Egypt. J. Hort. **Vol. 40,** No.1, pp.101-111 (2013)

Effect of Different Concentrations of Some Foliar Growth Regulators on Production and Fruit Quality of Kalamata Olive Cultivar.

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THIS EXPERIMENT was executed in an olive private farm at Cairo Alexandria desert road (64 kilometer) to study the impact of foliar application of Cytofex (10ml/L, 20ml/L and 30ml/L) and Naftoscene (0.5ml/L, 0.75ml/L and 1.0ml/L) 15 days after full bloom on 'Kalamata' olive trees planted 6X4m and irrigated with drip irrigation. The farm received the recommended field managements of Horticulture Research Institute. Concerning the number of retained fruits/m of "Kalamata" olive cv., Naftoscene at 0.75ml/L & 1.0ml/L increased significantly number of retained fruits compared to the control and other treatments after spraying, after June drop, and before harvesting during 2011 season, Whereas, Cytofex at 20ml/L & 30ml/L and Naftoscene at 0.5 ml/L & 0.75ml/L surpassed the rest of treatments and the control after June drop, and before harvesting in September in 2012 season. On the contrary, Cytofex at 30ml/L gave the least significant values of fruit drop after spraying, after June drop and before harvesting in both seasons. Cytofex at 30ml/L and 20ml/L influenced significantly fruit weight, flesh weight, oil as fresh weight and dry weight and finally the yield in both seasons, although Cytofex at 30ml/L and Naftoscene at 0.5ml/L gave the highest significant value of high moisture content in both seasons. Therefore Cytofex at 30ml/L can be recommended to be applied for olive to improve production of fruits and oil percentage, and in the meantime decreased the number of fruit drop.

Keywords: Cytofex , Naftoscene, Olive "Kalamata", Yield, Fruit weight, Oil percentage.

Olive (*Olea europaea L.*) belongs to family oleaceae, is one of the most important fruit crop grown worldwide due to its nutritional and economic importance. Unfruitfulness in olive has frequently been observed which may be attributed to numerous factors. Some of these factors are probably related to the internal imbalance of growth regulators and other physiological factors according to the nutritional diversion hypothesis (Sachs, 1977). Certain endogenous hormones are involved in the regulation of fruit setting in many fruits. Plant growth regulating chemicals like naphthalene acetic acid (NAA) may be used to increase fruit set of certain fruit crops like apples, dates, and citrus and olive. They could be used alone and/or combined with other managerial operations that may be playing an

important role in fruit production and quality of olive (Khalil *et al.,* 2012). It is found that Cytofex (CPPU) a new growth regulator with high physiological activity has been widely studied recently (Kassem, *et al.,* 2011). The discovery of plant hormones and their ability to regulate all aspects of growth and development were defining moments in horticulture (Greene, 2010).

Many researches of Plant growth regulating hormones have dealt with fruit trees to improve production and quality (Abotalibi & Behranoznab, 2006, Moustafa, *et al*, 1996, Roy, *et al*., 1980, Haidry, *et al*., 1997, Hartmann, *et al*, 1980 and Almeida *et al.,* 2004).

The aim of the current study was to assist the application of some plant growth regulators like Cytofex (N-(2-chloro-4-pyridinyl-CPPU) phnyl urea and Naftoscene (1g/L sodium -5-nitrogenal acetat, 2g/L sodium-ortho-nitrophenolat, 3g/L sodium-para-nitrophenolate and 25g/L sodium-naphthalneacetat foliar application on "Kalamata" olive trees to improve cropping potential of olive cultivar "Kalamata" and their efficiency to improve fruit quality and production.

Material and Methods

The present study was carried out during 2011 and 2012 growing seasons on 'Kalamata' olive trees (7 years old), planted in a private farm at Kilometer 64 from Cairo (Cairo Alexandria desert road). Trees were uniform in shape and size as possible and planted 6 X 4 meters apart and grown in sandy loam soil and irrigated with drip irrigation from well (underground water). Trees received the normal of organic and chemical fertilizers in winter at the beginning of November, and the chemical fertilization program during the growing season. Also, irrigation and pest control program executed according to the recommendation in olive and semiarid Dept. Horticulture Research Institute, ARC (Elsayed & Saad El-Din 2011).

The research study the effect of Cytofex (N-(2-chloro-4-pyridinyl-CPPU) phnyl urea and Naftoscene (1g/L sodium -5-nitrogenal acetat, 2g/L sodium-ortho-nitrophenolat, 3g/L sodium-para-nitrophenolate and 25g/L sodium-naphthalneacetat foliar application on "Kalamata" olive trees. The complete randomized design with three replicates per treatment (one tree of replicate) was adapted in this study. Foliar sprays were executed 15 days after full bloom according to the following:

- Control
- Cytofex at 10ml/L
- Cytofex at 20ml/L
- Cytofex at 30ml/L
- Naftoscene at 0.5ml/L
- Naftoscene at 0.75ml/L
- Naftoscene at 1.0ml/L

Measurements

Growth parameters

At the beginning of the growing season during first week of May the Shoot length (cm) was measured to relate the number of fruits.

Fruiting

1- Number of fruit set before spraying at the beginning of May, and number of fruits after spraying in mid June and before harvesting at the beginning of September were measured per meter.

Fruit quality: Thirty fruit per each tree were randomly selected for carrying out the fruit quality measurements:

Fruit length (cm), fruit diameter (cm), fruit form and volume, fruit weight (g), flesh/fruit weight, seed length (cm), seed diameter (cm), seed weight (g).

Yield: average yield per tree was calculated from each treatment (Kg/tree).

Oil percentage as dry weight. By means of soxhalt extraction apparatus using petroleum ether at 60-80^{o} boiling point as described by A.O.A. C. (1975).

Statistical analysis

The experiment included in this study followed a complete randomized design in factorial experiment. The obtained data were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Differences between treatments were compared by Duncan's multiple range test described in the SAS (SAS, 1986).

Results and Discussion

Fruit/m and fruit drop.

The effect of different concentrations of foliar Cytofex and Naftoscene on number of fruits/m and dropping percentage of "Kalamata" olive cv. in successive periods during 2011and 2012 growing seasons are showed in Table 1 & 2. Concerning the number of fruit/m of "Kalamata" olive cv. the Naftoscene (0.75ml/L & 1.0ml/L) treatments increased significantly number of fruit/m compared to the control and other treatments after spraying, after June drop, and before harvesting during 2011 season, Whereas, Cytofex (20ml/L & 30ml/L) and Naftoscene (0. 5 ml/L & 0.75ml/L) surpassed the rest of treatments and the control after June drop, and before harvesting in September in 2012 season. In the meantime, Naftoscene (0.75ml/L) gave the superior value compared to the control and other treatments after spraying.

On the contrary, Cytofex at (30ml/L) gave the least significant values of fruit drop after spraying, after June drop and before harvesting in both seasons. Whereas, at Cytofex (20ml/L) gave the same effect after spraying in the first season, Naftoscene (1.0 ml/L) gave the same analogous effect before harvesting in

the second one. The effect of NAA goes on line with Kassem *et al.* (2011). In addition, CPPU sprays were found to delay chlorophyll breakdown and fruit aging (Stern *et al.*, 2006).

Fruit dimensions and weight

Tables 3 & 4 presents the effect of foliar Cytofex and Naftoscene on fruit length, diameter, fruit weight and seed length, diameter and weight of 'Kalamata' olive cv. during 2011 and 20112 seasons. It is clear that, foliar application of Cytofex and Naftoscene on Kalamata olive cv. didn't take definite trend on fruit diameter, seed length, diameter and weight during 2011 season. Meantime, application of Cytofex at 20 & 30 ml/L increased significantly fruit length and weight in the first season, respectively. Although fruit and seed length and diameter were not affected by all treatments during 2012. Cytofex at 30ml/L and Naftoscene at 0.75ml/L. increased significantly seed and fruit weight. This increment in fruit physical characteristics was also reported by numerous researchers working on different fruit species (Aljuburi *et al.*, 2000, Stern *et al.*, 2006, Aboutalebi & Beharoznam, 2006, Kassem *et al.*, 2011 and Kassem *et al*., 2012).

Fruit flesh weight, volume, moisture and oil percentage and yield

The effect of different concentrations of foliar Cytofex and Naftoscene on fruit flesh weight and volume, moisture content (%), oil content (%), and yield of "Kalamata" olive cv. in successive periods during 2011 growing season presents in Table (5 & 6). Concerning flesh weight (g) and moisture percentage of kalamata cv. were increased significantly when sprayed with Cytofex at 30ml/L and 20ml/L during 2011 and 2012 seasons, respectively. Besides Naftoscene at 0.5ml/L treatment gave the same analogous effect on moisture content in both seasons. As for fruit volume, it is obvious that Cytofex at 20ml/L gave the highest values during 2011 and 2012 seasons. Naftosene at 0.75 ml/L and 0.1ml/L gave the highest significant values of oil percentage as fresh weight in 2011, whereas Cytofex at 30ml/L gave the highest significant values compared to the control in 2012 season. In regard to oil percentage as dry weight Cytofex at 30ml/L, Naftoscene at 0.5ml/L and 1.0ml/L gave the highest significant values compared to the control and other treatments in both seasons, where as Naftoscene 0.75ml/L and Cytofex 20ml/L gave the same analogous effect during 2011 and 2012 seasons, respectively. Finally, Cytofex at 30ml/L. increased significantly yield compared to control and other treatments in both seasons. The increase in yield was consistent with that was taken by Rizk-Alla and Meshrake (2006).

Finally, oil percentage as dry weight manifest the significant effect of Cytofex at 20ml/L, 30ml/L and Naftoscene at 0.5ml/L compared to Cytofex at 10ml/L without any significant response to other treatments during 2011 season and Cytofex at 30ml/L, Naftoscene 0.5ml/L, 0.75ml/L and 1.0ml/L surpassed compared to Cytofex at 10ml/L in 2012 season only. These results are consistent with those of Abou-El-Azayem (1996), Ryan *et al.* (2002) and Bianchi (2003).

Conclusion and Discussion

Conclusively, Cytofex at 30ml/L and 20ml/L influenced significantly fruit weight, flesh weight, oil as fresh weight and dry weight and finally the yield in both seasons, although high moisture content also was increased significantly by Cytofex at 30ml/L. This increase in moisture content in the fruit is not in the expense of the oil or flesh content because both of them were increased by the treatment but it is a logic achievement as a result of the increase in yield. On the other hand, the same treatment gave the least significant values of fruit drop.

Variable response of plant growth regulators (PGRs) might be due to fact that their role depends upon the time of application, concentration and absorbed quantity (Rajput and Haribabu, 1985). Moreover, NAA effect might be due to that to improve the internal hormonal and carbohydrate level of the canopy which is responsible for improving number of inflorescence (Levin and Lavee, 2005), flower number (Noor *et al.,* 1995) fruit setting and fruit size in Kalamata olive cv. (Proietti & Tombesi 1990 and Petrisou & Voyiatzis, 1994). Similarly, Mistra and Datta (2001).

The improvement in fruit physical properties as a result of the different sprayed growth regulators might be due to their influence in enlarging cell size and enhancing the strength of carbohydrate sink, thus increasing fruit size and weight. Kuiper (1993) suggested that sink strength is established and regulated by plant growth regulators which stimulate transport of nutrients through the phloem, modify the strength of the sink by stimulating fruit growth and increase the ability for sugar unloading from the phloem. They may also act on metabolism and compartmentalization of sugar and its metabolites (Brenner and Cheikh, 1995). The increase in fruit size as a result of exogenously applied NAA was found to be associated with an increase in the cells size of the mesocarp and the increase in sink demand (Khalil *et al.,* 2012).

As a conclusion we can recommend foliar application of Cytofex at 30 or 20 ml/L to improve the production and quality and minimizing fruit drop of ‘Kalamata olive cv.

TABLE 1. The effect of different concentrations of some foliar growth regulators on number of fruits/m and dropping percentage of "Kalamata" olive cv. in successive periods during 2011 growing season.

Treatments	2011 season						
	Number of fruitset/m before spraying	Number of fruits/m after spraying	% of drop fruits after spraying	Number of fruits/m after June drop	% of drop fruits after June drop	Number of fruits/m before harvesting	% of drop Fruits before harvesting
Control	34.76	33.62b	3.28b	29.94b	13.67a	29.46b	15.13a
Cytofex10ml/L	32.13	31.05bc	3.35b	29.31b	8.73cd	28.46b	11.41b
Cytofex 20ml/L	29.95	29.39c	1.84c	27.90bc	6.95d	27.41bc	8.59c
Cytofex 30ml/L	26.80	26.28d	1.95c	25.25c	5.79d	24.75c	7.65c
Naftosene 0.5ml/L	33.78	32.35b	4.24ab	29.75b	11.93ab	28.73b	14.96a
Naftosene 0.75ml/L	39.23	38.09a	2.92bc	35.16a	10.43bc	34.01a	13.26ab
Naftosene 1.0 ml/L	40.04	37.94a	5.19a	36.58a	8.49cd	35.47a	11.32b
L.S.D at 5 %		2.599	1.318	3.443	2.935	2.969	2.267

*Means followed by the same higher case letter within the same column are not significantly different, p = 0.05.

TABLE 2. The effect of different concentrations of some foliar growth regulators on number of fruits/m and dropping percentage of 'Kalamata" cv. in successive periods during 2012 growing season.

Treatments	2012 season						
	Number of fruits/m before spraying	Number of fruits/m after spraying	% of drop fruits after spraying	Number of fruits/m after June drop	% of drop fruits after June drop	Number of fruits/m before harvesting	% of drop fruits before harvesting
Control	16.62	15.28d	8.08a	14.91c	10.24a	14.42b	13.20a
Cytofex 10ml/L	19.32	18.07cd	6.38b	17.43bc	9.75a	17.18b	11.15a
Cytofex 20ml/L	23.64	22.45ab	5.06b-d	22.04a	6.64b	21.77a	7.87b
Cytofex 30ml/L	25.13	24.16ab	3.73d	23.84a	5.14b	23.68a	5.70b
Naftosene 0.5ml/L	23.67	22.26ab	5.97bc	21.84a	7.75ab	21.69a	8.35b
Naftosene 0.75ml/L	26.01	24.89a	4.27d	24.42a	6.21b	24.09a	7.29b
Naftosene 1.0 ml/L	22.19	21.06ba	4.91cd	20.93ab	5.60b	20.81a	6.07b
L.S.D at 5 %		3.082	1.287	3.749	2.714	3.113	2.618

*Means followed by the same higher case letter within the same column are not significantly different, p = 0.05.

TABLE 3. The effect of different concentrations of some foliar growth regulators on fruit dimensions and weight of "Kalamata" olive cv. during 2011 growing season.

Treatment	2011 season					
	Fruit length (ml/L)	Fruit diameter (ml/L)	Fruit weight (g)	Seed length (ml/L)	Seed diameter (ml/L)	Seed Weight (g)
Control	2.82ab	1.87a	5.60ab	1.94a	0.79a	0.66a
Cytofex 10ml/L	2.74b	1.87a	5.50b	1.80a	0.75a	0.64a
Cytofex20ml/L	2.93a	1.90a	5.74ab	1.95a	0.77a	0.66a
Cytofex 30ml/L	2.80ab	1.84a	5.78a	1.90a	0.78a	0.64a
Naftosene 0.5ml/L	2.80ab	1.84a	5.66ab	1.86a	0.79a	0.64a
Naftosene 0.75ml/L	2.74b	1.85a	5.59ab	1.81a	0.77a	0.62a
Naftosene 1.0 ml/L	2.70b	1.84a	5.66ab	1.82a	0.76a	0.62a
L.S.D at 5 %	0.138	N.S.	0.245	N.S.	N.S.	N.S.

*Means followed by the same higher case letter within the same column are not significantly different, p = 0.05.

TABLE 4. The effect of different concentrations of some foliar growth regulators on fruit dimensions and weight of "Kalamata" olive cv. during 2012 growing season.

Treatment	2012 season					
	Fruit length (ml/L)	Fruit diameter (ml/L)	Fruit weight (g)	Seed length (ml/L)	Seed diameter (ml/L)	Seed Weight (g)
Control	2.99a	1.84a	5.91a-c	2.12a	0.81a	0.81ab
Cytofex 10ml/L	2.97a	1.87a	5.88a-d	2.08a	0.82a	0.87ab
Cytofex20ml/L	2.98a	1.88a	5.93ab	2.09a	0.77a	0.79b
Cytofex 30ml/L	3.00a	1.86a	5.71b-d	2.17a	0.82a	0.89a
Naftosene 0.5ml/L	2.90a	1.85a	5.65d	2.03a	0.80a	0.82ab
Naftosene 0.75ml/L	2.96a	1.89a	5.98a	2.13a	0.81a	0.85ab
Naftosene 1.0 ml/L	2.97a	1.83a	5.68cd	2.13a	0.77a	0.83ab
L.S.D at 5 %	N.S.	N.S.	0.225	N.S.	N.S.	0.080

*Means followed by the same higher case letter within the same column are not significantly different, p = 0.05.

TABLE 5. The effect of different concentrations of some foliar growth regulators on fruit flesh weight; volume; moisture content (%), oil content (%) and yield of "Kalamata" olive cv. in successive periods during 2011 growing season.

Treatment	2011 season					
	Flesh weight (g)	Fruit volume	Moisture content %	Oil % as dry weight	Oil % as fresh weight	Yield/kg/tree
Control	4.94ab	5.50b	65.30ab	48.95b	16.99b	30.67d
Cytofex 10ml/L	4.86b	5.33b	65.30ab	51.67ab	17.93ab	33.50cd
Cytofex 20ml/L	5.06ab	5.83a	63.93b	49.71b	17.93ab	35.17c
Cytofex 30ml/L	5.14a	5.50b	66.61a	53.48a	17.86ab	48.50a
Naftosene 0.5ml/L	5.03ab	5.50b	65.94a	52.71a	17.91ab	32.67cd
Naftosene 0.75ml/L	4.97ab	5.33b	65.52ab	53.19a	18.33a	34.50c
Naftosene 1.0 ml/L	5.04ab	5.17b	66.44a	53.76a	18.04a	40.67b
L.S.D at 5 %	0.232	0.323	1.711	2.769	0.923	2.718

*Means followed by the same higher case letter within the same column are not significantly different, p = 0.05.

TABLE 6. The effect of different concentrations of some foliar growth regulators on fruit flesh weight; volume; moisture content (%), oil content (%) and yield of "Kalamata" olive cv. in successive periods during 2011 growing season.

Treatment	2012 season					
	Flesh weight (g)	Fruit volume	Moisture content %	Oil % as dry weight	Oil % as fresh weight	Yield (kg)/tree
Control	5.10a-c	5.73ab	65.48ab	50.42ab	17.38b	23.33e
Cytofex 10ml/L	5.01a-c	5.70ab	64.28b	49.07b	17.55ab	25.17de
Cytofex 20ml/L	5.15a	5.97a	66.26a	52.20a	17.57ab	30.50c
Cytofex 30ml/L	4.82c	5.40bc	64.66ab	52.36a	18.50a	37.50a
Naftosene 0.5ml/L	4.83c	5.40bc	66.40a	52.17a	17.53ab	24.50de
Naftosene 0.75ml/L	5.13ab	5.60ab	64.79ab	50.73ab	17.85ab	26.83d
Naftosene 1.0 ml/L	4.85bc	5.17c	65.31ab	52.44a	18.16ab	34.00b
L.S.D at 5 %	0.264	0.386	1.634	2.539	0.891	2.291

*Means followed by the same higher case letter within the same column are not significantly different, p = 0.05.

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(*Received* 14/3/2013;
accepted 5/5/2013)

تأثير الرش بتركيزات مختلفة من بعض منظمات النمو على إنتاج وجودة ثمار زيتون صنف الكلاماتا

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قسم بحوث الزيتون وفاكهة المناطق شبه الجافة- معهد بحوث البساتين- مركز البحوث الزراعية – الجيزة .

هذا البحث تم تنفيذه فى مزرعة خاصة فى الكيلو ٦٤ مصر إسكندرية الصحراوى وذلك لدراسة تأثير الرش بالسيتوفكس بتركيزات (١٠مل/لتر و٢٠مل/لتر و٣٠ مل/لتر) ونافتوسين بتركيزات (٠,٥مل/لتر و٠,٧٥مل/لتر و١,٠مل/لتر) على إنتاج وجودة زيتون صنف الكلاماتا (عمر ٧ سنوات) منزرعة على مسافة ٤ × ٦ م وتروى بالتنقيط. وهذه المزرعة كان يطبق عليها توصيات معهد بحوث البساتين لخدمة أشجار الزيتون وكانت النتائج كالأتى:

- نافتوسين بتركيز ٠,٧٥ مل/لتر و١,٠مل/لتر أدى إلى زيادة معنوية فى عدد الثمار المتبقية فى المتر الطولى بعد الرش وبعد تساقط يونيو وقبل الجمع فى موسم ٢٠١١.
- كما أن السيتوفكس بتركيز ٢٠ و٣٠ مل/لتر والنافتوسين ٠,٥مل/لتر و٠٧٥مل/لتر تفوقت هذه المعاملات على المعاملات الأخرى والكنترول بعد تساقط يونيو وقبل الجمع عام ٢٠١٢.
- ومن نااحية أخرى فقد أدى الرش بالسيتوفكس بتركيز ٣٠ مل/لتر إلى تقليل نسبة التساقط بصورة معنوية بعد الرش وبعد تساقط يونيو وقبل الجمع.
- فى حين سيتوفكس بتركيز ٢٠مل و٣٠مل/لتر أدى إلى التفوق المعنوى لقيم وزن الثمار ونسبة اللحم ونسبة الزيت كوزن طازج ووزن جاف وأخيراً المحصول. وعلى الرغم من زيادة نسبة الرطوبة فى الثمار والتى زادت بصورة معنوية نتيجة المعاملة بالسيتوفكس ٣٠مل/لتر ونافتوسين ٠,٥ مل/لترفى كلا موسمى النمو.
- ولذلك من الأفضل أن نوصى برش السيتوفكس بتركيز ٣٠مل/لتر لتحسين الإنتاج وجودة الثمار ونسبة الزيت وتقليل نسبة التساقط فى صنف الكلاماتا.