active dry yeast gave significantly increased P contents in the herb of plants. Wahba (2002) on *Oenothera biennis*, L. plants the nitrogen, phosphorus and potassium contents were increased with increasing the concentrations of yeast. Manoly and Nasr (2008) showed that, Gladiolus cv. Eurovision plants, were sprayed with high rate (6 g /l) active dry yeast+300 kg/fed. of Abou-Tartour gave

significantly increased P% contents in the leaves. El-Hindi *et al.,* (2009) on pot marigold plants. Reported that foliar spray with the high rate (4g/l) of active dry yeast was significant P% and N% contents in the leaf.

Table (12): Effect of yeast extract, phosphorus, potassium and their interactions on K% in leaves of *Polianthes tuberosa* L. during the two seasons of (2008/2009) and (2009/2010).

Potassium % in leaves									
First season						Second season			
$Y_{g/L}$ (Y)	$P_{g/plant}$ (P)	$K_{g/plant}$ (K)		Mean of (Y)	Mean of (P)	$K_{g/plant}$ (K)		Mean of (Y)	Mean of (P)
		0.70	1.40			0.70	1.40		
1	**1.05**	2.48	3.11	**2.84**	**3.00**	2.56	3.24	**2.94**	**3.11**
	2.10	2.55	3.23			2.65	3.32		
2	**1.05**	2.65	3.31	**3.06**		2.76	3.44	**3.18**	
	2.10	2.88	3.39		**3.11**	2.98	3.53		**3.21**
3	**1.05**	2.96	3.49	**3.27**		3.04	3.60	**3.35**	
	2.10	3.07	3.55			3.13	3.65		
Mean of (K)		**2.77**	**3.35**			**2.85**	**3.46**		

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تـأثير التغذيـة بالفسـفورو البوتاسـيوم و الخميـرة علـي النمـو ، و التزهيـر و كـذلك التركيب الكيميائي علي التبروز.

اميمـــة محمـــد عبـــد الكـــافي, علـــي منصـــور حمـــزة, خالـــد حامـــد الهنـــدي و مهند محمد عبد الباسط
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تم اجراء تجربتين حقليتين في جامعة المنصورة- كلية الزراعة- قسم الخضر و الزينة – مصر في موسمين متتاليين ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ لدراسة تاثير سوبر فوسفات الكالسيوم (١,٠٥ و ٢,١٠جم/نبات) , سلفات البوتاسيوم (٠,٧٠ و ١,٤٠ جم/نبات) و التغذية بالخميرة عن طريق رش الاوراق ٢،١ و٣ جم/لتر علي النمو, الازهار و التركيب الكيميائي لنبات التبروز.

مستخلص الخميرة بمعدل ٣جم/لتر كان له تاثير فعال في تحفيز النمو الخضري و الزهري و كذلك المحتوي المعدني، استخدام سوبر فوسفات الكالسيوم بمعدل ١,٠٥ جم/ نبات ادي لزيادة المساحة الورقية، الوزن الجاف للاوراق ، و زيادة طول الشمراخ و عدد الازهار بينما استخدام تركيز ٢,١٠ جم / نبات ادي لقلة عدد الايام من الزراعة حتي الازهار و الحصاد في كلي الموسمين و جد ان استخدام سلفات البوتاسيوم بتركيز ٠,٧٠ جم/نبات ادي لزيادة الوزن الجاف للاوراق وقلة عدد الايام من الزراعة حتي الازهار و الحصاد و طول الشمراخ الزهري و زيادة عدد الازهار / شمراخ و محتوي الكلوروفيل الكلي في الاوراق بينما استخدام تركيز ١,٤٠ جم/نبات ادي لزيادة المحتوي المعدني في الاوراق.

التغذية بالخميرة بمعدل ٣جم/لتر , سوبر فوسفات الكالسيوم ٢,١٠ جم و سلفات البوتاسيوم١,٤٠ جم و الخميرة ٣جم/لتر , سوبر فوسفات الكالسيوم ٢,١٠ جم و سلفات البوتاسيوم٠,٧٠ جم كان تاثيره فعال في تحفيز النمو الخضري(عدد الاوراق، المساحة الورقية و الوزن الجاف للاوراق), و الوصول الي اقل عدد من الايام من الزراعة حتي الحصاد, و زيادة جودة الازهار و ذلك يتمثل في طول الشمراخ , قطر الشمراخ من الجزء القاعدي , الوزن الجاف للشمراخ , طول الجزء المزهر ، عدد الزهيرات / شمراخ و محتوي الاوراق من صبغات البناء الضوئي عند المقارنة بالكنترول.

و بذلك يمكن الاستنتاج بان رش نباتات التبروز بالخميرة بمعدل ٣جم/لتر , سوبر فوسفات الكالسيوم ١,٠٥ جم و سلفات البوتاسيوم ٠,٧٠جم/ نبات علي التوالي ثلاث مرات شهريا لمدة ثلاثة شهور نحصل علي افضل نمو و جودة للازهار و توفير نصف كمية السماد الفسفوري والبوتاسي.

حيث تعتبر التغذية بالخميرة محفزة طبيعية رخيصة وامنة .

قام بتحكيم البحث

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Table (2): chemical analysis of yeast extract.

Minerals				Amino acids		Carbohydrates		Enzymes		Vitamins	
Macro (g/100gdry weight)		Micro (mg/100gdry weight)		(mg/100gdry weight)		(mg/100gdry weight)		(mg/100gdry weight)		(mg/100gdry weight)	
P_2O_5	7.23	Al	650.2	Arginine	1.99	Carbohydrate	23.2	Cytochrome	0.35	Vitamin B1	2.23
K_2O	51.68	B	175.6	Histidine	2.63	Glucose	13.33	Oxidase	0.29	Vitamin B2	1.31
N	34.39	Co	67.8	Isoleucine	2.31					Riboflavin	4.96
		Pb	438.6	Leucine	3.09					Nicotinic acid	39.88
		Mn	81.3	Lysine	2.95					Panthothenic acid	19.56
		Sn	223.9	Methionine	0.72					Biotin	0.09
		Zn	335.6	Phenylalanine	2.01					P-amino benzoic acid	9.23
		NaO	0.35	Thereonine	2.09					Vitamin B6	1.25
		MgO	5.76	Tryptophan	0.45					Folic acid	4.36
		Cao	3.05	Valine	2.19					Thiamine	2.71
		SiO2	1.55	Glutamic acid	2.00					Pyridoxine	2.90
		SO2	0.49	Serine	1.59					VitaminB12	153(mg/100g)
		Cl	0.06	Aspartic acid	1.33					Inositol	203(mg/100g)
		FeO	0.92	Cystine	0.23						
		NaCl	0.30	Proline	1.53						
				Tyrosine	1.49						

Chemical analysis of yeast extract according to Khedr and Farid (2000)