11 *Egypt. J. Hort.* **Vol. 41,** No. 2, pp. 169 - 182 (2014)

Effect of calcium Nitrate and Gibberellic Acid Foliar Sprays on Fruiting and Fruit Quality of "Manzanillo" and "Dolce" Olive Cvs.

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THIS WORK was implemented to study the impact of foliar applications of calcium nitrate at 3% provided with (Gibberellic acid) at 10 ppm and 20 ppm at full bloom (mid-April), at fruit set stage (mid-May) and at pit hardening stage on 'Manzanillo' and 'Dolce' olive cvs during 2012 and 2013 seasons. This experiment was carried out at an olive private farm (9 years old) at Cairo Alexandria desert road (90 kilometer). The olive trees were planted at 4 x 6 m and irrigated using drip irrigation system. In olives, yield together with fruit quality determinations crop value and farmer profits. Yield depends on the number of fruits cropped per tree and their average weight fruit and flesh weight and oil content are the most important determents of on-tree fruit quality. Calcium play significant roles in fruit set, fruit growth and maturation. Calcium nitrate at 3 % plus GA_3 at 10 and 20 ppm were applied as foliar sprays in three stages, mid April, mid May and during pit hardening. All, treatments have significantly reduced percentage of fruit drop and increased yield (kg/tree). Fruit yield had pronounced increases over the control with mid May treatment to score 47.5 and 57.6 % in the first season, 54.5 and 70.9 % in the second one, respectively. Best results were brought about when calcium nitrate at 3 % plus GA_3 at 10 and 20 ppm were applied in mid May followed by treatments during pit hardening and mid April, respectively. Such treatments have also had significant impacts on fruit, seed and flesh weight.

Keywords: Manzanillo cv., Dolce cv., Calcium nitrate, Gibberellic acid, HoklyGib, Fruit set, Fruit drop, Moisture content, Oil content.

The Olive is one of the most widely cultivated and economically important fruit crop for several subtropical Mediterranean countries olive trees are adaptable to a wide range of soil types. In Egypt, olive trees play an important economical role in the newly reclaimed area because of its ability to withstand the stress conditions. Olive is one of the fruit crops that can grow in sandy soil due to its capability to tolerate drought conditions. Manzanillo cv. Trees under the environment of Egypt, is subjected to high fruit drop after fruit set (Beltran *et al.*, 2004). During fruit development, spraying with calcium nitrate may improve the middle lamella of the cell and alleviate the dropping of its fruits, concerning the Dolce cv., it bears heavy load of fruits but the size of fruit may be small and have inferior size in marketing, therefore the application of (GA_3 at 10 & 20) ppm at full bloom stage, at fruit set stage and pit hardening may improve the fruit size (Casero *et al*. (2002) and El-Sese (2005).

Calcium provides cell wall rigidity by cross-linking of pectic chains of the middle lamella (Glenn *et al.* 1988 and Tretyn, 1994). Disintegration of cell walls and the collapse of affected tissues are typical symptoms of calcium deficiency (Marschner, 1995). Proportion of calcium pectate in cell walls is very important for the ripening of the fruit. The increase of fruit calcium content leads to increase fruit firmness and delays fruit ripening or prevents calcium-related disorders (Ferguson & Drobak, 1988 and Zocchi & Mignani,1995). A fruit is an organ with a low rate of transpiration and in spite of high concentration of calcium in soil solution just a little of this element can be needed (Himelrick and McDuffie, 1983). High growth rates of low-transpiring organs increase the risk of calcium tissue content falling below the critical level required for cell wall stabilization and membrane integrity. Foliar calcium spraying can be an effective way of increasing its concentration in fruits (Casero *et al.* 2002, Neilsen & Neilsen, 2002 and Tomala & Soska 2004). The effect of this treatment depends however on environmental factors connected with the technique of spraying, salt concentrations, time and number of treatments and type of fertilizers used (Mengel, 2002). Tomala (1997) recommends the first spray of winter apple cultivars with calcium salts at the beginning of June, not later than in the second half of June. According to a great number of studies, foliar application of calcium on apple trees was effective in the second half of vegetation period, when the delivery of Ca ions to fruits uptake by roots rapidly decreased (Zavalloni *et al.* 2001, Casero *et al.* 2002 and Neilsen & Neilsen, 2002). Calcium transported by xylem is moved effectively to young fruits, as organs of high metabolism rate and transpiration at the early stage of development. In the later period of fruit growth and ripening the transport of calcium can be limited to phloem, so spraying olive trees with calcium nutrients can improve fruit set, oil production and quality in Manzanillo olive (Desouky *et al.,* 2009).

Gibberellins are known for their ability to increase cell enlargement (Arteca, 1996, Davis, 2004 and Pharis & King, 1995), thus enhancing fruit growth in certain species such as citrus (Eman *et al.,* 2007 and El-Sese, 2005), litchi (Stern & Gazit, 2000 and Chang & Lin, 2006), guava (El-Sharkawy *et al.,* 2005), pear (Zhang *et al.,* 2007) olive (El-khawaga *et al.,* 2007), and (Makwana *et al.,* 2010) on Jatropha.

The aim of the present investigation was to evaluate the effect of foliar spray of Calcium nitrate (at 3%) and GA_3 10 and 20 ppm in April & May and during pit hardening on fruit drop, yield and fruit quality of Manzanillo and Dolce olive cultivars.

Materials and Methods

The present study was carried out during 2012 and 2013 growing seasons on nine- years -old "Manzanillo and Dolce" olive trees, planted in a private farm at Cairo Alexandria desert road. Trees were uniform in shape and size as possible and planted at 6 x 4 meters apart in sandy loam soil and irrigated with drip irrigation from well (underground water). Trees received normal Horticultural Practices and Pest Control Program according to (El-Sayed and Abou Shanab, 2011).

This research was carried out to study the effect of calcium nitrate and (Gibberellic acid) HoklyGib at (10 & 20 ppm GA_3) as foliar applications on "Manzanillo and Dolce" olive cvs. A randomized complete block design with three replicates per treatment (one tree per replicate) were adopted in this study. Foliar sprays were started in April, May and during pit hardening according to the following treatments:

- Control.
- Spraying calcium nitrate at 3% and HokleyGib (GA_3) at 10 ppm concentration at full bloom stage in mid April.
- Spraying calcium nitrate at 3% and HokleyGib (GA_3) at 20 ppm at full bloom stage in mid April.
- Spraying calcium nitrate at 3% and HokleyGib (GA_3) at 10 ppm at fruit set stage in mid May.
- Spraying calcium nitrate at 3% and HokleyGib (GA_3) at 20 ppm. at fruit set stage in mid May
- Spraying calcium nitrate at 3% and HokleyGib (GA_3) at10 ppm during pit hardening.

Measurements

Fruiting

Number of fruit set at the beginning of May, and number of fruits in mid June and before harvesting at the beginning of September were calculated per meter.

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

Fruit length (cm), fruit diameter (cm), fruit shape index, fruit weight (g), flesh weight (g), seed length (cm), seed diameter (cm), seed weight (g).

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

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

Statistical analysis

The experiment layout included in this study followed a randomized complete block design in a factorial experiment. The obtained data during the two experimental seasons were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Differences between treatments were compared by using multiple range test (Duncan, 1955) as described in the SAS (SAS, 1986).

Results and Discussion

Fruiting and yield

Data presented in Tables 1 and 2 show the effect of foliar sprays of calcium nitrate at 3% and (GA_3) at (10 & 20 ppm) in mid April, mid May and at pit hardening on fruit set/m, fruit retained/m, No. of fruit drop/m, percentage of fruit

drop and yield (Kg/tree) of 'Manzanillo' and 'Dolce' olive cvs. during 2012 and 2013 seasons. It is clear that Dolce olive trees surpassed Manzanillo in fruit set/m, retained fruit/m and yield in both seasons. On the other hand, Manzanillo cv. attained the highest fruit drop percentage in all treatments of Dolce and Manzanillo cvs.

Moreover, foliar tested application of calcium nitrate at 3% and (Gibberellic acid) HoklyGib (10 & 20 ppm) in mid May and pit hardening on Dolce and Manzanillo gave the highest significant values of fruit set/m, retained fruit/m and yield compared with the control and other treatment ascendingly during 2012 and 2013 seasons. It should pointed out that foliar sprays with calcium nitrate at 3 % plus GA_3 at 10 and 20 ppm in mid May have resulted in an increase over the control by 47.5 and 57.6 % for the first season, and 54.5 and 70.9 for the second season, respectively However, for the No. of fruit drop/m and fruit drop percentage/m the control showed the lowest significant values compared to the other treatments in both seasons which reflect a very positive effects in this concern.

Concerning the combinations of Dolce and Manzanillo cvs. with calcium nitrate at 3% and HoklyGib (10 & 20 ppm) treatments foliar application in mid April, mid May and at pit hardening. Dolce cv. treated with foliar spray of Calcium Nitrate 3% and HoklyGib (20 ppm) treatment showed the highest significant values compared with the Manzanillo, the other treatments and the control. Manzanillo, other tested combinations showed the intermediate significant value in this concern. Meanwhile, the control treatment showed had the highest values for No. of fruit drop/m and percentage of fruit drop for both cultivars under study.

These results are in agreement with those reported by Tomala (1997) and Zavalloni *et al.* (2001), who mentioned that the first spray of winter apple cultivars with calcium salts to the at the beginning of June, not later than in the second half of June. According to a several number of studies, foliar application of calcium on apple trees was effective in the second half of vegetation period, when the delivery of Ca ions to fruits uptake by roots rapidly decreased. Also the effect of GA_3 go in line with those reported by Arteca (1996) and Davis (2004). Data of the second season reaffirm these achieved in the first one with more pronounced values.

Fruit characteristics and dimensions

The effect of Calcium Nitrate (3%) and (Gibberellic acid) HoklyGib (10 & 20 ppm) on fruit length and diameter, fruit shape index, fruit weight (g), seed length and diameter during 2012 and 2013 are shown in Tables 3 and 4. Results showed that Dolce cv. had higher significant values regarding fruit length, fruit shape index and seed length as compared to Manzanillo cultivar gave the highest significant values with Dolce cv. compared to Manzanillo cv. fruit length (cm), fruit shape index and seed length (cm) in both seasons. On the other hand, fruit diameter (cm.), fruit weight (g.) and seed diameter (cm) had the opposite trend with Manzanillo cv. which proved to be superior as compared to Dolce cv. during the two growing seasons of the study.

TABLE 1. The effect of different concentrations of foliar calcium nitrate (3%) and (Gibberellic acid) HokleyGib on number of fruit set/m, retained fruits, dropping percentage and yield of "Manzanillo" and "Dolce" olive cv. in successive periods during 2012 growing season.

Characters	Fruit set /m			Fruit retained/m			No. of fruit drop/m			% fruit drop			Yield (kg/tree)		
Cvs / Treatments	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean
Control	29.97c	50.10ab	43.03A	24.86g	50.11d	37.49D	5.11b	5.99a	5.55A	17.04a	10.66d	13.85A	34.00m	51.67g	42.83G
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid April	29.14c	56.98ab	43.06A	24.99g	52.44b	38.72C	4.15d	4.54c	4.34B	14.25b	7.97f	11.11B	36.00l	55.00f	45.50F
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid April	29.76c	55.63b	42.69A	25.96fg	51.24c	38.60C	3.80e	4.39cd	4.10C	12.77c	7.90f	10.34C	39.33k	62.00d	50.67E
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid May	29.87c	56.86ab	43.37A	27.22e	54.63a	40.93A	2.65h	2.23i	2.44E	8.86e	3.92h	6.39E	50.33h	76.00a	63.17B
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid May	29.05c	56.94ab	42.99A	26.52ef	54.75a	40.63AB	2.53hi	2.19i	2.36E	8.70e	3.85h	6.27E	59.33e	75.67a	67.50A
Calcium Nitrate (3%) + 10 ppm HoklyGib during pit hardening	28.95c	57.50a	43.22A	25.88fg	54.08a	39.98B	3.07g	3.42f	3.24D	10.59d	5.95g	8.27D	43.00j	66.00c	54.50D
Calcium Nitrate (3%) + 20 ppm HoklyGib during pit hardening	29.34c	57.47a	43.40A	26.21ef	54.18a	40.19AB	3.14fg	3.29fg	3.21D	10.69d	5.73g	8.21D	48.00i	70.00b	59.00C
Mean	29.44B	56.78A		25.95B	53.06A		3.49B	3.72A		11.84A	6.57B		44.29B	65.19A	

*Means followed by the same letter(s) within the same column are not significantly different, at p = 0.05

TABLE 2. The effect of different concentrations of foliar calcium nitrate (3%) and (Gibberellic acid) HokleyGib on number of fruit set/m, retained fruits, dropping percentage and yield of "Manzanillo" and "Dolce" olive cv. in successive periods during 2013 growing season.

Characters	Fruit set/m			Fruit retained/m			No. of fruit drop/m			% fruit drop			Yield (kg/tree)		
Cvs / Treatments	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean
Control	13.45f	28.61c	21.03C	12.47g	29.96d	19.71D	0.980c	1.663a	1.322A	7.27a	5.80b	6.54A	15.00m	40.00f	27.50G
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid April	15.48e	31.57b	23.52B	14.64f	30.11c	22.38C	0.837d	1.457b	1.147B	5.41c	4.61d	5.01B	16.00l	42.00e	29.00F
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid April	15.10e	32.30b	23.70B	14.29f	30.79bc	22.54C	0.810d	1.510b	1.160B	5.37c	4.67d	5.02B	18.00k	54.67c	36.33D
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid May	16.37de	32.09b	24.23B	15.95e	31.58b	23.76B	0.423h	0.503gh	0.463D	2.60f	1.56g	2.08D	26.00h	59.00b	42.50B
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid May	16.64de	34.38a	25.51A	16.22e	33.82a	25.02A	0.413h	0.557fg	0.485D	2.47f	1.61g	2.04D	30.33g	63.67a	47.00A
Calcium Nitrate (3%) + 10 ppm HoklyGib during pit hardening	16.58de	34.81a	25.69A	15.93e	33.97a	24.95A	0.653ef	0.830d	0.742C	3.93e	2.40f	3.16C	21.00j	49.00d	35.00E
Calcium Nitrate (3%) + 20 ppm HoklyGib during pit hardening	17.39d	33.96a	25.67A	16.70e	33.03a	24.87A	0.687e	0.927cd	0.807C	3.95e	2.72f	3.34C	23.00i	55.00c	39.00C
Mean	15.86B	32.53A		15.17B	31.47A		0.686B	1.064A		4.43A	3.34B		21.33B	51.90A	

*Means followed by the same letter(s) within the same column are not significantly different, at p = 0.05

TABLE 3. The effect of different concentrations of foliar calcium nitrate (3%) and (Gibberellic acid) HokleyGib on fruit dimensions of "Manzanillo" and "Dolce" olive cv. in successive periods during 2012 growing season .

Characters	Fruit length (cm)			Fruit diameter (cm)			Fruit shape index			Fruit weight (g.)			Seed length (cm)			Seed diameter (cm.)		
Cvs / Treatments	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean
Control	2.34g	2.69d	2.52E	1.82d	1.51i	1.66G	1.28c	1.79b	1.54B	4.24d	3.77e	4.01C	1.39d	2.10c	1.75B	0.923c	0.710de	0.817BC
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid April	2.37g	2.87bc	2.62D	1.87c	1.53h	1.70F	1.27c	1.88a	1.58A	4.70c	4.18d	4.44B	1.40d	2.19b	1.79B	0.937c	0.720d	0.828AB
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid April	2.46f	3.16a	2.81B	1.91b	1.67f	1.79C	1.29c	1.90a	1.59A	5.27a	4.96b	5.12A	1.43d	2.29a	1.86A	0.940bc	0.687f	0.813C
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid May	2.46f	2.86c	2.66CD	1.92b	1.55g	1.74D	1.28c	1.84a	1.56AB	4.63c	4.21d	4.42B	1.43d	2.16bc	1.80B	0.937c	0.710de	0.823A-C
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid May	2.52e	3.19a	2.86A	1.97a	1.69e	1.83A	1.28c	1.89a	1.59A	5.32a	4.95b	5.13A	1.45d	2.29a	1.87A	0.957ab	0.707de	0.832A
Calcium Nitrate (3%) + 10 ppm HoklyGibduring pit hardening	2.44f	2.92b	2.68C	1.88c	1.57g	1.72E	1.30c	1.86a	1.58A	4.64c	4.18d	4.41B	1.45d	2.31a	1.88A	0.963a	0.703d-f	0.833A
Calcium Nitrate (3%) + 20 ppm HoklyGib during pit hardening	2.49ef	3.20a	2.85AB	1.93b	1.69e	1.81B	1.29c	1.90a	1.59A	5.33a	4.95b	5.14A	1.44d	2.34a	1.89A	0.970a	0.693ef	0.832A
Mean	2.44B	2.99A		1.90A	1.60B		1.29B	1.87A		4.88A	4.46B		1.43B	2.24A		0.947A	0.704B	

*Means followed by the same letter(s) within the same column are not significantly different, at p = 0.05

TABLE 4. The effect of different concentrations of foliar calcium nitrate (3%) and (Gibberellic acid) HokleyGib on fruit dimensions of "Manzanillo" and "Dolce" olive cv. in successive periods during 2013 growing season.

Characters	Fruit length(cm)			Fruit diameter(cm)			Fruit shape index			Fruit weight (g.)			Seed length(cm)			Seed diameter (cm.)		
Cvs / Treatments	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean
Control	2.48c	2.73bc	2.61C	1.87d	1.52i	1.70F	1.32d	1.79bc	1.56AB	4.68f	4.17g	4.42D	1.54c	2.16b	1.85C	0.970a	0.753bc	0.862AB
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid April	2.52c	2.92b	2.72C	1.92c	1.55h	1.74E	1.31d	1.88ab	1.60AB	5.30e	4.65f	4.98C	1.54c	2.20b	1.87C	0.973a	0.740c	0.857B
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid April	2.58c	3.29a	2.93AB	1.96b	1.68f	1.82C	1.32d	1.95a	1.63A	5.89a	5.51c	5.70B	1.55c	2.31a	1.93AB	0.980a	0.703c	0.842B
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid May	2.57c	2.94b	2.75BC	1.96b	1.56gh	1.76D	1.31d	1.88ab	1.60AB	5.39d	4.64f	5.02C	1.59c	2.17b	1.88C	0.983a	0.837c	0.860AB
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid May	2.60c	2.98b	2.79A-C	2.03a	1.71e	1.87A	1.28d	1.75c	1.52B	5.95a	5.66b	5.81A	1.61c	2.31a	1.96A	0.993a	0.803b	0.898A
Calcium Nitrate (3%) + 10 ppm HoklyGibduring pit hardening	2.55c	2.96b	2.75BC	1.91c	1.58g	1.75E	1.33d	1.88ab	1.60AB	5.30e	4.66f	4.98C	1.59c	2.19b	1.89BC	0.973a	0.727c	0.850B
Calcium Nitrate (3%) + 20 ppm HoklyGibduring pit hardening	2.57c	3.34a	2.95A	1.97b	1.71e	1.84B	1.30d	1.95a	1.63A	5.89a	5.69b	5.79A	1.56c	2.33a	1.95A	0.993a	0.720c	0.857B
Mean	2.55B	3.02A		1.95A	1.62B		1.31B	1.87A		5.49A	5.00B		1.57B	2.24A		0.981A	0.741B	

*Means followed by the same letter(s) within the same column are not significantly different, at p = 0.05

Concerning the effect of the treatments, although there were no significant difference of fruit shape index and seed length compared the control treatment of Dolce and Manzanillo in both seasons, yet, fruit length fruit, diameter, fruit weight and seed diameter were affected significantly with foliar application of calcium nitrate at (3 %) and HoklyGib (10 & 20 ppm) in mid May and pit pit hardening treatments in both seasons of the study.

However, data in hand declared distinguished effects regarding fruit weight, seed length and seed weight when calcium nitrate at 3 % was supplemented with GA_3 at 10 and 20 ppm in mid April at mid May.

As for the combinations of the effect of the treatments and the two cultivars on fruit length (cm), fruit diameter (cm), fruit shape index, fruit weight (g), and seed diameter (cm.) the foliar spray of calcium nitrate (3%) and 20 ppm HoklyGib in mid May with Dolce cv., in the course of pit hardening performed the highest significant value compared with other treatments during both 2012 and 2013 seasons. With Manzanillo cv. it gave the superior values with regard fruit and seed properties without and significant differences in both cultivars. An analogous trend was also obtained in the second season of the study. These results are in harmony with those reported by Neilsen and Neilsen (2002).

Seed weight (g.) and chemical component

Data in Tables 5 and 6 concerning the inspects of different implemented treatments, obviously pronounced and significant increases in seed weight and flesh weight were noted when calcium nitrate at 3 % was applied with GA3 at 10, 20 ppm in mid May and pit hardening and in mid April, respectively. In the mention no significant effects were noted when dealing with moisture %, oil % as dry and fresh.

As for the interaction their were significant increases in values of seed and flesh weight of Dolce cv., over the control treatment, whereas no active effects were noticed in values of seed weight and oil % as dry and fresh weight, regarding Manzanillo cv. data of the second season indicate the same trend as those previously described in the first season.

The proportion of calcium pectate in cell walls is very important for the ripening of fruit and the increase of fruit calcium content leads to the increase in fruit firmness and delays fruit ripening or prevents calcium-related disorders (Ferguson & Drobak, 1988 and Zocchi & Mignani, 1995). High growth rates of low-transpiring organs increase the risk of calcium tissue content falling below the critical level required for cell wall stabilization and membrane integrity. Foliar calcium spraying can be an more or less effective way of increasing its concentration in fruits (Casero *et al.*, 2002, Neilsen & Neilsen, 2002 and Tomala & Soska, 2004).

TABLE 5. The effect of different concentrations of foliar Calcium Nitrate(3%)and(Gibberellic acid) HokleyGib on seed and flesh weight, moisture (%), oil (%), of "Manzanillo" and "Dolce" olive cv. in successive periods during 2012 growing season.

Characters	Seed weight (g.)			Flesh weight (g.)			Moisture (%)			Oil (%) as fresh weight			Oil (%) as dry weight		
Cvs / Treatments	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean
Control	0.763bc	0.487e	0.625E	3.48e	3.28f	3.38E	65.08ab	65.51ab	65.30A	18.32a	16.32b	17.32A	52.52ab	47.31d	49.92A
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid April	0.837ab	0.493e	0.665DE	3.86c	3.69d	3.77C	65.14ab	65.41ab	65.27A	18.33a	16.42b	17.37A	52.55ab	47.46d	50.01A
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid April	0.867a	0517e	0.692CD	4.40a	4.44a	4.42A	65.72ab	63.28c	64.50A	18.36a	16.52b	17.44A	53.57a	46.31d	49.94A
Calcium Nitrate (3%) and 10 ppm HoklyGib in mid May	0.867a	0.717c	0.792AB	3.76cd	3.49e	3.63D	63.75c	66.04a	64.90A	18.30a	16.50b	17.40A	50.49bc	48.62cd	49.56A
Calcium Nitrate (3%) and 20 ppm HoklyGib in mid May	0.907a	0.727c	0.817A	4.41a	4.22b	4.32B	65.07ab	65.40ab	65.23A	18.49a	16.40b	17.44A	53.09a	47.40d	50.24A
Calcium Nitrate (3%) + 10 ppm HoklyGib during pit hardening	0.860a	0.620d	0.740BC	3.78cd	3.56e	3.67D	65.15ab	65.21ab	65.18A	18.46a	16.24b	17.35A	52.97a	46.67d	49.82A
Calcium Nitrate (3%) + 20 ppm HoklyGib during pit hardening	0.897a	0.607d	0.752B	4.44a	4.34a	4.39AB	64.37bc	66.22a	65.29A	18.53a	16.12b	17.33A	52.08ab	47.74d	49.91A
Mean	0.857A	0.595B		4.02A	3.86B		65.90A	65.29A		18.40A	16.36B		52.47A	47.36B	

*Means followed by the same letter(s) within the same column are not significantly different, at $p = 0.05$

TABLE 6. The effect of different concentrations of foliar calcium nitrate (3%) and (Gibberellic acid) HokleyGib on seed and flesh weight, moisture (%), oil (%), of "Manzanillo" and "Dolce" olive cv. in successive periods during 2013 growing season.

Characters	Seed weight (g.)			Flesh weight (g.)			Moisture (%)			Oil (%) as fresh weight			Oil (%) as dry weight		
Cvs / Treatments	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean	Manzanillo	Dolce	Mean
Control	0.793bc	0.500e	0.647D	3.88f	3.67g	3.78D	65.72ab	65.81a	65.76A	18.75a	16.17b	17.21A	53.21bc	47.31g	50.26AB
Calcium Nitrate (3%) and 10 ppm Hokly Gib in mid April	0.867ab	0.510e	0.688CD	4.43c	4.14d	4.29B	63.69c	65.48ab	64.59B	18.31a	16.24b	17.27A	50.38de	47.05g	48.71C
Calcium Nitrate (3%) and 20 ppm Hokly Gib in mid April	0.927a	0.540e	0.733BC	4.96ab	4.97ab	4.97A	66.10a	65.79a	65.95A	18.70a	16.18b	17.44A	55.20a	47.31g	51.26AB
Calcium Nitrate (3%) and 10 ppm Hokly Gib in mid May	0.923a	0.710cd	0.817A	4.47c	3.93f	4.20C	64.50bc	66.18a	65.34AB	18.67a	16.09b	17.38A	52.61c	47.58g	50.10B
Calcium Nitrate (3%) and 20 ppm Hokly Gib in mid May	0.940a	0.743cd	0.842A	5.01a	4.92b	4.97A	66.03a	65.61ab	65.82A	18.60a	16.59b	17.59A	54.85ab	48.27fg	51.56A
Calcium Nitrate (3%) + 10 ppm Hokly Gib during pit hardening	0.887ab	0.660d	0.773AB	4.41c	4.00e	4.21C	64.91ab	66.14a	65.53A	18.12a	16.57b	17.35A	51.71cd	49.73ef	50.72AB
Calcium Nitrate (3%) + 20 ppm Hokly Gib during pit hardening	0.943a	0.677d	0.810A	4.95b	5.02a	4.98A	65.48ab	65.82a	65.65A	18.44a	16.26b	17.35A	53.43a-c	47.59g	50.51AB
Mean	0.897A	0.620B		4.59A	4.38B		65.20A	65.83A		18.44A	16.30B		53.06A	47.83B	

* Means followed by the same letter(s) within the same column are not significantly different, at p = 0.05

Conclusions

Conclusively, it could be mentioned on the basis of the obtained results that foliar sprays with calcium nitrate at 3 % plus GA_3 at 10 and 20 ppm in (mid-May), (treatments during pit hardening) and (mid-April) respectively for both "Manzanillo" and "Dolce" cvs. could be recommended to improve yield and fruit quality especially oil content.

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(*Received* 17/6/2014;
accepted 3 /9/2014)

تـأثير الـرش بنتـرات الكالسـيوم وحـامض الجبـرلين علـى الإثمـار وصفات جودة الثمار فى صنفي الزيتون منزانيللو ودولسي

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أجري هذا البحث لدراسة تاثير الرش بنترات الكالسيوم ٣٪ مع مركب (حامض الجبرلين) هوكلي جب (١٠ و٢٠ جزء فى المليون) فى مراحل إكتمال التزهير فى منتصف إبريل والعقد فى منتصف مايو وعند تصلب النواة على أشجار الزيتون صنفى المنزانيللو والدولسي خلال موسمين ٢٠١٢ و٢٠١٣. أجريت هذه الدراسة في مزرعة زيتون خاصة علي اشجار عمر تسع سنوات منزرعه على طريق القاهرة الأسكندرية الصحراوى (الكيلو٩٠) وزرعت أشجار الزيتون على مسافات ٤ × ٦ م وتروى بنظام الري بالتنقيط.

وحيث أن القيمة الاقتصادية للزيتون تتحدد بكمية المحصول وجودة الثمار ويعتمد المحصول على محصول الثمار/شجرة ومتوسط وزن الثمار ووزن اللحم ومحتوى الثمار من الزيت، وتلعب نترات الكالسيوم أدوار معنوية فى عقد ونمو واكتمال الثمار وأظهرت المعاملات الاتى :

- الرش بنترات الكالسيوم بتركيز ٣ ٪ مع حامض الجبرلين بتركيز ١٠، ٢٠ جزء فى المليون المضافة رشا فى ٣ مراحل هى (منتصف أبريل ومنتصف مايو ومرحلة تصلب النواة) أظهرت زيادة معنوية فى محصول الشجرة بالكيلو جرام وأدت إلى إنخفاض النسبة المئوية لتساقط الثمار.

- زاد محصول الثمار زيادة واضحة عن الكنترول بمعاملة منتصف مايو مسجلة (٤٧,٥ و ٥٧,٦ ٪) فى الموسم الأول و (٥٤,٥ و ٧٠,٩ ٪) فى الموسم الثانى على التوالى.

- كانت أفضل النتائج تفوقاً عند رش نترات الكالسيوم بمعدل ٣ ٪ مع حمض الجبرلين بتركيز ١٠، ٢٠ جزء فى المليون التى أضيفت فى منتصف مايو تليها المعاملة التى أضيفت خلال مرحلة تصلب النواة تبعها معاملة منتصف أبريل على التوالى ، وهذه المعاملات أيضاً أدت إلى زيادة معنوية على الثمار والبذور ووزن اللحم.