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EFFECT OF PUTRESCINE, GIBBERELLIC ACID AND CALCIUM ON QUALITY CHARACTERISTICS AND MATURITY DELAY OF "DESERT RED" PEACH FRUIT CULTIVAR.
A: DEVELOPMENTAL ASPECTS AND PHYSICAL PROPERTIES OF THE FRUIT.

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ABSTRACT

Prolonging the marketing period of peach fruits in Egypt through introducing new cultivars, breaking dormancy early or delaying maturity of some cultivars by safe compounds would increase the growers' profits. This study was conducted during two successive seasons 2005 and 2006 by using "Desert Red" peach cultivar (*Prunus persica L.*) grafted on Nemaguard rootstock. Trees were grown at El-Noubarya province, Behera, Egypt. were sprayed with a hand sprayer to the run off. At the initiation of phase III of the double sigmoid curve the treatments included putrescine at 5 and 10 mM, GA_3 at 200 and 400 ppm, in addition to each of the above treatments plus calcium chloride (at 2%, w/v), $CaCl_2$ alone, and the control (water spray). The surfactant tween-80 was added to all treatments at 0.05% (v/v).All putrescine and GA_3 treatments whether alone or in the presence of calcium, in addition to $CaCl_2$ alone resulted in retarding the loss of tissue firmness as compared with the control in both seasons. Fruit size, weight, length, and flesh weight were significantly increased by GA_3 at 200 and 400 ppm as compared with the control in both seasons. Furthermore, $CaCl_2$ did not significantly affect fruit size, fruit weight, fruit diameter and flesh weight in both seasons. Putrescine treatments, in the presence or absence of $CaCl_2$, were not affective on altering fruit length and diameter in

both seasons. The incorporation of calcium with either putrescine or GA_3 did not consistently result in an added advantage on fruit weight and length. Meanwhile, GA_3-treated fruit, at 200 or 400 ppm, had a significant increase in flesh weight as compared with the control. Moreover, $CaCl_2$ alone did not significantly alter flesh weight in both seasons. It could be recommended to use preharvest spray with either GA_3 at 200 ppm, Putrescine at 5 ppm (441 ppm) to delay maturity of "Desert Red" peach fruits by at least on week without adversely affecting the firmness.

INTRODUCTION

Peaches are highly demanded by Egyptian consumers. Peach acreage in Egypt reached 78646 feddans in 2004 produced 302667 Metric tons of fruits (Annual Book of Statistics, Egypt in 2005).

To expand the peach market and to prolong the time of marketing, many new peach cultivars have been cultivated in Egypt. Moreover, breaking dormancy early in spring by some agents such as Dormix and some cultural practices extended the period of peach harvest. Meanwhile, most of the new cultivars reach to maturity in mid season which increases the supply and lowers prices. Peach fruits are also known with their short shelf life and weak storability. Consequently, many fruit are lost which forces peach producers to harvest their fruits at minimum maturity. Peach fruits at such stage lack the desired flavor and aroma. Peach was classified into climacteric fruit ripening. In peach, the rise in ethylene production regulates the ripening process (Kende, 1993; Leliever *et al*, 1997; Mathooko *et al*., 2001). However, the climacteric ethylene in peach is an event occurring late when the fruit has already consistently softened (Tonutti *et al*., 1997). For this reason, peach fruits exhibit short storage life that limit their commercial potential and farmers to anticipate the harvest date. As a negative consequence for this excessive early harvest, the overall peach fruit quality is reduced and does not fulfill the consumer's expectation.

Aforementioned, there is a great need to treatments that delay fruit maturity and ripening of peaches and to extend the shelf life of such

fruits. To reach this goal and improve fruit quality, substances able to interfere with ethylene biosynthesis would manipulate peach fruit ripening. Polyamines such as "putrescine", gibberellic acid and calcium play important roles in the life of fruits and could have the potential to achieve the desired goals.

Polyamines are well- known regulators of growth and differentiation (Bagni and Torrigini, 1992), and compete directly with ethylene for their common precursor S-adenosy-L-methionine (SAM) (Valero *et al.*, 2002).

Whereas the high calcium content in fruit tissues has been shown to reduce disorders, retard softening, and inhibit decay of apples. In addition to strengthening cell walls and membranes, calcium also regulates some physiological processes that may directly or indirectly affect the quality of fruit (Poovaiah, 1988).

Gibberellic acid was found to delay ripening and senescence of fruits, as well as fruit maturity in peaches (Sher-Muhammad *et al.*, 1996).

Under desert agriculture conditions, newly introduced cultivars of temperate-region origin may have a change in the developmental aspects of the ir fruits. For example, abortion of embryos may occur which leads to the absence of intermittent growth or short duration of the second phase of the double sigmoid curve of the fruit (Tukey, 1963). The modifications in the third phase of the fruit growth curve need to be monitored since the treatments were applied at the beginning of this phase. Thus, the objectives of this part of the study were to monitor the developmental aspects of "Desret Red" peach fruit in relation to treatments of putrescine, gibberellic acid and calcium, and to examine the changes in physical properties of the fruit due to the attempt of delaying their maturity and ripening.

MATERIALS AND METHODS

The present investigation was carried out during two successive growing seasons 2005 and 2006 on "Desert Red" peach cultivar (*Prunus persica L.*) budded on Nemaguard peach rootstock and grown in Nubaria region, Beheira governorate, Egypt. Trees were healthy, uniform and free of defects. The orchard trees were maintained under the standard cultural practices commonly adopted for this area. The soil was sandy, well drained, the depth of water table was at least at two meters and the trees were under dripping irrigation. Experiments were performed on 5-year-old trees trained to open-vase shape. Trees were sprayed to the run off using a hand sprayer on 17, 20 April during 2005 and 2006, respectively. Treatments included water as the control, Putrescine [1, 4-Diaminobutane ($C_4H_2N_2$)] at 5 mM (441 ppm) or 10 mM (882 ppm), GA_3 at 200 or 400 ppm in addition to each of the above treatments plus $CaCl_2$ (at 2%, w/v, meaning 20,000 ppm) and finally $CaCl_2$ alone at 2% (w/v). The non-ionic surfactant Tween 80 at 0.05% (v/v) was added to all treatments.

The treatments were sprayed at the time corresponding to specific fruit growth stages which coincided with the initiation of phase III of the double sigmoid curve. Thus, periodical fruit samples were harvested at weekly intervals following fruit set until the fruit sample of the control maturity in both seasons. Samples of generated curves of some physical properties (fruit size and weight) are shown (in figures 1 to 10) to show the developmental aspects of the fruit under filed conditions throughout the growing season whether for treated or the control fruits.

The fruit physical properties parameters were measured at weekly intervals during the entire growth season from fruit set to harvest. At each week, a random sample of ten fruits from each replication was weighed, in grams, and the average weight of the fruits was calculated. The stones were extracted, washed, air-dried and weighed. Fruit size determined by displacement in cylindrical tube containing water. Fruit length and diameter were measured by using a Vernier caliper. Fruit firmness as ($lb/Inch^2$), was determined by using Effigi pressure tester (model, FT 327 (scale of, 3-27 Lbs.).

The study treatments were arranged in a factorial experiment in randomize complete block design. Four replications were used per each treatment. Thus forty trees were employed in this study. Comparisons

among means were made via the Least Significant Differences multiple ranges by using SAS (2000) program.

RESULTS & DISCUSSION

I. Developmental Aspects of Fruit in Relation to the Treatments:

Monitoring some morphological aspects of "Desert Red" fruit such as fruit size, and weight through different phases growth and development provided data through the season to drew the growth curve. It was evident that fruits of this cultivar followed a clear double sigmoid curve with the three distinguished phases (figures 1 to 10. Like all members of the subfamily "Prunoideae", peaches are characterized by their drupaceous fruits (Bailey, 1961). These fruits with fleshy outer pericarp usually follow an intermittent pattern of growth resulting in a double sigmoid curve. The endocarp portion is the first part of the drupaceous fruits that reaches to its maximum size (Esau, 1953). In peaches. the duration between full bloom and fruit maturity was related to the relative length of the second stage of fruit development (Tukey, 1963). It appeared that the first phase of rapid enlargement following fruit set was approximately of similar rate and duration for many peach fruit varieties. Fruits of early maturing cultivars were characterized by aborted embryos and absence of intermittent growth. Midseason peach cultivars were found to have a relatively short duration of phase two of the double sigmoid curve. Meanwhile, those of later maturation showed prominent retardness in the second phase and gave rise to fully developed embryos (Tukey, 1963). Figures 1 to 5 emphasized the above information though monitoring the changes in fruit size of "Desert Red" peach cultivar during the two seasons, a typical double sigmoid curve was obtained with a relatively short duration in second phase. Some treatments were still able to modify the curve by the end of the third phase. The more pronounced modification was obtained with GA_3 treatments at 200 or 400 ppm whether in the presence or absence of calcium chloride. This effectiveness of GA_3 was related to its ability to stimulate cell elongation or enlargement since peach fruits at the third phase of the double sigmoid curve still accommodate more increase in the cell size (Marini, 2006). Responses of fruit weight to the application of various

treatments in terms of modifying the growth curve were illustrated in figures 6 to 10. Although, the total effect of purescine at 5 or 10 mM was presented before, as a reduction in fruit weight as compared with the control, the growth curves showed that this reduction required a prolonged period during the third phase of fruit development. Meanwhile, GA_3 applications at 200 or 400 ppm needed more time before starting to show a clear difference between the curve of the control and that of GA_3 whether in the absence or presence of calcium chloride. Thus, GA_3 at both concentrations was still effective in increasing tissue weight up to the harvest time. In addition, the double sigmoid curve showed a smooth transition between phase one and three which indicated to a relatively short duration of the second phase of the developmental curve. It was also obvious that calcium chloride treatment did not lead to noticeable modification in the third phase of double sigmoid curve during both seasons.

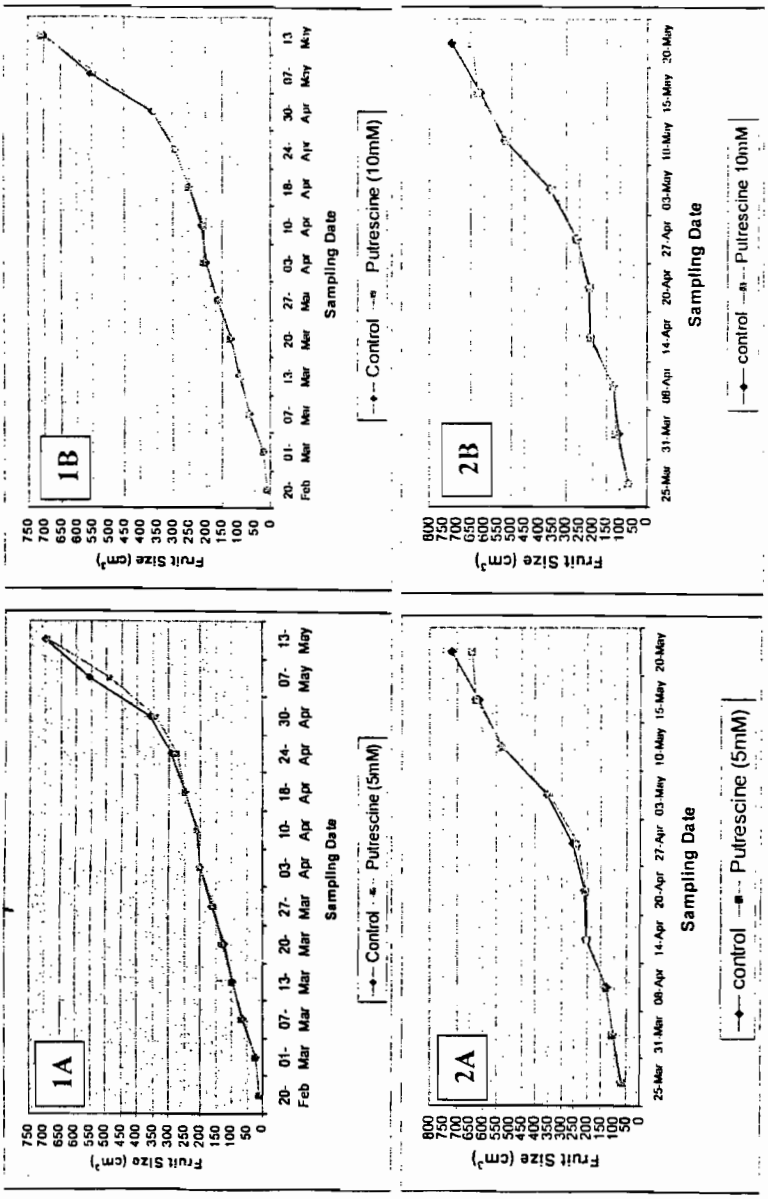

Fig 1 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit size of "Desert Red" peach fruits as treated with putrescine 5 mM throughout the two growing seasons 2005 and 2006, respectively.

Fig 2 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit size of "Desert Red" peach fruits as treated with putrescine 10 mM throughout the two growing seasons 2005 and 2006, respectively.

Fig 3 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit size of "Desert Red" peach fruits as treated with gibberellic acid 200 ppm throughout the two growing seasons 2005 and 2006, respectively.

Fig 4 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit size of "Desert Red" peach fruits as treated with gibberellic acid 400 ppm throughout the two growing seasons 2005 and 2006, respectively.

Fig 5 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit size of "Desert Red" peach fruits as treated with $CaCl_2$ 2% throughout the two growing seasons 2005 and 2006, respectively.

Fig 6 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit weight of "Desert Red" peach fruits as treated with putrescine 5 mM throughout the two growing seasons 2005 and 2006, respectively.

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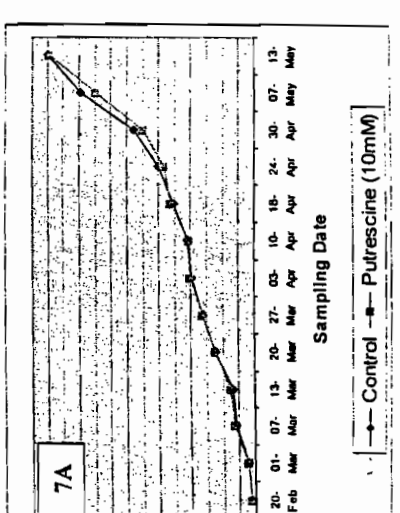

Fig 7 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit weight of "Desert Red" peach fruits as treated with putrescine 10 mM throughout the two growing seasons 2005 and 2006, respectively.

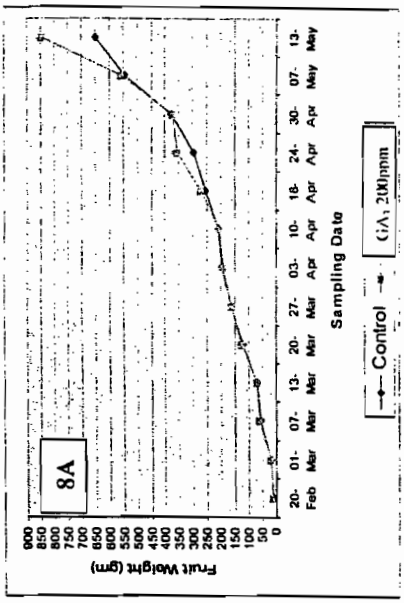

Fig 8 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit weight of "Desert Red" peach fruits as treated with gibberellic acid 200 ppm throughout the two growing seasons 2005 and 2006, respectively.

Fig 9 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit weight of "Desert Red" peach fruits as treated with gibberellic acid 400 ppm throughout the two growing seasons 2005 and 2006, respectively

Fig 10 (A, B). The double sigmoidal curve generated by monitoring the changes in fruit weight of "Desert Red" peach fruits as treated with $CaCl_2$ 2% throughout the two growing seasons 2005 and 2006, respectively

II. Physical properties of fruits as influenced by the treatments:

II.1- Fruit Firmness:

Changes in fruit firmness as influenced by various treatments, regardless the time factor, were shown in Table 1. The data indicated that, putrescine either at 5 or 10 mM significantly retarded the loss of fruit firmness in a consistent manner in the two seasons as compared with the control. However, putrescine at 5 mM was as effective as putrescine at 10 mM on fruit firmness in both seasons.

Furthermore, gibberellic acid spray at each used concentration led to a significantly increase in fruit firmness when compared with control. In a similar trend to the above finding, the two GA_3 concentrations were equally effective on peach fruit firmness. Moreover, the efficacy of putrescine at 10 mM on retarding the loss of fruit firmness did not significantly vary from that of GA_3 at 400 ppm in both seasons. However, the lower concentration of putrescine (5 mM) did not result in a consistent trend in the two seasons when compared with the used low concentration of GA_3 (200 ppm) with regard two delaying the loss of fruit firmness of "Desert Red" peaches.

Calcium chloride alone was also able to maintain the firmness of peach fruits as shown in Table 1. It was evident that $CaCl_2$-treated fruits had significantly higher firmness than that of the control in the two seasons. Such calcium treatment, however, was less effective than that obtained with putrescine at 5mM in both seasons but equally effective to GA_3 (at either used concentrations) especially in the first season.

There was no consistent synergism between putrescine and calcium chloride in terms of their effect on peach fruit firmness when the results of the two seasons were compared. Similar conclusion could be drawn when the effect of calcium alone was compared with calcium plus GA_3 at the two used concentrations (200 or 400 ppm).

The increase in fruit firmness of peaches, found in this study, as result of putrescine, GA_3 or even calcium treatments agreed with the finding of Kramer *et al.*, (1991), Wang *et al.*, (1993), Bregoli *et al* (2002), Saure (1990), Sher-Mohammmad *et al.*, (1997), Lee-ChongSuk *et al.*, (2000, a), Raese (1989), Glenn and Poovahiah (1990), Ochei *et al.*, (1993). Bregoli *et al* (2002) explained the role of

(Table 1) Physical characteristics of "Desert Red" Peach fruits as influenced by various used treatments, regardless the Time, during the two seasons 2005 and 2006

Treatment	Firmness (Lb/Inch²)		Size (cm³)		Diameter (cm)		Length (cm)		Weight (gm)		Stone weight (gm)		Flesh weight (gm)		Flesh/Stone Ratio %	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Control	19.064 d	19.933 e	432.50 e	495.50 b	4.158 bcd	4.357 b	4.329 de	4.531 c	424.84 d	490.37 b	49.601 e	70.071 bcd	375.248 d	420.304 c	7.54 a	6.00 c
Putrescine 5mM	24.062 a	24.009 bc	410.00 d	474.25 c	4.100 cd	4.320 b	4.273 e	4.491 c	391.78 f	473.20 c	53.508 bcd	69.807 e	338.275 f	405.401 d	6.15 e	5.85 cde
Putrescine 10mM	23.414 ab	23.792 c	428.25 c	479.00 c	4.132 cd	4.321 b	4.329 de	4.487 c	406.67 e	471.21 c	53.678 bcd	68.755 cde	352.994 e	402.461 d	6.42 ed	5.77 cde
GA3 200ppm	23.009 bc	24.676 ab	494.50 a	535.50 a	4.277 bc	7.523 a	4.439 ab	4.611 b	480.56 ab	525.17 a	53.797 bcd	70.671 bc	426.768 ab	454.500 ab	7.71 a	6.35 b
GA3 400ppm	23.750 ab	24.335 abc	477.50 b	539.25 a	4.280 bc	4.542 a	4.461 ab	4.650 ab	463.03 c	533.05 a	55.813 a	68.342 ed	407.218 c	464.713 a	7.05 b	6.67 a
Putrescine 5mM + $CaCl_2$ 2%	23.270 abc	24.970 a	412.00 d	485.25 bc	4.098 d	4.345 b	4.320 de	4.506 c	403.82 e	478.80 bc	51.997 d	71.090 b	351.824 e	407.714 cd	6.63 cd	5.66 ed
Putrescine 10mM + $CaCl_2$ 2%	22.359 c	23.835 c	429.50 c	481.25 c	4.212 bcd	4.327 b	4.410 bc	4.490 c	425.72 d	471.35 c	54.292 abc	70.406 bcd	371.430 d	400.495 d	6.69 cd	5.61 e
GA3 200ppm + $CaCl_2$ 2%	23.106 abc	24.352 abc	471.75 b	532.00 a	4.472 a	4.518 a	4.501 a	4.674 a	473.36 b	526.95 a	52.691 cd	74.014 a	420.674 b	452.943 ab	7.76 a	5.99 c
GA3 400ppm + $CaCl_2$ 2%	23.212 abc	23.967 c	489.50 a	527.50 a	4.290 b	4.508 a	4.496 b	4.648 ab	489.10 a	520.85 a	54.918 b	70.446 bcd	434.186 a	450.413 b	7.65 a	6.28 b
$CaCl_2$ 2%	22.796 bc	22.845 d	437.25 c	483.00 bc	4.172 bcd	4.348 b	4.362 cd	4.505 c	428.23 d	479.11 bc	52.971 bcd	69.362 bcde	375.266 d	409.754 cd	6.95 cb	5.90 cd

Values, within a column, of similar letters, were not significantly different according to the least significant difference (LSD) at 0.05 level.

polyamines in this aspect via strongly reducing or nullifing ethylene production. They reported that ethylene and polyamines use a common precursor SAM, for their biosynthesis and exert opposite effects with respect to fruit ripening and senescence. On the other hand, Kramer *et al.* (1991) studied the effect of polyamines on apple cultivars, proposed that, polyamines affected fruit softening through rigidification of cell walls by directly inhibiting polygalacturonases rather than through the interaction with ethylene synthesis. Furthermore, Valero *et al* (2002), suggested that the effect of polyamines on increasing fruit firmness can be attributed to their cross-link to the $-COO^-$ group of the pectic substances in the cell wall, resulting in rigidification that is detectable immediately after treatment. This binding also blocks the access of degrading enzymes such as pectinmethylasterase, pectinestrase and polygalacturonase, reducing the rate of softening during storage. Similar observations were reported by Mesiaen and Van Cutsem (1999). They proposed that, the reduction in softening rate caused by polyamines may depend upon their role in cell wall dynamics by directly cross-linking urinates.

To explain the role of GA_3 on fruit firmness, Andrews and Li (1995) found that, the preharvest application of GA_3 in climactric sweet cherry, decreased the polygalacuronases and pectin methylestrase activities, and increased fruit firmness compared with control fruits, and they suggested that GA_3 treatments may maintain fruit firmness by their inhibitory effects on these enzymes. Moreover Suzuki *et al* (1999) found that in whole apple fruits, similarly treated with GA_3, ethylene evolution was significantly decreased 2 weeks after treatment compared with control. Furthermore, Kondo and Danjo (2001) suggested that GA_3 treatment delayed fruit ripening by blocking ABA activity.

Furthermore, Glenn and Poovahiah (1986) suggested that calcium ions interact with pectic polymers to form a cross-linked polymer network that increases mechanical strength, thus delaying senescence and controlling physiological disorders in fruits and vegetables. Moreover, Glenn and Poovahiah (1990) demonstrated that calcium in fresh Golden Delicious apples, binds to the cell wall and middle lamella, where major influences on firmness were expected. Furthermore, Valero *et al* (2002) found that, calcium-treated plums

increased the conjugated forms of putreascine (conjugated-soluble and cell wall bound), were related to higher firmness. Moreover, Kramer *et al* (1991) suggested that, $CaCl_2$ inhibited ethylene evolution in Golden Delicious, which reflected on delaying the loss of firmness.

II.2- Fruit Size:

With regard to the effect of various treatments on fruit size of "Desert Red" peaches, changes in fruit size as influenced by various treatments, regardless the time factor, were shown in Table 1. The results revealed that putrescine at 5mM caused a significantly reduction in fruit size as compared with the control. Similar trend was obtained when putrescine-treated fruits at 10 mM were compared with the control but the significant reduction was only found in the second season. Moreover, the difference between the effects of the two used putrescine concentrations was not consistent in the two seasons.

The application of GA_3 either at 200 or 400 ppm was effective in a significant manner on increasing peach fruit size when compared with the control in both seasons. The efficacy of GA_3 at the two used concentrations was even higher than that obtained with both used putrescine concentrations when fruit size was compared in the two studied seasons.

Calcium treatment alone resulted in fruit size similar to control in both seasons. Furthermore, the application of $CaCl_2$ alone led to significantly smaller fruit size than that obtained with GA_3 concentrations in the two seasons. On the other hand, $CaCl_2$ treatment resulted in fruit size similar to that found with putrescine at 10 mM in both seasons. When the effect of $CaCl_2$ alone on fruit size was compared with that of the combination including GA_3 plus calcium, it was found that the presence of calcium had no consistent added advantage on fruit size whether it was added to GA_3 at 200 or 400 ppm. Thus, conclusion, however, could not be drawn where calcium treatment alone was compared with the combination of putrescine plus calcium in terms of their impact on fruit size. In general, fruit size of calcium-treated fruit did not significantly vary from that treated with the combination of calcium plus putrescine at 10 mM. Thus, the obvious increase in fruit size was obtained with the application of either GA_3 (200, 400 ppm) alone or in a formulation containing calcium. Even the combination of calcium plus GA_3 was more

effective than that of calcium plus putrescine at the two used concentrations of GA_3 and putrescine in both seasons.

Results of fruit size, obtained in this study, were in line with that found by Facteau *et al* (1985, a-b), Facteau *et al* (1992), Sher-Mohammed *et al* (1997), and Usenik *et al* (2005). The increasing in fruit size by GA_3 treatment by Arteca (1996) proposed that Gibberellins promote growth by increasing plasticity of the cell wall followed the hydrolysis of starch to sugar which reduces the water potential in the cell, resulting in the entry of water into the cell then causing elongation.

II.3- Fruit Diameter:

Changes in fruit diameter as influenced by various treatments, regardless the time factor, were shown in Table 1. The results revealed that putrescine at 5 or 10 mM did not significantly affect fruit diameter as compared with the control in both seasons. Similar trend was obtained when putrescine-treated fruits at 5 or 10 mM plus $CaCl_2$ were compared with the control.

The application of GA_3 either at 200 or 400 ppm was significantly effective on increasing peach fruit diameter when compared with the control in the second season only. But in the first season, the two used concentrations of GA_3 at 200 or 400 ppm did not significantly increase the fruit diameter as compared with the control. Similar trend was obtained when fruits treated with GA_3 at 400 ppm plus $CaCl_2$ (2% w/v) were compared with the control in both seasons. On the other hand, GA_3 at 200 ppm plus $CaCl_2$ caused a significantly increased in fruit diameter in the two seasons.

Calcium treatment alone resulted in fruit diameter similar to control in both seasons. Moreover, $CaCl_2$ treatment resulted in fruit diameter similar to that found with putrescine at 5 or 10 mM in the presence or absence of $CaCl_2$ in both seasons. When the effect of $CaCl_2$ alone on fruit diameter was compared with that of GA_3 plus calcium, it was found that the presence of calcium had no added advantage on fruit diameter when combined with GA_3 at 200 ppm in the two seasons. In general, diameter of calcium-treated fruits did not significantly vary from those treated with the combination of calcium plus putrescine whether at 5 or 10 mM. Thus, the obvious increase in fruit diameter was obtained with the application of GA_3 (200ppm) alone or in a formulation containing calcium in two seasons.

Results of fruit diameter, obtained in this study, were in line with that found by Bregoli *et al* (2002), Torrigiani *et al* (2004) and Qayum *et al* (2002)

II.4- Fruit length:

Data of length as affected by various treatments in both seasons is shown in Table 1. The data indicated that fruit length was not significantly influenced by putrescine treatment either at 5 or 10 mM when compared with the control. However, GA_3 treatment caused a significant increase in such length in both seasons whether at 200 or 400 ppm.

In the meantime, there was no significant difference between the effectiveness of GA_3 at 200 and at 400 ppm in terms of their efficacy on increasing fruit length. The application of $CaCl_2$ alone did not cause any appreciated increase in fruit length as compared with the control in both seasons. Thus, GA_3 spray at both used concentrations was more effective than $CaCl_2$ on increasing fruit length. The addition of calcium to GA_3 solutions did not considerably increase fruit length, in most cases, when compared with just using calcium solution alone. In a similar way, the combination of putrescine at either used concentrations and calcium did not cause a significant change in fruit length when compared with calcium alone except with putrescine (10 mM) plus calcium in the first season.

The above findings whether with use of putrescine, GA_3 or calcium agreed with that found by Sakurai and Watanabe (1994) who attributed the increase in fruit length by GA_3 applications to enhanced growth of the calyx end. Since calcium and putrescine are not involved in the process of elongation, it was acceptable to find that fruit length was not significantly affected by both treatments.

II.5- Fruit Weight:

Responses of fruit weight to various treatments regardless the time, were shown in Table 1. The data revealed that the control fruits had significantly greater fruit weight than that treated with putrescine at 5 or 10 mM in both seasons.

Moreover, a remarkable increase in fruit weight occurred with GA_3 applications whether at 200 or 400 ppm in both seasons when compared with the control or putrescine-treated fruits. Eventhough GA_3 at 200 ppm resulted in a significant increase in fruit weight but the rise in GA_3 concentration to 400 ppm did not result in a

proportional increase in fruit weight. Thus, GA_3 at 200 ppm might have exerted its maximum potential in increasing fruit weight of "Desert Red" peaches.

Furthermore, calcium chloride spray did not result in a significant change in fruit weight as compared with the control. Hence, it could be concluded that GA_3 applications were superior to either calcium or putrescine treatments in terms of their positive influence on fruit weight. With regard to the added advantage of calcium when added to GA_3 or putrescine concentrations, it was concluded that the presence of calcium in its formulation with GA_3 did not in general, make a significant difference in fruit weight when compared with such effect obtained with GA_3 alone. Similar conclusion could be reached when the influence of calcium plus putrescine (at 5 or 10 mM) was compared with just using putrescine alone.

Trend of results obtained in fruit weight due to putrescine, GA_3 or calcium treatments was in accordance with Bregoli *et al* (2002), Utashiro *et al* (1995), El- Seginy *et al* (2003), Horvits *et al* (2003), Usenik *et al* (2004), Amarante *et al* (2005).

On the other hand, Looney (1985) found that, the calcium treatments reduce the average of fruit weight. Mir et al (1996) found that, sprayed Red Delicious apple trees with $CaCl_2$ at 0.3 or 0.5% increased fruit weight. Similar observations were reported by Kadir (2004) who found that, sprayed Jonathan apple trees with $CaCl_2$ increased fruit weight. The increase in fruit weight by GA_3 treatments could be attributed to the increase in phloem loading of carbohydrates from the source to the sink and to the cell enlargement caused by GA_3 application. On the contrary, putrescine reduction to fruit weight might be due to the delay in fruit maturity. The non-significant effect of calcium on fruit weight could be due to the involvement of calcium in the cell wall and plasma membrane integrity, rather than loading carbohydrates in fruit tissue.

II.6- Stone Weight:

Changes in stone weight of "Desert Red" peaches as influenced by various treatments were shown in Table 1. There was no specific trend of stone weight in both seasons as a result of putrescine treatment whether at 5 or 10 mM. Similar case was found with GA_3 treatments whether at 200 or 400 ppm. Even when $CaCl_2$ effect on

stone weight was compared with the control, the considerable increase in such weight was only obtained in the first season. The incorporation of calcium with putrescine did not result in a specific or well defined pattern in stone weight when compared with the effect of calcium alone. In a similar way, no specific conclusion could be drawn from the comparison of GA_3 plus calcium versus calcium alone. It could be generally concluded that various treatments did not lead to a well defined pattern of stone weight in this peach cultivar. This could be demonstrated on the fact that these applications were preformed after the completion of stone (endocarp) formation in this study. The endocarp was reported to form during part of phase one and the second phase of the double sigmoid curve of peach fruit development (Monsiles, 1986).

Thus, the non-specific pattern of the impact of putrescine, GA_3, or calcium on stone weight could be due to the application of such compounds after the completion of pit (stone) hardening and no further evidence was provided to show that there were any chemicals that caused and increase in the precipitation or incorporation of legnin or cellulose into the stone during the last phase of the double sigmoid curve.

II.7- Fruit Flesh Weight:

The effect of various treatments on flesh weight of "Desert Red" peaches was shown in Table 1. The results revealed that such weight was significantly reduced by putrescine treatments at 5 or 10 mM as compared with the control and in a consistent manner in both seasons.

On the other hand, GA_3 application at either used concentrations led to a marked increase in flesh weight in both seasons. However, the increase in applied GA_3 concentration from 200 to 400 ppm did not result in a proportional increase in flesh weight. Thus with the application of 200 ppm of GA_3 at this time of fruit development might have induced the maximum potential to flesh weight.

The application of calcium chloride did not result a significant change in flesh weight of "Desert Red " peaches as compared with the control. Among the three used treatments, namely GA_3, putrescine and calcium, it could be concluded that GA_3 at 200 or 400 ppm was the most effective treatment in increasing flesh weight

in both seasons. When flesh weight of the fruit treated with the formulation of GA_3 plus calcium was compared with that resulting from GA_3 alone, it was found that the presence of calcium did not make a consistent and noticeable difference. In a similar manner, no well defined trend could be observed when the effect of putrescine in the presence or absence of calcium was compared on flesh weight was compared in both seasons. Peach was reported to daily gain size and weight during the third phase of the double sigmoid curve (Marini., 2006) this would explain the higher potential of GA_3 in increasing flesh weight than that found by putrescine or calcium. Gibberellic acid was reported to stimulate cell enlargement or elongation in fruit tissue (Marini., 2006). This was reflected on increasing flesh weight of treated "Desert Red" peaches in this study.

The delay in the maturity processes by putrescine treatments might explain or interpret the reduction in flesh weight in a consistent manner. In addition, putrescine and calcium are not involved in the process of enlarging the mesocarp cells in fruit.

II.8- Flesh/Stone Ratio:

Changes in the ratio of flesh to stone of "Desert Red" peach fruits were recorded in Table 1. The data proved that putrescine whether at 5 or 10 mM tended to reduce flesh / stone ratio but in a significant manner in the first season only. Furthermore, GA_3 treatments, whether at 200 or 400 ppm resulted in greater flesh/stone ratio than that obtained with putrescine at 5 or 10 mM in both seasons. In a similar way, both GA_3 concentrations resulted in greater flesh / stone ratio than that found with calcium chloride application. The combinations of putrescine at 5 mM plus calcium did not result in a significant difference from that obtained with calcium alone. This trend was consistent in both seasons. Similarly, there was no added advantage from the incorporation of calcium along with putrescine at 10 mM. The increase in putrescine concentration from 5 to 10 mM did not make a difference in terms of its influence on flesh/stone ratio. In addition, no consistent trend was found when the result of GA_3 at 200 and 400 ppm were compared. In general, the most pronounced effect on flesh to stone ratio was obtained with the application of GA_3 at both concentrations which could be attributed to the positive influence of GA3 on flesh weight of peaches at the time rather than to its effect on the stone weight since the endocarp has been already formed.

III. The Time Factor Regardless The Treatments:

Data of fruit firmness as influenced by various times of sampling were shown in Table 2. The results showed that, fruit firmness was significantly decreased at fifth week following the treatment (at harvesting) compared with the fourth and third week, respectively. Fruit firmness was significantly decreased during the progress of times as a consequence of the progress of fruit maturation and ripening and a rise in ethylene which regulating these processes. Many of hydrolysis enzymes such as polyglacturinase, pectinmethylestrase and pectinase were produced after autocatalytic of ethylene production and induced the loss of fruit firmness. To explain the loss of fruit firmness during fruit maturation, Glenn and Poovaial, (1990) reported that the textural changes during maturation have been often related to modification of the cell wall properties (thickness, integrity, and cohesion). In other words, cell walls thicken steadily during cell wall enlargement to a maximum occurring at about the onset of maturation. Deposition then ceases and cell walls undergo a final hydration swell.

Present data on the effect of time in growth of fruit size, diameter, length weight and flesh weight of "Desert Red" peach fruit were presented in Table 2. The data indicated that, in the final week (fifth week), the characteristics of fruit growth such as size, diameter, length, weight and flesh weight increase as the fruits toward progress maturation. The fruit growth very rapidly during the final 5 weeks before harvest. Fruit growth during this stage is due primarily to cell expansion as the fruit flesh accumulates water and the nearly fully developed canopy supplies fruits with sugars.

The above findings agreed with Monsiles, 1986 who reported that, Stage three is the one of rapid increase of fresh and dry weight in the mesocarp. Rapid cell enlargement resumes in all diameters. Intercellular space decreases, becoming practically nil at maturation. Flesh volumetric gains occur in all directions. Growth along the cheek diameter prevails, however occurring for the final subglobular shape.

Responses of stone weight to various sampling times were shown in Table 3. The data revealed that, stone weight increased by time, as the fruit progressed toward maturity in the two seasons except the fifth week after spray in the second season. Completion of pit

(Table 2) Physical characteristics of "Desert Red" Peach fruits throughout the period following treatments during the two seasons 2005 and 2006:

Time	Firmness(Lb/inch²)		Size(cm³)		Diameter(cm)		Length(cm)		Weight(gm)		Stone weight(gm)		Flesh weight (gm)		Flesh/Stone Ratio %	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Second week	Off scale	Off scale	305.000 d	360.000 d	3.711 d	3.958 d	4.077 d	4.267 d	296.638 d	356.949 d	52.065 c	70.052 c	244.572 d	286.896 d	4.70 d	4.09 d
Third week	27.742 a **	36.120 a	361.500 c	525.550 c	3.988 c	4.563 c	4.237 c	4.634 c	66.069 c	518.184 c	51.172 c	74.177 b	314.897 c	444.006 c	6.17 c	6.00 c
Fourth week	22.575 b	24.001 b	535.500 b	647.250 b	4.702 b	4.888 b	4.641 b	4.845 b	525.250 b	638.686 b	56.860 b	75.872 a	468.381 b	562.813 b	8.28 b	7.43 b
Fifth week	18.095 c	20.893 c	774.375 a	727.625 a	5.149 a	5.152 a	5.057 a	5.081 a	744.43 a	717.334 a	58.975 a	69.103 c	685.463 a	648.230 a	11.62 a	9.38 a

* Off scale meant that fruits were too firm to be able determine their firmness within the scale of the pressure taster.
** Values, within a column, of similar letters were not significantly different according to the leact significant difference (LSD) at 0.05 level.

hardening by the end of phase II of fruit growth, deosnot imply the ceasation of stone-gain weight. It has been suggested that the transition between one and two in the double sigmoid curve of fruit development. Lignification begins in late stage one, becomes prominent in stage two, and perdures during stage three (Marini., 2006).

Changes in flesh to stone weight ratio in "Desert Red" peaches in response to various times of sampling were shown in Table 3. The data revealed that, flesh to stone weight ratios rapid increased during the final 5 weeks before harvest. Fruit growth during this stage is due primarily to cell expansion as the fruit flesh accumulates water and the nearly fully developed canopy supplies fruits with sugars. The consistent increase in flesh to stone ration indicated also to a higher rate of flesh weight gain than that occurred to the stone with time.

IIII. The Effect of the Interaction between Treatment and Time:

Data in Tables 3 to 8 represented the interaction between treatments and times for some physical properties of peach fruits that could be used as maturity indices. The data in Table 3 revealed that fruit firmness with all treatments significantly decline with time. However, the decline rate differed among treatments. For example, the fourth week sample showed that all treatments led to higher fruit firmness than that of the control. Putrescine at 5mM after 4 weeks following the treatment resulted in a firmness similar to that found in the third week sample of the control. Even the fifth week sample, after spray of all treatments, had higher fruit firmness than that of the control. Fruits of many treatments in the fifth week still had similar firmness to that of the control in the forth-week sample such as putrescine at 5 or 10 mM in the presence or absence of calcium, and GA_3 at both used concentrations without or with calcium. Thus, used treatments retarded the loss of fruit firmness. This trend was consistent in both seasons. Calcium treated peaches in the fifth week sample had statistically similar firmness to that of the third week sample in the control during 2005 season. It could be concluded that used treatments were rapidly effective and their efficacy lasted for several weeks until harvest date.

The effect of the interaction between treatments and time on flesh to stone ratio was shown in Table 4. The data proved that the increase in such ratio in control fruits was significant after 2 weeks of the treatment and kept increasing until the fifth week (harvest time) after application. This was also found with putrescine at 5 or 10 mM. Moreover, after 5 weeks, there was a significant reduction in flesh /stone ratio in putrescine-treated fruits whether at 5 or 10 mM. Similarly, putrescine at both used concentrations in the presence of calcium resulted in a significant reduction in flesh /stone ratio after 5 weeks of spray. However, GA_3 at 200 or 400 ppm caused a significant increase in flesh /stone ratio when compared with control. This was not the case after 4 weeks which indicated that GA_3 solutions needed more than 4 weeks to cause a significant increase in such ratio. On the other hand, calcium chloride alone caused a significant reduction in flesh /stone ratio after 5 weeks of its application when compared with the control.

Fruit diameter data as influenced by the interaction between treatments and time was reported in Table 5. The data indicated to a significant and consistent increase in fruit diameter that was gained by the third week following the application whether in the control or treatments. After 4 weeks of spray, it was found that GA_3 at 200 or 400 ppm in the presence of calcium led to a consistent increase in fruit diameter as compared with that of the control and this effect lasted until the harvest time (fifth week after spray). Sampling GA_3 treated fruits whether at 200 or 400 ppm tended to increase fruit diameter as compared with the control at the harvest time. Putrescine effect in the fourth sample after spray was not significant relative to that found in the control. The ability of calcium chloride to increase fruit diameter was not evident after 3, 4 or 5 weeks of the application. Thus, GA_3 applications needed about 4 weeks to show a significant effect on increasing fruit diameter whether alone or in the presence of calcium. The progress of fruit diameter from one week to another in that phase of growth was considerable in "Desert Red" peach fruits.

The data regarding the effect of the interaction between treatments and time on fruit length was reported in Table 6. It was clear that as the time progressed following spray, fruit length of the control increased significantly from on week to another. This was true for most treatments in both seasons. Even when the difference

between the fourth and fifth weeks following treatment was compared, it was found that GA_3 whether at 200 or 400 ppm led to a significant increase in fruit length of "Desert Red" peaches. In a similar manner, the combination between GA_3 (at 200 or 400 ppm) plus calcium were still significantly effective in increasing such length between the fourth and fifth weeks after the treatment. On the other hand, calcium chloride alone or putrescine (at 5 or 10 mM) did not result in a consistent increase in fruit length by the last week prior harvesting. When fruit length of the control and treatments were compared, it was evident that the increase in such length did not occur shortly after the treatments but needed about 4 weeks to show a considerable increase. Even after 5 weeks of the application, GA_3 treatments at both concentrations were able to increase fruit length as compared with the control. This conclusion could be also apply to the combinations of GA_3 plus calcium. Other treatments, by fifth week, were not significantly effective on increasing fruit length relative to the control. Meanwhile, GA_3 solutions, whether alone or in a combinations were effective on increasing fruit length but needed more than 4 weeks following the application to achieve that in a significant manner.

Fruit weight data of "Desert Red" peaches as influenced by the interaction between treatment and time was reported in Table 7. Many treatments after 2 weeks of application were not able to achieve a significant increase in fruit weight as was the case with putrescine containing solutions. Meanwhile GA_3 treatments whether alone or in combinations with calcium chloride resulted in an appreciated increase in such weight as compared with second week data. Moreover, most treatments needed more than three weeks to achieve a significant increase in fruit weight as compared with the control. Even GA_3 at 200 or 400 ppm resulted in a consistent increase in fruit weight in both seasons by the fifth week following the treatment. Similarly, the combination of GA_3 at 200 ppm plus calcium needed more time as compared with GA_3 at 400 ppm plus calcium to give a consistent increase in "Desert Red" peach fruit weight. Calcium chloride treatment tended to reduce fruit weight when compared with the control, but by the fifth week it did not show a specific trend. In general, calcium chloride application did not lead to a well defined

influence on fruit weight over time when followed throughout the time after spray.

The effect of the interaction between treatments and time on fruit size was shown in Table 8. By the second week after spray, most treatments achieved a significant increase in fruit size as compared with the spray time. The consistent efficacy on fruit size was obtained with GA_3 (at 200 or 400 ppm) as compared with the control in the fifth sample that followed the spray. Similar trend was found when GA_3 at both concentrations was combined with calcium chloride while other treatments did not achieve a consistent gain in such size by the fifth sample. The difference between GA_3 effectiveness and that of putrescine at the two used concentrations started to considerably appear after four weeks of spray where GA_3 influence on fruit size was superior to that found by putrescine applications. Moreover, the effectiveness of GA_3, at 200 or 400 ppm in the presence of calcium on fruit size was higher than that found by putrescine at both used concentrations even after four weeks of the application. Thus, the duration of the last phase of the growth curve was critical in increasing fruit size even in the control. The positive effect of GA_3 either alone or plus calcium on fruit size needed about 2 weeks to show a significant effect and lasted until the harvest time.

(Table 3) Fruit firmness (Lb/Inch^2) of "Desert Red" peach fruits as influenced by the interaction between treatments and time during the two seasons 2005 and 2006:

Treatment	Weekly interval samples after spray					
	Third week		Fourth week		Fifth week	
	2005	2006	2005	2006	2005	2006
Control	24.995 b	22.695 jkl	18.117 ghi	19.971 o	14.080 j	17.135 p
Putrescine 5mM	28.342 a	26.390 abcde	24.017 bc	24.712 fgh	19.827 ef	20.925 no
Putrescine 10mM	28.330 a	26.230 bcde	22.727 cd	23.973 ghi	19.185 fgh	21.172 mno
GA3 200ppm	27.680 a	26.905 ab	23.262 cd	25.548 cdef	18.085 ghi	21.575 lmn
GA3 400ppm	28.497 a	26.767 abc	23.507 cd	25.225 ef	19.247 fg	21.012 mno
Putrescine 5mM + $CaCl_2$ 2%	27.522 a	27.505 a	23.552 cd	25.193 efg	18.735 fgh	22.212 klm
Putrescine 10mM + $CaCl_2$ 2%	27.860 a	26.367 abcde	20.950 e	23.875 hi	18.267 ghi	21.262 mn
GA3 200ppm + $CaCl_2$ 2%	28.267 a	26.510 abcd	22.642 d	24.446 fgh	18.410 ghi	22.100 klmn
GA3 400ppm + $CaCl_2$ 2%	28.012 a	26.327 abcde	23.790 bcd	24.000 ghi	17.835 hi	21.575 lmn
$CaCl_2$ 2%	27.920 a	25.505 def	23.185 cd	23.068 jk	17.285 j	19.962 o

Values, within the table, of similar letters were not significantly different where compared by using the least significant difference (LSD) at 0.05 level.

Table (4) Fruit flesh/ stone ratio (%) of "Desert Red" peach fruits as influenced by the interaction between treatments and time during the two seasons 2005 and 2006:

Treatment	Weekly interval samples after spray							
	Second week		Third week		Fourth week		Fifth week	
	2005	2006	2005	2006	2005	2006	2005	2006
Control	5.01 qrs	4.00 o	6.58 lmn	5.71 mn	9.78 e	7.10 ij	11.97 c	10.12 bc
Putrescine 5mM	4.19 tu	3.97 o	5.50 opq	6.12 lmn	7.14 ijkl	7.51 hi	9.83 e	8.45 fg
Putrescine 10mM	4.41 stu	3.90 o	5.66 opq	5.97 mn	7.43 ijk	7.47 hi	9.85 e	8.26 fg
GA3 200ppm	5.92 no	4.15 o	6.64 lm	6.30 klm	8.27 gh	7.62 hi	13.10 ab	10.48 ab
GA3 400ppm	4.53 stu	4.31 o	6.12 mno	6.61 jkl	7.68 hi	8.35 fg	12.63 bc	10.85 a
Putrescine 5mM + $CaCl_2$ 2%	4.27 tu	4.03 o	5.67 opq	5.65 n	8.50 fg	6.78 jk	10.72 d	8.59 ef
Putrescine 10mM + $CaCl_2$ 2%	4.35 stu	4.16 o	6.03 mno	5.74 mn	7.57 hij	7.13 ij	10.89 d	7.99 fgh
GA3 200ppm + $CaCl_2$ 2%	5.18 pqr	4.04 o	6.74 klm	5.94 mn	9.01 f	7.06 ij	12.87 ab	9.82 c
GA3 400ppm + $CaCl_2$ 2%	4.65 stu	4.19 o	6.90 jkl	6.06 lmn	8.72 fg	7.89 gh	13.41 a	10.14 bc
$CaCl_2$ 2%	4.53 stu	4.17 o	5.89 nop	5.86 mn	8.70 fg	7.44 hi	10.96 d	9.13 d

Values, within the table, of similar letters were not significantly different where compared by using the least significant difference (LSD) at 0.05 level.

(Table 5) Fruit diameter (cm) of "Desert Red" peach fruits as influenced by the interaction between treatments and time during the two seasons 2005 and 2006:

Treatment	Weekly interval samples after spray							
	Second week		Third week		Fourth week		Fifth week	
	2005	2006	2005	2006	2005	2006	2005	2006
Control	3.707 jklmnop	3.846 t	4.022 ij	4.579 k	4.617 efg	4.811 hi	4.992 bcd	5.065 b
Putrescine 5mM	3.650 klmnop	3.864 st	3.902 ijklm	4.560 kl	4.450 g	4.842 fgh	4.957 bcde	4.880 ef
Putrescence 10mM	3.607 mnop	3.902 rs	4.000 ij	4.528 lm	4.522 fg	4.833 fghi	5.005 bcd	4.853 efgh
GA3 200ppm	3.875 ijklmn	4.018 no	3.950 ijkl	4.630 j	4.677 defg	4.934 cd	5.345 ab	5.544 a
GA3 400ppm	3.747 ijklmnop	4.018 no	4.040 ij	4.600 jk	4.632 efg	5.060 b	5.447 a	5.521 a
Putrescine 5mM + $CaCl_2$ 2%	3.592 mnop	3.949 qr	3.850 ijklmno	4.498 mn	4.547 fg	4.784 i	4.900 cde	4.954 c
Putrescine 10mM + $CaCl_2$ 2%	3.735 ijklmnop	3.961 pq	3.955 ijk	4.498 mn	4.707 defg	4.866 efg	5.050 bc	4.822 ghi
GA3 200ppm + $CaCl_2$ 2%	3.760 ijklmno	3.997 opq	4.050 i	4.609 jk	5.547 a	4.974 c	5.430 a	5.494 a
GA3 400ppm + $CaCl_2$ 2%	3.710 ijklmnop	4.023 no	4.092 h	4.562 kl	4.802 cdef	4.931 cd	5.297 ab	5.495 a
$CaCl_2$ 2%	3.727 ijklmnop	4.002 nop	4.025 ij	4.563 kl	4.522 fg	4.848 efgh	5.065 bc	4.895 de

Values, within the table, of similar letters were not significantly different where compared by using the least significant difference (LSD) at 0.05 level.

(Table 6): Fruit length (cm) of "Desert Red" peach fruits as influenced by the interaction between treatments and time during the two seasons 2005 and 2006:

Treatment	Weekly interval samples after spray							
	Second week		Third week		Fourth week		Fifth week	
	2005	2006	2005	2006	2005	2006	2005	2006
Control	3.99 qrstu	4.24 l	4.28 kl	4.69 fghijk	4.61 ghij	4.74 efghij	4.88 bcd	4.92 bcd
Putrescine 5mM	3.96 stuv	4.22 l	4.11 opqr	4.68 ghijk	4.52 j	4.81 defgh	4.84 cde	4.87 bcde
Putrescence 10mM	4.03 qrstuv	4.20 l	4.27 klm	4.63 ijk	4.58 hij	4.81 defgh	4.82 cde	4.83 de
GA3 200ppm	4.12 nopqr	4.20 l	4.21 klmnop	4.61 jk	4.70 efgh	4.75 efghi	5.22 a	5.46 a
GA3 400ppm	4.13 mnop	4.26 l	4.28 kl	4.61 jk	4.66 fghij	5.00 b	5.28 a	5.42 a
Putrescine 5mM + $CaCl_2$ 2%	4.03 qrstu	4.23 l	4.10 nopqrs	4.62 ijk	4.60 hij	4.83 de	4.91 bc	4.82 def
Putrescine 10mM + $CaCl_2$ 2%	4.09 pqrst	4.31 l	4.28 kl	4.56 k	4.67 fghi	4.81 defgh	4.98 b	4.74 efghij
GA3 200ppm + $CaCl_2$ 2%	4.20 lmnop	4.29 l	4.24 klmn	4.68 hijk	4.75 def	4.980 bc	5.34 a	5.44 a
GA3 400ppm + $CaCl_2$ 2%	4.09 opqrs	4.34 l	4.35 k	4.65 ijk	4.74 defg	4.85 cde	5.30 a	5.44 a
$CaCl_2$ 2%	4.092 pqrs	4.34 l	4.235 klmn	4.583 k	4.557 ij	4.843 cde	4.965 bc	4.824 defg

Values, within the table, of similar letters were not significantly different where compared by using the least significant difference (LSD) at 0.05 level.

(Table 7) Fruit weight (gm) of "Desert Red" peach fruits as influenced by the interaction between treatments and time during the two seasons 2005 and 2006:

Treatment	Weekly interval samples after spray							
	Second week		Third week		Fourth week		Fifth week	
	2005	2006	2005	2006	2005	2006	2005	2006
Control	299.10 vwx	356.28 mno	377.26 nop	523.94 jkl	544.33 hi	607.17 i	648.78 f	713.26 b
Putrescine 5mM	268.87 yz	336.38 n	321.81 tu	522.60 jkl	465.54 l	627.03 fghi	654.62 ef	644.11 efgh
Putrescine 10mM	281.83 xyz	334.70 o	347.67 rs	506.17 kl	497.95 k	617.51 ghi	645.88 f	640.69 efghi
GA3 200ppm	356.45 pqr	366.10 mn	374.25 nopq	540.12 j	556.31 gh	650.29 def	845.68 b	806.12 a
GA3 400ppm	294.29 wx	364.40 mno	383.10 nopq	531.05 jk	522.99 ij	696.86 bc	856.55 b	817.75 a
Putrescine 5mM + $CaCl_2$ 2%	269.84 yz	347.23 nmo	333.40 st	502.30 kl	498.42 k	616.36 hi	673.38 de	664.38 de
Putrescine 10mM + $CaCl_2$ 2%	279.83 xyz	357.6 2 mno	353.22 qrs	496.57 l	518.36 jk	625.46 fghi	698.69 c	621.46 fghi
GA3 200ppm + $CaCl_2$ 2%	318.90 tuv	368.81 m	388.32 n	528.80 jk	557.86 gh	675.67 cd	835.33 b	807.07 a
GA3 400ppm + $CaCl_2$ 2%	307.80 uvw	367.16 m	418.28 m	516.82 jkl	567.22 g	646.22 defg	891.24 a	816.10 a
$CaCl_2$ 2%	289.44 wxy	370.7 7 m	363.34 opqr	513.43 jkl	523.48 ij	624.25 fghi	694.20 cd	642.35 efgh

Values, within the table, of similar letters were not significantly different where compared by using the least significant difference (LSD) at 0.05 level.

(Table 8) Fruit size (cm^3) of "Desert Red" peach fruits as influenced by the interaction between treatments and time during the two seasons 2005 and 2006:

Treatment	Weekly interval samples after spray							
	Second week		Third week		Fourth week		Fifth week	
	2005	2006	2005	2006	2005	2006	2005	2006
Control	292.50 stu	356.25 k	361.25 lmn	527.50 hij	558.75 g	617.50 g	700.00 de	720.00 b
Putrescine 5mM	275.00 tuvwx	343.75 k	342.50 nop	525.00 hij	490.00 j	626.25 g	695.00 de	638.75 efg
Putrescence 10mM	292.50 stu	350.00 k	352.50 nmo	516.25 hij	532.50 hi	625.00 g	711.25 cd	645.00 efg
GA3 200ppm	362.50 lmn	367.50 k	381.25 kl	547.50 h	570.00 fg	665.00 de	881.25 ab	835.00 a
GA3 400ppm	322.50 pqr	366.25 k	373.75 klm	540.00 hi	548.75 gh	706.25 bc	880.00 ab	825.00 a
Putrescine 5mM + $CaCl_2$ 2%	272.50 uvwxy	343.75 k	336.25 opq	506.25 j	511.25 ij	626.25 g	682.50 e	681.25 cd
Putrescine 10mM + $CaCl_2$ 2%	296.25 st	361.25 k	356.25 mno	507.50 j	505.00 j	632.50 fg	707.50 de	646.25 efg
GA3 200ppm + $CaCl_2$ 2%	315.00 qrs	372.50 k	356.25 mno	532.50 hij	552.50 gh	683.75 cd	862.50 b	815.00 a
GA3 400ppm + $CaCl_2$ 2%	315.00 qrs	366.25 k	387.50 k	533.75 hij	582.50 f	658.75 df	890.00 a	823.75 a
$CaCl_2$ 2%	306.25 rs	372.50 k	367.50 klm	518.75 hij	503.75 j	631.25 fg	733.75 c	646.25 efg

Values, within the table, of similar letters were not significantly different where compared by using the least significant difference (LSD) at 0.05 level.

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الملخص العربى

تاثير البيوترسين و حمض الجبريلليك و الكالسيوم على خصائص الجودة و التاخير فى ميعاد اكتمال نمو ثمار الخوخ "ديزرت رید". A: تاثر الملامح التطورية و الصفات الطبيعية للثمار.

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هناك عدة وسائل لزيادة ربحية منتج الخوخ فى مصر منها اطالة فترة ظهور المحصول فى الاسواق عن طريق زراعة اصناف جديدة، أو كسر سكون البراعم مبكرا، او تاخير اكتمال نمو الثمار برش مركبات امنه. اجرى هذا البحث خلال موسمى 2005، 2006 باستخدام صنف الخوخ "ديزرت رید" حيث كانت الاشجارمنزرعة فى منطقة النوبارية بمحافظة البحيرة و مطعومة على اصل النيماجارد. تم رش الاشجار برشاشة يدوية حتى نقطة الجريان السطحى عند بداية المرحلة الثالثة من منحنى نمو الثمار، و قد اشتملت المعاملات على: البيوترسين اما بتركيز 5 او 10 ملى مولار، حمض الجبريلليك بتركيزى 200، 400 جزء فى المليون ، كلوريد الكالسيوم بتركيز 2% (وزن/حجم)،و الكنترول (رش بالماء)، باضافة لكل من تركيزى البيوترسين او حمض الجبريلليك فى وجود كلوريد الكالسيوم. أضيفت المادة الناشره توين 80 لكل محاليل المعاملات بتركيز 0.05% (حجم/حجم). أدت جميع المعاملات البيوترسين و حمض الجبريلليك سواء بمفردها او فى وجود الكالسيوم الى تأخير فقد صلابة انسجة الثمار بالمقارنة بالكنترول فى كلا الموسمين. كما أدى رش حمض الجبريلليك بتركيزيه الى حدوث زيادة معنوية فى حجم الثمار وزنها و طولها فى كلا الموسمين، بنما لم تؤثر الرش بكلوريد الكالسيوم معنويا على حجم الثمار و وزنها و قطرها و كمية اللحم بها، و لم يؤثر البيوترسين بطريقة فعاله على قطر الثمار سواء بمفردة او فى وجود كلوريد الكالسيوم، و لم تؤثر معاملات البيوترسين معنويا فى وجود او غياب الكالسيوم فى طول او قطر الثمار عند الجمع. بصفة عامه لم ينتج عن وجود الكالسيوم فى تركيبة مع اى من تركيزات البيوترسين او حمض الجبريلليك اى ميزه اضافية لتحسين الصفات الطبيعية لثمار الخوخ المعاملة. و يمكن التوصية من خلال نتائج الدراسة باستخدام معاملات حمض الجبريلليك عند تركيز 200 جزء فى المليون او البيوترسين بتركيز 5 ملى مولار لتاخير اكتمال نمو ثمار الخوخ صنف "ديزرت رید" دون التاثير سلبيا على الخصائص الطبيعية خاصة صلابة الانسجة.