

## **EFFECT OF FOLIAR SPRAY WITH SOME NATURAL PLANT EXTRACTS ON EARLINESS, PRODUCTIVITY AND QUALITY OF GLOBE ARTICHOKE**

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### **ABSTRACT**

*This study was conducted to estimate whether foliar spray with some natural plant extracts could enhance earliness, productivity and quality of globe artichoke hence, two field experiments were carried out during two seasons of 2012 /2013 and 2013/ 2014 at the Hort. Res. Farm of El-Bramoon, Dakahlia Governorate, to investigate the effect of foliar spray with garlic extract rates (1, 2 and 3 ml/L) and moringia leaf extract rates (1, 2 and 3 ml/L) on earliness, productivity and quality as well as chemical constituents of globe artichoke(*Cynara scolymus L.*) plants cv. *Balady*.*

***The main results can be summarized as follows:***

*The results indicated that increasing moringia leaf extract and garlic extract rates up to 3 ml/L of each were accompanied with significant increases in vegetative growth characters (plant height, Leaf area of leaves, dry weight of leaves and number of shoots/plant) and yield distribution (early, middle , late yield and total yield/fed.) compared with control.*

*Application of moringia leaf extract and garlic extract rates improved most head quality characteristics (head weight, length, diameter, receptacle fresh and dry matter). However, there were no significant differences in terms of head TSS in the second seasons.*

*Dry matter, N, P, K, protein, total sugars and total carbohydrates contents in receptacle were positively and significantly responded to moringia leaf extract and garlic extract rates in the two seasons.*

*The foliar spraying with moringia leaf extract at rates of 3 ml/L seemed to be the most effective treatment, which gave a balanced vegetative growth, a higher early yield as well as a good quality.*

*Moreover, this particular treatment was more beneficial compared to all other treatments.*

**Key words:** *Cynara scolymus L*, Garlic extract, Moringa extract

## INTRODUCTION

Globe artichoke (*Cynara scolymus L*) is considered as one of the most important vegetable crops in Egypt, for local consumption and exportation, either fresh or processed. It gained an important nutritional value due to its high contents of crude protein, amino acids, crude fiber, reducing and total sugars and phenolic compounds, flavonoids, inulin, fibers and many minerals (Lattanzio and Sumere, 1987). In addition, leaves, stems and industry residues are used for cattle feed (Hammouda *et al.*, 1993 and Feleafel, 2005).

Egypt is ranked the second world producer of globe artichoke with the highest productivity per unit area in the world, it was cultivated on 17895 fed. in 2012, which produced 387,672704 ton of bud yield with an average of 9.847 ton fed. (FAO, 2012),

The production areas around Behira, Alexandria, Giza Governorates and newly reclaimed land have favorable climatic conditions to grow good quality artichoke for export marketing. The major production of globe artichoke in Egypt is obtainable usually during the months of March and April, but the optimum export window to European countries is the period from November up to February (Ghoneim, 2005). The early production through this period represents a vital importance, since the demand for either export or local market is great and the prices are high which affects the net income of globe artichoke production (Okàsha *et al.*, 1997).

Since ancient times, plant extracts were used in many ways. at the present time, public health and environmental safety concerns encouraged the use of these natural products for improving growth, production, nutritional status and against most insect pests. The higher content of plant extracts from chemical constituents and phenol seem to have synergistic effects on growth, yield and mortality of most fungus. ( Abd El-Hamied and El-Amary, 2015)

Garlic (*Allium sativum* ) extract contains enzymes and more than 200 chemical compounds, some of its volatiles are more important i.e. Allicin that gives garlic its antibiotic properties. Its higher contents of volatile and sulphur compounds put both in the top due to their real and essential roles they play in growth process of various crops. Also, contains minerals, vitamins, flavonoids, sulphur, ascorbic acid, trace of iodine and essential oils (El-Desouky *et al.*, 1998).

Effect of garlic extract on plant characters has been interpreted by Sayeeda and Ahmed (2005) and El-Shayeb (2009). They reported that garlic extract showed comparatively greater efficacy on promoting growth and

nutrition status of groundnut and EL-Desouky *et al.* (1998) on squash plant, Husain and EL-Rekaby (2006) and Abbas *et al.* (2007) on cucumber plant, they found that the natural extract of garlic cloves improve the growth, sex expression and fruit yield and quality. Since, these extracts contain many growth materials and essential requirements at vegetative and reproductive growth.

Ramesh *et al.* (2014) show that spray of garlic extract 10 and 15 g/ L on lettuce plant had significant effect include increasing in rate on the lettuce characteristics such as head length, head diameter, head width, head weight, leaf number, healthy leave number and unhealthy leave number.

*Moringa* is an important plant of *Moringaceae* family, it is the most known and widely cultivated species throughout the world for impressive effect of medication, food and industrial purposes (Fuglie, 1999; Khalafalla *et al.*, 2010; Adebayo *et al.*, 2011; Mishra *et al.*, 2013 and Moyo *et al.*, 2011). Also, it is one of the natural alternatives, being studied to achieve its effect on growth and yield of crops and thus can be promoted among farmers as a possible supplement or substitute to inorganic fertilizers (Phiri, 2010).

Fresh *moringa oleifera* leaves have been shown to have high zeatin which plays an important role in cell elongation and cell division that led to promote the plant growth; hence, it is used as a natural plant growth enhancer also, has anti-aging potential and protective effects in plants. In addition, its content proteins, vitamins,  $\beta$  carotene, amino acids, phenolic compounds, sugars, minerals and several flavonoid pigments. (Fuglie, 2000; Siddhuraju and Becker, 2003; Marcu, 2005; Nagar *et al.*, 2006; Anwar *et al.*, 2007 and Jacob and Shenbagaraman, 2011).

Moreover, moringia leaf extract was sprayed onto leaves of onions, bell pepper, soya beans, sorghum, chili, melon and maize and was shown to accelerated growth, increased leaf duration, increased number of roots, and generally increased yield of these crops (Fuglie, 2000).

Furthermore, Azra, (2011) and EL-Sayed *et al.* (2014) found that spraying wheat, peas and tomato with *M. oleifera* extract increased all growth parameters, productivity and crop characteristics.

In addition, Mona (2013) found that spraying rocket (*Eruca vesicaria* subsp. *sativa*) plants with the aqueous extracts of *M. oleifera* at rates of 1, 2 and 3% increased all measured growth criteria (plant height), the amounts of each of chlorophyll a and b, total sugars, ascorbic acid and N, P and K.

In light of the above discussion, therefore, the object of this work was to investigate the effect of foliar spraying with garlic extract and moringia leaf extract on earliness, productivity and quality of globe artichoke.

## MATERIALS AND METHODES

Two field experiments were conducted at the Baramoon Research Station, Mansoura, Dakahlia Governorate, Egypt (+ 7m altitude, 30° 11-latitude and 28° 26- longitude), during seasons of 2012/2013 and 2013/2014, to study the effect of foliar spray with garlic extract and moringia leaf extract at different rate on earliness , productivity ,quality and chemical constituents of globe artichoke (*Cynara scolymus* L.).

Table 1 shows some physical and chemical properties of the experiment soil before planting, according to the methods described by Black (1982).

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

Physical properties	Value		Chemical Properties	Value	
	1 <sup>st</sup> Season	2 <sup>nd</sup> Season		1 <sup>st</sup> Season	2 <sup>nd</sup> Season
Sand (%)	27.2	27.5	pH value	8.1	7.9
Silt (%)	31.5	31.4	EC dSm <sup>-1</sup> in soil	0.9	0.8
Clay (%)	41.3	41.1	Total N (%)	0.03	0.04
Texture class	Clay-loam	Clay-loam	Available P (ppm)	11.3	11.5
CaCO <sub>3</sub> (%)	3.1	3.2	Available K (ppm)	306	298

Experimental design was randomized complete block with three replicates. The planting dates were 15 and 19 of August in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively. Pre-planting, the old grown pieces (stumps) were treated with fungicides for 30 minutes and hand planted at 1m apart between each two plants on the ridge and 1m between the ridges. Plot area was 24m<sup>2</sup>(4 lines × 6 m long × 1 m width). Other agriculture practices and pest control were applied as commonly recommended for commercial globe artichoke production by Ministry of Agriculture.

### The experiment included seven treatments as follows:

- 1-Control (tap water)
- 2- Garlic extract 1ml/L
- 3- Garlic extract 2ml/L
- 4- Garlic extract 3m/L
- 5- Moringia leaf extract 1m/L
- 6- Moringia leaf extract 2ml/L
- 7- Moringia leaf extract 3ml/L

**Garlic extract:**

According to EL-Desouky *et al.* (1998) the garlic extract was prepared, hence, fresh mature garlic cloves were blended in distilled water 100 g cloves/ liter distilled water. Frozen and thawed two times then filtered. The final extracts were collected separately in other dark glass bottles then stored in a refrigerator at 5 °C until needed.

Main contents of garlic extract have been analyzed by Arid Land Agricultural Research Unit Fac. of Agric. Ain Shams Univ. in Table 2.

**Table 2:** Some chemical constituents of garlic cloves

Components	Concentration
GA3	1.633 mg/100gm F.W
IAA	Trace amount
ABA	Trace amount
Ca	1.363%
Mg	1.230%
S0 <sub>4</sub>	0.181 %
Zn	66.5 ppm
Mn	94.4 ppm

**Moringa leaf extract:-**

According to Culver *et al.* (2012), moringa leaf extract was prepared as follow: An amount of 20 g of young moringa leaves (shoots were harvested at 35 days after emergence) was mixed with 675 ml of 80% ethanol. The suspension was stirred using a homogenizer to help maximize the amount of the extract. The solution was then filtered by wringing the solution using a mutton cloth. The solution was re-filtered using No. 2 Whatman filter paper. The extract was diluted with distilled water at a ratio 1:32 (v/v) and then sprayed directly onto plants. The extract was used within five hours from cutting and extracting (if not ready to be used, the extract or the solution prepared was stored at 0 °C and only taken out when needed for use).

Spraying treatments were applied four times started after 45 days from planting date and repeated every 15 days through the growth season.

**Studied characteristics****Plant growth parameters:**

A randomly chosen sample of five plants / plot was picked up after 120 days from planting date to determine plant height, dry weight of leaves /plant and number of shoots/plant. leaf area/ plant was determined according to Koller (1972).

***Yield distribution:***

All flower heads of plants in each plot were harvested and counted to study yield distribution and to determine early yield, was calculated from the start of harvest until the end of February, middle yield, was harvested during March and late yield was harvested during April up to end of May. The total yield was calculated as ton/fed.

***Heads quality characteristics:***

At the peak of harvesting period (March), head quality characters were considered and the following measurements and determinations were achieved; average head weight, length and diameter, receptacle fresh weight and dry weight of receptacle as well as total soluble solids (TSS) in the edible portions, using a hand [refract meter](#).

***Chemical constituents:***

At 120 days after planting, dry matter of receptacle, were finely ground and wet digested for N, P and K determination;

- Nitrogen concentration was determined by Nessler method according to AOAC (1995).
- Phosphorus was estimated calorimetrically using the reduced molybdophosphoric blue color method according to Jackson (1970).
- Potassium was determined using the flame photometer (CORNING, M 410).
- Total sugars and total carbohydrate in head receptacles were determined according to the methods described by Forsee (1938) and Michel *et al.* (1956), respectively.
- Total protein was determined by multiplying nitrogen content by 6.25 according to AOAC (1995).

***Statistical analysis:***

All recorded data were subjected to statistical Analysis of Variance and least significance differences (Duncan's, 1955) at 0.05 level of probability to separate means, as mentioned by Snedecor and Cochran (1980).

**RESULTS AND DISCUSSION*****1-Vegetative growth characteristics:***

The results presented in the Table (3) clearly revealed that, foliar spraying of natural plant extracts “garlic and moringa” significantly had influence on all growth characters (plant height, leaf area of leaves, dry weight of leaves and number of shoots/plant) in the two seasons. The highest values of growth characters included (plant height, leaf area of



leaves, dry weight of leaves and number of shoots/plant) were recorded by foliar spray with moringa leaf extract at 3ml /L. Meanwhile, the lowest values were found by control treatment (foliar spray with tap water). These similar results were obtained in both seasons of study. There were no significant differences were found between foliar spray with moringa at 2 or 3ml/ L on all growth characters in the two seasons. Also, between foliar spray with garlic extract at 1ml/L and control (tap water) in the two seasons of study.

The stimulative effect of garlic extract on vegetative growth might be attributed to being contain natural sources of many growth promoting substances (macro and micronutrients, IAA,) (El-Desouky *et al.*, 1998).

These results are in harmony with the findings of Helmy (1992) on summer squash, El-Sawy (2007) on cucumber, Shehata *et al.* (2012) on cucumber, Swelam (2012) on pepper and Tartoura *et al.* (2013) on squash plants.

Regarding the growth enhancing potential of moringa leaf extract on increment effect on vegetative growth might be due to its role as a plant growth stimulator. It being a rich source of vitamins, essential macro and micro plant minerals, , amino acids, natural antioxidants and plant growth regulators such as gibberellins and zeatin (cytokinins), it can be effectively exploited as plant growth enhancer (Makkar and Becker, 1996, Mahmood *et al.*, 2010). These results are concerned with those of (Culver *et al.* 2012; Muhamman *et al.* 2013; Bashir *et al.* 2014; Yasmeen *et al.* 2014) on tomato, and (Ndor *et al.* 2012) on watermelon.

#### ***Yield distribution:***

Foliar spraying of natural plant extracts garlic and moringa on early, medium , late and total yield/fed. were illustrated in Table 4. Results proved that spraying globe artichoke plants with garlic and moringa extracts at different tested rates resulted in a significant improvement in yield distribution in both seasons, compared with control. The highest rate of moringa leaf extract (3ml/L) resulted in highest yield distribution in the first and second seasons, respectively. The moringa leaf extract at 2m/L had a similar effect to that of moringa leaf extract at 3m/L on most characters of study. The increases in early yield than control treatment were about 6.9, 38.0 , 75.6, 61.0, 80.5, 86.6 in the 1<sup>st</sup> season and 17.1, 22.4, 56.5, 49.1, 72.4 and 80.5% as for garlic extract at 1, 2 and 3m/L and moringa extract at 1, 2 and 3ml/L in the 2<sup>nd</sup> season . Such foundation may be due to the role of both garlic extract and moringa leaf extract in, exhibition different regulatory and defensive roles through elicitation and signaling of different physiological and metabolically processes.



Garlic extract is a natural product with anti-oxidative, antibiotic, anti-viralic and antifungal activities Curtis *et al.* (2004). It has improves the availability of soil nutrients and slows down the growth of plant antagonists Konkov and Kiram (1988). Many investigations found the favorable effect of garlic extract on plant growth and productivity on many plants (Helmy, 1992 and Shafshak *et al.*, 2004) on squash and Bhyan *et al.* (2007) on okra.

The favorable effect of moringa leaf extract on yield might be connected with the role of plant growth regulators in improving crop growth and hence yield (Muhamman *et al.*, 2013). It contains endogenous cytokinins (zeatin, dihydrozeatin and isopentyladenine) which affect on assimilate mobilization and/or distribution (Emongor, 2015). Zeatin is a plant growth hormone from the cytokinines group, it plays an important role in cell division and cell elongation (Taiz and Zeiger, 2006) and involved in carbohydrate mobilization as well as distribution to the sink where more carbohydrate are needed to cater the needs of rapidly increasing growth (Iqbal, 2014).

Moreover, Hussain *et al.* (2013) reported that moringa extracts accelerate the growth of plants, strengthen plants and improve resistance against pests and diseases.

#### ***Heads quality characteristics:***

Data recorded in Table (5) showed that, foliar spraying with garlic and moringa extracts at different rates were responsible for significant improvements on head quality characteristics, expressed as head's weight, length, diameter, and receptacle fresh weight, dry matter and total soluble solids (TSS) compared to the control. The highest heads quality characteristics were recorded by foliar sprayed with moringa extract at 3ml/L followed by, moringa extract at 2ml/L.

There were no significant differences between moringa extract at 3 or 2m/L and garlic extract at 3m/L on head's length and receptacle fresh weight, in the first season of study, head's diameter and receptacle dry matter in the second season of study, and TSS in the tow seasons of study. Meanwhile, the lowest values of these parameters were recorded by control treatment. These increments may be explained on the bases that all used treatments had favorable stimulatory effects on vegetative growth characters and enhanced photosynthetic apparatus, and consequently reproductive growth triggers a switch in partitioning from vegetative growth sinks to reproductive sinks. The obtained results are in a same direction with that of EL-Sayed *et al.* (2014) on sugar pea and Azra (2011) on wheat, peas and tomato, they found that spraying with moringa extract increased productivity and crop characteristics.



***Chemical constituents:***

Data in Table (6) illustrate that receptacle contents of N,P,K, total carbohydrate %, total sugars % and protein percent contents were greatly affected by all treatments compared with the control in the two seasons. moringa extract at 3ml/L treatments were superior in their effects on all mentioned characters followed by moringa extract at 2ml/L treatments and no significant differences between moringa extract at 2ml/L treatments and garlic extract at 3ml/L in all studied characters except for P % in the first season only . The significant increments in the obtained characters over control may be attributed to its effects on enhancing ion uptake (Marschner, 2013). Moringa leaf extract foliar application was more effective as natural biostimulant to improve fruit quality of tomato. It increased lycopene , total soluble solids, total sugar and vitamin C content in fruits (Yasmeen *et al.*, 2014). Spraying garlic extracts increased chemical constituents as( N, P, K, Fe, Zn and Mn) compared with control on squash plants (Tartoura *et al.*, 2013).

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## تأثير الرش ببعض المستخلصات النباتية الطبيعية علي التبرير والإنتاجية والجودة للخرشوف

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أجريت هذه الدراسة لتقدير ما إذا كان الرش الورقي ببعض المستخلصات النباتية الطبيعية يمكن أن تحسن من التبرير والإنتاجية والجودة للخرشوف. ومن ثم، تم إجراء تجربتين حقليتين خلال الموسمين الشتويين المتتاليين من عام ٢٠١٢/٢٠١٣ و ٢٠١٣/٢٠١٤ بالمزرعة البحثية بالبرامون التابعة لمعهد بحوث البساتين لدراسة تأثير الرش بمستويات مختلفة من مستخلص الثوم بمعدلات (١ و ٢ و ٣ مل/لتر) و مستخلص أوراق المورينجا بمعدلات (١ و ٢ و ٣ مل/لتر)

**وكانت النتائج المتحصل عليها من هذه الدراسة كالآتي: -**

أظهرت النتائج أن الرش بمختلف التركيزات من مستخلص أوراق المورينجا وكذلك مستخلص الثوم أدى إلى زيادة معنوية في صفات النمو الحضري (ارتفاع النبات، المساحة الورقية، والوزن الجاف لأوراق النبات و عدد الافرع النبات) ، و صفات المحصول (المبكر، والمتوسط، والمتاخر والكلية) وذلك بالمقارنة بالكنترول، كما لوحظ أن الزيادة في الصفات المذكورة كان متزامنا مع زيادة مستويات مستخلص أوراق المورينجا وكذلك مستخلص الثوم.

أدت المعاملات السابقة إلي تحسين في معظم صفات رؤوس الخرشوف (وزن وطول وقطر الرأس، الوزن الطازج والمادة الجافة للتخت، بينما لم تصل الزيادة إلى المعنوية بالنسبة للمواد الصلبة الذائبة الكلية خلال الموسم الثاني).

استجاب محتوى التخت من النتروجين والفوسفور والبوتاسيوم والكاربوهيدرات الكلية والسكريات الكلية والبروتين الكلية معنويا لمعاملات الرش المذكورة خلال موسمي البحث .

**التوصية:** حققت المعاملة بمستخلص أوراق المورينجا بمعدل (٣ مل/لتر) أفضل النتائج في الحصول على نمو خضري جيد وكذلك أعلى محصول مبكر ذو جودة مرتفعة. وعلاوة على ذلك، كانت هذه المعاملة أكثر فائدة مقارنة بجميع المعاملات الأخرى.