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EFFECT OF FARMYARD MANURE, IRRIGATION WATER QUANTITY AND SOME ANTITRANSPIRANTS ON GLOBE ARTICHOKE IN SANDY SOILS.

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ABESTRACT

The search was conducted for two successive seasons of 2007/2008 and 2008/2009 at Private Farm El-Salhia City, Sharkia Governorate, Egypt, (+7 m ultitude, 31^{o} 06^{-} Latitude and 31^{o} 26^{-} longitude) to investigate the effect of FYM application at 10,20 and 30 m^3/fed.; irrigation water quantity at 1200,1800 and 2400 m^3/fed. and antitranspirants i.e. kaolin and Ca CO_3 on vegetative growth, yield and its components, as well as chemical composition of globe artichoke plants .

The most important finding could be summarized as follows:

- Increasing farmyard manure levels from 10 to 30 m^3 / fed. significantly increased vegetative growth of globe artichoke, yield and its chemical components N P K , inulin and total sugars. Increasing water quantity levels from 1200 to 2400 m^3 / fed., significantly increased growth characters and chemical components as N P K, inulin and total sugars concentration.Also, The spraying with kaolin and Ca CO_3 at 6 % led to significant increase in growth characters traits, NPK ,inulin and total sugar concentrations compared tom control .While, Proline content in leaves was observed under lower application of farmyard manure ,water quantity as well as received no antitranspirants.
- The interaction between farmyard manure at 30 m^3 / fed. and water quantity *at* 1800 m^3/fed. was superior treatment regarding growth characters and also gave the highest values of chemical composition in both seasons. Also, interaction between farmyard manure at 30 m^3 / fed. with kaolin 6 % was superior treatment *for* growth characters and gave the highest values of N P K ,inulin and sugar concentrations .On the other hand , interaction between water quantity 1800 or 2400m^3 / fed. with kaolin at 6 % increased growth characters and gave the highest values of chemical composition. While, Proline content in leaves was observed under interaction of lower application farmyard manure ,water quantity and no received antitranspirants.
- The interaction between farmyard manure at 30 m^3/fed. and water quantity 1800 m^3 / fed. as well as kaolin 6% gave the highest values of growth characters and N P K, inulin and total sugar concentrations. While, Proline content was obtained under application of farmyard manure at 10 m^3 / fed., water quantity 1200 m^3/fed. as well as received no antitranspirants (distilled water).
- Generally, it could be concluded that, application farmyard manure at 30 m^3/fed., water quantity 1800 m^3 / fed. and kaolin at 6 % was the best combination for globe artichoke production which resulted in maximum water use efficiency in this study.

Keywords: Globe artichoke-farmyard manure-water quantity–antitranspirants–chemical composition.

INTRODUCTION

Egypt is considered as one of the countries with the highest artichoke productivity per unit area in the world (F.A.O., 2004) , Artichoke was cultivated on 6670 fed. in 2004,which produced 54441 ton of bud yield with an average of 8.76 ton fed^{-1} (the year book of Agric. Statistics and Economic Agric. Dept., Ministry of Agric., Egypt). Artichoke is grown in El-Behira, Alexandria and Giza governorates and newly reclaimed land. Nowadays, more attention is given to promote artichoke production in order to satisfy the increased demands of the local consumption as well as for exportation purposes.

The new reclaimed sandy soils in Egypt are characterized by their poverty in nutrient elements, water retention, very low organic matter content and has poor physical, chemical and biological properties. Recently deficiency of water resources in Egypt has led to the adoption of appropriate strategies to save water and improve irrigation efficiency. This creates the need for methods that use water as efficiently as possible. Efficient use of water depends on applying enough water to prevent serious plant water deficits which in turn reflected on the productivity (Abo El- Kheir 2000 and Simpson, 1981).

Certain chemicals with some biological activities could be used to reduce the transpiration rate and mitigate plant water stress by increasing the leaf resistance to the diffusion of water vapor. Based on their mechanism of action, such antitransparents (AT'S) were grouped into three categories (Mahfouz 1997), namely film forming types (which coat leaf surface with films that are impervious to water vapor), reflecting materials (which reflect back a protion of the incident radiation falling on the surface of the leaves) and stomata closing types (which affect the metabolic processes in leaf tissue). Film forming and reflecting AT'S were found to be non-toxic and have longer period of effectiveness than metabolic types (Gawish, 1992). Moreover, in contrast to most film forming AT'S which are impermeable to Co_2 exchange and thus may reduce the rate of photosynthesis (Moftah, 1997) . In addition a reflective kaolin spray was found to decrease leaf temperature by increasing leaf reflecting and to reduce transpiration rate more than photosynthesis in many plant species grown at high solar radiation levels (Nakano and Liehara, 1996) . Early studies demonstrated that the reflective kaolin improved the water status and the yield of water-stressed tomato plants, while it did not deduce carbon assimilation (Glenn *et al.,* 2003) . It is clear that much of the water applied in irrigation is lost through transpiration of plant. Reduction of transpiration could minimize the irrigation water quantity required and thus relieve the plant from water stress to creation extent .Application AT'S such as kaolin and white wash ($Ca\ Co_3$) to plant could reduce transpiration by increasing leaf resistance to diffusion of water vapor (Anwar,2005 and Abou El-Khair, 2004).

Organic manures play a direct role in plant growth as they are the source of all necessary macro - and micro - nutrients .They also improve agrochemical, physical and physiochemical properties of soil, they improve

air and water regimes of the soil .Thus growth of most vegetable crops improved by applying organic manures (Dahama, 1999).

For these reasons, the objective of this work was to determine the suitable amounts of farmyard manure, irrigation water quantity and antitranspirant to obtain high productivity and minerals content of globe artichoke crops under sandy soil conditions.

MATERIALS AND METHODS

Two successive field experiments were established during 2007/2008 and 2008/2009 seasons at El-Salhia (Private Farm) Sharkia Governorate, Egypt, (+7 m altitude, 31^{o} 06^{-} Latitude and 31^{o} 26^{-} longitude).Globe artichoke (*Cynara scolymus* L.) was obtained from Agric. Res. Center. The sowing dates were 5^{th} and 2^{th} of August in the 1^{st} and 2^{nd} seasons, respectively. the old grown pieces (stumps) were treated pre-planting with fungicides for 30 minutes and hand planted at 1 m apart between each two plants on the ride and 1 m between the ridges. The sub-sub plot area was 25 m^{2} (5 rides, each 5 m long and 1 m width).

The experimental design was split-split plot with 3 replicates. Main treatments were assigned to farmyard manure (FYM) application which added at rates 10, 20 and 30 m^{3} / fed. Treatments of Irrigation water quantity were applied in subplot which were 1200, 1800 and 2400 m^{3} / fed. Sub-sub area were assigned to treatments of antitranspirnts as foliar application (distilled water as the control, Kaolin at 6 % as aluminum silicate and calcium carbonate at 6% as white wash .

At the beginning of the experiment, surface soil samples were collected and analyzed according to (Black, 1982).Some physical and chemical characteristics of the experimental soil are shown in table 1.ChemIcal analysis of FYM were carried out according to (Black, 1982) and listed in Table 2

Table 1: Some physical and chemical properties of the experimental soil.

Some Physical properties	Values	Some Chemical properties	Values
Sand %	90.29	pH	8.11
Silt %	8.40	EC dsm^{-1} (Soil paste)	1.08
Clay %	1.31	O.M %	0.03
Texture	Sandy	Total N %	0.02
S.P %	16.20	Available –N(ppm)	5.11
F.C %	8.10	Available –P(ppm)	4.16
W.P %	3.20	Available –K(ppm)	13.01

Table 2 : The chemical properties of farmyard manure.

Chemical properties	pH	O.M %	Total N%	Available –N- ppm	Available – P-ppm	Available –K-ppm
Values	7.13	1.66	0.48	397.0	49.0	1018.0

The experiment included 27 treatments in 3 replicates of 81 all experimental units which received equal amounts of water from planting (100 m^3 water / fed.). The water was added using water control and pressure gauge at 0.5 bar. The amounts added water at different treatment were calculated and expressed in terms of time based on the rate of water flow through the drippers (2liter / h) to give such amount of water .Irrigation numbers, the time (min) and water quantity (m^3) in every irrigation are shown in table 3.

Table 3: The time (min) and amounts of applied irrigation water (m^3 / fed.) as well as / plot) in every irrigation during the growth period of Globe artichoke .

Water quantity (m^3/ fed.)	Irrigation number	Irrigation in every irrigation (min)	Water quantity (m^3/fed.) in every irrigation	Water quantity (m^3/plot) in every irrigation
1200	44	50	27.27	0.042
1800	44	75	40.91	0.063
2400	44	100	54.55	0.084

Globe artichoke (Balady C.V) plants were sprayed with antitranspirnts (AT'S) solutions at 60,90 and 120 days after planting .Each plot received 2 liter aqueous solution of AT'S using spreading agent. The control plants (check) were sprayed with distilled water and spreading agent only.

All experimental units received 90 kg N, 60 kg P_2O and 72 kg K_2O / fed. as ammonium sulphate (20.6 %N) ,triple super phosphate (15.5 % P_2O5)and potassium sulfate (48% K_2O), respectively .One third of these commercial fertilizers was added at soil preparation time with FYM. The rest of commercial fertilizers (two thirds) were applied in eight equal split applications through irrigation water.

Recorded data:

The following data were recorded at 150 days after planting

1- Vegetative growth parameters i.e., plant height (cm) and dry matter of leaves %

2- yield and its components i. e., early yield (all flower heads were harvested, calculated in ton /fed.during December up to the end of February) and total yield (all flower heads were harvested from the beginning of harvest until the end of season). Flower characters (A random sample of 10 flower heads was taken from each plot to measure average weight and length of flower heads).

3- Some nutrients and chemical composition.

Content of N, P and K.

The dry matter of receptacle at 150 days after planting ,were finely ground and wet digested for N, P and K determination. total nitrogen, phosphorus and potassium were determined according to the methods described by Black (1982),respectively .

-Total sugars was determined according to Forsec ,(1938).

-Inulin was determined according to Winton and Winton (1958).

4- Proline content was determined in leaves at 150 days from planting in both seasons of study according to Bates, (1973)

5-Water use efficiency (WUE)

It was calculated according to equation of Begg and Turner (1976) as follows

$$\text{Water use efficiency} = \frac{\text{Yield (ton / fed)}}{\text{Water quantity (m}^3\text{/fed)}} = \text{ton / m}^3$$

6- Statistical analysis:

The data of both experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran,(1980) and means were compared according LSD at 5 % level.

RESULTS AND DISCUSSION

A- Effect of farmyard manure, (FYM):

Data presented in Table 4 , show that farmyard manure,(FYM) significant affected the vegetative growth characters i.e., plant height and dry matter of leaves, yield and its components i.e., early yield, total yield and average weight and length of flower heads of plant in both seasons. Increasing, (FYM) levels addition, in general, significantly increased vegetative growth and yield and its components .the highest, (FYM) levels addition, i.e., 30 m^3/ fed. came in the first rank in this respect .This treatment was the most superior one for enhancing plant growth and yield and its components. It is seen also, from the same data, that all the plant growth characters and yield and its components of plants were lowest mean values under FYM levels addition ; i.e. 10 ton /fed. in both seasons.

This increase in globe artichoke plants after FYM application my be due to that application of organic manure to sandy soil can result in improving their physico-chemical and biological properties. Moreover, increasing the vegetative growth and yield and its components of globe artichoke plants after FYM application my be due that application of FYM to sandy soil increase soil organic matter, cation exchange capacity, available mineral nutrients and this in turn stimulate plant growth and yield (Marschner, 1995).Theses results are in agreement with those reported by Farag and Hussein (2000) on onion, Abo El-Kheir (2004) on garlic crop, Salamah (2005)on globe artichoke, they found that increasing FYM levels to plant led to increase in vegetative growth and yield and its components.

B. Effect of irrigation water quantity:

Data in Table 4, revealed that the irrigation water quantity had significant effect on vegetative growth characters and yield and its components of globe artichoke plants in both seasons. Increasing irrigation water quantity levels, in general, significantly increased vegetative growth characters and yield and its components .

T4

The highest irrigation water quantity, i.e., 2400 m^3/ fed. came in the first rank in this respect .This treatment was the most superior one for enhancing plant growth and yield and its components of globe artichoke plants. It is seen also, from the same data, that all the plant growth characters and yield and its components were the lowest values under irrigation water quantity, i.e., 1200 m^3/ fed. in both seasons.

It could be suggested that increasing irrigation water quantity applied to globe artichoke plants led to keep higher moisture content in the soil and this in turn might favored the plant metabolism that leads to increase the plant growth characters and yield (Saleh,2003).Obtained results are in confirmed with those reported by Pellicciari and Sismondo (1976), Husain and Stewatr (1996) and Litrico *et al.* (1998), They found that increasing irrigation water quantity levels increased plant growth characters and yield of globe artichoke plants.

C. Effect of antitranspirants (AT'S):

Data in Table4 revealed that spraying AT'S had significant effect on vegetative growth and yield and its components of globe artichoke plants in both seasons. Application AT'S ; i.e., Ca CO_3 and kaolin showed ,in general, favorable effect on vegetative growth and yield and its components when compared with control .It is evident from the same data in Table 4 that AT'S were different in their effects on vegetative growth characters and yield and its components .Where, kaolin at 6% was the superior treatments .

Increasing in growth resulted from AT'S treatments were attributed primarily to their effect on increasing plant water potential at a time when the growth of that particular plant more depended on water status than on photosynthesis (Boyer,1970).The reduction in transpiration by reflecting material such as kaolin was reported to increase the reflectivity of incident radiation as especially in the visible region , this would lead to reduction of net energy uptake, lower temperature and subsequently decrease in transpiration rate (Abou-Khaled *et al.*,1970).The obtained results are agreeable with those reported by Upadhyaya and Mathur (1992) on wheat, Gawish and Fattahallah (1997)on taro, and Abd El-Aal *et al.* (2008)on eggplant.

A.B- Effect of interaction of farmyard manure (FYM) with water quantity:

Regarding the effect of interaction of farmyard manure (FYM) with water quantity on vegetative growth ,yield and flower characters of globe artichoke ,data in Table 5 ,showed significant effect for the interaction on plant height , dry weight of leaves ,total yield and weight of flowers in both seasons and length of flowers in the first seasons only, were significantly increased by the interaction between(FYM) and water quality.

The highest mean values of all treatments, in both seasons, were obtained from the interaction of (FYM) and 1800 m^3 / fed. The superiority effect could be explained in the light of the great roles played by (FYM) as the soil amendment which improves water holding capacity of sandy soils and increase macro and micro elements availability in the rhisospher around root system which in turn decrease the needed applied irrigated water to sandy soil and increased vegetative growth and yield of plant (Nour and Anwar ,2009).

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Obtained results are confirmed with those reported by EL-Mansi *et al.* (1999)on pea and Abou-EL-Khair (2004)on garlic, they found that water economy of plants increased with increasing the amount of FYM.

A.C- Effect of interaction between farmyard manure (FYM) and antitranspirants:

As for the effect of interaction between (FYM) and antitranspirants on globe artichoke, data in Table 6, indicated that the interaction ,generally ,resulted in the highest mean values of all studied characters at 30 m^3 / fed. with kaolin compared with other treatments, dry weight of leaves ,total yield and weight of flowers were significantly increase in both seasons .On the contrary ,length of flowers was not significantly influenced by the above mentioned interaction in the both seasons .Also, plant hight in the second seasons and early yield in the first seasons only. It could be suggested that farmyard manure contains many species of living organisms which release photo-hormones as AG, IAA and CYT which stimulate plant growth and yield (Reynders and Vlassan, 1982).Also, antitranspirants led to keep more water content in plant tissues due to lowering evaporation and transpirations rate, and this in turn led to enhance and favor the growth rate, photosynthesis and enzymes activities that finally led to increase dry matter and total yield (sawan *et al.* 2001)

B.C- Effect of interaction between water quantity and antitranspirants:

Concerning the interaction effect of water quantity with antitranspirants data in Table 7, reveled that increasing water quality from 1200 to 2400 m^3 /fed. in the presence of kaolin or $CaCo_3$ caused increase in plant height ,dry weight ,early yield ,total yield and flowers characters .

These increases were significant in the case of total yield and weight of flowers, in both seasons, but not significant in the case of early yield and length of flower in both seasons .Meanwhile, plant height was significantly in the second seasons only.

It could be suggest that adding sufficient water markedly favored the total yield via its favorable effect on plant growth, as it is well known that water plays great role and has important function in all physiological processes starting from minerals absorption from the soil up to building different components inside the plant and finally the yield is the sum of plant growth and development (Suryanarana and Venkateswarlu, 1981). The obtained results are agreeable with those reported by Irmak *et al.,*(1999),El-Abd (1986) and Cszinsky (2001) .

A.B.C- Effect of interaction among FYM, irrigation water quantity and antitranspirants:

Illustrated data in Table 8, indicated that the interactions between FYM, irrigation water quantity and AT'S had significant effect on total yield and weight of flowers of globe artichoke plants in both seasons. While, dry weight of leaves and early yield were significantly affected in the second season only. However, plant height and length of flowers were not affected in both seasons .As it has been mentioned above, higher farmyard manure (FYM) 30 m^3/ fed. and irrigation water quantity 1800 m^3/ fed. applied to plants ,besides spraying with kaolin at 6% gave the highest values of all studied characters globe artichoke plants .

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while, plants were not spray with AT'S ,received FYM at 10 m^3/ fed. And irrigated with 1200 m^3/ fed. gave the lowest values in both seasons. in this connection, Moftah, (1997) found that kaolin or white wash at 6% at the lower irrigation levels improved growth characters of Soybean particularity.

A- Effect of farmyard manure, (FYM) on some nutrients and Chemical composition

Concerning the effect of levels of farmyard manure (FYM) ,data given in table 9 ,reflected a significant influence for the level of FYM applied on receptacle content of nutrients, inulin and total sugars. Using FYM at 30 m^3/ fed. Promoted a higher content of nutrients, inulin and total sugars than 20 m^3/ fed The response of plants to the FYM levels may be due to increasing soil acidity, organic matter, available P, exchangeable Mn and Zn , and this in turn may affect on nutrient content in plant (Hsiehan and Hsu 1993).Several previous studies recorded significant increases in content of nutrients, inulin and total sugars due to using higher levels of farmyard manure in the fields Salama (2005)on globe artichoke. Meanwhile, Proline content in leaf tissues was at the lowest level under higher values of applied FYM 30 m^3/ fed. The decrement in the amount of prolein with FYM may be attributed to that FYM decrease water loss through evaporation and leaching in soil and this in turn increases the availability of water for longer time (Lancher,1993). in this connection, EL-Mansi *et al.* (1999) found that Proline content in pea shoots significantly decreased with increasing FYM up to the highest level.

B-Effect of irrigation water quantity:

illustrated data in Table 9,show that irrigation water quantity reflected significant effect on nutrients, inulin and total sugars contents. the highest level of irrigation water quantity 2400 m^3/ fed. in general ,showed enhancing effect on mineral concentration ,while they were minimum under irrigation water quantity (1200 m^3/ fed.)

Nutrients, inulin and total sugars contents were enhanced by increasing applied irrigation water quantity level 2400 m^3/ fed. Nutrients ,inulin and total sugars were minimum under irrigation water quantity (1200 m^3/ fed.) .As it was previously mentioned increasing the applied irrigation water quantity to the soil increased the moisture content that makes mineral more available to the plant , factor that led to enhance mineral concentration and their uptake .These results are confirmed with Foti *et al.* (2000), Macua *et al.* (2000). (Abd-Rheem,2003).Meanwhile, Proline content in leaf tissues was at the highest level under lower values of applied water (1200 or 1800 m^3/ fed.).In the other words, the highest applied water quantity to the plants and lowest of Proline content in leaf tissue can be considered as an indicator for water stress.

It has been reported that Proline oxidation proceeds readily in turgid tissue and this process could be stimulated by higher concentration of prolien. This suggests that prolien oxidation could function as a control mechanisms for maintaining low cellular levels of Proline in turgid cell. Proline oxidation is reduced to negligible rate under water stress .

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It seems likely that ,inhibition of Proline oxidation in necessary in maintaining high levels of Proline found under water stress (Stwart,1977, Tarantino *et al.* 2000, Saleh 2003 and Saker and Gadalla 2009).

C- Effect of antitranspirants:

As for NPK concentration, inulin and total sugars in receptacle, Data in Table9, reflected significant effect on N,P,K, inulin and total sugars in both seasons of study, in this connection ,spraying plant with kaolin gave the highest values compared with other treatments. These results are confirmed with Mahfouz,1997, Anwer (2005), Abd El-Aal *et al.,* (2008)and Ezat *et al., (2009),* they found that spraying plants with antitranspirants increased N,P K and total carbohydrates contents compared with control .

Data in table 9, raveled that different use AT'S reflected significant effect on Proline content in globe artichoke leaf tissues. It is obvious that Proline content was the lowest levels after spraying with either kaolin or Ca Co_3 at 6 %. However, kaolin seemed to the lowest one compared to all other treatments. plants received no AT'S attained maximum values of Proline content. The decrement in the amount of Proline in leaf tissues after spraying with AT'S may be attributed to that AT'S led to decrease water loss from plant through evaporation and transpiration, and this in turn increase the amount of water content in the tissue, resulting to decrease in Proline content. The present results are confirmed with those reported by Zowain and Norsong (1991) and Irmak *et al.,* (1999).

A.B-Effect of interaction between farmyard manure (FYM) and irrigation water quantity:

Data illustrated in table 10 show that total sugars was significantly increased, in both seasons, by the interaction of (FYM) and water quantity .However, N,P, K and inulin were not significantly in both seasons of study. In general, plant received 30 m^3 /fed. farmyard manure with 1800 or 2400 m^3/fed. water ,gave the highest values of chemical components in both seasons. There was no significant differences between total sugars content at 1800 or 2400 m^3 /fed. Under 30 m^3 (FYM).It could be said that application of (FYM) to sandy soil is essential for its fertility and for increasing the available water, field capacity and wiliting point in such soil which ,in turn decrease the needed applied irrigated water to sandy soil (Marshner 1995).

Proline amino acid was significantly reduced by the interaction between FYM at 30 m^3 /fed. with 2400 m^3 water in both seasons of study. plants received lower water quantity, i.e., 1200 m^3 /fed. With out adding FYM recorded maximum Proline content in their leave tissue. Since then, Proline content in leaves, can be taken as an indicator for water stress(Saker and Gadalla 2009). These results agree with those reported by EL-Mansi *et al.* (1999) who found that the combination between FYM and water quantity decreased significantly Proline content in pea shoots plants.

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A.C- Effect of interaction between farmyard manure (FYM) and antitranspirants:

Data presented in Table 11, show the interaction effect of FYM and antitranspirants, on chemical components of globe artichoke. This interaction had no significant effect on N,P,Kand inulin in both seasons of study. However, total sugars were significantly increased in both seasons of study. Plant supplied with30 m^3 /fed. (FYM) in the presence of kaolin or Ca CO_3 gave higher values of N,P,K, inulin and total sugars in both seasons of study .

Proline was significantly reduced by the interaction effect of FYM and antitranspirants in both seasons. The lowest values of proline was obtained from 30 m^3/fed. (FYM) and kaolin. The decrement in the amount of prolein in leaf may be attributes to that (FYM) and AT'S led to decrease water loss from plants through evaporation and transpiration, and this in turn increase the amount of water in tissues, resulting in decrease in prolein content. Similar finding was reported by Zowain and Narong (1991).

B.C- Effect of interaction between irrigation water quantity and antitranspirants:

It is evident from Table 12, that interaction of water quantity with antitranspirants had no significant effect on N, P, K, inulin and total sugars during the two seasons. However it is worth to mention that highest values of N,P,K,inulin and total sugars were produced when 1800 or 2400 m^3 / fed. interacted with kaolin in both seasons of study.

Proline amino acid content was significantly affected by the interaction treatments .The lowest values of Proline were obtained from 2400 m^3 / fed. with kaolin in both seasons, increasing the applied. water to the soil increased the moisture content that makes mineral more available to the plant, factor that led to enhance mineral concentration and their uptake . on other hand, Proline content increased under water stress. Jones (1981) reported that water stress decreased photosynthesis and its enzymes activities, but increased Proline accumulation, while Barker *et al.*, (1993) found that leaf Proline concentration averaged 20 times greater in the stressed compared to well watered plants. These results agree with Pomares *et al.,* (2004) on globe artichoke and Abd El- Reheem (2003)on potao plant.

A.B.C- Effect of interaction among FYM, irrigation water quantity and antitranspirants:

The results in Table 13, indicated that the uppermost values of N,P,K, inulin and total sugars content were obtained after treating with kaolin and1800 or 2400 m^3/ fed. irrigation water quantity under 30 m^3 / fed farmyard manure ,while the lower most values ,in general ,were obtained with out AT'S with the lowest level of irrigation water .i.e., 1200 m^3/ fed. , under the lowest level of farmyard manure, i.e., 10 m^3/ fed.

With respect to the interaction between farmyard manure (FYM) ,irrigation water quantity and AT'S ,it is evident from the data in table13, that Proline amino acid content was significantly affect by the interaction treatments .

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It is quite clear that treating globe artichoke plants with kaolin at 6 % was the lowest under all irrigation water quantity as well as all farmyard manure. However, the values were obtained when plants received no AT'S (distilled water) under the lowest irrigation water quantity 1200 m^3/ fed. as well as farmyard manure 10 m^3/ fed. were the highest in both seasons of study .

Water use efficiency (W U E):

The effect of water quantity on water use efficiency ,the results presented in table 14, show that, the maximum mean values of water use efficiency was obtained under the lowest water quantity 1200 values of (W U E)) compared to 1800 and 2400 m^3/ fed.,in the both seasons of study .The mean values of (W U E) gradually decreased with increasing water quantity up to the highest level and showed opposite trend to that of total yield .The results are confirmed with Saleh (2003) on globe artichoke and Anwar (2005) on potato ,he found that the efficiency of water use was increased by applying deficit water quantity .

Regarding the interaction, the results show significant effect among the different combinations .The highest mean values of (W U E) was obtained in plant grown under the high level of water quantity with control under water quantity at 1800 m^3/ fed. compared with control with applied of FYM at 30 m^3/ fed. as well as spraying kaolin at 6% in both seasons.

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تأثير مستويات السماد العضوي وكميات ماء الري والرش بمضادات النتح على الخرشوف فى الاراضى الرملية.

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نفذت تجربتان حقليتان خلال موسمي ٢٠٠٧ / ٢٠٠٨ و ٢٠٠٨ / ٢٠٠٩ بمزرعة خاصة بمدينه الصالحية - محافظه الشرقية وذلك لدراسة تأثير مستويات السماد العضوي وهى ١٠ ،٢٠ ، ٣٠ م^3 / فدان وثلاث مستويات من ماء الري وهى ١٢٠٠ ، ١٨٠٠ ،٢٤٠٠ م^3 / فدان تحت الرش بثلاث معاملات من مضادات النتح وهى الكاؤلين و كربونات الكالسيوم و ماء مقطر بالاضافه إلى التفاعل بينهم على النمو الخضري والمحصول ومكوناته بالاضافه إلى المحتويات الكيماوية لمحصول الخرشوف .

وكانت اهم النتائج المتحصل عليها كما يلى :-

- أدى زيادة أضافه السماد العضوي من ١٠ إلى ٣٠ م^3 / فدان إلى زيادة معنوية في كلا من صفات النمو الخضري وكذلك المحصول ومكوناته ومحتواه من عناصر النيتروجين والفوسفور والبوتاسيوم كما أدى إلى زيادة الانيولين والسكريات، كما أن زيادة أضافه ماء الري من ١٢٠٠ إلى ٢٤٠٠ م^3 / فدان أدى إلى زيادة معنوية في معظم صفات النمو الخضري وكذلك المحصول ومحتوياته ومحتواه من عناصر النيتروجين والفوسفور والبوتاسيوم وأيضا زيادة كلا من الانيولين والسكريات الكلية بينما أدى استخدام الكاؤلين وكربونات الكالسيوم بتركيز ٦ % (كمضادات للنتح) رشا إلى زيادة معنوية فى صفات النمو الخضري وكذلك المحصول ومحتوياته ومحتواه من عناصر النيتروجين والفوسفور والبوتاسيوم وكذلك زيادة الانيولين وتركيز السكريات مقارنه بالرش بالماء المقطر (كنترول).

لوحظ زيادة محتوى الأوراق من البرولين نتيجة أضافه اقل كميه من السماد البلدي وماء الري .

- كانت معاملة التفاعل بين أضافه معامله السماد البلدي ٣٠ م^3 / فدان مع معامله كميه ماء الري ١٨٠٠ م^3/ فدان هي الأفضل بالنسبة لصفات النمو الخضري والمحصول للخرشوف ومحتواه الكيماوي. وأيضا أدى التفاعل بين أضافه معامله السماد البلدي ٣٠ م^3 / فدان مع الرش بمعامله الكاؤلين ٦ % إلى أفضل صفات للنمو الخضري واعلي قيم لكلا من النيتروجين والفوسفور والبوتاسيوم والانيولين وكذلك تركيز السكريات . كذلك أدى التفاعل بين معامله ماء الرى ١٨٠٠ أو ٢٤٠٠ م^3 / فدان في وجود الرش الكاؤلين بتركيز ٦ % إلى زيادة صفات النمو الخضري والمحتوى الكيماوي للمحصول. وقد لوحظ أن محتوى الأوراق من البرولين قد نتج عن أقل معامله من السماد البلدي وماء الري.
- أدى التفاعل الثلاثى بين أضافه معامله السماد البلدي ٣٠ م^3 / فدان مع معامله كميه ماء الري ١٨٠٠ م^3 للفدان وكذلك الرش بالكاؤلين بتركيز ٦ % إلى أفضل صفات للنمو الخضري واعلي قيم لمحتوى المحصول من النيتروجين والفوسفور والبوتاسيوم والانيولين وكذلك تركيز السكريات . بينما وجد ان أعلى محتوى من البرولين كان ناتج من تفاعل معامله السماد البلدى ١٠ م^3 / فدان ومعامله ماء الري ١٢٠٠ م^3 / فدان فى حالة عدم أضافه اى مضادات للنتح .

وأخيرا توصى الدراسة باضافه معامله السماد البلدي ٣٠ م^3 / فدان و معامله كميه ماء الري ١٨٠٠ م^3 للفدان وكذلك معامله الكاؤلين بتركيز ٦ % رشا للحصول على أفضل محصول ذو جودة عالية من الخرشوف.

قام بتحكيم البحث

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Table 4: Vegetative growth, yield and flower characters of globe artichoke as affected by farmyard manure,water quantity and antitranspirants ,during 2007 / 2008 and 2008 / 2009 seasons.

Characters	Plant height (cm)		Dry weight %		Early yield ton/fed.		Total yield ton/fed.		Flower characters			
									Weight (gm)		Length (cm)	
seasons / Treatments	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
A-FYM :												
10 m^3 / fed.	39.76	41.80	12.08	11.48	0.392	0.385	6.328	5.414	133.13	141.30	12.6	11.30
20 m^3 / fed.	44.34	46.62	15.95	15.12	0.616	0.588	7.812	7.086	151.70	156.87	14.96	13.90
30 m^3 / fed.	47.93	49.70	18.22	17.42	0.711	0.634	8.543	8.029	164.28	174.30	16.11	15.12
L.S.D. 5%	**1.60**	**0.72**	**0.443**	**0.065**	**0.030**	**0.004**	**0.053**	**0.101**	**4.75**	**1.63**	**1.27**	**1.14**
B-water quantity:												
1200m^3/fed.	40.99	41.85	13.66	13.18	0.513	0.408	6.545	5.793	113.20	119.11	12.20	11.18
1800m^3/fed.	45.32	47.43	16.05	14.94	0.575	0.566	7.827	7.163	159.06	167.46	15.17	14.04
2400m^3/fed	46.62	48.73	16.53	15.89	0.631	0.633	8.310	7.571	176.84	185.89	16.31	15.11
L.S.D 5%	**1.12**	**0.57**	**0.41**	**0.115**	**0.041**	**0.011**	**0.060**	**0.065**	**4.19**	**3.68**	**0.67**	**0.63**
C- antitranspirants												
control	37.12	38.54	12.85	12.93	0.529	0.489	6.799	6.111	122.63	125.00	12.16	11.55
Ca Co_3	44.44	46.92	16.03	14.65	0.578	0.536	7.700	6.956	157.57	168.01	14.88	13.59
Kaolin	51.36	52.64	17.36	16.44	0.611	0.582	8.183	7.461	168.91	179.46	16.61	15.18
L.S.D. 5%	**0.83**	**1.55**	**0.433**	**0.056**	**0.031**	**0.009**	**0.067**	**0.063**	**2.08**	**2.14**	**0.35**	**0.64**

*** S_1 = the first season.**

*** S_2 = the second season.**

Table 5 : Vegetative growth, yield and flower characters of globe artichoke as affected by the interactions between farmyard manure and water quantity during 2007 / 2008 and 2008 / 2009 seasons

Characters		Plant height (cm)		Dry weight%		Early yield ton/fed.		Total yield ton /fed.		Flower characters			
										Weight (gm)		Length(cm)	
Seasons / FYM - WATER		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
10 m^3 / fed.	1200m^3fed.	37.77	36.82	11.16	10.38	0.339	0.327	5.706	4.406	87.98	94.50	10.94	8.88
	1800m^3 fed.	40.30	43.57	12.20	11.30	0.393	0.376	6.343	5.628	141.61	151.46	12.37	11.30
	2400m^3 fed.	41.21	45.17	12.86	12.75	0.444	0.451	6.933	6.207	169.80	177.94	14.49	13.72
20 m^3 / fed.	1200m^3fed.	41.86	42.25	13.37	13.18	0.552	0.444	6.663	6.108	121.39	121.77	12.23	11.57
	1800m^3 fed.	44.04	46.69	16.25	15.12	0.603	0.602	7.872	7.088	154.08	159.04	15.52	14.42
	2400m^3 fed.	49.78	50.92	18.22	17.05	0.693	0.719	8.899	8.061	179.63	189.80	17.13	15.71
30 m^3 / fed.	1200m^3fed.	43.33	46.48	16.46	15.99	0.648	0.455	7.266	6.865	130.23	141.08	13.43	13.09
	1800m^3 fed.	51.60	52.18	19.71	18.41	0.730	0.720	9.267	8.774	181.51	191.89	17.59	16.84
	2400m^3 fed.	48.85	50.08	18.48	17.87	0.756	0.729	9.097	8.446	181.10	189.93	17.31	15.84
L.S.D 5%		**1.94**	**0.99**	**0.72**	**0.198**	**N.S**	**0.02**	**0.105**	**0.113**	**7.26**	**6.37**	**1.16**	**N.S**

*** S_1 = the first season.**
*** S_2 = the second season**

Table 7 : Vegetative growth, yield and flower characters of globe artichoke as affected by by the interactions between water quantity and antitranspirants ,during 2007 / 2008 and 2008 / 2009 seasons.

Characters		Plant height (cm)		Dry weight %		Early yield ton/fed.		Total yield ton/fed.		Flower characters			
										Weight (gm)		length (cm)	
Seasons / Water - AT,S		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
1200m^3fed.	control	34.69	34.34	11.24	11.50	0.459	0.366	5.990	5.236	95.44	93.28	10.06	9.73
	Ca Co_3	41.26	42.41	14.37	13.29	0.526	0.408	6.721	5.871	117.01	129.22	12.16	11.42
	Kaolin	47.02	48.80	15.38	14.76	0.553	0.453	6.924	6.272	127.14	134.84	14.40	12.38
1800m^3fed.	control	36.91	38.68	13.69	13.33	0.540	0.515	6.989	6.275	127.33	132.41	12.89	11.84
	Ca Co_3	45.91	48.19	16.63	14.83	0.577	0.569	7.986	7.317	169.71	178.27	15.51	13.99
	Kaolin	53.13	55.40	17.83	16.66	0.609	0.615	8.507	7.899	180.16	191.71	17.11	16.18
2400m^3fed.	control	39.77	41.27	13.61	13.95	0.591	0.588	7.416	6.821	145.11	149.32	13.59	12.98
	Ca Co_3	46.16	50.18	17.09	15.82	0.630	0.634	8.394	7.680	185.98	196.53	17.00	15.35
	Kaolin	53.92	54.72	18.87	17.90	0.671	0.677	9.119	8.213	199.44	211.82	18.34	19.99
L.S.D 5%		**1.45**	**N.S**	**N.S**	**0.01**	**N.S**	**N.S**	**0.11**	**0.11**	**3.62**	**3.73**	**N.S**	**N.S**

*** S_1 = the first season.**
*** S_2 = the second season**

Table 8: Vegetative growth, yield and flower characters of globe artichoke as affected by the interaction among farmyard manure, water quantity and antitranspirants, during 2007 / 2008 and 2008 / 2009 seasons.

Characters			Plant height (cm)		Dry weight%		Early yield ton/fed.		Total yield ton/fed.		Flower characters			
											Weight (gm)		Length (cm)	
seasons / treatments			S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
10 m^3/ fed.	1200m^3 fed.,	control	31.17	30.15	9.27	8.31	0.295	0.266	5.293	4.074	68.8	76.17	8.87	7.63
		$Ca Co_3$	36.31	36.86	11.64	10.28	0.346	0.331	5.853	4.465	93.5	100.10	10.63	8.93
		Kaolin	45.84	43.45	12.58	12.54	0.376	0.385	5.974	4.678	101.63	107.23	13.33	10.07
	1800m^3 fed.	control	33.78	35.44	10.62	9.80	0.362	0.361	5.669	4.656	96.60	106.43	10.33	9.90
		$Ca Co_3$	39.41	42.82	11.94	11.29	0.396	0.373	6.583	5.657	156.17	166.07	12.70	10.73
		Kaolin	47.73	51.96	14.04	12.81	0.422	0.395	6.777	6.571	172.07	181.87	14.17	13.27
	2400m^3 fed.	control	34.65	37.59	11.15	11.23	0.430	0.430	6.298	5.630	123.23	130.57	11.37	12.37
		$Ca Co_3$	39.92	45.12	12.58	12.95	0.437	0.444	6.989	6.156	185.03	197.20	15.37	13.73
		Kaolin	49.06	52.80	14.86	14.07	0.464	0.480	7.513	6.836	200.13	206.07	16.73	15.07
20 m^3 / fed.	1200m^3 fed.,	control	34.94	33.50	11.17	11.81	0.516	0.421	5.996	5.426	101.20	100.40	9.97	10.03
		$Ca Co_3$	43.92	43.85	14.11	13.39	0.555	0.434	6.959	6.125	127.17	128.70	12.17	11.73
		Kaolin	46.75	49.40	14.85	14.34	0.585	0.478	7.033	6.773	135.80	136.20	14.57	12.93
	1800m^3 fed.	control	36.00	38.37	13.49	13.90	0.567	0.533	6.955	6.515	131.77	133.07	13.27	12.23
		$Ca Co_3$	43.38	47.8	17.11	15.31	0.606	0.601	7.994	7.329	162.97	170.03	15.50	14.43
		Kaolin	52.73	53.89	18.15	16.14	0.634	0.672	8.669	7.420	167.50	174.03	17.80	16.60
	2400m^3 fed.	control	43.30	44.02	14.95	14.99	0.628	0.665	7.963	7.489	156.73	161.03	14.70	13.17
		$Ca Co_3$	49.81	53.25	18.99	16.92	0.696	0.723	8.895	8.229	184.1	196.40	17.63	16.03
		Kaolin	56.24	55.51	20.71	19.25	0.755	0.768	9.841	8.465	198.07	211.97	19.07	17.93
30m^3 / fed.	1200m^3 fed.,	control	37.96	39.38	13.30	14.37	0.566	0.411	6.683	6.207	116.33	103.27	11.33	11.53
		$Ca Co_3$	43.55	46.51	17.36	16.21	0.677	0.459	7.351	7.024	130.37	158.87	13.67	13.60
		Kaolin	48.48	53.56	18.72	17.39	0.699	0.495	7.765	7.364	144.00	161.10	15.30	14.13
	1800m^3 fed.	control	40.95	42.24	16.97	16.30	0.690	0.652	8.344	7.654	153.63	157.73	15.07	13.70
		$Ca Co_3$	54.93	53.97	20.86	17.89	0.728	0.732	9.383	8.966	190.00	198.70	18.33	16.83
		Kaolin	58.93	60.35	21.31	21.20	0.772	0.777	10.074	9.704	200.90	219.23	19.37	18.67
	2400m^3 fed.	control	41.36	42.22	14.73	15.63	0.716	0.669	7.989	7.345	155.37	156.37	14.70	13.40
		$Ca Co_3$	48.76	52.17	19.70	17.61	0.756	0.734	9.298	8.656	188.8	196.00	18.00	16.30
		Kaolin	56.45	55.86	21.02	20.38	0.795	0.784	10.005	9.338	199.13	217.43	19.23	17.97
LSD 5%			**N.S**	**N.S**	**N.S**	**0.17**	**N.S**	**0.030**	**0.205**	**0.192**	**6.29**	**6.46**	**N.S**	**N.S**

*** S_1 = the first season.**
*** S_2 = the second season**

Table (6): Vegetative growth, yield and flower characters of globe artichoke as affected by the interaction between farmyard manure and antitranspirants, during 2007 / 2008 and 2008 / 2009 seasons

Characters		Plant height (cm)		Dry weight %		Early yield ton/fed.		Total yield ton fed.		Flower characters			
										Weight (gm)		length (cm)	
Seasons / FYM - ATS		S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
10 m^3 / fed.	control	33.38	34.39	10.34	9.78	0.362	0.352	5.753	4.787	96.21	104.39	10.16	9.97
	Ca Co_3	38.54	41.60	12.05	11.51	0.393	0.383	6.475	5.426	144.90	154.46	12.90	11.13
	Kaolin	47.54	49.40	13.83	13.14	0.421	0.420	6.755	6.028	158.28	165.06	14.74	12.80
20 m^3 / fed.	control	38.08	38.63	13.20	13.57	0.571	0.540	6.971	6.477	129.90	131.50	12.64	11.81
	Ca Co_3	45.70	48.30	16.73	15.21	0.619	0.586	7.949	7.227	158.08	165.04	15.10	14.07
	Kaolin	51.91	52.93	17.90	16.58	0.658	0.639	8.514	7.553	167.12	174.07	17.14	15.82
30 m^3 / fed.	control	40.09	41.28	15.00	15.43	0.657	0.577	7.672	7.068	141.78	139.12	13.70	12.88
	Ca Co_3	49.07	50.88	19.30	17.23	0.721	0.642	8.677	8.215	169.72	184.52	16.67	15.58
	Kaolin	54.62	56.73	20.35	19.60	0.755	0.686	9.281	8.802	181.34	199.26	17.97	16.92
L.S.D 5%		**1.45**	**N.S**	**0.77**	**0.099**	**N.S**	**0.017**	**0.12**	**0.110**	**3.63**	**3.72**	**N.S**	**N.S**

*** S_1 = the first season.**
*** S_2 = the second season**

Table 10 : Chemical composition of globe artichoke as affected by the interactions between farmyard manure and water quantity ,during 2007 / 2008 and 2008 / 2009 seasons.

*** S_1 = the first season.**
*** S_2 = the second season**

Characters		N %		P %		K%		Inulin %		Total sugars %		Proline (ug/g d.wt.)	
Seasons / FYM - WATER		S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
10 m^3 / fed.	1200 m^3 fed.	1.93	1.72	0.249	0.245	2.44	2.22	1.20	1.17	2.77	2.62	443.2	489.1
	1800 m^3 fed.	1.99	1.93	0.262	0.248	2.49	2.26	1.41	1.34	3.09	2.86	372.4	422.6
	2400 m^3fed.	2.09	2.00	0.267	0.252	2.54	2.28	1.58	1.45	3.29	3.15	323.7	337.8
20 m^3 / fed.	1200 m^3 fed.	2.15	2.10	0.302	0.291	2.80	2.60	1.41	1.32	3.20	2.97	378.1	393.6
	1800 m^3 fed.	2.17	2.12	0.310	0.294	2.87	2.65	1.54	1.52	3.55	3.38	311.2	333.3
	2400 m^3fed.	2.20	2.15	0.314	0.298	2.91	2.73	1.71	1.69	3.81	3.85	240.0	272.9
30.m^3 / fed.	1200 m^3 fed.	2.28	2.26	0.317	0.309	3.04	2.88	1.52	1.48	3.72	3.32	299.6	300.4
	1800 m^3 fed.	2.30	2.27	0.342	0.308	3.09	2.98	1.71	1.69	3.93	3.88	244.4	267.7
	2400 m^3fed.	2.32	2.30	0.344	0.314	3.11	2.99	1.72	1.71	3.99	3.94	232.0	353.3
L.S.D 5%		**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**0.09**	**0.092**	**11.32**	**13.56**

Table 11 : Chemical composition of globe artichoke as affected by the interactions between farmyard manure and antitranspirants, during 2007 / 2008 and 2008 / 2009 seasons.

Characters		N %		P %		K%		Inulin		Total sugars		Proline (ug/g d.wt.)	
Seasons / FYM- ATS		S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
10 m^3 / fed	control	1.90	1.77	0.256	0.243	2.39	2.11	1.23	1.17	2.78	2.44	480.9	526.3
	$Ca\ Co_3$	1.96	1.88	0.259	0.248	2.49	2.28	1.43	1.34	3.11	2.91	342.4	373.5
	Kaolin	2.15	2.01	0.264	0.254	2.59	2.63	1.53	1.44	3.26	3.27	315.9	349.7
20 m^3 / fed	control	2.11	2.12	0.303	0.287	2.73	2.51	1.30	1.34	3.25	3.14	372.2	384.8
	$Ca\ Co_3$	2.16	2.11	0.308	0.294	2.88	2.66	1.62	1.57	3.61	3.48	285.7	321.7
	Kaolin	2.26	2.15	0.315	0.303	2.97	2.80	1.72	1.62	3.69	3.58	271.5	293.3
30 m^3 / fed	control	2.26	2.26	0.330	0.304	2.99	2.81	1.39	1.49	3.44	3.47	295.5	312.1
	$Ca\ Co_3$	2.29	2.27	0.334	0.311	3.08	2.94	1.73	1.67	4.05	3.80	251.2	263.6
	Kaolin	2.34	2.31	0.340	0.316	3.18	3.09	1.82	1.73	4.15	3.86	229.3	245.8
L.S.D 5%		**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**0.10**	**0.10**	**7.83**	**10.8**

*** S_1 = the first season.**
*** S_2 = the second season**

Table 12: Chemical composition of globe artichoke as affected by the interactions of water quantity and antitranspirants, during 2007 / 2008 and 2008 / 2009 seasons.

*** S_1 = the first season.**

*** S_2 = the second season**

Characters		N %		P %		K%		Inulin %		Total sugars %		Proline (ug/g d.wt.)	
Seasons / FYM- ATS		S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
1200 m^3 fed.	control	2.07	1.99	0.285	0.277	2.66	2.43	1.17	1.16	2.91	2.59	447.7	484.1
	$Ca Co_3$	2.11	2.02	0.289	0.282	2.75	2.55	1.42	1.35	3.33	3.05	334.3	368.0
	Kaolin	2.18	2.08	0.295	0.286	2.87	2.71	1.55	1.45	3.45	3.26	311.9	330.9
1800 m^3 fed.	control	2.09	2.08	0.301	0.277	2.71	2.49	1.35	1.36	3.22	3.04	372.9	406.0
	$Ca Co_3$	2.13	2.09	0.304	0.283	2.82	2.63	1.63	1.57	3.59	3.47	286.5	318.8
	Kaolin	2.23	2.17	0.309	0.290	2.92	2.77	1.68	1.62	3.75	3.61	268.5	298.8
2400 m^3 fed.	control	2.11	2.08	0.302	0.280	2.74	2.52	1.41	1.48	3.35	3.42	300.9	333.1
	$Ca Co_3$	2.17	2.15	0.308	0.287	2.86	2.70	1.75	1.66	3.84	3.67	258.5	271.9
	Kaolin	2.33	2.23	0.315	0.298	2.96	2.78	1.85	1.72	3.91	3.84	236.3	259.0
L.S.D. 5%		**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**7.84**	**10.9**

Table 13: Chemical composition of globe artichoke as affected by the interaction among farmyard manure , water quantity and antitranspirants, during 2007 / 2008 and 2008 / 2009 seasons.

Characters			N %		P %		K%		Inulin %		Total sugars %		Proline (ug/g d.wt.)	
Treatments \ Seasons			S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
10 m^3 / fed	1200 m^3	control	1.86	1.66	0.246	0.240	2.35	2.09	1.08	1.02	2.43	2.05	621.9	639.8
		Ca Co_3	1.93	1.72	0.249	0.246	2.44	2.23	1.18	1.15	2.88	2.66	367.1	435.1
		Kaolin	2.01	1.80	0.254	0.250	2.54	2.33	1.36	1.33	3.00	3.16	340.6	392.3
	1800 m^3	control	1.92	1.83	0.259	0.243	2.40	2.11	1.29	1.19	2.90	2.42	456.5	535.5
		Ca Co_3	1.95	1.93	0.261	0.249	2.49	2.28	1.47	1.39	3.05	2.95	339.2	374.7
		Kaolin	2.10	2.05	0.266	0.253	2.58	2.37	1.49	1.45	3.31	3.22	321.5	357.5
	2400 m^3	control	1.93	1.82	0.262	0.246	2.43	2.12	1.34	1.31	3.02	2.86	364.5	403.7
		Ca Co_3	2.00	2.00	0.267	0.250	2.53	2.33	1.66	1.50	3.39	3.13	320.8	310.6
		Kaolin	2.33	2.18	0.273	0.260	2.65	2.38	1.75	1.55	3.47	3.45	285.8	299.2
20 m^3 / fed	1200 m^3	control	2.10	2.07	0.299	0.285	2.68	2.44	1.15	1.13	2.96	2.74	468.4	465.8
		Ca Co_3	2.13	2.09	0.301	0.292	2.79	2.58	1.48	1.39	3.27	3.05	340.8	377.5
		Kaolin	2.23	2.15	0.307	0.297	2.93	2.76	1.59	1.44	3.38	3.12	325.2	337.4
	1800 m^3	control	2.11	2.16	0.306	0.286	2.74	2.51	1.32	1.37	3.32	3.04	368.8	371.6
		Ca Co_3	2.16	2.08	0.308	0.293	2.90	2.65	1.60	1.58	3.61	3.51	290.1	328.4
		Kaolin	2.25	2.13	0.314	0.303	2.97	2.80	1.68	1.64	3.71	3.60	274.6	299.9
	2400 m^3	control	2.12	2.13	0.305	0.289	2.77	2.59	1.44	1.56	3.48	3.63	279.3	317.1
		Ca Co_3	2.20	2.16	0.315	0.296	2.94	2.75	1.78	1.73	3.96	3.89	226.2	259.2
		Kaolin	2.29	2.18	0.323	0.310	3.02	2.85	1.90	1.78	3.99	4.02	214.8	242.6
30 m^3 / fed	1200 m^3	control	2.25	2.25	0.311	0.305	2.95	2.76	1.28	1.34	3.34	3.00	333.8	346.6
		Ca Co_3	2.26	2.25	0.317	0.309	3.03	2.85	1.59	1.50	3.84	3.44	294.9	291.4
		Kaolin	2.32	2.29	0.325	0.312	3.13	3.03	1.69	1.58	3.97	3.51	270.1	263.1
	1800 m^3	control	2.25	2.24	0.338	0.303	2.98	2.83	1.44	1.56	3.44	3.65	293.4	311.1
		Ca Co_3	2.29	2.26	0.342	0.308	3.09	2.97	1.81	1.75	4.13	3.95	230.3	253.1
		Kaolin	2.35	2.32	0.346	0.313	3.19	3.13	1.88	1.78	4.22	4.02	209.5	238.9
	2400 m^3	control	2.29	2.29	0.341	0.304	3.03	2.84	1.47	1.57	3.55	3.75	259.2	278.5
		Ca Co_3	2.31	2.30	0.344	0.315	3.11	3.02	1.80	1.74	4.18	4.00	228.5	246.1
		Kaolin	2.36	2.33	0.349	0.323	3.20	3.13	1.90	1.83	4.26	4.05	208.3	235.4
LSD 5%		**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**13.57**	**18.82**

*** S_1 = the first season.**

*** S_2 = the second season**

Table 9 : Chemical composition of globe artichoke as affected by farmyard manure, water quantity and antitranspirants, during 2007 / 2008 and 2008 / 2009 seasons

Characters	N %		P %		K%		Inulin %		Total sugar %		Proline (ug/g d.wt.)	
Seasons / Treatments	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
A - FYM application												
10 m^3 / fed	2.00	1.89	0.260	0.249	2.49	2.25	1.40	1.32	3.05	2.88	379.8	416.5
20 m^3 / fed	2.18	2.13	0.309	0.295	2.86	2.66	1.55	1.51	3.52	3.40	309.8	333.3
30 m^3 / fed	2.30	2.28	0.335	0.310	3.08	2.95	1.65	1.63	3.88	3.71	258.7	273.8
L.S.D. 5%	**0.017**	**0.023**	**0.001**	**0.002**	**0.037**	**0.055**	**0.090**	**0.099**	**0.064**	**0.022**	**5.28**	**8.94**
B - Water quality												
1200 m^3	2.12	2.03	0.290	0.282	2.76	2.56	1.38	1.32	3.23	2.97	373.6	394.3
1800 m^3	2.15	2.11	0.304	0.283	2.82	2.63	1.55	1.52	3.52	3.37	309.3	341.1
2400 m^3	2.20	2.15	0.309	0.288	2.85	2.67	1.67	1.62	3.69	3.64	265.3	288.0
L.S.D 5%	**0.050**	**0.028**	**0.004**	**0.006**	**0.047**	**0.081**	**0.063**	**0.078**	**0.053**	**0.053**	**6.53**	**7.80**
C - AT'S												
control	2.09	2.16	0.296	0.278	2.70	2.48	1.31	1.33	3.16	3.02	382.9	407.7
Ca CO_3	2.14	2.09	0.300	0.284	2.81	2.63	1.59	1.53	3.59	3.39	293.1	319.5
kaolin	2.25	2.05	0.306	0.291	2.91	2.75	1.69	1.59	3.70	3.57	272.3	296.2
L.S.D. 5%	**0.063**	**0.051**	**0.008**	**0.006**	**0.069**	**0.077**	**0.068**	**0.076**	**0.058**	**0.060**	**4.49**	**6.20**

*** S_1 = the first season.**
*** S_2 = the second season**

Table 14: Effect of interaction between water quantity , antitranspirants and FYM application (10,20 and 30 m^3/ fed) on water use efficiency (WUE) by globe artichoke plants in 2007 /2008 and 2008 / 2009 seasons.

Treatments / Seasons	Water quantity (m^3/fed.)			antitranspirants X water quantity								
				Control			$Ca CO_3$			Kaolin		
	1200 m^3 / fed	1800 m^3 / fed	2400 m^3 / fed	1200 m^3 / fed	1800 m^3 / fed	2400 m^3 / fed	1200 m^3 / fed	1800 m^3 / fed	2400 m^3 / fed	1200 m^3 / fed	1800 m^3 / fed	2400 m^3 / fed
				With FYM 10 m3 / fed.								
2007 / 2008	5.04	3.74	3.08	4.66	6.03	5.61	3.44	3.88	4.13	2.65	3.00	3.32
2008 / 2009	3.94	3.33	2.78	3.62	4.18	5.05	2.66	3.35	3.67	2.11	2.90	3.05
With FYM 20 m3 / fed.												
2007 / 2008	6.02	4.71	4.00	5.43	6.27	7.16	4.17	4.78	5.33	3.17	3.88	4.42
2008 / 2009	5.46	4.27	3.66	4.87	5.87	6.80	3.64	4.41	4.97	3.02	3.37	3.85
With FYM 30 m3 / fed.												
2007 / 2008	6.59	5.56	4.10	6.04	7.53	7.25	4.46	5.62	5.59	3.53	4.52	4.50
2008 / 2009	6.10	5.27	3.83	5.52	6.92	6.68	4.16	5.39	5.22	3.27	4.37	4.22