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EFFECT OF GA_3, UREA AND PINCHING TREATMENTS ON "ZEBDA" MANGO TREES

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ABSTRACT

The present work was carried out to study the effect of GA_3 at 50 and 100 ppm, urea at (0.5 and 1.5%) and pinching early flowering on growth of Zebda mango trees grown in the experimental orchard of El-Kassasin Horticultural Research Station, Ismailia Governorate, Egypt. The results indicated that different treatments of GA_3 or urea each alone or in combination with pinching both of delayed panicle emergence and full bloom, but increased number of fruits at harvest and yield/tree. Data also revealed that the same treatments promoted shoot length and number of leaves/ shoots without pinching. While, these treatments tended to increase the number of healthy panicles and total number of panicle/tree, while obviously depressed number of malformed panicle/tree and malformation percentage.

From this study it could be recommended to spray "Zebda" mango trees once at mid November with GA_3 at 100 ppm with pinching early flowering in the winter. Since, this treatment was the most effective enhanced vegetative growth which in term increased the yield of the trees.

INTRODUCTION

Mango (*Mangifera indica*, L.) has a great importance in the Egyptian fruit production, it comes in the third rank, after citrus and grapes.

Unfortunately, mango trees suffer from colossal losses due to early flowering. Early blooming or flowering during winter considered a problem that can decrease the yield. Warm periods during winter may allow early flowering to occur in all mango cvs. which may be damaged by subsequent cold temperature (Litz, 1997).

Gunjate *et al*. (1983) reported that the percentage of fruit set was greater in late than in early flushes. On the other hand, Singh (1997) found that the maximum number of flower visitors during a minute occurred on late emerged panicles giving maximum fruit set compared with early and very late panicles emergence.

Also, the number of pollinators/panicle during one minute increased as the average temperature increased to 19.5 ^{o}C.

Away from the causality of early flowering, different attempts have been made to control this phenomenon. Due to the beneficial effect of GA_3, urea and pinching to induce delayed flowering of "Zebda" mango cultivar. This experiment was carried out for three seasons to evaluate the effects of these treatments.

MATERIALS AND METHODS

The present investigation was carried out during the three consecutive seasons of 2006-2007, 2007-2008 and 2008-2009 on mature "Zebda" mango trees *(Mangifera indica* L.) grown in the experimental orchard

of El-Kassassin Hort. Research Station, Ismailia Governorate. The trees were 20 years old, budded on "Sucary" root stock spaced at 7m apart grown in sandy soil under drip irrigation system.

Ninety mature "Zebda" mango trees were selected to be nearly similar size from an orchard receiving the normal management practices concerning irrigation, soil fertilization, pruning, pests and weeds control following the usual management program applied in the region.

The experimental trees received one foliar spray with GA_3 on mid-November (Abou Rawash *et al*., 1983) at two concentrations (50 and l00 ppm) and two foliar sprays with Urea on mid-Nov. and mid-Dec at two concentrations (0.5% and 1%), and pinching of early flowering at first emergence on trees from mid-Dec. to mid-Feb. The applied treatments were the following :

1. Control (water).
2. Gibberellic acid (GA_3) at 50 ppm.
3. GA_3 100 ppm.
4. Urea at 0.5 %.
5. Urea at 1 %.
6. Pinching.
7. GA_3 at 50 ppm + pinching.
8. GA_3 100 ppm + pinching.
9. Urea 0.5 % + pinching.
10. Urea 1 % + pinching.

The following parameters were considered to evaluate the effect of tested treatments :

1- Date of first panicle emergence

2- Date of full bloom

3- Numbers of healthy and malformed panicles and total number of panicles per tree as well as the percentage of malformation.

$$\frac{\text{No. of malformed panicle}}{\text{Total number of panicles}} \times 100$$

4- Vegetative growth: in April of each season, twelve new shoots were tagged on each experimental tree. The shoot length and number of leaves per shoot were determined in late September.

5. The yield: harvesting took place on successive pickings beginning with the first week of August. Fifteen fruits were labeled on trees of each replicate. The number and weight of fruits at each picking date was recorded and the total number and weight per tree (the yield/tree) was then calculated. Moreover, the hypacthetic yield per fed. was calculated considering that (85 trees are grown per fed. (planting distance 7 x 7).

Statistical analysis:

Data of the three seasons of the study were statistically analyzed according to Snedecor and Cochran (1980) for the experiment in a complete randomized block design. The differences among each treatment were compared using LSD at 5 % level.

RESULTS AND DISCUSSION

1. Date of panicle emergence and full bloom:

Data from Table (1) indicated that GA_3, urea and pinching each alone delayed panicle emergence and full bloom compared with the control. The higher tested GA_3 concentration (100 ppm) was more effective than the lower concentration (50 ppm). However, the most prominent delays were induced by the combined treatment GA3 100 ppm + pinching.

The delay in panicle emergence and full bloom goes in the benefit of mango production under Egyptian condition. With such delays, panicle emergence and flowering occur under warmer weather conditions which improve activity of the pollinating insects, consequently pollination and fruit set. In addition, the processes of pollen tube growth and fertilization would be more active under warmer weather conditions. On the other hand, panicle emergence and flowering (on the control) may enhance the probability of fungal disease infection (powdery mildew & flower blight) under conditions of the more cool and humid weather. Moreover, pollination and fruit set are usually inferior under such cool and humid weather conditions.

Table (1): Effect of GA3, urea and pinching treatments on date of first panicle emergence and Date of full bloom of "Zebda" mango trees.

Treatments	Date of first panicle emergence			Date of full bloom		
	Season 2006	Season 2007	Season 2008	Season 2006	Season 2007	Season 2008
Control	4/3	5/3	5/3	23/3	24/3	25/3
GA3 50 ppm	8/3	9/3	10/3	29/3	28/3	30/3
GA3100ppm	15/3	12/3	16/3	4/4	31/3	5/4
Urea 0.5 %	6/3	8/3	7/3	27/3	22/3	28/3
Urea1 %	11/3	12/3	12/3	31/3	2/4	1/4
Pinching	2/4	2/4	2/4	19/4	20/4	21/4
GA350ppm + Pinching	5/4	7/4	7/4	24/4	26/4	26/4
GA3100ppm + Pinching	15/4	15/4	16/4	3/5	28/4	4/5
Urea 0.5% + Pinching	3/4	4/4	5/4	22/4	25/4	24/4
Urea 1% + Pinching	9/4	9/4	11/4	29/4	24/4	30/4

The delay in panicles emergence and full bloom by GA3 or urea were in agreement with (Sanchez *et al*., 2004; Vazques and Perez, 2006; Perez-Baraza *et al*., 2008 and Vazquez–Valdivia *et al*., 2009) they found that delayed flowering of Ataulfo mango trees was observed only in GA3 treated trees (50 and 100 ppm) compared with no delayed flowering in the control.

2. Number of panicle / tree and percent of malformation / tree:

As shown in Table (2), pinching treatment (alone) induced the highest increments in total number/tree and percentage of malformation, this was clear in the three seasons. The use of GA_3 or urea was effective in depressing percentage of malformation especially at higher concentrations. This is may be due to that GA3 delayed the flowering and increased the level of gibberellin in the tissue. So, Singh & Dhillon (1990) mentioned that

endogenous GA was lower in malformed panicles but it was higher in healthy ones at fully swollen buds.

Table (2): Effect of GA_3, urea and pinching treatments on total number of panicle/tree and percentage of malformation of "Zebda" mango trees.

Treatments	Total number of panicle / tree			Percentage of malformation		
	Season 2006	Season 2007	Season 2008	Season 2006	Season 2007	Season 2008
Control	360.2	220.2	398.7	27.4	14.8	25.1
GA3 50 ppm	409.5	197.0	409.8	16.8	21.6	13.1
GA3100ppm	428.5	219.0	446.5	12.3	14.9	12.4
Urea 0.5 %	445.0	227.0	444.2	20.8	23.6	18.0
Urea1.0 %	472.5	283.2	474.3	17.6	18.5	14.8
Pinching	582.8	387.7	607.6	23.7	27.3	24.6
GA350ppm + Pinching	461.5	332.8	413.0	17.2	12.4	11.8
GA3100ppm + Pinching	493.8	367.3	463.2	14.1	6.5	9.6
Urea 0.5% + Pinching	486.2	388.0	423.5	20.4	24.0	15.6
Urea 1.0% + Pinching	529.8	425.5	475.2	19.4	19.6	11.5
L.S.D at 5 %	17.9	42.1	37.6	2.1	6.6	2.3

In this respect, the relation between GA and floral malformation of different mango cvs. was studied by Pandey & Pandey (2000) they found that GA_3 at 25 ppm in combination, with MH at 50 ppm reduced floral malformation in mango trees significantly (32.85% against 57.00% for the control). Also, Kasem (2001) mentioned that sprayed GA3 at 0, 50, 100 or 200 ppm on Taymour and Hindy Bi-Sinnara mango trees at pre bloom time, the flowering malformation was reduced in the two seasons for both mango cvs.

In this respect , Singh & Dillon, (1990) cleared that malformed panicles of the cv. Dusehri maintained lower endogenous GA levels than healthy ones at the stage of fully swollen buds , white the converse was true with the following stages (i.e. bud inception, fully grown panicles and fully blooming panicles). Similar conclusion was suggested by Raafat *et al.*, (1995 –b) .

The depressing, effect of urea on percentage of malformed panicles confirmed the previous reports by Thakure *et al*. (2000) and Baghel & Rajesh (2003) they found that combined application of 4% urea + 150 ppm NAA was superior for increasing healthy panicles/m^2.

3. Vegetative growth:

Concerning the effect of treatments on vegetative growth parameters expressed as length of new shoots and number of leaves per shoot, data from Table (3) showed that all treatments used significantly increased number of leaves per shoot and length of new shoots compared with the control. Trees sprayed with GA3 at 100 ppm alone or with pinching gave a higher number of leaves per new shoot and the highest length of new shoots than the other treatments or the control. Whereas, the pinching treatment produced shortest length of new shoots and lower number of leaves per new shoots than the other treatment expect the control.

Generally, the obtained results on vegetative growth cleared significant promotions in shoot length and number of leaves / shoot with the treatments of GA3 and urea foliar spray.

Table (3): Effect of GA3, urea and pinching treatments on length of new shoots (cm) and number of leaves per shoot of "Zebda" mango trees.

Treatments	Length of new shoots (cm)			Number of leaves per shoot		
	Season 2006	Season 2007	Season 2008	Season 2006	Season 2007	Season 2008
Control	17.2	18.7	16.9	8.9	9.3	6.8
GA3 50 ppm	19.7	23.3	23.5	11.3	13.5	10.8
GA3 100 ppm	23.4	25.1	25.3	12.5	15.7	11.6
Urea 0.5 %	18.8	19.6	32.1	10.1	12.8	13.0
Urea 1.0 %	22.6	22.2	20.8	10.9	13.9	10.2
Pinching	17.4	19.5	18.1	8.7	10.5	7.3
GA3 50 ppm + Pinching	21.0	25.8	23.1	11.0	14.7	10.4
GA3 100 ppm + Pinching	24.5	27.4	24.7	11.8	17.4	11.2
Urea 0.5 % + Pinching	19.5	21.9	21.1	9.1	11.9	9.1
Urea 1.0 % + Pinching	22.6	24.6	25.1	10.7	14.0	9.4
L.S.D at 5 %	1.898	1.745	4.566	0.93	1.09	1.76

The promotion in vegetative growth induced by GA3 and urea treatments were in accordance with Das *et al*. (1989) who sprayed GA3 at 50 ppm on limps of Langra mango trees on mid June; the treatment enhanced shoot length and number of leaves per shoot. Also, Sanchez *et al*. (2004) found that spraying GA3 (50 ppm) on mango trees during Sept. – Nov., Jan and July- Sept.- Jan. recorded the highest percentage of vegetative sprouting (77% and 55% respectively). In addition, El-Shenawy (2005) found that GA3 or KNO3 treatments either alone or combined with inflorescences thinning stimulated tree growth of mango cv. Kiett. On another treatment he found that GA3 or $ZnSO_4$ were most effective for enhancing production of new shoots. He concluded that, inflorescence thinning treatments at 75% combined with GA3 or GA3 + CPPU could stimulate new flushes.

Khattab *et al*. (2009) studied the effect of pruning severity after harvest, GA3 at (50 & 100 ppm) and Ethrel at (500 & 1000 ppm). They found that the highest number of vegetative shoots was obtained with removing the intact terminal shoots and spraying GA3 at 100 ppm on Sedik mango trees.

Other literature reports indicated that urea foliar spray enhanced vegetative growth. Banik *et al*. (1997) found that application of 1% urea + 0.4% boron promoted vegetative growth.

The effect of pruning and pinching on vegetative growth of mangoes cultivars indicated variable trends. Thus, Mohan *et al*. (2001) found that pruning of off years Dashehari mango trees increased new shoots production and more vegetative growth, Yeshitela *et al.* (2003) found that the longest shoot of mango Keitt were observed with inflorescence removal together with apical whorl of leaves during full bloom. Similar results were found in Tommy Atkins cultivar. Also, Shaban (2005) found that removing terminal lushes or heading back seemed to increase shoot length more than pinching. Removing terminal flushes proved to be the most effective treatment for

increasing the number of leaves per shoot on mango trees. Khattab *et al*. (2009) reported that the removal of terminal flushes with 100 ppm of GA3 resulted in the highest number of vegetative shoots in Sedik mango. On the other hand Crane (2004) found that pinching decreased the number of emerged shoots.

Shaban, (2009) cleared that promotion in vegetative growth, expressed as shoot and leaf growth, was obtained by all treatments implying GA3 or Urea alone. The most effective treatment was GA3 100ppm without pinching, the considered parameters were shoot length and number of leaves/ shoot.

4. Yield component (number of fruit per tree and the yield per tree and per feddan) :

Generally, the number of fruits per tree at harvest ranged from 67.1 to 140.9; 40.5 to 105.4 and 82.4 to 165.7 in the three seasons respectively according to the tested treatment (Table 4).

The data show significant promotions in number of fruit/tree at harvest and the most significant effect resulted from GA_3 at 100 ppm or urea at 1.0% each with pinching. Similar trend was obtained from the yield per feddan. The increment in yield per tree and per feddan may be due to the increment of number of fruits per tree.

The increase in number of fruits/tree by GA3 application agreed with Ruby & Brahmachari, 2004 who found that preharvest sprays of GA3 at 100 ppm and CCC 500 ppm on mango cv. Amrapali gave the highest number of fruits compared with the control and the highest yield was obtained with GA3 at 100 ppm. The same results were obtained by Sarker and Ghosh (2004) using GA3 at 30 ppm.

Guillermo *et al*. (2007) found that spraying Kent mango trees with 40 ppm GA_3 plus calcium boron 0.4% increased significantly the fruit set, production and reduced fruit drop. The yield had also significant differences in relation with the concentration of GA3 and calcium boron.

Singh (2009) found that foliar spray of GA3 75 ppm at flower bud differentiation stage onto mango cv. Kensington Pride trees resulted in significantly higher fruit set (84fruit/panicle). In a second experiment, GA_3 sprayed at full bloom resulted in higher fruit set (43 fruit / panicle) at 10 ppm concentration.

Regarding to the use of urea, mango literature reports indicated that urea foliar spray treatments on mango trees increased number of fruits and/or the yield/tree. Yeshitela *et al*. (2005) sprayed Tommy Atkins mango trees with urea and KNO_3. Urea 0.5 g+ KNO_3 4% produced better results for most of the yield parameters. In this respect, Jain (2006) using foliar applied urea (0 and 4%) + biozym crop (0 and 1000 ppm) on mango trees at pre-flowering and pea–stages, single and double spray treatment with 4% urea alone gave maximum yield and average fruit weight.

On the other hand, the increments in number of fruits/tree and/or the yield / tree by pinching was in agreement with Shaban, (2005) who reported that heading back or pinching Hindi–Bi Sinnara mango trees in December recorded the highest number of fruits per tree in the first season. However, pinching in December or January was the most effective treatment for

increasing this number in the second one, both pinching and heading back treatments increased the number of fruits per tree comparing to the control. Results of pruning treatments indicated that heading back or pinching in December, January and February significantly enhanced tree yield comparing to the control.

Table (4): Effect of GA_3, urea and pinching treatments on number of fruits at harvest/ tree, yield per tree (kg) and yield per feddan (ton) of "Zebda" mango trees.

Treatment	No. of fruits at harvest/ tree			Yield per tree (kg)			Yield per feddan (ton)		
	Season 2006	Season 2007	Season 2008	Season 2006	Season 2007	Season 2008	Season 2006	Season 2007	Season 2008
Control	67.1	42.1	82.4	33.3	21.1	40.7	2.831	1.791	3.457
GA3 50 ppm	100.0	40.5	110.4	47.8	19.6	52.4	4.060	1.669	4.456
GA3100ppm	116.5	52.5	130.5	51.6	24.8	57.5	4.389	2.111	4.885
Urea 0.5 %	91.7	40.6	103.1	44.9	20.0	50.3	3.820	1.700	4.276
Urea1.0 %	118.0	59.1	130.9	54.5	27.7	60.0	4.633	2.355	5.098
Pinching	121.5	68.4	137.5	53.4	30.4	60.0	4.536	2.587	5.100
GA350ppm + Pinching	123.5	83.9	129.9	52.9	36.4	55.4	4.500	3.086	4.706
GA3100ppm+ Pinching	120.1	105.4	165.7	50.6	45.0	69.3	4.304	3.825	5.888
Urea 0.5% + Pinching	117.3	79.5	117.8	51.9	45.6	51.7	4.414	3.026	4.395
Urea 1.0% + Pinching	140.9	103.6	149.9	59.9	54.3	63.2	5.095	3.851	5.372
L.S.D at 5 %	15.3	16.0	21.7	6.2	7.2	9.1	0.522	0.610	1.168

In conclusion, from the obtained results it could be recommended to use GA_3 at 100 ppm once in November as well as pinching of early flowering in the winter to achieve better vegetative growth and increase the yield of Zebda mango trees but also decreased the malformation percentage under Ismailia conditions.

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تأثير معاملات الرش بالجبريلين واليوريا والتطويش على أشجار المانجو صنف الزبدة

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أجريت هذه الدراسة خلال ثلاث مواسم متتالية ٢٠٠٦-٢٠٠٧ و ٢٠٠٧-٢٠٠٨ و ٢٠٠٨-٢٠٠٩ على أشجار مانجو بالغة صنف الزبدة. تم رش الأشجار بالجبريلين بتركيز ٥٠ و ١٠٠ جزء فى المليون مرة واحدة فى منتصف شهر نوفمبر كما تم رش اليوريا بتركيز ٠,٥ و ١,٠ % مرتين فى منتصف نوفمبر ومنتصف ديسمبر ، أما قصف البراعم الزهرية المبكرة كان يجرى فى الشتاء بداية من شهر نوفمبر وديسمبر حتى بداية شهر فبراير.

أظهرت النتائج أن المعاملات المختلفة للجبريلين أو اليوريا كلاً بمفرده أو مع قصف البراعم أدت لتأخير خروج الشماريخ الزهرية وكذا ميعاد إكتمال التزهير وأدت لزيادة عدد الثمار على الأشجار عند الجمع ومحصول الشجرة بالكيلوجرام. كما أظهرت النتائج أيضاً حدوث تشجيع للنمو الخضرى متمثلاً فى زيادة طول الأفرخ الخضرية الحديثة وعدد الأوراق الخارجة عليها وذلك بدون إجراء معاملة القصف. بينما أدت هذه المعاملات لزيادة عدد الشماريخ السليمة وإنخفاض النسبة المئوية للشماريخ المشوهة.

من خلال هذه الدراسة يمكن التوصية برش أشجار المانجو صنف الزبدة مرة واحدة فى منتصف نوفمبر بالجبريلين بتركيز ١٠٠ جزء فى المليون مع قصف البراعم المبكرة خلال فصل الشتاء.

قام بتحكيم البحث

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