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EFFECT OF SOME FOLIAR APPLICATION SUBSTANCES ON GROWTH, YIELD AND FRUIT QUALITY OF KEITTE MANGO CULTIVAR

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ABSTRACT: *An experiment was conducted through two successive seasons (2009 and 2010) on Keitte mango cv. trees to study the effect of some foliar application substances on the vegetative growth, fruit set, fruitlet abscission, fruit retention, yield and fruit quality. There was significant improve by the different treatments on the vegetative growth. Fruit number per tree, fruit weight, yield and fruit firmness were significantly increased by spraying Putrescine at 250 ppm. Ascorbic acid, total sugars and soluble solids content increased in the fruit of the treated trees. The obtained results led to conclude that foliar spraying of mango cv. Keitte with some substances is very essential in improving fruit number, weight, yield, fruit firmness and fruit quality.*

Key words: *Keitte mango, polyamines, Putrescine, growth regulators, amino acids, yeast, antioxidants, Algae extract.*

INTRODUCTION

Mango is considered a tropical fruit crop having an important role in supporting nutrition requirement for the population as well as increasing the grower income. In Egypt, mango cultivated areas reached 209040 feddans while its production is 505741 tons (Ministry of Agriculture, 2010) and distributed in most governorates. Mango yields worldwide are generally poor, ranging from 4 to 9 tons/ha in the major production countries (Oosthuyse, 1993 a). This is attributable to wide tree spacing, malformation, alternate bearing, environmental factors and fruit drop. (Guzman-Estrad, 1997; Kumar and Chakrabarti, 1997 and Jana and Sharangi, 1998). However, flower drop in mango occurred on early blooming and gradually decreased nearly at fruits mature (Chacko, 1984). Ali and Malik (1980) reported that fruit drop problem was present in almost all the orchards of Pakistan greater extent, which results in loss to the mango growers. Moreover, Samson (1980) mentioned that only 1 from 1000 flowers develop to maturity. In this respect, growth regulators were used by Oosthuyse 1993 b and Shaban 2000 to overcome fruit drop in mango. Davenport and Nunez-Elisea (1997) concluded that naphthalene acetic acid (NAA) is the most effective auxin for reducing fruit drop. Many growers of mangoes sprayed their orchards at pre or post – bloom with NAA at different concentrations (40, 100, 150 and 200 ppm) to decrease fruit drop, increase fruit set, fruit retention and improve fruit quality and yield as well as vegetative growth (Khan *et al.*, 1993; Singh *et al.*, 1994; Abou-Rawash *et al.*, 1998 a,b; Gofur *et al.*, 1998 and Notodimedjo, 2000). The effect of NAA has been extensively studied on mango as previously evidence, but the mixture of NAA and Naphthyl acetamide (NAAM) has not been examined. So, in this work a mixture of NAA and NAAM (Amcotone) was sprayed to study fruit drop, fruit set and retention, fruit quality and yield. Also, lower concentration of auxins, gibberellins and cytokinnins as well as higher concentration of absisic acid during developing fruitlets and their pedicels have been associated with fruit abscission (Ram, 1992; Murti and Upreti, 1995; Bains *et al.*, 1997 and Murti and Upreti, 1997). A reduction in fruit abscission with spray of auxins and gibberellins indicated their role in abscission (Chandha, 1993). However, acceleration of fruitlet abscission in mango with exogenous application of ethephon have been reported by Malik and Singh (2003). On the other hand, increasing fruit retention with ethylene inhibitors such as silver, nickel or cobalt (Naqui *et al.*, 1990) and polyamines (Singh and Singh, 1995; Singh and Janes, 2000 and Malik and Singh, 2003) indicate the involvement of ethylene in mango fruitlet abscission. So, the role of polyamines in reducing fruitlet abscission in mango is further supported by the fact that intact fruitlet and their pedicels had significantly higher endogenous polyamines and lower levels of endogenous ethylene compared with about – to – abscised ones (Malik and Singh, 2003 and Malik *et al.*, 2003). Furthermore, associated with lower levels of endogenous polyamines (Biasi *et al.*, 1988 and Aziz *et al.*, 2001). Exogenous application of polyamines has been resulted in increasing fruit set and retention, fruit firmness, titralable acidity, TSS/acid ratio and fruit weight in many mango cultivars (Singh and Singh, 1995; Khattab *et al.*, 2000 a,b; Shaban, 2000; Singh and Janes, 2000 and Malik and Singh, 2005). Meanwhile, Khattab and Shaban (2005) reported that polyamines decreased fruit weight and TSS/acid ratio in mango cv. Ewais. Also, polyamines are small positively charged aliphatic amines that play various roles in plant physiology (Egea-Cortines and Mizrahi, 1991). Considerable research has suggested a closed connection between polyamines, such as Putrescine, Spermidine and Spermine, and a wide range on growth and developmental processes including flower induction, reproductive development, growth and fruit ripening (Kakkar and Rai, 1993; Galston *et al.*, 1997; Walden *et al.*, 1997; Applewhite *et al.*, 2000 and Aziz *et al.*, 2001). Furthermore, polyamines are new class of growth substances that play an essential role in plant physiology including the regulation of DNA replication, transcription of genes, cell division, organ development, floral process, fruit ripening and leaf senescence (Bagni and Torrigiani, 1992; Galston and Kaur-Sawhney, 1995; Baigorri *et al.*, 2001 and Colin *et al.*, 2002).

Recently, great attention has been focused on the possibility of using natural and safe substituents, i.e., yeasts in order to improve plant growth, flowering, fruit setting and total yield. Yeasts are found in different soils and rhizosphere of various plants. Although, the numbers of yeasts are low in soils in comparison with other microorganisms; many investigators claimed that this group of organisms seems to play an important role in the soil fertility and in producing certain growth promoting substances such as hormones, amino acid, vitamins and most of nutritional elements (Monib *et al.*, 1982; Moawad *et al.*, 1986 and Nagodawithana, 1991).

Algae extract as a new bio fertilizer containing N, P, K, Ca, Mg, and S as well as Zn, Fe, Mn, Cu, Mo, and Co, some growth regulators, polyamines and vitamins applied to improve nutritional status, vegetative growth, yield and fruit quality in different orchard as well as vineyards (Abd El-Migeed *et al*, 2004; Eman and Abd-Allah, 2008 and Spinelli *et al.*, 2009).

Amino acids are considered as precursors and constituents of proteins (Rai, 2002), which are important for stimulation of cell growth. They contain both acid and basic groups and act as buffers, which help to maintain favorable pH value within the plant cell (Davies, 1982). Amino acids can directly or indirectly influence the physiological activities in plant growth and development such as exogenous application of amino acids have been reported to modulate the growth, yield and biochemical quality of mango trees (El-Kosary *et al.*, 2011).

The objective of the present study was added more informations on the effect of some amino acids, polyamines, antioxidants, growth regulators and natural and safe substituents on vegetative growth, fruit set% and retention%, fruit quality and yield of Keitte mango cultivar.

MATERIALS AND METHODS

This investigation was carried out during two successive seasons 2009 and 2010 on Keitte mango cv. trees (*Mangifera indica* L.) grown in a sandy soil in a private orchard at Al-Sadat city, Menoufiya Governorate, Egypt, to study the effect of some foliar application substances on vegetative growth, fruit set, fruitlet abscission, fruit retention, yield and fruit quality. Selected trees were 10-year-old, healthy, nearly uniform in growth vigor, planted at 5.0 × 5.0 m apart and received the same cultural practices. The complete randomized block design was used, where the experiment involved 14 treatments with three replicates, one tree in each replicate; so, 42 trees were used.

The experimental treatments were as follows:

1- Arginine at concentration of 250 ppm.
2- Aspartic acid at concentration of 250 ppm.
3- Glutamic acid at concentration of 250 ppm.
4- Phenylalanine (2-amino-3phenylpropionic acid) at concentration of 250 ppm.
5- Gibberellic acid (GA_3) at concentration of 25 ppm.
6- Naphthalen acetic acid (NAA) at concentration of 100 ppm.
7- Amcotone (commercial mixture of 1-naphthyl acetamide 1.2% and 1- naphthyl acetic acid 0.45% manufactured by Amvac, USA) at concentration of 500 ppm.
8- Putrescine (1, 4 diamino butane) at concentration of 500 ppm.
9- Spermidine (N- [3-amino propyl] butane 1, 4 diamine) at concentration of 500 ppm.
10- Ascorbic acid at concentration of 500 ppm.
11- Citric acid at concentration of 500 ppm.
12- Yeast at concentration of 5000 ppm (5 g/L active dry yeast).
13- Sea Algae extract at concentration of 2%.
14- Control treatment was sprayed with tap water.

All substances were sprayed three times at the beginning of Spring growth flush (first week of February); at full bloom (first week of April) and at after fruit setting (third week of May). Another agricultural practices such as irrigation, hoeing, pruning as well as pest and fungi management were done as usual.

Triton at (0.1%) was added to the spray solution or water as a surfactant.

The following parameters were used:

1- Vegetative growth:

In each season, ten shoots from spring growth cycle per tree were chosen and labeled. The number of leaves on chosen shoots were counted and the length of each shoot was measured (cm), ten developed mature leaves on the third node of spring shoots were taken per tree on the first of November to determine leaf area (cm^2) by using the following formula (Nii *et al.*, 1995).

$$Y = 0.146 + 0.706\,X$$

where Y = leaf area (cm^2)

and X = leaf length (cm) × leaf width (cm)

2- Percentages of fruit set, fruitlet abscission and fruit retention:

Five panicles of different sizes per tree were collected to determine the total perfect flowers. In each tree ten panicles from all directions were tagged, before treatment, by wrapping adhesive plastic around the shoots, 5 cm below the panicle. Initial fruit set was considered to have occurred when all the flowers were dried, but were still intact on the panicle. Total number of fruitlets on tagged panicles was counted. Fruit set percentage was calculated proportionally to number of total perfect flowers per panicle. Fruitlet abscission percentage was determined by subtracting the fruit present from the initial fruit set. Fruit retention percentage was estimated at harvest by dividing the number of mature fruits per panicle by the number of setting fruits per panicle.

3- Tree yield:

Fruits were picked when reached commercial maturity and number of fruits per tree were recorded. Total yield (kg) was estimated by multiplying number of fruits per tree by average fruit weight.

4- Fruit quality:

Fifteen unblemished fruits were handy picked from each treated tree at early mature stage to study the average of fruit weight (g), skin firmness (lb/inch^2) by using Effegi pentrometer (Mc Cormick, Yakima, Washington), fruit length (cm), fruit width (cm), fruit shape index (length/ width), percentages of pulp, soluble solids content (SSC%) by using a Carl-Zeiss hand refractrometer, fruir acidity (%), vitamin C content (mg ascorbic acid/100 g pulp) and total sugars (%) according to A.O.A.C. (1995).

5- Statistical analysis:

All data obtained during both 2009 and 2010 experimental seasons were subjected to analysis of variances according to Snedecor and Cochran (1990) and means were differentiated using Duncan's multiple rang test (Duncan, 1955). whereas small letters were used for differentiating the values of specific effects of the investigated treatments.

RESULTS AND DISCUSSION

1- The effect on vegetative growth:

The data concerning the effect of some foliar application of substances on the investigated growth parameters (Shoot length, No. of leaves and leaf area) of Keitte mango trees during 2009 and 2010, seasons are shown in Table (1).

It is clear from the obtained data that the evaluated growth measurements followed to great extent the same trend of response during both seasons. Herein, all foliar application substances used exceeded statistically the control treatment. GA_3 and Putrescine had the significantly highest values, however, it did not significantly differ from Amcotone, Arginine, Glutamic acid, NAA and Yeast.

Table (1): Effect of some foliar application substances on shoot length (cm), number of leaves and leaf area (cm^2) of Keitte mango cultivar during 2009 and 2010 seasons.

	Shoot length (cm)		number of leaves		leaf area (cm^2)	
Treatments	2009	2010	2009	2010	2009	2010
Amino acids						
Arginine	48.00 abc	51.50 ab	37.33 ab	40.33 ab	81.94 abc	90.06 abc
Aspartic	43.30 bcd	47.70 abc	35.00 ab	38.00 ab	76.96 cd	84.63 def
Glutamic acid	47.00 abc	51.57 ab	38.33 ab	41.33 ab	86.04 ab	93.21 ab
Phenylalanine	42.80 bcd	47.83 abc	34.33ab	37.00ab	72.25 d	84.18 ef
Growth regulators						
Gibberellic acid	50.77 a	53.27 a	39.33 a	43.00 a	83.19 abc	93.19 ab
Naphthalen acetic acid	45.3 abc	50.67 ab	36.00 ab	39.67 ab	79.59 bcd	84.63 def
Amcotone	48.66 abc	52.36 ab	37.33 ab	41.00 ab	80.55abcd	91.40 abc
Polyamines						
Putrescine	49.00 ab	53.00 ab	39.67 a	42.67 a	88.02 a	93.31 a
Spermidine	44.00 bc	49.53 abc	37.00 ab	39.33 ab	82.96 abc	91.42 abc
Antioxidants						
Ascorbic acid	43.63 bcd	47.90abc	36.00 ab	38.00 ab	77.46 cd	87.35cde
Citric acid	42.36 cd	44.60 c	33.33 b	36.33 b	72.84 d	73.54 f
Biostimulants						
Yeast	45.10 abc	47.93 abc	36.33 ab	39.00 ab	79.61 bcd	89.15 bcd
Sea Algae	43.30bcd	47.30 bc	35.00 ab	37.00 ab	75.94 cd	82.63 ef
Control	37.56 d	38.30 d	25.33 c	31.00 c	56.06 e	69.18 g

The opposite trend was observed with Citric acid where it gave the significantly lowest values and there were insignificant differences when compared with other remaining treatments including the control. These results were true during the two seasons.

The present findings are in general agreement with the fact that GA_3 increases both shoot length and leaf area Wareing and Phillips (1973), stated that gradients of gibberellin concentration appear to be present in the stem with the highest concentrations in the apical region, they stated also that there is a positive correlation between growth rates in different regions of the stem and the gradients of auxin and gibberellin concentrations. Their concept show the way how auxin increases stem elongation is that auxin increases cell wall plasticity. They stated also that there was a positive correlation between the effects of different auxin concentrations on promotion of elongation growth and on cell wall plasticity.

Concerning the mode of action of gibberellins they stated that gibberellin treatment of intact plants can cause enhanced elongation of existing internodes cells and also increase the number of cells present in each internode, principally as a result of an increase in mytosis in the sub-apical region of the stem. .

The same line was found by Das *et al.* (1989), Singh and Rajput (1990) and El-Kheshin (2010) reported that GA_3 led to increase in the shoot length, No. of leaves and leaf area of mango. Besides, Mouftah (2007) and Mohamed *et al.* (2008) found that the vegetative growth of mango increased with Putrescence, Amcotone and Yeast applications compared with the unsprayed ones.

2- The effect on percentages of fruit set, fruitlet abscission and fruit retention:

Data in Table (2) show the effect of some foliar application substances on the percentage of fruit set, of Keitte mango trees in 2009 and 2010 seasons. It is clear from the obtained data that percentage of fruit set was significantly varied among different foliar application substances. The maximum values of fruit set percentage was detected on the trees sprayed with Putrescine and Amcotone during the two seasons of study. The minimum percentage of fruit set was recorded on the control trees. However, percentage of fruit set of other treatments came in between. Similar results were recorded in both seasons.

The improvement of fruit set in all studied mango cultivars could be attributed to higher level of endogenous polyamines during cell division and early period of fruit growth as reported by Biasi *et al.,* (1988) on apples. Recent report also indicated that exogenous application of polyamines during the beginning of blooming, increased fruit set in mango Langra and Dusheri cvs (Singh and Singh, 1995), in Kensington Pride cv. (Singh and Janes, 2000), in Alphonso cv. (Khattab *et al.,* 2000 a) and in Ewais cv. (Kattab and Shaban, 2005). So, the increment in initial fruit set was influenced by the particular polyamines, its concentration and cultivar.

The data concerning the effect of some foliar application substances on fruitlet abscission of Keitte mango cultivar in 2009 and 2010 seasons are shown in Table (2).

In both seasons of study, fruitlet abscission significantly affected by foliar application used. Putrescine was the most effective, by exhibiting the minimum fruitlet abscission (98.24 and 98.37%) compared to control (98.77 and 98.96%) in the two seasons, respectively. However, fruitlet abscission of other treatments came in between.

The reduction in fruitlet abscission with exogenous application of polyamines was observed in all studied cultivars, as Spermidine at 125 and 500 ppm emerged as the most effective on both Succary Abiad and Langra cvs, respectively. In this respect, Malik *et al.,* (2003) found that about-to-abscise fruitlets and their pedicels produced more ethylene than intact fruits in Kensington Pride and Glen cvs. Similarly, higher levels of ethylene have been found in young abscised fruits of Haden cv. but not in Sensation cv., which is less prone to abscission (Van Lelyved and Nel, 1982). The association of ethylene and fruitlet abscission in mango have also been reported by Nunez-Elisea and Davenport (1986).

However, ethylene in synthesized from S-adenosylmethionine (SAM), which is also the precursor of polyamines (Walden *et al.,* 1997). Increases in polyamines biosynthesis, particularly via SAM decarboxylase activity, are likely to affect the rates of ethylene synthesis. Any changes in polyamines are more likely to affect 1-aminocylopropane -1-carboxylic acid (ACC) and ethylene biosynthesis than vice versa (Galston and Kaur-Sawhney, 1995). So polyamines inhibit the conversion of ACC ethylene (Apelbaum and Icekson, 1983). Moreover, higher levels of endogenous polyamines in intact fruitlets and their pedicels compared with about-to- abscised ones, and the reduction of fruitlet abscission with exogenous application of polyamines, as well as the acceleration of abscission with inhibitors of polyamines are confirmed the role of polyamines in mango fruitlet abscission (Murti and Upreti, 1999 and Malik and Singh, 2004).

The data concerning the effect of some foliar application substances on fruit retention of Keitte mango variety in 2009 and 2010 seasons are shown in Tables (2).

It is clear from Tables (2) that fruit retention took a similar trend where polyamines (Putrescine & Spermidine) and Amcotone were significantly increased fruit retention compared to control treatment. Putrescine was better than Amcotone and Spermidine. Meanwhile, Putrescine recorded the maximum fruit retention. The increment in fruit retention with the exogenous application of polyamines may be attributed to the inhibition of fruitlet abscission, similar results were recorded during the two seasons of study.

Similar results have been reported in many mango cultivars by Singh and Singh, 1995; Khattab *et al.,* 2000 a; Shaban, 2000; Singh and Janes, 2000 and Khattab and Shaban, 2005.

Table (2): Effect of some foliar application substances on fruit set %, fruitlet abscission % and fruit retention % of Keitte mango cultivar during 2009 and 2010 seasons.

Treatments	fruit set %		fruitlet abscission %		fruit retention %	
	2009	2010	2009	2010	2009	2010
Amino acids						
Arginine	16.697 ab	17.607 bcd	98.39 cd	98.47 def	1.60 cd	1.53 bcd
Aspartic	16.117 cd	17.073 ef	98.59 b	98.53 de	1.41 e	1.46 cd
Glutamic acid	16.733 ab	17.850 b	98.30 ef	98.42 fg	1.69 ab	1.57 ab
Phenylalanine	15.360 e	16.496 g	98.64 b	98.63 c	1.36 e	1.36 e
Growth regulators						
Gibberellic acid	16.443 bc	17.810 b	98.36 de	98.41 fg	1.64 bc	1.58 ab
Naphthalen acetic acid	16.196 cd	17.566bcde	98.40 cd	98.44 efg	1.59 cd	1.55 abc
Amcotone	16.776 ab	17.863 b	98.27 ef	98.41 fg	1.72 ab	1.59 ab
Polyamines						
Putrescine	16.933 a	18.793 a	98.24 f	98.37 g	1.76 a	1.63 a
Spermidine	16.210 cd	17.720 bc	98.43 cd	98.44 efg	1.57 cd	1.56 abc
Antioxidants						
Ascorbic acid	16.080 d	16.866 fg	98.59 b	98.71 c	1.40 e	1.29 e
Citric acid	15.112 ef	16.453 g	98.63 b	98.80 b	1.36 e	1.19 f
Biostimulants						
Yeast	16.543 b	17.263 cdef	98.46 c	98.49 def	1.53 d	1.51 bcd
Sea Algae	16.117 cd	17.153 def	98.48 c	98.54 d	1.51 d	1.45 d
Control	14.896 f	16.006 h	98.77 a	98.96 a	1.23 f	1.04 g

3- The effect on yield per tree:

Table (3) show the effect of some foliar application substances on the yield per tree of Keitte mango trees in 2009 and 2010 seasons. The data in both seasons, showed that all treatments increased significantly the yield per tree than those of untreated trees. Putrescince treatment was more effective in increasing tree yield as compared to other treatments.

On the contrary, the least value of tree yield was closely linked with control trees. However, tree yield of other investigated foliar substances treatments came in between the aforesaid two extremes. These results were true in both seasons .

The increase in tree yield of Keitte cv. due to spray of Putrescine may be attributed to the inhibition of fruitlet abscission and to the increase in fruit retention and number of fruit per tree Fig. (1) as well as fruit weight. These results are in harmony with those of Zora *et al.* (1995), Ahmed (2000) and Malik and Singh (2006). The increments in the yield per tree in the treated tree could due to the increase in both fruit number per tree and the average of fruit weight.

4- The effect on fruit quality:

4.1. Fruit physical characteristics:

Tables (3 and 4) and Fig. (2) show the effect of some foliar application substances on fruit weight, fruit dimension (length and width), fruit shape index, percentages of fruit pulp and fruit firmness of Keitte mango fruits during 2009 and 2010 seasons.

Data in Table (3) indicated that fruit weight significantly increased with all treatments, compared to control in the two seasons of study.

Putrescine treatment had the significantly highest value compared to other different treatments for mango Keitte cv. during the two seasons.

The polyamines treatments resulted in significantly increase of fruit weight due to higher levels of endogenous polyamines during cell division and early period of fruit growth (Galston and Kaur-Sawhney, 1995 and Murti and Upreti, 2003).

It may be argued that treatments with exogenous polyamines may have stimulated fruit weight because of increase cell division. These results are in line with those of Khattab *et al.,* 2000 b and Shaban, 2000 who reported that fruit weight of Alphonso cv. increased by spraying Putrescine (150 ppm).

Fruit dimensions (length and width) showed similar trend. Nevertheless, both fruit dimensions (length & width) and fruit index, data obtained during both seasons displayed that the former one (width) followed to some extent the same trend previously detected with fruit length, while the later one (fruit shape index) had no specific trend regarding the response to various foliar application substances. The variances in rates of response of two fruit dimensions (length & width) to a given Putrescine treatment directly reflected on the absence of firmer trend representing the response of fruit shape index Table (3) and Fig. (2).

Data concerning the effects of some foliar application substances on percentages of fruit pulp of Keitte mango in both seasons are shown in Table (4). In the first season, Citric acid treatment gave the highest significantly value (82.17%), while in the second season, Glutamic acid treatment gave the highest significantly value (82.24%) and it did not significantly differ from Putrescine (82.17%) and Spermidine (82.16%) treatments. On the contrary, NAA and Sea Algae treatments had the lowest significantly value (81.27 and 81.58%) in the first and second seasons, respectively.

The data obtained herein are supported by El-Rayes *et al.* (1992) on Taymour mango trees and Ahmed (2000) on Alphons mango trees.

It is clear from the obtained data that the results concerning the effect of some foliar application substances on fruit firmness of Keitte mango in 2009 and 2010 seasons are tabulated in Table (4).

The data showed that in both seasons, there were significant differences among treatments tested. Polyamines (Putrescine and Spermidine) treatments gave the highest significantly value and it did not significantly differ from Arginine, Glutamic acid, GA_3 and Amcotone treatments. On the contrary, Citric acid treatment had the lowest significantly value and there were insignificant differences when compared with all other remaining treatments including the control.

More firm fruits treated with polyamines could be due to their ability to cross-link carboxylate group of pectic substances in cell walls, resulting in rigirification (Valero *et al.,* 2002) or to an inhibition of polygalacturonase activity (Kramer *et al.,* 1989).

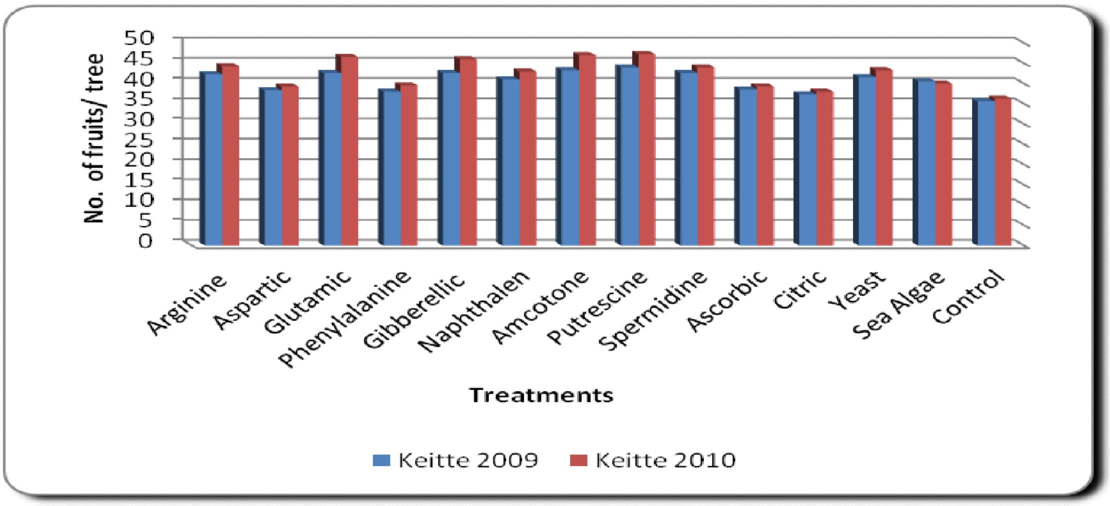

Fig.(1): Effect of some foliar application substances on number of fruits per tree of Keitte mango cultivar during 2009 and 2010 seasons.

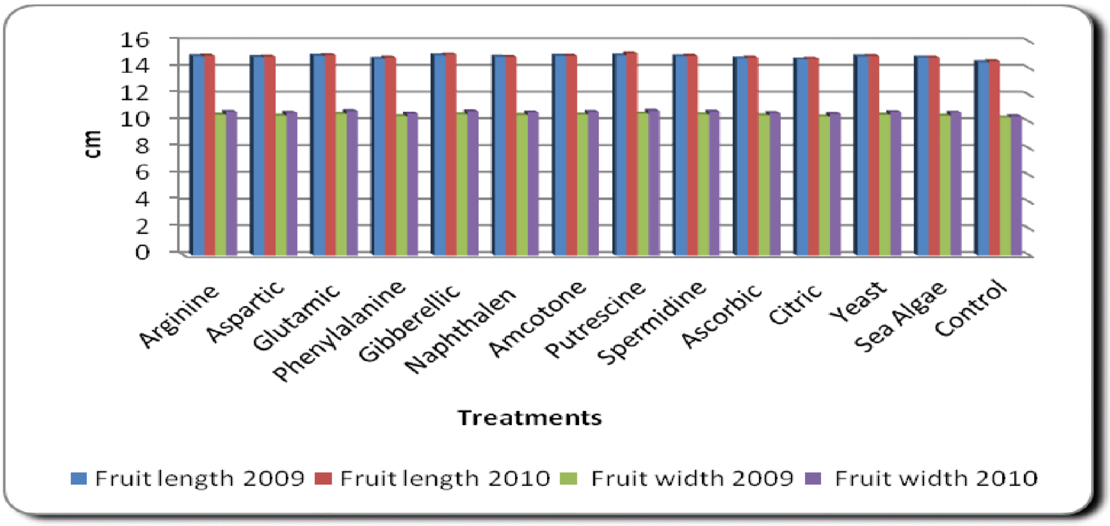

Fig.(2): Effect of some foliar application substances on fruit dimensions (length and width) of Keitte mango cultivar during 2009 and 2010 seasons.

Table (3): Effect of some foliar application substances on total yield/tree (kg), fruit weight (g) and fruit shape index (length/ width) of Keitte mango cultivar during 2009 and 2010 seasons.

	total yield/tree (kg)		fruit weight (g)		fruit shape index	
Treatments	2009	2010	2009	2010	2009	2010
Amino acids						
Arginine	27.932 bc	30.303 bc	659.82 cd	680.52 c	1.415 ab	1.389 abc
Aspartic	24.828 de	25.980 d	647.65 ef	666.52 de	1.418 a	1.393 abc
Glutamic acid	28.745 ab	32.424 a	673.78 b	694.82 b	1.411 bc	1.386 bc
Phenylalanine	24.519 e	25.885 d	645.34 fg	652.58 fg	1.412 abc	1.395 ab
Growth regulators						
Gibberellic acid	28.392 b	31.837 ab	665.41 c	692.05 b	1.416 ab	1.395 ab
Naphthalen acetic acid	26.734 c	28.762 c	652.08 ef	668.97 d	1.414 ab	1.387 bc
Amcotone	28.643 ab	32.066 ab	660.98 c	682.29 c	1.416 ab	1.390 abc
Polyamines						
Putrescine	30.065 a	33.410 a	688.46 a	705.98 a	1.409 bcd	1.396 a
Spermidine	28.415 b	30.416 bc	665.99 c	691.32 b	1.409 bcd	1.385 c
Antioxidants						
Ascorbic acid	25.009 de	25.793 d	646.86 ef	655.66 f	1.406 cd	1.387 abc
Citric acid	23.879 e	24.545 d	639.70 g	645.88 g	1.409 bcd	1.388 abc
Biostimulants						
Yeast	27.252 bc	29.107 c	654.05 de	671.75 d	1.414 ab	1.390 abc
Sea Algae	26.316 cd	26.370 d	647.05 ef	659.09 ef	1.415 ab	1.385 c
Control	21.483 f	22.449 e	602.48 h	617.86 h	1.403 d	1.394 abc

Table (4): Effect of some foliar application substances on fruit pulp % and fruit firmness ($lb/inch^2$) of keitte mango cultivar during 2009 and 2010 seasons.

	fruit pulp %		fruit firmness	
Treatments	2009	2010	2009	2010
Amino acids				
Arginine	81.51 cdef	81.96 abc	36.05 ab	35.82 ab
Aspartic	81.74 abcde	81.90 abc	35.21 cde	35.70 abc
Glutamic acid	81.87 abcde	82.24 a	36.13 ab	35.92 ab
Phenylalanine	82.03 ab	81.94 abc	35.02 de	35.18 de
Growth regulators				
Gibberellic acid	81.56 bcdef	82.09 ab	35.92 b	35.87 ab
Naphthalen acetic acid	81.27 f	81.69 bc	35.45 c	35.68 abc
Amcotone	81.52 cdef	81.81 abc	35.94 b	35.81 ab
Polyamines				
Putrescine	81.98 abc	82.17 a	36.35 a	36.07 a
Spermidine	81.74 abcde	82.16 a	36.23 ab	36.06 a
Antioxidants				
Ascorbic acid	81.94 abcd	81.95 abc	35.28 cd	35.55 bcd
Citric acid	82.17 a	82.10 ab	34.96 de	35.15 de
Biostimulants				
Yeast	81.47 def	81.90 abc	35.14 cde	35.22 de
Sea Algae	81.45 ef	81.58 c	35.19 cde	35.32 cde
Control	81.86 abcde	82.02 ab	34.89 e	35.11 e

4.2. Fruit chemical properties:

The data concerning the effect of some foliar application substances on soluble solids content (SSC%), total acidity %, SSC/ acidity ratio, ascorbic acid content (V.C.), total sugars content % of Keitte mango variety in 2009 and 2010 seasons are shown in Table (5) and Fig. (3).

The data in both seasons showed that there were highly significant differences among treatments tested. It is clear from the obtained data that spraying of all treatments significantly was preferable than the control in improving chemical characteristics of the fruits in terms of increasing percentages of SSC, vitamin C content and total sugars and decreasing percentage of total acidity. These results were nearly the same during the two seasons.

The best results with regard to quality of the fruit were observed with spraying the trees with Putrescine at 500 ppm. The application of polyamines (Putrescine and Spermidine) significantly induced the SSC/ acid ratio, but they decreased acidity. The higher SSC/ acid ratio in polyamines treated fruit is due to the relatively lower acidity values compared to the control. These results are in harmony with those reported by Abou-Rawash *et al.* (1998 a), Ahmed (2000) and Malik and Singh (2006) on mangoes.

Table (5): Effect of some foliar application substances on soluble solids content (SSC %), titratable acidity (%) and vitamin C content (mg ascorbic acid/100 g pulp) of keitte mango cultivar during 2009 and 2010 seasons.

	SSC %		**acidity (%)**		**ascorbic acid (mg/100 g pulp)**	
Treatments	2009	2010	2009	2010	2009	2010
Amino acids						
Arginine	9.57 cd	10.05 bc	1.31 ef	1.18 g	43.40 bc	44.19 cd
Aspartic	9.21 gh	9.52 g	1.41 bc	1.36 c	43.23 de	43.86 efg
Glutamic acid	9.63 bc	10.11 b	1.25 g	1.15 gh	43.46 b	44.43 b
Phenylalanine	9.11 h	9.26 h	1.43 b	1.38 bc	43.11 f	43.81 efg
Growth regulators						
Gibberellic acid	9.54 cd	10.05 bc	1.36 d	1.31 de	43.34 bcd	44.05 de
Naphthalen acetic acid	9.37 ef	9.88 de	1.37 cd	1.35 cd	43.29 cde	43.91 ef
Amcotone	9.45 de	9.96 cd	1.32 e	1.28 e	43.34 bcd	43.99 def
Polyamines						
Putrescine	9.84 a	10.24 a	1.18 h	1.07 i	43.97 a	44.74 a
Spermidine	9.73 b	10.16 ab	1.28 fg	1.12 h	43.42 bc	44.31 bc
Antioxidants						
Ascorbic acid	9.27 fg	9.56 g	1.41 bc	1.38 bc	43.24 de	43.84 efg
Citric acid	8.95 i	9.18 h	1.43 b	1.42 ab	43.09 f	43.76 fg
Biostimulants						
Yeast	9.37 ef	9.81 e	1.36 d	1.23 f	43.31 cde	43.92 ef
Sea Algae	9.34 ef	9.68 f	1.40 bcd	1.41 b	43.20 ef	43.83 efg
Control	8.71 j	8.96 i	1.49 a	1.45 a	42.89 g	43.64 g

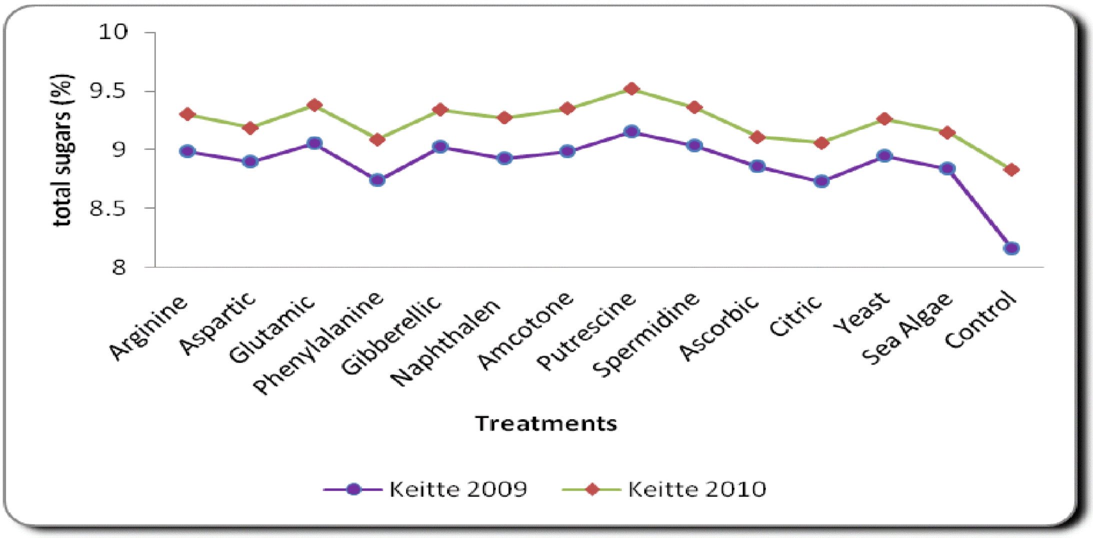

Fig.(3): Effect of some foliar application substances on fruit total sugars (%) of Keitte mango cultivar during 2009 and 2010 seasons.

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تأثير الرش الورقي ببعض المواد على النمو والمحصول وجودة ثمار المانجو صنف الكيت

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الملخص العربى

أجري هذا البحث على أشجار مانجو عمرها 10 سنوات صنف الكيت نامية في تربة رملية بمزرعة خاصة بمدينة السادات , محافظة المنوفية خلال موسمي 2009 ، 2010 م ، لدراسة تأثير إستخدام الرش الورقي ببعض المواد على النمو الخضري والمحصول وأيضاً صفات الثمار , وقد تم اختيار 42 شجرة في 3 مكررات لكل معاملة وتم توزيعها عشوائيا في تصميم القطاعات العشوائية الكاملة وكانت كل شجرة تمثل مكررة وطبق عليها نفس المعاملات الزراعية المتبعة في المزرعة وفد أوضحت النتائج مايلي:

صفات النمو الخضري التى تمت دراستها وهى طول الفرع وعدد الأوراق والمساحة الورقية قد تأثرت بالرش بجميع المواد المستخدمة بالمقارنة بالكنترول خلال موسمي التجربة . اعطى الرش بالجبرلين والبتروسين أعلى القيم لجميع الصفات السابقة بدون فروق معنوية عن معاملات الرش بالأمكوتون والأرجنين وجمض الجلوتاميك والنفثالين أسيتك أسيد والخميره وأعطى الرش البتروسين والأمكتون أعلى نسبة مئوية لعقد الثمار وضحت النتائج أن الرش البتروسين أعطى أقل نسبة لتساقط الثمار خلال موسمى التجربة (98.24 ، 98.37) على التوالى بالمقارنة بالكنترول (98.77 ، 98.96), وأوضحت النتائج أيضاً أن الرش بجميع المعاملات المستخدمة فى الدراسة قد أدت إلى زيادة المحصول خلال موسمي الدراسة بالمقارنة بالكنترول , وأعطى الرش بالبتروسين أعلى محصول بالمقارنة بباقى المعاملات , وأوضحت النتائج أن الرش بجميع المعاملات المستخدمة فى الدراسة كان لها تأثير إيجابي على الخواص الكميائية للثمار خاصة فيما يتعلق بنسبة المواد الصلبة الذائبة ونسبة الحموضة والنسبة بينهما وكذلك زيادة محتوى الثمار من السكريات الكلية وفيتامين ج ومحتوى الثمار من الأحماض الآمينية خلال موسمي الدراسة بالمقارنة بالكنترول, وكانت افضل النتائج عند الرش بالبتروسين أو الاسبيرمدين بتركيز 500 جزء في المليون.

ويمكن التوصية بالبتروسين بتركيز 500 جزء في المليون هي أفضل المعاملات والتي أعطت أفضل النتائج للنمو الخضري ونسبة العقد والمحصول وصفات الجوده للثمار ويمكن التوصية بإستخدامها تحت نفس ظروف هذا البحث.

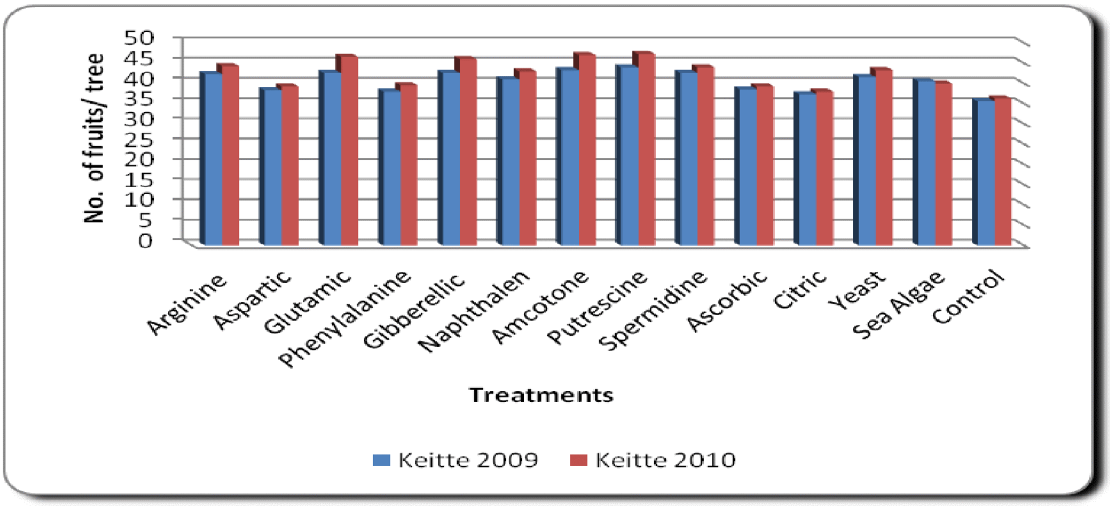

Fig.(1): Effect of some foliar application substances on number of fruits per tree of Keitte mango cultivar during 2009 and 2010 seasons.

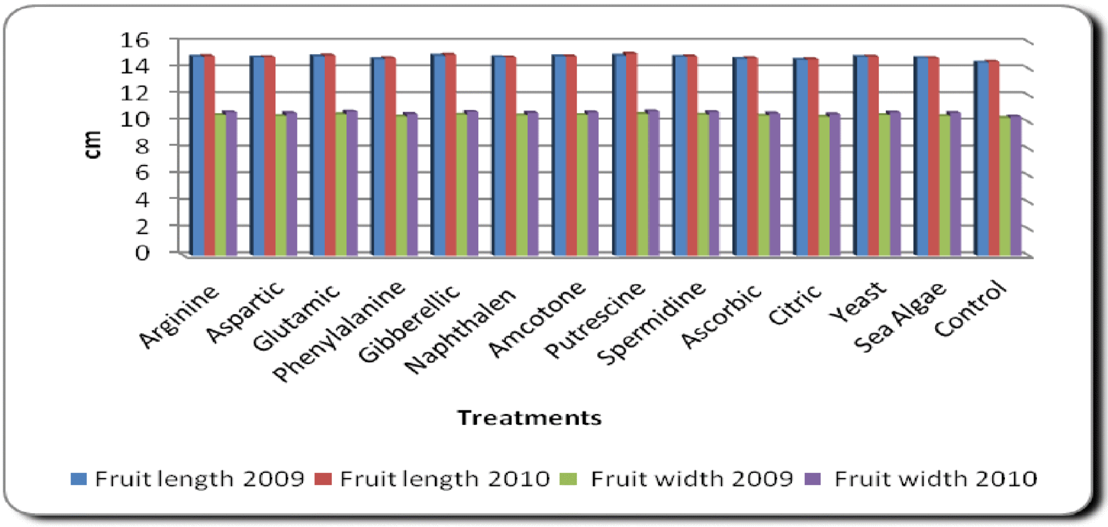

Fig.(2): Effect of some foliar application substances on fruit dimensions (length and width) of Keitte mango cultivar during 2009 and 2010 seasons.

Table (2): Effect of some foliar application substances on fruit set %, fruitlet abscission % and fruit retention % of Keitte mango cultivar during 2009 and 2010 seasons.

Treatments	fruit set %		fruitlet abscission %		fruit retention %	
	2009	2010	2009	2010	2009	2010
Amino acids						
Arginine	16.697 ab	17.607 bcd	98.39 cd	98.47 def	1.60 cd	1.53 bcd
Aspartic	16.117 cd	17.073 ef	98.59 b	98.53 de	1.41 e	1.46 cd
Glutamic acid	16.733 ab	17.850 b	98.30 ef	98.42 fg	1.69 ab	1.57 ab
Phenylalanine	15.360 e	16.496 g	98.64 b	98.63 c	1.36 e	1.36 e
Growth regulators						
Gibberellic acid	16.443 bc	17.810 b	98.36 de	98.41 fg	1.64 bc	1.58 ab
Naphthalen acetic acid	16.196 cd	17.566bcde	98.40 cd	98.44 efg	1.59 cd	1.55 abc
Amcotone	16.776 ab	17.863 b	98.27 ef	98.41 fg	1.72 ab	1.59 ab
Polyamines						
Putrescine	16.933 a	18.793 a	98.24 f	98.37 g	1.76 a	1.63 a
Spermidine	16.210 cd	17.720 bc	98.43 cd	98.44 efg	1.57 cd	1.56 abc
Antioxidants						
Ascorbic acid	16.080 d	16.866 fg	98.59 b	98.71 c	1.40 e	1.29 e
Citric acid	15.112 ef	16.453 g	98.63 b	98.80 b	1.36 e	1.19 f
Biostimulants						
Yeast	16.543 b	17.263 cdef	98.46 c	98.49 def	1.53 d	1.51 bcd
Sea Algae	16.117 cd	17.153 def	98.48 c	98.54 d	1.51 d	1.45 d
Control	14.896 f	16.006 h	98.77 a	98.96 a	1.23 f	1.04 g