Effect of Some Growth Regulators on Yield and Fruit Quality of Manzanillo Olives

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ABSTRACT

This research was carried out to study the effect of the application of some plant growth regulators, i.e.GA_3 at (100, 150, 200 ppm), NAA at (25, 50, 75 ppm) and CPPU at (10, 15, 20 ppm) at full bloom, a month before and one and two months after full bloom, on the qualitative and quantitative characteristics of olive Manzanillo cv. during 2007 and 2008 seasons. Results revealed that, in both experimental seasons, CPPU significantly increased no. of flowers per inflorescence than those of GA_3 and NAA. Fruit set and yield enhanced by GA_3 and CPPU and reduced by NAA in two seasons. All both growth regulators increased fruit and flesh weight, fruit volume and leaf N and P and decreased leaf K. Data showed that GA_3 treatments increased the fruit dimension, fruit percentage and decreased moisture content .Seed weight and oil percentage were not affected significantly with the GA_3 treatments, while, NAA spraying significantly increased the seed weight, fruit width and oil percentage. On the other hand, NAA not affect fruit length, moisture content and flesh percentage. Data also revealed that, flesh and oil percentage were increased by CPPU treatments, however, CPPU not affect seed weight, fruit dimension and moisture content.

INTRODUCTION

Olive is considered one of the important fruit crops in Egypt. The total acreage grown with olive reached about 135692 feddans in 2007 with total production of about 507053 tons fruits (Ministry of Agriculture Statics). Around 30% of this area is grown in newly reclaimed lands. The Spanish Cv. Manzanillo is the most important commercial variety in the world (Hartmann and Papaionnou, 1971). Manzanillo is early ripening cultivar, it is considered the best dual purpose olive cultivar in the world. One of the major problems of olive growers is the bearing behavior of their trees. Many orchards, although producing an abundance of blossoms fail to set a crop this condition is not believed to be a pollination problem as the olive varieties grown in Egypt are generally considered to be self- fruitful, and this species is wind pollinated. A plant growth regulator is an organic compound either natural or synthetic that modifies or controls one or more specific physiological processes within a plant. Several trials were carried out to study the use of different plant growth regulators for the control of flower and fruit numbers on the olive tree so as to diminish the alternate bearing (Akilliodlu *et al.* 1990).

Gibberellins, naphthalene acetic acid and other growth regulators are reported to increase fruit set in apples (Costa and Bagni, 1983), Androulakis, 1987 and Rugini *et al.* 1986 on olives. Studies on the synthetic cytofex CPPU [(N- (2- Chloro- 1- pyridinyl)- N- phenylurea)] has indicated that, in many fruit crops, it is one of the main factor affecting fruit growth and fruit size. CPPU gave promising results in controlling fruit growth and cropping of grapes (Nickell, 1986), apple (Greene, 1989), and persimmon (Ital *et al.* 1995).

GA_3 intensifies an organ ability to function as a nutrient sink to increase the synthesis of IAA in plant tissues, and to involve accelerating synthesis of hydrolytic enzymes as amylase and other hydrolytic enzymes in aleurone cell (Addicott and Addicott, 1982).

Moreever, 1- naphthalene acetic acid (NAA) is an old thinning compound which is based on its hormonal action as a synthetic auxin. NAA performs best when applied to 7 to 10 mm fruit let diameter (Westwood, 1993).

Thus, the present investigation was designed to study the possibility of producing high yield and good quality of Manzanillo olive trees by spraying with gibberellic acid (GA_3), naphthalene acetic acid (NAA) and cytofex (CPPU).

MATERIALS AND METHODS

The present investigation was carried out during two successive seasons (2007 and 2008) on 17 years old "Manzanillo" olive trees grown in an orchard located at Alexandria – Cairo desert road (about 30 km from Alexandria). The experimental soil was analyzed and the data are presented in Table (1).

All trees in this orchard were annually fertilized with 2 kg\tree ammonium sulfate (20.5%N) in two equal doses in March and May, 0.5kg\tree potassium sulphate (48%K_2O) in three doses in March, April and May, 1.5kg calcium super phosphate (15.5%P_2O_5) and 10 kg cattle manure in January. All trees received the same normal cultural practices commonly adopted in this orchard.

The selected trees were nearly similar in vigor and free from any pathogens.

The trees sprayed with different treatments in the two seasons, as follows:-

1- Foliar spray with water only (control).
2- Foliar spray with Gibberellic acid (GA_3) at 100 ppm.

3- Foliar spray with Gibberellic acid (GA_3) at 150 ppm.
4- Foliar spray with Gibberellic acid (GA_3) at 200 ppm.
5- Foliar spray with naphthalene acetic acid (NAA) at 25 ppm.
6- Foliar spray with naphthalene acetic acid (NAA) at 50 ppm.
7- Foliar spray with naphthalene acetic acid (NAA) at 75 ppm.
8- Foliar spray with Cytofex (CPPU) at 10 ppm.
9- Foliar spray with Cytofex (CPPU) at 15 ppm.
10- Foliar spray with Cytofex (CPPU) at 20 ppm.

Trees were sprayed with the above treatments, four times at full bloom, one month before and one and two months after full bloom.

Forty trees, as uniform as possible, were selected for the present study. The treatments were applied and arranged in a randomized complete block design. Each treatment included four replicates with one tree for each replicate.

The following parameters were determined in the two successive seasons:-

1- Fruit set: two main branches from the two directions (east and west) on each tree were chosen and tagged in the first of April of the two experimental seasons. The number of the flowers was recorded and then set fruits on the selected branches were counted to caiculate the percentage of the fruit set.
2- Leaf mineral content: at the beginning of July of the both seasons, samples of leaves per tree were taken forth or fifth leaf from the base of branch. Leaf samples were washed with tap water, rinsed with distilled water and oven dried at 70 °C to constant weight and then ground. The ground samples were digested with sulphuric acid and hydrogen peroxide according to Evenhuis and DeWaard (1980). Suitable aliquots were taken for the determine of N, P and K. Nitrogen and phosphorus were determined colorimetrically according to Evenhuis (1976) and Murphy and Riely (1962), respectively. Potassium was determined against a standard by Flame photometer.
3- Yield and fruit quality: at harvest stage (in October), yield per tree was estimated and a sample of 50 fruits per experimental tree were taken at random for quality determination. In each sample physical properties including fruit pulp and seed weight, fruit volume and dimensions as well as fruit length and width were determined. In addition, oil content percentage of fruits was determined according Juan (1990).

The moisture percentage was determined after the fruits flesh was oven dried to a constant weight at 60 °C. The oil content of the fruits was determined by soxhalt fat – extracting apparatus using petroleum ether (A.O.A.C., 1980).

Data were statistically analyzed according to Snedecor and Cochran (1990), and L.S.D. test at 0.05 levels was used for comparison between treatments.

RESULTS AND DISCUSSION

Effects of growth regulator on flowering, fruit set and yield of Manzanillo olive trees:

Data in Table (2) showed that, spraying the olive trees with CPPU was gradually increased the number of flowers per inflorescence compared to both GA_3 and NAA treatments which had no effects on the same parameter and compared to the control trees. These results are in consistent with the published results by Bist (1990). Indeed, percentages of fruit set were also significantly increased in all the treatments of CPPU and GA_3 through the two seasons compared to the control. The high percentage of fruit set was recorded in the medium and high concentrations for both CPPU and GA_3 (15 and 200 ppm). Although, there were difference between both concentrations on the effects, these differences were not significant. These results are in complete agreement with those found by Bartolini *et al.* (1993) on olive, Guirguis *et al.* (2003) on pear, Abd El- Megeed *et al.* (2007) on apricot and Sanna Ebeed *et al.* (2008) on banana plants. The improvement of the fruit set can be a direct influence by a stimulation of the parthenocarpic fruit set or can be an indirect effect due to change in the balance vegetable growth (Decker and Daemen, 2000). On the other hand, treatment trees with NAA were significantly decreased the percentage of the fruit set, the number of fruits per tree as well as, yield / kg/ tree compared to the control. These results are in agreement with those obtained by Akilliolu *et al.* (1990) on olive, Steven *et al.* (1993) on pear and Abd El- Megeed (2007) on peach trees.

Effects of growth regulators on fruit quality:

1. Physical Fruit Quality:

Regarding the effect of the growth regulators on fruit and flesh weights of Manzanillo olive trees, the data in Table (3) revealed that, fruit and flesh weights were significantly increased in all the treatments of growth regulators compared to the control trees in both seasons. The pronounced effects regarding this parameter were recorded by the medium and high concentrations of CPPU (15 and 20 ppm) compared the other treatments and control. The difference between two concentration groups was not statistically significant. These results are in coincidence with the published data of Antognozzi *et al.* (1993b) and Antognozzi and proietti (1995) on

olive, Guirguis *et al.* (2003) on pear and Abd El- Megeed (2007) on apricot, while treatment of NAA was significantly affected the seed weights, GA_3 and CPPU had no effects on the same parameter compared to the control treatment.

The same results were reported by Antognozzi *et al.* (1993b) on olive and Abd El- Megeed (2007) on peach and Abd El- Megeed *et al.* (2007) on apricot.

It is evident from data presented in Table (4) in the two seasons that different treatments of growth regulators on the fruit size of olive trees were affected the fruit size. The most pronounced effects were noticed by CPPU at 20 ppm followed by 15 ppm treatments compared to the control and other treatments. These differences between both medium and high treated concentrations were not statistically significant. The previous results of Akilliolu *et al.* (1990), Antognozzi *et al.* (1993b), Antognozzi and Proietti (1995) on olive, Antognozzi *et al.* (1993a) on kiwi fruit, Rahemi and Atahosseini (2004) on pomegranate and Guirguis *et al.* (2003) on pear. The synthetic CPPU acts on the early cell division in the fruit set and also on subsequent growth. It was postulated that the chemical directly affect cell division or it acts through changing natural hormone activity, thus fruit gets bigger on size because it has enough cells, the building blocks of fruit mass and also because the cells have been able to attract so much water, minerals and carbohydrates that enabled the fruit to expand to a large size (Lowes and Wolley, 1992).

Furthermore, growth regulators often affect fruit size indirectly, usually by modifying the crop load and thereby altering the supply of metabolites available to the individual fruit (Stembridge, 1973). Data shown in Table (4) indicated that the most pronounced increasing in the highest fruit length was observed in the treatments of 150 and 200 ppm of GA_3 with slightly differences in effects between two concentrations. No significant effects were occurred in neither treatments of NAA nor CPPU. On the other hand, treatments of 100 and 200 ppm increased the diameter of fruit. In addition, no effects on the same parameter were recorded in any of treatments of CPPU compared to the control treatment. These results are confirmed by those of Zilkah *et al.* (1995) on avocado, Guirguis *et al.* (2003) on pear and Abd El- Megeed (2007) on peach.

As shown in Table (5), the flesh percentage was significantly increased on the highest concentrations of CPPU and GA_3 (200 and 20 ppm of GA_3 and CPPU, respectively) compared to control trees in both experimental

season. No effects on the percentage of flesh were appeared in any of treatments of NAA compared to control treatment. These results were in line with Antognozzi and Proietti (1995) on olive trees.

2. Chemical Fruit Quality:

Data in Table (5) show that moisture content was not affected by treating the trees by NAA or CPPU, while it was decreased by increasing the concentration of GA_3 compared with unspraying trees. Antognozzi and Proiett (1995) on olive trees got the same results when applied NAA and CPPU, while the oil percentage was increased on the trees treated by NAA and CPPU. No effects on the oil percentage were recorded for GA_3 treatments. These results were inagreement with those obtained by Akilliolu *et al.* (1990) on olive.

Leaf Mineral Content:

Regarding the effect of different growth regulators treatments on leaf nitrogen, phosphorus and potassium of Manzanillo olive trees, data in Table (6) revealed that most pronounced increasing of the percentages of nitrogen and phosphorus in leaf of olive trees was recorded in the treatments of 200, 100 and 20 ppm of GA_3, NAA and CPPU, respectively compared to control treatment in both seasons. On the other hand, the percentage of leaf potassium content was reduced in the same previous treatments compared to the control. These results are in consistent with those found by Bist (1990).

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Table (1): Chemical and Mechanical Analysis of the experimental soil before starting the study

Depth (cm)	Ec Ds/ m	pH	$CaCO_3$ %	Cations (meq/ L)				Anions (mq / L)			Sand	Silt	Clay	Texture
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}				
0 - 30	2.30	8.36	38	10.50	3.50	14.5	0.10	10.00	11.3	7.30	64.01	16.71	19.28	Sandy Loam
30 – 60	2.72	7.96	46.80	4.50	55.50	17.0	1.20	4.00	12.0	2.20	66.56	7.72	25.72	Sandy Clay Loam
60 – 90	3.52	8.20	41.70	6.00	8.00	18.7	1.30	4.50	17.5	12.00	65.23	11.59	23.18	Sandy Clay Loam

Table (2): Effect of some growth regulators on the number of flowers per inflorescences, fruit set and yield of Manzanillo olives in 2007 and 2008 seasons:

Treatments	No. of flowers/ inflorescences		Fruit set (%)		Yield (kg/tree)	
	2007	2008	2007	2008	2007	2008
Control	10.59	11.58	9.16	12.15	19.16	21.06
GA_3 at 100 ppm	10.88	11.83	11.77	15.58	20.35	22.06
GA_3 at 150 ppm	10.91	12.03	14.16	18.17	25.26	26.19
GA_3 at 200 ppm	11.04	12.36	15.13	18.44	25.80	28.29
NAA at 25 ppm	10.00	11.00	8.65	11.98	18.07	19.81
NAA at 50 ppm	10.39	11.11	7.80	10.83	17.59	17.21
NAA at 75 ppm	11.49	11.42	6.31	8.93	15.48	16.48
CPPU at 10 ppm	12.42	12.14	13.66	16.19	22.46	25.52
CPPU at 15 ppm	14.51	14.34	15.83	18.22	25.32	28.37
CPPU at 20 ppm	14.94	14.64	16.02	18.67	25.84	28.66
L.S.D. (0.05)	0.60	0.62	0.89	0.59	0.97	0.75

Table (3): Effect of some growth regulators on fruit, flesh and seed weight of Manzanillo olives in 2007 and 2008 seasons:

Treatments	Fruit weight (gm)		Flesh weight (gm)		Seed weight (gm)	
	2007	2008	2007	2008	2007	2008
Control	4.17	4.07	3.31	3.23	0.85	0.84
GA_3 at 100 ppm	4.65	4.61	3.82	3.78	0.83	0.83
GA3 at 150 ppm	5.54	5.41	4.70	4.59	0.83	0.82
GA_3 at 200 ppm	5.68	6.00	4.86	5.20	0.82	0.80
NAA at 25 ppm	4.40	5.06	3.52	4.18	0.88	0.88
NAA at 50 ppm	4.81	5.70	3.88	4.76	0.93	0.94
NAA at 75 ppm	5.18	6.00	4.20	5.01	0.98	0.99
CPPU at 10 ppm	5.20	5.43	4.36	4.58	0.84	0.85
CPPU at 15 ppm	6.27	6.09	5.44	5.24	0.83	0.85
CPPU at 20 ppm	6.36	6.15	5.54	5.32	0.82	0.83
L.S.D. (0.05)	0.34	0.15	0.34	0.15	0.06	0.02

Table (4): Effect of some growth regulators on fruit volume, length and width of Manzanillo olives in 2007 and 2008 seasons:

Treatments	Fruit volume (cm3)		Fruit length (cm)		Fruit width (cm)	
	2007	2008	2007	2008	2007	2008
Control	3.75	3.15	1.99	2.00	1.62	1.68
GA_3 at 100 ppm	3.95	4.33	2.20	2.29	1.86	1.85
GA_3 at 150 ppm	5.64	5.78	2.39	2.35	2.02	1.93
GA_3 at 200 ppm	6.83	6.87	2.44	2.48	2.17	2.09
NAA at 25 ppm	4.59	4.66	2.09	2.05	1.75	1.79
NAA at 50 ppm	6.43	6.24	2.11	2.10	2.05	2.11
NAA at 75 ppm	6.89	6.70	2.14	2.19	2.22	2.32
CPPU at 10 ppm	5.14	5.31	2.00	2.10	1.61	1.68
CPPU at 15 ppm	7.39	6.80	2.06	2.14	1.68	1.70
CPPU at 20 ppm	7.54	6.90	2.13	2.15	1.69	1.70
L.S.D. (0.05)	0.48	0.51	0.06	0.11	0.11	0.09

Table (5): Effect of some growth regulators on fruit flesh, moisture and oil percent of Manzanillo olives in 2007 and 2008 seasons:

Treatments	Flesh percent		Moisture percent		Oil percent	
	2007	2008	2007	2008	2007	2008
Control	79.51	79.26	0.73	0.76	21.00	21.76
GA_3 at 100 ppm	82.08	81.86	0.66	0.74	20.70	21.62
GA_3 at 150 ppm	84.88	84.84	0.63	0.70	21.70	21.94
GA_3 at 200 ppm	85.55	86.66	0.61	0.67	21.52	21.51
NAA at 25 ppm	80.02	82.60	0.73	0.75	23.64	24.25
NAA at 50 ppm	80.54	83.50	0.72	0.73	25.80	26.12
NAA at 75 ppm	80.97	83.50	0.72	0.73	28.51	26.51
CPPU at 10 ppm	83.82	84.35	0.74	0.75	21.12	23.98
CPPU at 15 ppm	86.70	86.04	0.72	0.74	22.05	26.51
CPPU at 20 ppm	87.66	86.50	0.71	0.74	22.11	26.59
L.S.D. (0.05)	1.01	0.72	0.03	0.02	0.85	1.44

Table (6): Effect of some growth regulators on nitrogen, phosphorus and potassium content (percent on dry weight basis) of Manzanillo olives in 2007 and 2008 seasons:

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	2007	2008	2007	2008	2007	2008
Control	1.48	1.50	0.45	0.47	0.68	0.73
GA_3 at 100 ppm	1.65	1.72	0.58	0.61	0.61	0.66
GA_3 at 150 ppm	1.92	1.89	0.69	0.70	0.56	0.61
GA_3 at 200 ppm	2.04	2.08	0.71	0.72	0.48	0.51
NAA at 25 ppm	1.52	1.55	0.61	0.66	0.63	0.70
NAA at 50 ppm	1.76	1.73	0.68	0.75	0.56	0.63
NAA at 75 ppm	1.94	1.93	0.70	0.77	0.50	0.55
CPPU at 10 ppm	1.63	1.76	0.59	0.62	0.67	0.68
CPPU at 15 ppm	1.83	1.90	0.67	0.72	0.60	0.61
CPPU at 20 ppm	2.02	2.16	0.68	0.75	0.51	0.53
L.S.D. (0.05)	0.05	0.03	0.05	0.02	0.04	0.02

الملخص العربى

تأثير بعض منظمات النمو على المحصول وجودة ثمار الزيتون صنف المنزانيللو

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اجريت هذه التجربة لدراسة تأثير بعض منظمات النمو مثل الجبريليك اسيد بتركيز ٢٠٠,١٥٠,١٠٠ جزء فى المليون والنفثالين اسيتيك اسيد بتركيز ٧٥,٥٠,٢٥ جزء فى المليون وكذلك السيتوفكس بتركيز ٢٠,١٥,١٠ جزء فى المليون عند وقبل الأزهار الكامل بشهر وبعد شهر وشهرين من الازهار الكامل على الصفات الكمية والنوعية على اشجار زيتون صنف المنزانيللو خلال عامى ٢٠٠٧-٢٠٠٨ . وقد اوضحت النتائج انه خلال موسمى الدراسة فان استخدام السيتوفكس أدى الى زيادة معنوية فى عدد الأزهار فى النورة مقارنة بكل من الجبريلليك اسيد والنفثالين اسيتيك اسيد. كذلك زادت نسبة العقد والمحصول باستخدام الجبريلليك اسيد والسيتوفكس وانخفضت باستخدام النفثالين اسيتيك اسيد فى كلا الموسمين . ايضا اوضحت النتائج ان كل منظمات النمو ادت الى زيادة وزن الثمرة واللحم وحجم الثمرة ومحتوى الاوراق من النتروجين والفوسفور والى نقص فى محتوى الاوراق من البوتاسيوم . كما افادت النتائج ايضا ان معاملات الجبريلييك اسيد ادت الى زيادة فى ابعاد الثمرة (طول وعرض الثمرة) ونسبة اللحم والى نقص فى المحتوى الرطوبى للثمرة ولم يتأثر وزن البذرة ونسبة الزيت بمعاملات الجبريلليك اسيد فى حين ان الرش بالنفثالين اسيتيك اسيد ادى الى زيادة فى وزن البذرة وعرض الثمرة وكذلك فى نسبة الزيت . ومن ناحية اخرى فقد وجد أن طول الثمرة والمحتوى الرطوبى للثمرة وكذلك نسبة اللحم لم يتأثر بمعاملات النفثالين اسيتيك اسيد . وأشارت النتائج ايضا ان نسبة اللحم والزيت زادت مع معاملات السيتوفكس بينما لم تؤثر معاملات السيتوفكس على وزن البذرة وأبعاد الثمرة (طول وعرض الثمرة) وكذلك المحتوى الرطوبى.