Influence of Nitrogen and Yeast on Production of Marigold Plants *Tagetes erecta*

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Abstract: This investigation was carried out during 2015 and 2016 seasons on *Tagetes erecta* grown at HoshIssa, El-Beheira Governorate, Egypt. The experimental layout was factorial experiment in complete randomized block design with three replications. The aim of this work was to evaluate the impact of nitrogen fertilization rate at (90, 180 and 270 kg fed^{-1}) and foliar spray with dry yeast at three concentrations (2, 4 and 6 g L^{-l}) as well as spraying with distilled water as a control and their interaction on vegetative growth, flowering and chemical constituents in of *Tagetes erecta*. From the obtained results it was concluded that treating *Tagetes erecta*p lants with combination of nitrogen at (270 kg fed^{-1})and foliar spray with dry yeast at (4 g L^{-1}) or (6 g L^{-1}) improve the vegetative growth, flowering characteristics and chemical constituents in *Tagetes erecta* plants.

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1. Introduction

***Tagetes erecta* L.** is popularly known as "African marigold" produces large size flowers with colors ranging from yellow to orange **(Sunitha, 2007)**. It is a member of family Asteraceae it has a beautiful commercial flower that is gaining status because of its wide range of adaptation and increasing demand in wide area of the world **(Asif, 2008)**. It is also one of the most important herbaceous ornamental with aromatic plants, is valued in landscape settings and also as cut flowers. It is highly ornamental in flowerbeds, borders and may be used effectively in window and porch boxes **(Nau, 1997)**. This plant has been used for medicinal purposes, scientific study shows that thiophenes, natural phytochemicals that include sulfur-containing rings, may be the active ingredients. They have been shown to kill gram negative and gram positive bacteria in vitro. This marigold may help protect certain crop plants from nematode pests when planted in fields **(Topp *et al*. 1998).**

Nitrogen is an essential element that could improve the growth during the vegetative phase and protein synthesis **(Inugraha *et al*. 2014)**, it plays its role through forming chlorophyll for photosynthetic process, nitrogen is applied to plants, which is going to be taken by the leaves, because it would make the foliar grow well **(Hardjowigeno, 2010)**. Nitrogen has great effect right from cell division to formation and development of vegetative and reproductive organs. It is a component of protoplasm, proteins, nucleic acids and chlorophyll. It is most mobile of all the mineral nutrients absorbed by the plant. So it is the essential element of life. **(Watson, 1952)**.

Active dry yeast is a natural safety biofertilizers causes various promote effect on plants. It is considered as a natural source of cytokinins which stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and B-vitamin. It also releases CO_2 which reflected in improving net photosynthesis **(Kurtzman and Fell, 2005).** Active dry yeast as foliar fertilizer enhanced growth, plant nutritional and essential oil yield of thyme plants **(Heikal, 2005). (Khedr and Farid 2000)** demonstrated that the effectof dry yeast is due to its capability in induction of endogenous hormones like GA_3 and IAA. 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)**. Thus, the main objective of this work is to study the impact of nitrogen fertilization rate, dry yeast as foliar application andtheir suitable interaction on vegetative growth, flowering characteristics and chemical components in *Tagetes erecta* plants.

2. Materials and Methods

Two similar field experiments, each in summer season of 2015 and 2016, were conducted to assess the effect of two factors; nitrogen fertilization rate and foliar spray with dry yeast and their interaction on vegetative growth, flowering characteristics and chemical constituents in *Tagetes erecta*. The first factor comprised three nitrogen rates; 90, 180 and 270 kg fed^{-1}. The second factor included Three concentrations 2, 4 and 6 g L^{-1} as well as spraying with distilled water as a control. There were 12 combined treatments in total. The experiments were conducted at a private farm located at HoshIssa, El-Beheira Governorate, Egypt.

Before the initiation of each field experiment, soil samples of 30 cm depth were collected to identify some physio-chemical characters of the experimental site. The soil samples were analyzed at Soil Fertility Laboratory, Damenhour, Ministry of Agriculture according to the standard published procedures **(Wilde *et al.*, 1985).** Results of soil samples analysis are presented in **Table (1).**

Table (1): Some physical and chemical characteristics of the soil samples in both seasons of 2015 and 2016.

	Season 2015	Season 2016
Physical properties		**Physical properties**
Soil texture	**Sandy**	**Sandy**
ECe (dsm^{-1})	**0.32**	**0.19**
Chemical properties		**Chemical properties**
PH	**7.6**	**8.1**
$CaCo_3$ (%)	**3.0**	**3.5**
Available macronutrients (ppm)		**Available macronutrients (ppm)**
N	**42**	**47**
P	**27**	**31**
K	**83**	**78**
Soluble ions (m mole L^{-1})		**Soluble ions (m mole L^{-1})**
Ca++	**3.0**	**2.0**
Mg++	**2.5**	**2.1**
Na+	**0.66**	**0.59**
K+	**0.56**	**0.49**
HCO3-	**0.5**	**0.8**
SO4--	**1.2**	**1.8**
Fe	**4.0**	**2.3**
Zn	**2.2**	**2.5**

Planting material: Seeds were sown in the prepared nursery on 15th of February in both seasons. The seedlings were transplanted on March 20th in the two years of study.

Nitrogen fertilizer levels; 90, 180 and 270 kg fed^{-1} were side banded at two equal applications; after 15 day from transplanting and 21 days thereafter. The nitrogenous fertilizer was used in form of ammonium nitrate (33% N). The experimental layout was factorial experiment in complete randomized block design with three replications. Nitrogen rates for each experimental unit was planned to cover an area of 8.4 m^2 including three rows of 4 m long and 0.7 m wide. Each two adjacent experimental unites were separated by 1.0 m alley to protect against border effects.

The powder from the active dry yeast was purchased from the local market. Yeast was activated overnight by sucrose at a rate of 2, 4 and 6g L^{-1} aqueous solution of dry yeast before spraying on the plant. Plants were sprayed until droplets fell.

All experimental unites received identical doses of (45 kg fed^{-1}) P_2O_5 and (96 kg fed^{-1}) K_2O in the form of calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48 % K_2O), respectively. Calcium superphosphate fertilizer was broadcasted during soil preparation whilst, potassium sulphate was side banded in two equal portions at the same times of N application. All other agro-management practices were performed whenever it was necessary and as recommended in the commercial production of marigold.

Data Recorded

Morphological characters

After 40 days of transplanting, five randomly chosen plants from each experimental unit were cut off at the ground level and immediately carried to the laboratory and the following measurements were recorded: Plant height (cm) from the ground level to the apical meristem of the main stem, Number of branches per plant, plant fresh weight (g), plant dry weight (g) by drying the plant in a forced-air oven at 70 C^{o} till the weight became constant, number of the flowers per plant, the average fresh weight of the flowers (g) and the average of flower dry weight (g).

Chemical constituents of the leaves

Leaf Chemical constituents: Leaf N, P and k contents

After 60 days of transplanting, leaf samples from the 5th upper leaf of four randomly plants, in each experimental unite, were collected. Fresh leaf samples were washed with tap water, rinsed with distilled water and dried at 70 C^{o} in a forced-air oven till constant weight. The dried leaf samples were finally ground and weights of 0.5 g of the fine powder were digested using a mixture of sulphoric and perchloric acids. The following determinations were performed; leaf N content using Microkjeldahal apparatus as described in **A. O. A. C. (2000)**, leaf P and K contents using Stannous molybdata chloride method as illustrated in **A. O. A. C. (2000).**

Leaf photosynthetic pigments content: Leaf samples from 5th upper leaf of three randomly plants, in each plot, were chosen, after 90 days of transplanting. Chlorophyll a, b and caroteneiode contents in fresh leaves (mg/g leaves fresh weight) were determined according to **Saric *et al.* (1967) as follow:** Fresh samples of leaves (0.5 g) were homogenized with acetone (85% v/v) in the presence of little amounts of silica quartz, then filtered through centered glass funnel G4. The residue was washed several times with acetone until the filtrate became colorless, and the combined extract was completed to a known volume (25ml). A portion of this extract was taken for the colorimetric determination of pigments. The determination was conducted using acetone (85% v/v) as a blank at wave lengths of 660, 640 and 440 nm.

Analysis of variance was performed on the obtained data. Comparisons among means of treatments were performed using the Least Significant Difference (L.S.D.) procedure at P= 0.05 level as illustrated by (**Gomez and Arturo, 1983**).

3. Results and Discussion

Vegetative growth characters:

The effects of the two studied factors (nitrogen rates and yeast concentrations and their interactions on plant height (cm), number of branches per plant in the two growing seasons of 2015 and 2016, were given in **Table (2).**

Table 2: Means of plant height (cm) and number of branches per plant of *Tagetes erecta* plant as influenced by the different rates of Nitrogen (N), yeast (Y) and their interaction (N ×Y) in the two seasons of 2015 and 2016.

	Yeast concentrations (Y) (g L^{-1})					Yeast concentrations (Y) (g L^{-1})				
	zero	2	4	6	Mean	zero	2	4	6	Mean
	2015 season					2016 season				
Nitrogen (N) (kg fed^{-1})	plant height (cm)					plant height (cm)				
90	60.27	60.53	61.52	60.99	60.83	46.63	50.70	53.39	52.01	50.68
180	62.70	60.35	68.52	65.76	64.33	54.74	56.48	61.08	59.77	58.02
270	62.79	64.66	73.21	67.17	66.96	55.83	57.25	64.31	60.31	59.52
Mean	61.92	61.85	67.75	64.64		52.40	54.81	59.72	57.36	
L.S.D (5%) (N) 0.23						L.S.D (5%) (N) 0.23				
L.S.D (5%) (Y) 0.27						L.S.D (5%) (Y) 0.27				
L.S.D (5%) (NXY) 1.76						L.S.D (5%) (NXY) 1.76				
Nitrogen (N) (kg fed^{-1})	Number of branches plant^{-1}					Number of branches plant^{-1}				
90	16.42	16.42	17.18	16.62	16.74	14.99	15.04	15.69	15.14	15.22
180	17.71	18.71	20.47	19.61	19.13	16.26	16.79	17.58	16.93	16.89
270	18.08	19.22	22.58	20.37	20.06	16.42	16.92	19.65	17.44	17.61
Mean	17.40	18.12	20.08	18.87		15.89	16.25	17.64	16.50	
L.S.D (5%) (N) 1.44						L.S.D (5%) (N) 1.61				
L.S.D (5%) (Y) 1.44						L.S.D (5%) (Y) 1.61				
L.S.D (5%) (NXY) 2.49						L.S.D (5%) (NXY) 1.7				

L.S.D = least significant differences at 0.05 probability.

The results showed a significant increase in plant height due to increased nitrogen fertilization during the two seasons of the study. The number of branches formed on the plant significantly increased as the result of increasing the rate of nitrogen fertilization from 90 to 180 (kg fed^{-1}). The increase in the nitrogen fertilization rate from 90 to 270 (kg fed^{-1}) also increased the number of branches formed on the plant significantly compared to the lowest rate 90 (kg fed^{-1}) but the effect was statistically equal the average of 180 (kg fed^{-1}) during the two seasons of study.

Regarding the yeast effect, foliar spraying with yeast on marigold plants generally showed a significant increase in plant height compared to control plants (distilled water), with an exception of treatment at the lowest rate (2 g/L) in the first season.

Spraying the plant with yeast at a concentration of (4 g/L) produced the longest plants compared to the control plants, as well as the other tested concentrations.

With regard the effect of yeast on the number of branches formed on the plant, results indicate almost the same effect as found in the plant height.

The combined treatment (fertilization with higher nitrogen content of 270 kg fed^{-1} with spray with yeast at the average concentration of 4 g/L) produced the longest marigold plants (73.21 and 64.31cm), respectively in the two seasons of the study. On the other hand the combined treatment (nitrogen fertilization with 180 kg fed^{-1} accompanied with the lowest concentration of yeast) resulted in shortest plants (60.35cm) in the first season. While in the second season, the shortest plants (50.70cm) were produced from the combined treatment (fertilization with the lowest rate of nitrogen fertilizer 90 kg fed^{-1} combined with spraying with the lowest concentration of yeast 2 g/L).

Regarding the number of branches formed on the plant, the combined treatment (fertilization with the minimum nitrogen fertilization rate of 90 kg fed^{-1} combined with the minimum yeast concentration of 2 g/L) recorded the lowest number of branches per plant (16.42 and 15.04), respectively in the two seasons of the study. While the highest number of branches (22.58 and 19.65), respectively in the two seasons of the study was resulted from the combined treatment (fertilization with the higher rate of nitrogen 270 kg fed^{-1}with spray with the average concentration of yeast 4 g/L).

Plant fresh and dry weights:

The data in Table 3 show the effect of fertilization with three different rates of nitrogen fertilizer as well as spraying with three yeast concentrations as well as their interactive effects on fresh and dry weight of marigold plants in 2015 and 2016.

In the first season, the fresh weight of the plant showed a positive significant effect with the nitrogen fertilization rate. Each increase in the fertilizer rate added significant increase to the fresh weight of the plant. In the second season there was no increase in fresh weight when the rate of fertilization increased from (90 to 180 kg fed^{-1}), but the increase in the rate to (270 kg fed^{-1}) significantly increased fresh weight compared to the minimum (90 kg fed^{-1}) or the middle (180 kg fed^{-1}) levels of fertilization. There were no significant differences in the dry weight of the plant due to the difference in the studied nitrogen fertilization rates or the yeast concentrations used during the two years of study.

Table 3. Means of plant fresh (g) and dry weight per plant (g) of *Tagetes erecta* plant as influenced by the different rates of Nitrogen (N), yeast (Y) and their interaction (N ×Y) in the two seasons of 2015 and 2016.

	Yeast concentrations (Y) (g L^{-1})					**Yeast concentrations (Y) (g L^{-1})**				
	zero	**2**	**4**	**6**	**Mean**	**zero**	**2**	**4**	**6**	**Mean**
	2015 season					**2016 season**				
Nitrogen (N) (kg fed^{-1})	**Fresh weight (g)**					**Fresh weight (g)**				
90	254.54	264.12	282.22	310.00	277.72	225.12	230.62	244.63	335.03	283.85
180	309.60	315.82	322.62	342.31	322.59	248.94	254.63	292.04	342.00	284.40
270	346.38	398.28	418.15	351.17	378.50	318.15	338.46	351.60	360.00	342.05
Mean	303.51	326.17	341.00	334.49		264.07	274.57	296.09	345.68	
L.S.D (5%) (N)	44.9					L.S.D (5%)		(N)	8.39	
L.S.D (5%) (Y)	44.9					L.S.D (5%)		(Y)	8.39	
L.S.D (5%) (NXY)	74.36					L.S.D (5%)		(NXY)	15.5	
Nitrogen (N) (kg fed^{-1})	**Dry weight (g)**					**Dry weight (g)**				
90	16.42	16.42	17.18	16.62	16.74	14.99	15.04	15.69	15.14	15.22
180	17.71	18.71	20.47	19.61	19.13	16.26	16.79	17.58	16.93	16.89
270	18.08	19.22	22.58	20.37	20.06	16.42	16.92	19.65	17.44	17.61
Mean	17.40	18.12	20.08	18.87		15.89	16.25	17.64	16.50	
L.S.D (5%) (N)	N.S					L.S.D (5%)		(N)	N.S	
L.S.D (5%) (Y)	N.S					L.S.D (5%)		(Y)	N.S	
L.S.D (5%) (NXY)	5.0					L.S.D (5%)		(NXY)	5.0	

L.S.D = least significant differences at 0.05 probability.

For the interaction effect, the combined treatment (fertilization at a minimum rate nitrogen of 90 kg fed^{-1}with a spraying by 2 g/L of yeast) achieved the lowest fresh (264.12 and 23.62 g) and dry (16.42 and 15.04 g) weight respectively, in the two seasons of the study on the marigold plant. The combined treatment (fertilization with a higher nitrogen fertilization rate of 270 kg fed^{-1}combined with spraying with the average concentration of yeast 4 g /L) resulted in heaviest fresh (418.15 and 360 g) or dry (22.58 and 19.65 g) plants respectively, during the two seasons of the study.

Flowering

The tabulated results shown in Table 4 show the effect of fertilization at gradual rates of nitrogen fertilizer and yeast spraying at different concentrations on the number of flowers on the plant as well as flower diameter during the 2015 and 2016 seasons.

The number of flowers on the plant increased significantly as the nitrogenous fertilizer increased through the two seasons of study.

The number of flowers formed on the plant showed a significant positive relationship with the used concentrations of yeast in the two years of the study.

Compound treatments showed significant effects on the number of flowers formed on the plant. The combined treatment (fertilization with the highest nitrogen fertilizer rate of 270 kg fed^{-1}accompanied with spray with the highest concentration of yeast 6 g/L) produced the highest number of flowers on plant in the two seasons 2015 and 2016, where it recorded 43, 95.24 flower per plant in the first and second seasons, respectively.

The results in Table 4 did not show any effects of different treatments at the different fertilization rates or the tested concentrations of yeast or even the composite treatments among them on the flower diameters in the two seasons of the study except in the second season, there were an exception, the yeast spray at the highest concentration (6 g/L)recorded the highest flower diameter (7.37 cm) with a significant difference compared with spraying with distilled water, which recorded less flower diameter (5.64 cm).

Table 4. Means of number of flowers per plant and flower diameter (cm) of ***Tagetes erecta*** plantas influenced by the different rates of nitrogen (N), yeast (Y) and their interaction (N ×Y) in the two seasons of 2015 and 2016.

	Yeast concentrations (Y) (g L^{-1})					**Yeast concentrations (Y) (g L^{-1})**				
	zero	**2**	**4**	**6**	**Mean**	**zero**	**2**	**4**	**6**	**Mean**
	2015 season					**2016 season**				
Nitrogen (N) (kg fed^{-1})	**Number of flowers per plant**					**Number of flowers per plant**				
90	27.40	32.17	35.67	37.50	33.19	27.81	36.30	38.10	39.21	35.36
180	33.06	33.81	38.40	39.41	36.17	35.30	38.15	40.20	40.75	38.60
270	29.25	37.32	40.79	43.00	37.59	32.70	40.60	44.75	46.24	41.07
Mean	29.90	34.43	38,29	39.97		31.94	38.35	41.02	42.07	
L.S.D (5%) (N) 1.36						L.S.D (5%) (N) 1.40				
L.S.D (5%) (Y) 1.36						L.S.D (5%) (Y) 1.40				
L.S.D (5%) (NXY) 2.36						L.S.D (5%) (NXY) 2.80				
Nitrogen (N) (kg fed^{-1})	**Flower diameter (cm)**					**Flower diameter (cm)**				
90	4.04	4.50	4.69	4.69	4.48	4. 10	4.52	4.62	4.63	4.47
180	4.28	4.50	4.77	4.75	4.58	4.31	4.53	4.67	4.82	4.58
270	4.44	4.53	4.83	5.15	4.74	4.50	4.61	4.91	5.44	4.87
Mean	4.25	4.51	4.76	4.86		4.30	4.55	4.73	4.85	
L.S.D (5%) (N) 0.30						L.S.D (5%) (N) 0.32				
L.S.D (5%) (Y) 0.30						L.S.D (5%) (Y) 0.32				
L.S.D (5%) (NXY) 1.02						L.S.D (5%) (NXY) 1.10				

L.S.D = least significant differences at 0.05 probability.

Flower fresh and dry weight

As shown in Table 5, increase the rate of fertilization to 180 kg fed^{-1}in the first season which led to increase the fresh weight of the flowers but did not reach the significant level. However, increase the rate to 270 kg fed^{-1}, the fresh weight of the flowers increased significantly compared to the minimum of 90 kg fed^{-1}, but statistically equal with the middle rate (180 kg fed^{-1}) in the two seasons of study.

Spraying of yeast at concentrations of 4 and 6 g/L significantly increased the fresh weight of flowers in both of 2015 and 2016 years.

Spray with The highest concentration of yeast significantly increased the dry weight of flowers compared to the plants sprayed with distilled water but statistically equal compared with the other concentrations in the two years of study.

The combined treatments achieved significant differences in the fresh and dry weight of the flowers. The combined treatment (fertilization with the highest nitrogenous fertilizer rate of 270 kg fed^{-1} with foliar spray with the highest concentration of yeast 6 g/L) achieved the largest fresh weight of marigold flower in the two seasons. On the other hand, the least flower fresh weight resulted from the compound treatment (N fertilization with minimum concentration accompanied by the lowest concentration of yeast).

The combined treatment (the highest rate of nitrogenous fertilizer with the highest concentration of yeast) produced the highest dry weight of flowers. We can discuss the stimulant effect of nitrogenous fertilization on the characteristics of vegetative growth of marigold plants on the base that Nitrogen (N) is often the most limiting factor in crop production. It is so vital because it is a major component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide (*i.e*., photosynthesis). It is also a major component of amino acids, the building blocks of proteins. Some proteins act as structural units in plant cells while others act as enzymes, making possible many of the biochemical reactions on which life is based. Nitrogen is a component of energy-transfer compounds, such as ATP (adenosine triphosphate). ATP allows cells to conserve and use the energy released in metabolism. Finally, nitrogen is a significant component of nucleic acids such as DNA, the genetic material that allows cells (and eventually whole plants) to grow and reproduce **Hardjowigeno (2010)**. Thus, it is a basic constituent for life. It is most mobile of all the mineral nutrients absorbed by the plant **Watson, (1952)**. Our results were in harmony with the findings of SGadagia et al (2004) on ***Gaillardia pulchella*, Monish *et al*. (2008)** on China aster and **Naik (2015)** on *Targets* plant.

We can discuss the stimulant effect of dry yeast on the characteristics of vegetative growth of marigold plants on the base that Active dry yeast is a natural safety bio fertilizers causes various promote effect on plants. It is considered as a natural source of cytokinins which stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and B-vitamin. It also releases CO_2 which reflected in improving net photosynthesis (Kurtzman and Fell, 2005). Active dry yeast as foliar fertilizer enhanced growth, plant nutritional and essential oil yield of thyme plants (Heikal, 2005).Khedr and Farid 2000 demonstrated that the effect of dry yeast is due to its capability in induction of endogenous hormones like GA_3 and IAA. 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).

Table 5. Means of flower fresh and dry weight (g) of *Tagetes erecta* plant as influenced by the different rates of nitrogen (N), yeast (Y) and their interaction (N ×Y) in the two seasons of 2015 and 2016.

	Yeast concentrations (Y) (g L^{-1})					**Yeast concentrations (Y) (g L^{-1})**				
	zero	**2**	**4**	**6**	**Mean**	**zero**	**2**	**4**	**6**	**Mean**
	2015 season					**2016 season**				
Nitrogen (N) (kg fed^{-1})	**Flower fresh weight (g)**					**Flower fresh weight (g)**				
90	2.65	2.87	2.96	2.99	2.87	2.83	4.17	4.21	4.25	3.25
180	2.87	2.90	3.36	3.39	3.13	3.83	4.00	4.36	4.42	4.15
270	2.88	3.20	3.53	3.80	3.35	3.77	4.71	4.82	4.77	4.52
Mean	2.80	2.99	3.29	3.39		3.48	4.29	4.61	4.48	
L.S.D (5%) (N)	0.46					L.S.D (5%) (N) 1.08				
L.S.D (5%) (Y)	0.46					L.S.D (5%) (Y) 1.08				
L.S.D (5%) (NXY)	0.80					L.S.D (5%) (NXY) 1.10				
Nitrogen (N) (kg fed^{-1})	**Flower dry weight (g)**					**Flower dry weight (g)**				
90	0.19	0.24	0.26	0.28	0.24	0.26	0.35	0.45	0.45	0.38
180	0.24	0.24	0.27	0.30	0.26	0.30	0.37	0.43	0.46	0.39
270	0.24	0.28	0.29	0.33	0.29	0.28	0.44	0.44	0.47	0.41
Mean	0.22	0.25	0.27	0.30		0.29	0.39	0.44	0.46	
L.S.D (5%) (N)	0.07					L.S.D (5%) (N) 0.08				
L.S.D (5%) (Y)	0.07					L.S.D (5%) (Y) 0.08				
L.S.D (5%) (NXY)	0.10					L.S.D (5%) (NXY) 0.10				

L.S.D = least significant differences at 0.05 probability.

N, P and K content

1-Nitrogen

Data presented in table (6) shows the content of marigold plant leaves from nitrogen, phosphorus and potassium as affected by nitrogen fertilizer rates and spraying with different concentrations of yeast during the 2015 and 2016 seasons. The results revealed that increasing the nitrogen fertilization rate of the marigold plant to 180 kg fed^{-1}resulted in a significant increase in nitrogen content in the plant compared with the minimum rate (90 kg fed^{-1}). The continuous increase of fertilization rate to 270 kg fed^{-1}did not differed than the 180 kg while was significant compared to the lowest rate (90 kg fed^{-1}) in the first season. In the second season, raising the fertilization rate to 180 kg fed^{-1}did not increase the plant content of nitrogen compared to the minimum rate (90 kg fed^{-1}), but with an increase of fertilization rate to 270 kg fed^{-1}plant content of nitrogen increased significantly compared to each of the minimum (90 kg fed^{-1}) or the medium rate (180 kg fed^{-1}).

Foliar spray of targets plant with yeast caused a significant increase in nitrogen content. No significant differences were observed between the effect of the medium concentration of yeast (4 g/L) and the highest concentration (6 g/L).

Compound treatments resulted in significant differences in the plant content of nitrogen. The highest nitrogen content of the plant was recorded from the combined treatment (fertilization with highest nitrogen content 270 kg fed^{-1} combined with the higher concentration of yeast 6 g/L) through the two seasons of study, while the lowest nitrogen content in the plant was recorded in plant that received the combined treatment (the minimum level of nitrogen fertilizer 90 kg fed^{-1} with spraying with a low yeast level of 2 g/L) in the first season and the combined treatment (fertilization with the medium nitrogen fertilizer level of 180 kg fed^{-1} combined by spray with the middle level of yeast 4 g/L) in the second season.

2-phosphourus

The results show a positive correlation, as the nitrogen fertilization rate increases, the plant content of the phosphorus significantly increased during the two seasons of the study.

As for the effect of yeast, the results showed that there was no fixed trend in the plant content of phosphorus, but foliar application of highest concentration of yeast in the two seasons of the study achieved the highest content of the plant of phosphorus.

The results showed that the highest plant content of phosphorus was achieved during the combined treatment (fertilization with the highest nitrogen content of 270 kg fed^{-1} with the highest concentration of yeast 6g/L) during the two seasons of the study.On the contrary the lowest values of the plant content of phosphorus were recorded in the compound treatment (The lowest nitrogen fertilization rate 90 kg fed^{-1}, accompanied by spraying with the lowest concentration of yeast 2g/L) during the two successive seasons.

3- Potassium

The results in Table 6 did not show significant differences in the plant content of potassium as a result of the difference in nitrogen fertilization rate in the first season. In the second season, increase the fertilization rate to 180 kg fed^{-1} did not affect plant content of potassium, however, with an increase in fertilization rate to 270 kg fed^{-1}, the plant content increased significantly compared to the two lower rates.

As for the effect of yeast, the plant content of potassium was not significantly differentiated by low concentration (2 g/L). However, with an increase of concentration to 4 and then 6 g/L, the potassium content of the plant significantly increased compared to the lower concentrations.

Regarding the interactive effect, the combined treatments (different rates of nitrogen and spray with yeast at different concentrations) led to significant differences in plant content of potassium. The combined treatment (the highest nitrogen fertilization rate of 270 kg fed^{-1} combined with the foliar addition of the yeast at concentration of 6 g/L plant) resulted in the highest content the potassium in the plant, while the lowest content of the potassium plant was recorded in the combined treatment (fertilization at the higher or lower nitrogen level 270 or 90 kg fed^{-1}, accompanied by spraying with the medium concentration of the yeast 4 g/L) in the first and second seasons respectively.

Our results were in harmony with the findings of **Babalar et al. (2007), Buskiene and Uselis (2008)** on ***raspberries*, and Shafshak et al. (2010) Abo-Sedera *et al*. (2014) on strawberry.**

Plant pigments: Chlorophyll A

Increase the rate of the nitrogenous fertilizer significantly increased the plant content of chlorophyll A and B, but this increase was highest when fertilizing at the middle rate (180 kg fed^{-1}) with a significant difference compared to the lowest and upper levels, this was confirmed during the two seasons of study. With regard the yeast effect, the results showed that the higher the yeast concentration, the more the content of the marigold leaves of chlorophyll A and B increased during the two seasons of the study. Therefore, the highest content of the chlorophyll leaves was achieved when spraying the plants with yeast at a concentration of 6 g/L. The results showed significant differences due to the combined effect of nitrogen fertilization rate and yeast spray. The combined treatment (highest rate of Nitrogenous fertilizer with highest yeast concentration) yielded the highest plant content of chlorophyll A and B, while the combined treatment (fertilization with the lowest nitrogen fertilization rate and spraying with the minimum concentration of yeast) yielded the least content during the two seasons of the study.

Carotene: The higher rate of nitrogen fertilization significantly increased the content of the leaves of carotene, therefore treated with the highest level of nitrogen 270 kg fed^{-1} produced the highest content of the plant leaves of carotene. As for the effect of yeast, the treatment of yeast resulted in increased content of carotene. The medium concentration of yeast 2 g/L achieved the highest value of carotene in the first season, while the highest concentration of yeast 6 g/L was highest in the second season. Compound treatments recorded significant differences in the content of plant leaves from carotene, The composite treatment (the highest rate of nitrogen with the medium concentration of yeast) was recorded the highest content of carotene leaves in the first season, while in the second season, the composite treatment (highest nitrogen rate with highest yeast concentration) showed the highest values of carotene in plant leaves.

Table (6): Means of Nitrogen, Phosphorus, and Potassium contents (% dry weight) in leaves of *Tagetes erecta* plant as influenced by the different rate of Nitrogen (N), Yeast (Y) and their interaction (N ×Y) in the two seasons of 2015 and 2016.

	Yeast concentrations (Y) (g L^{-1})					**Yeast concentrations (Y) (g L^{-1})**				
	zero	**2**	**4**	**6**	**Mean**	**zero**	**2**	**4**	**6**	**Mean**
Nitrogen (N)(kg fed^{-1})	**2015 season**					**2016 season**				
	Nitrogen (%)					**Nitrogen (%)**				
90	2.06	2.69	2.96	3.00	2.68	2.07	3.07	2.34	2.37	2.46
180	2.53	2.74	3.94	3.98	3.28	2.95	2.92	2.25	2.30	2.61
270	2.48	2.76	4.47	4.50	3.55	3.02	3.27	3.32	3.40	3.25
Mean	2.36	2.73	3.79	3.83		2.68	3.09	2.64	2.69	
LSD (5%) (N) 0.22						LSD (5%) (N) 0.19				
LSD (5%) (Y) 0.22						LSD (5%) (Y) 0.19				
LSD (5%) (NXY) 0.41						LSD (5%) (NXY) 0.34				
Nitrogen (N)(kg fed^{-1})	**Phosphorus (%)**					**Phosphorus (%)**				
90	0.23	0.43	0.44	0.74	0.46	0.23	0.33	0.34	0.49	0.35
180	0.69	0.73	0.51	0.77	0.68	0.67	0.43	0.69	0.74	0.63
270	0.73	0.77	0.61	0.80	0.73	1.00	0.51	0.76	1.07	0.84
Mean	0.55	0.64	0.52	0.77		0.63	0.42	0.60	0.77	
LSD (5%) (N) 0.02						LSD (5%) (N) 0.02				
LSD (5%) (Y) 0.02						LSD (5%) (Y) 0.02				
LSD (5%) (NXY) 0. 03						LSD (5%) (NXY) 0.03				
Nitrogen (N)(kg fed^{-1})	**Potassium (%)**					**Potassium (%)**				
90	0.19	0.57	0.73	1.89	0.85	0.82	0.78	0.90	1.06	0.89
180	0.47	0.56	0.84	1.73	0.90	0.78	0.97	0.98	0.96	0.92
270	0.52	0.54	0.94	1.89	0.97	0.41	1.44	1.83	1.95	1.41
Mean	0.39	0.56	0.84	1.84		0.67	1.06	1.24	1.32	
LSD (5%) (N) N.S						LSD (5%) (N) 0.02				
LSD (5%) (Y) 0.20						LSD (5%) (Y) 0.02				
LSD (5%) (NXY) 0.42						LSD (5%) (NXY) 0.35				

L.S.D = least significant differences at 0.05 probability.

Table (7): Means of Chlorophyll A, Chlorophyll B, and Carotene (mg g^{-1} fresh weight) content in leaves of *Tageteserecaplant* as influenced by the different rate of Nitrogen (N), yeast (Y) and their interaction (N ×Y) in the two seasons of 2015 and 2016.

	Yeast concentrations (Y) (g L^{-1})					**Yeast concentrations (Y) (g L^{-1})**				
	zero	**2**	**4**	**6**	**Mean**	**zero**	**2**	**4**	**6**	**Mean**
	2015 season					**2016 season**				
Nitrogen (N) (kg fed^{-1})	**Chlorophyll A (mg g^{-1} fresh weight)**					**Chlorophyll A (mg g^{-1} fresh weight)**				
90	1.02	1.12	1.15	1.16	1.11	1.01	1.10	1.14	1.18	1.11
180	1.16	1.26	1.66	1.88	1.49	1.13	1.26	1.58	1.62	1.64
270	1.28	1.42	1.99	2.00	1.43	1.34	1.39	2.01	2.01	1.42
Mean	1.15	1.27	1.60	1.68		1.16	1.25	1.58	1.52	
LSD (5%)	(N)	0.12				LSD (5%)			(N)	0.09
LSD (5%)	(Y)	0.12				LSD (5%)			(Y)	0.09
LSD (5%)	(NXY)	0.21				LSD (5%)			(NXY)	0.16
Nitrogen (N) (kg fed^{-1})	**Chlorophyll B (mg g^{-1} fresh weight)**					**Chlorophyll B (mg g^{-1} fresh weight)**				
90	0.45	0.51	0.51	0.57	0.51	0.50	0.52	0.54	0.56	0.53
180	0.57	0.69	0.77	0.79	0.71	0.57	0.75	0.82	0.85	0.75
270	0.68	0.82	0.90	0.97	0.84	0.65	0.85	1.06	1.07	0.91
Mean	0.57	0.67	0.73	0.78		0.57	0.71	0.81	0.83	
LSD (5%)	(N)	0.05				LSD (5%)			(N)	0.04
LSD (5%)	(Y)	0.05				LSD (5%)		(Y)	0.04	
LSD (5%)	(NXY)	0.09				LSD (5%)			(NXY)	0.07
Nitrogen (N) (kg fed^{-1})	**Carotene (mg g^{-1} fresh weight)**					**Carotene (mg g^{-1} fresh weight)**				
90	0.68	0.76	0.77	0.84	0.76	0.66	0.73	0.78	0.83	0.75
180	0.78	0.84	1.10	0.98	0.93	0.76	0.85	1.06	1.48	1.04
270	0.86	0.95	1.34	1.05	1.05	0.90	0.93	1.35	1.55	1.18
Mean	0.77	0.84	1.07	0.96		0.77	0.84	1.06	1.29	
LSD (5%)	(N)	0.08				LSD (5%)			(N)	0.06
LSD (5%)	(Y)	0.08				LSD (5%)		(Y)	0.06	
LSD (5%)	(NXY)	0.14				LSD (5%)			(NXY)	0.11

L.S.D = least significant differences at 0.05 probability.

The combined treatment (minimum nitrogen rate 90 kg fed^{-1} combined with spray at the lowest concentration of yeast 6 g/L) achieved the lowest values of carotene.

Our results were in harmony with the results obtained by **Inugraha *et al.* (2014)** on Stevia, **Nikbakht *et al*. (2008)** on Gerbera, **Karakurt *et al.* (2009)** on Pepper, and **Mazhar *et al.* (2012)** on *Chrysanthemum* plants. They stated that, increasing N fertilization led to an increase in chlorophyll A, B and total chlorophyll and carotenoids. Also many authers working on humaic substances on different crops and were in agreement with our results such as **Inugraha *et al.* (2014)** on Stevia, **Nikbakht *et al*. (2008)** on Gerbera, **Karakurt *et al*. (2009)** on Pepper, **Farouk *et al*. (2011)** on (*Raphanussativus*, L. var. sativus).

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