

EFFECT OF GIBBERELIC ACID AND MICRONUTRIENTS ON HEAD YIELD OF ARTICHOKE

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ABSTRACT

Experiments were conducted over two successive growing seasons (1997/98 and 1998/99) at Kaha research station, Hort. Res. Institute. Artichoke plants were sprayed with GA₃ at concentrations of 50, 100, 150 and 200 ppm in combination with 4g /l Nutramin-6 contains manganese 8%, iron 7.5%, copper 3.5, zinc 4.5%, boron 1.5%, molybdenum 0.05% and sulfur 15%. Plants were treated with 4g /l alone and water only as a control. The treatments and water were applied twice to the foliage at 50 and 65 days after planting. Artichoke plants treated with GA₃ in combination with micronutrients and micronutrients alone gave significant earliness in head production 4 weeks before control. Early yield (November-February) was significantly greater from plants treated with GA₃ + micronutrients than micronutrients treatment and control plants.

Head, receptacle diameter and weight were more than the control in both seasons for early heads. Other variables such as T.S.S, reducing, non reducing sugars, inulin and phenols did not response significantly to the applied treatments.

INTRODUCTION

Globe artichoke (*Cynara scolymus* L.) is grown for local market and export. In Egypt, production peak of artichoke occurs during March and April.

A great demand for early production is needed to be from November up to late February. Research work has been done to enhance early and total yield by Gibberellic acid (GA₃) application (Foury and Guimbard, 1984; Garcia *et al.*, 1993). GA₃ accelerated head development and controlled time of the production (Turner and Lagaude, 1970; Schrader 1994). One or more applications of GA₃ advanced artichoke harvest up to 8 weeks as reported by Snyder *et al.* (1971). Abou Hadid *et al.* (1995) found that GA₃ application affected head, receptacle weight and diameter. Micronutrients such as B, Cu, Fe, Mn and Zn are essential for plant growth and production of artichoke (Taiz and Zeiger, 1991).

Therefore, this study was designed to apply GA₃ in combination with micronutrients in commercial formula as Nutramin-6 to induce earliness in artichoke head production.

MATERIALS AND METHODS

Two field experiments were conducted during two growing seasons (1997/98 and 1998/99) at Kaha Experiment Station, Vegetable Research Department. That is to test the effect of foliar application of GA₃ treatments; i.e., 50, 100, 150 and 200 ppm, combined with 4g /l Nutramin-6 (manganese

8% , iron 7.5% , copper 3.5% , zinc 4.5% , boron 1.5% , molybdenum 0.05% and sulfur 15%) on artichoke. Mother plants (stumps) were taken from production field to be divided to parts for planting. The french cultivar; named Hyrious , was planted on 15th July in the two growing seasons. Planting space was one meter between plants and one meter within rows. Experiment plot consisted of three rows each rows 5m long.

Artichoke plants were sprayed with GA₃ treatments combined with Nutramin-6 or Nutramin-6 alone or water only with 4g /l as a control. Artichoke plants of 4-5 leaves were treated twice at 50 and 65 days from planting. A complete randomized block design with three replicates was used. Recommended agricultural practices were followed

Recorded data were:

- 1-Average number of days from planting up to 25% of plants produced heads. This recorded figure was to determine earliness.
- 2-Total heads yield; number of heads picked all over the harvesting season (from November to April).
- 3-Number of heads per plant was calculated as total number of heads per plot divided by number of plants.
- 4-Early yield was determined by the number of heads picked over the period from November to February.
- 5-Average head weight was calculated as total heads weight divided by number of heads for early yield and total yield.
- 6-Head, receptacle (edible portion) diameter was measured in cm and receptacle weight in gm.
- 7-Chemical properties of the receptacle.
 - 7.1 Total soluble solids were determined using hand refractometer.
 - 7.2 Reducing and non-reducing sugars were determined using potassium ferricyanide method according to Forsee (1938) and Morell (1941).
 - 7.3 Inuline was determined according to Whistler *et al.* (1962)
 - 7.4 Phenols were determined according to Khalifa *et al.* (1968).

Statistical analysis:

All the obtained data were subjected to the analysis of variance following the method described for a complete randomized block design by Snedecor and Cochran (1967). Means separation, comparisons, were done using Duncans multiple range test (1955).

RESULTS AND DISCUSSION

The data in Table (1) show that all GA₃ concentrations plus. Nutramin-6 decreased significantly number of days from planting to heading than the control plants and plants treated with Nutramin-6 in both seasons. Also Nutramin-6 treatment was significantly effective in comparison with control.

Table 1: Effect of GA₃ plus Nutramin-6 on heading of artichoke in 1997/1998 and 1998/1999 seasons. Days from planting to heading.

Treatments	First season	Second season
GA ₃ 50 ppm + 4g/l Nutramin-6	86.97 c	84.33 d
GA ₃ 100 ppm + 4g/l Nutramin-6	86.13 c	88.33 c
GA ₃ 150 ppm+ 4g/l Nutramin-6	83.47 c	89.30 c
GA ₃ 200 ppm + 4g/l Nutramin-6	83.70 c	89.50 c
Nutramin-6 4g/l	93.50 b	102.17 b
Control.	119.30 a	120.30 a

Means with the same letter are not significantly different at 5% level.

This means that application GA₃ + Nutramin-6 accelerated heading. These results are in line with results reported by Snyder *et al.* (1971). They found that application of Gibberellic acid promoted capitulum development and advanced harvest up to 8 weeks. Concerning the early yield (November to February) Table (2) illustrated the effect of GA₃ plus Nutramin-6 on number of heads per plant. Number of heads per plant was significantly greater than those produced by control plants or plants treated with Nutramin-6 alone in both seasons. Such results are in agreement with Foury and Guimbard, (1984); Garcia *et al.* (1994). Head weight of early yield (Table 2) showed significant increase than control in plants sprayed with GA₃ plus Nutramin-6 or Nutramin-6 only in the first season. However, in the second season there was no difference between treated plants and control in head weight. Head diameter, edible portion (receptacle) weight and diameter were improved in plants sprayed with GA₃ combined with Nutramin-6 alone in both seasons.

Abou Hadid *et al.* (1995) found that GA₃ application affected head, receptacle weight and diameter. Regarding to total yield as number of heads per plant and head weight (Table 3) GA₃ combined with Nutramin-6 was significantly effective in both seasons. Treated plants were more in production than control plants. These results are in line with results reported by Garcia *et al.*, (1994) and Schrader (1994). Adding micronutrients to GA₃ improved head production. Taiz and Zeiger (1991) reported that micronutrients are essential for growth and production of artichoke.

Table (4) showed the chemical composition of the edible portion of artichoke in both seasons. These chemical compositions did not show significant response to the applied treatments.

It can be concluded that GA₃ application in combination with micronutrients was effective in early production of artichoke.

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تأثير حمض الجبريلين والعناصر الصغرى علي محصول النورات في الخرشوف
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أجريت التجارب في موسمي ١٩٩٨/٩٧ و ١٩٩٩/٩٨ في محطة أبحاث قها-معهد بحوث البساتين. عوملت نباتات الخرشوف بالجبريلين بالتركيزات التالية ٥٠، ١٠٠، ١٥٠ و ٢٠٠ جزء في المليون مضافا لكل تركيز ٤ جرام /لتر نيوترامين ٦- المحتوي علي العناصر الصغرى وهي المنجنيز ٨% و الحديد ٧,٥% و النحاس ٣,٥% و الزنك ٤,٥% و البورن ١,٥% و المولبدنوم ٠,٠٥% و الكبريت ١٥%. كما عوملت نباتات الخرشوف رشيا بمحلول نيوترامين ٦- بمعدل ٤ جرام /لتر أو بالماء فقط كمقارنة. عوملت نباتات الخرشوف رشيا بالمعاملات المذكورة أو بالماء مرتين علي الأوراق عند عمر ٥٠ و ٦٥ يوم من الزراعة. أعطت النباتات المعاملة بالجبريلين ونيوترامين ٦- المحتوي علي العناصر الصغرى محصولا مبكرا من النباتات التي لم تعامل (المقارنة) بأربعة أسابيع. كان المحصول المنتج في الفترة من نوفمبر وحتى فبراير وهو المحصول المبكر وقد تفوقت النباتات المعاملة بالجبريلين والعناصر الصغرى علي النباتات المعاملة بالعناصر الصغرى أو الماء تفوقا معنويا. وأوضحت النتائج أن المحصول وقطر ووزن النورة في كلا الموسمين أعلي من المقارنة. ولم تتأثر معنويا بالمعاملات بعض الصفات الكيماوية مثل المواد الصلبة الذائبة والسكريات الكلية المختزلة وغير المختزلة والأنبولين والفينولات.

Table 2. Effect of GA₃ plus Nutramin-6 on early yield (November- February) of artichoke in 1997/1998 and 1998/1999 seasons.

Treatment	First season					Second season				
	Head per plant	Head weight (g)	Head diameter (cm)	Receptacle weight (g)	Receptacle diameter (cm)	Head per plant	Head weight (g)	Head diameter (cm)	Receptacle weight (g)	Receptacle diameter (cm)
GA ₃ 50ppm+ 4 g/l Nutramin- 6	7.3 c	204.1 a	6.7 b	52.1 b	5.5 bc	8.1 a	203.6 a	6.8 abc	52.1 b	5.6 a
GA ₃ 100ppm+ 4 g/l Nutramin- 6	8.3 c	202.5 a	6.8 b	61.1 a	5.7 abc	8.2 a	200.3 b	6.9 ab	62.1 a	5.6 a
GA ₃ 150ppm+ 4 g/l Nutramin- 6	8.5 ab	203.7 a	6.9 ab	61.3 a	5.9 ab	8.4 a	199.3 b	6.8 abc	62.3 a	5.6 a
GA ₃ 200 ppm+ 4 g/l Nutramin- 6	8.9 a	205.0a	7.0 a	61.5 a	6.0 a	7.8 a	203.9 a	7.0 a	62.5 a	5.8 a
Nuramin- 6 4 g/l	4.3 d	202.9a	6.7 b	52.0 b	5.4 c	4.4 b	205.7 a	6.6 c	52.2 b	4.9 c
Control	2.1 e	185.3 b	6.1 c	43.0 c	4.8 d	2.5 c	204.3 a	6.7 bc	43.9 c	5.1 b

Means with the same letter are not significantly different at 5 % level.

Table 3 :Effect of GA₃ plus Nutramin-6 on number of head per plant and average head weight over all the season.

Treatment	First season 97/98		Second season 98/99	
	Heads /plant	Head weight (g)	Heads / plant	Head weight (g)
GA ₃ 50ppm+ 4 g/l Nutramin- 6	16.3 b	141.3 c	15.5 ab	141.3 a
GA ₃ 100ppm+ 4 g/l Nutramin- 6	16.4 ab	141.3 c	15.7 ab	139.4 a
GA ₃ 150ppm+ 4 g/l Nutramin- 6	16.7 ab	140.1 c	16.2 a	135.5 b
GA ₃ 200 ppm+ 4 g/l Nutramin- 6	16.8 a	141.1 c	15.9 ab	135.6 b
Nuramin- 6 4 g/l	16.5 ab	160.7 a	15.8 ab	135.7 b
Control	15.5 c	151.7 b	14.9 b	133.9 b

Means with the same letter are not significantly different at 5 % level.

Table 4. Effect of GA₃ plus Nutramin-6 on chemical composition of edible portion of artichoke.

Treatment	First season					Second season				
	Tss %	Reducing sugars (mg/100 g)	Non reducing sugars (mg/100g)	Inulin (mg /100g)	Phenols (mg/100g)	Tss %	Reducing sugars (mg/100 g)	Non reducing sugars (mg/100 g)	Inulin (mg/100g)	Phenols (mg/100g)
GA ₃ 50ppm+ 4 g/l Nutramin- 6	9.8 a	0.74 b	0.13 a	1.38 a	0.369 ab	9.2 a	0.73 ab	0.12 ab	1.37 ab	0.360 ab
GA ₃ 100ppm+ 4 g/l Nutramin- 6	9.1 bc	0.78 a	0.13 a	1.40 a	0.336 cb	9.3 a	0.81 a	0.13 a	1.35 b	0.353 ab
GA ₃ 150ppm+ 4 g/l Nutramin- 6	9.4 ab	0.77 ab	0.11 b	1.38 a	0.358 abc	9.4 a	0.78 ab	0.13 a	1.35 b	0.358 ab
GA ₃ 200 ppm+ 4 g/l Nutramin- 6	8.6 c	0.77 ab	0.12 ab	1.38 a	0.361 ab	9.4 a	0.75 ab	0.13 a	1.34 b	0.347 b
Nuramin- 6 4 g/l	9.1 bc	0.69 c	0.12 ab	1.43 a	0.327 c	9.1 a	0.72 b	0.12 ab	1.38 ab	0.350 ab
Control	9.5 ab	0.69 c	0.13 a	1.43 a	0.378 a	9.2 a	0.75 ab	0.12 ab	1.40 a	0.360 a

Means with the same letter are not significantly different at 5 % level.