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EFFECT OF SOME GROWTH REGULATORS TREATMENTS ON INDUCING PARTHENOCARPIC FRUITS IN EWAIS MANGO CV

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ABSTRACT: *This study was conducted in the Orchard of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt during seasons 2007 and 2008 to study the effect of some growth regulators i.e. GA_3 at 50, 100 and 200 PPm, kinetin and BAP both at 10 and 20 PPm each alone or with various combination were sprayed before flowers start to opening on the bagged panicles of Ewais mango cv. followed by spraying for fruit set five times at weekly intervals.*

Results indicated that, application of kinetin or BAP both at 10 and 20 PPm alone failed to induce parthenocarpic fruits. Fully developed parthenocarpic fruits were obtained by using GA_3 at 50, 100 and 200 PPm alone or combined with kinetin and BAP at 10 PPm.

The best treatment was spraying GA3 at 50 PPm which increased percentage of fruit set, gave higher fruit weight and pulp/stone ratio than the other treatments.

Keywords: *Mango seedless, treatments of growth regulators, parthenocarpic fruits, physical and chemical properties of seedless fruits.*

INTRODUCTION

Mango *(Mangifera indica L.)* is one of the most important fruits of the tropical and subtropical countries. Fruits of some mango cvs. has big seed thus the percentage of pulp is low/ fruit weight. Therefore, the production of seedless mango fruits, which contain high percentage of sugars and high pulp/stone ratio attracted the attention for industrial purpose. Natural parthenocarpy in mango appears to be caused by low or high temperature during the first few days following fruit set Young and Sauls (1979) Whiley *et al.*, (1988) and Sukhvibul *et al.*, (2000).Sanaa (1989) on Pairi and Ewais mango cvs. revealed that, as the level of GA_3 increased, the number of perfect flowers decreased, conversely, as the concentration of BA increased, the percentage of perfect flowers increased. On the other hand, Haggag (1986) on Taymour mango cv. reported that, application of GA_3 increased the perfect flower in the panicles. Fully developed parthenocarpic fruits were obtained by spraying BA and GA_3 at 50 PPm at the time of anthesis Kulkarni and Rameshwar (1978) and Sasaki and Utsunomiya (2002). The effect of

growth substances on fruit set was explained by Gustafson (1936) who reported that, the pollen grain and pollen tube contain more auxins and they might be responsible for early stage of fruit growth. He suggested that, synthetic auxin has the same effect, could induce fruit set, therefore the plant growth regulators have been used for improving the fruit set in many fruit crops. Roa *et al.,* (1963) and Ezzat *et al.,* (1972) on loquat, reported that, seedless fruits which resulted from spraying flowers with GA3 were smaller in size, lower in weight than seeded fruits. Galila (1982) on annona, spraying gibberelic acid at 1600 PPm 5 or 7 times succeeded in producing full grown seedless fruits. Ehab (2005) showed that, Ewais mango cv. fully developed parthenocarpic fruits were obtained by using mixture of BA and GA3 each at 250 PPm , Nubbin fruits were greater in pulp/stone ratio and total soluble solids(TSS%). Singh and Shuklo (1978) and Galila *et al.,* (1991) on loquat, found as GA_3 treatment reduced TSS and increased fruit acidity than control.

The aim objective of the present work was to study the effect of some growth regulators i.e.GA3, Kinetin and BAP alone or in combination to improve fruit set and production of parthenocarpic fruits.

MATERIALS AND METHODS

The present study was carried out during the successive years 2007 and 2008 in mango Ewais cv. cultivated in Horticulture Research Institute, Orchard at Giza, Egypt. Trees were about 20 years old planted in loamy sand soil at 5mx5 m centers grafted on seedling rootstocks. Chosen trees were uniform in growth vigor and received the same horticultural treatments.

Twelve panicles in three replicates of each treatment were bagged with paper bags before flowers opening to prevent cross pollination.

Panicles of each treatment were sprayed with either of the following treatments:

1- Control
2- 50 PPm GA3
3- 100 PPm GA3
4- 200 PPm GA3
5- 10 PPm Kinetin
6-20 PPm Kinetin
7-10 PPm BAP
8-20 PPm BAP
9-100 PPm GA3 + 10 PPm Kinetin+10 PPm BAP
10-100 PPm GA3 + 20 PPm Kinetin+20 PPm BAP
11-200 PPm GA3 + 10 PPm Kinetin+10 PPm BAP
12- 200 PPm GA3 + 20 PPm Kinetin+20 PPm BAP

In the two seasons all spraying treatments were started when flowers opening (during the second week of March), then spraying on fruitlets was carried out five times at weekly intervals Chacko and Singh (1969).

Determination of physical and chemical properties of seedless fruits:

$$\text{Perfect flower \%} = \frac{\text{Total number of perfect flower}}{\text{Total number of flower}} \times 100$$

$$\text{Fruit set \%} = \frac{\text{Total number of flower set}}{\text{Total number of perfect flower}} \times 100$$

$$\text{Fruit retention \%} = \frac{\text{Total number of retained fruit}}{\text{Total number of perfect flower}} \times 100$$

Sample of nine fruits representing three replicates for each treatment was harvested at mature stage and were examined for the following aspects:

1- Fruit weight
2- Fruit length
3- Fruit diameter
4- Fruit shape (L/D)
5- Pulp weight
6- Stone weight
7- Pulp/stone ratio
8- Pulp thickness

Chemical contents of fruit at harvest:

Total Indole was determined according to the method described by Selim *et l.*, (1978).

Total Phenols were carried out by colorimetric method (A.O.A.C., 1970), while total soluble sugar were evaluated according to Smith *et al.*,(1956).

TSS% was determined by using hand refractmeter.

Acidity was measured by titration against o.1 N NaOH using phenolphthalein as an indicator (A. O. A. C., 1985) and calculated as citric acid / 100 g fruit pulp.

All data were subjected to statistical analysis according to the procedures reported by Sendecor and Cochran (1980) treatments means were compared by the New Least significant difference test (L.S.D) at the %5 level of probability in the two seasons of experimentation.

RESULTS AND DISSCUSSION

Effect of growth regulators on fruit set and fruit retention

Table (1) shows the effect of growth regulators on initial fruit set and fruit retention in Ewais mango cv. for the two seasons. From data it is clear that, all the studied treatments gave lower initial fruit set as compared with control, it is noticed also that, when GA3 spraying at 50 PPm, gave the higher

fruit retention percentage followed by 100 PPm while, concentration 200 PPm came the third and gave nearly similar results when flowers were sprayed with kinetin or BAP for the two concentrations at 10 or 20 PPm. Regarding to the effect of mixture of GA3 with the two other materials (kinetin or BAP) data indicate that, spraying of GA3 at 100 PPm.or at 200 PPm with kinetin and BAP each at 10 PPm gave the best results than used them at 20 PPm and GA3 at 100 PPm gave nearly double percentage than 200 PPm this results are similar for the two seasons of study.

Table (1): Effect of some growth regulators on percentage of initial and fruit retention of mango Ewais cv. during 2007 and 2008.

Treatment	2007			2008		
	% of perfect flowers	% of initial fruit set	% of fruit retention	% of perfect flowers	% of initial fruit set	% of fruit retention
Control	23	8.50	0.20	26	9.50	0.12
50PPm GA_3	28	5.90	1.42	31	6.90	1.34
100 PPm GA_3	30	4.87	1.30	33	5.87	1.22
200 PPm GA_3	35	3.80	0.61	38	4.80	0.53
*10 PPm kinetin	26	3.50	0.00	29	4.50	0.00
*20 PPm kinetin	30	3.80	0.00	33	4.80	0.00
*10 PPm BAP	28	3.80	0.00	31	4.80	0.00
*20 PPm BAP	31	3.90	0.00	34	4.90	0.00
100 PPm GA_{3+}10 PPm kinetin+10 PPm BAP	33	4.05	0.67	36	5.05	0.59
100 PPm GA_{3+}20 PPm kinetin+20 PPm BAP	34	3.16	0.61	37	4.16	0.53
200 PPm GA_{3+}10 PPm kinetin+10 PPm BAP	35	2.32	0.58	38	3.32	0.50
200 PPm GA_{3+}20 PPm kinetin+20 PPm BAP	36	2.27	0.50	39	3.27	0.42
New L.S.D	2.92	0.32	0.03	3.03	0.32	0.03

** ovaries retained green color and start developing but soon dropped during the first week of May when spraying kinetin and BAP at 10 or 20 PPm

Concerning to the effect of spraying these growth substances on fruit retention it is clear that, spraying GA_3 alone at 50 or 100 PPm gave higher results than 200 PPm while kinetin or BAP at the two concentrations 10 and 20 PPm failed to continue to this stage but it dropped after about 45 days. On

the other hand sprayed Kinetin or BAP at 10 PPm gave higher fruit retention when mixed with GA_3 at 100 or 200 PPm than 20 PPm of the two materials (kinetin and BAP). These results agreed with Haggag (1986) who reported that, application of GA_3 increased the perfect flower percentage in the panicles. Fully developed parthenocarpic fruits were obtained by spraying BA and GA_3 at the time of anthesis. On the other hand, Sanaa (1989) revealed that, as the level of GA_3 increased, the number of perfect flowers decreased, conversely, as the concentration of BA increased, the percentage of perfect flowers increased.

Effect of growth regulators on Physical properties of seedless fruits:

1-Fruit weight.

It's obvious from data in Table (2) and Fig (1) that, weight of fruits which resulted when spraying all the growth substances was lower than control, on the other hand, used GA_3 alone either at 50 or 100 PPm gave heaviest fruit weight and was nearly similar when sprayed mixture of GA_3 at 200 PPm, kinetin and BAP each at 10 PPm followed by GA_3 at 200 PPm only then GA_3 at 100 PPm mixed with kinetin and BAP each at 20 PPm. Moreover, least weight was resulted when sprayed the two substances (kinetin and BAP) at 20 PPm mixed with GA_3 either at 100 PPm or 200 PPm

2- Fruit shape.

It is clear from data that, low concentration of GA_3 gave the higher fruit shape than the two levels (100 or 200 PPm, meanwhile, the mixture of GA_3 at 100 PPm with kinetin and BAP at 20 PPm gave the highest fruit shape, moreover, GA_3 at 200 PPm when mixed with the two substances (kinetin and BAP) at 10 or 20 PPm gave similar results. This result was similar for two seasons 2007 and 2008.

3-Fruit pulp.

Concerning the pulp weight, it is regarded that, GA_3 at 50 PPm gave heavier weight then degraded descending by increasing the level of GA_3 from 100 to 200 PPm. It is also noticed that, same trended was showed when used the mixture of GA_3 with kinetin and BAP when the lower concentration of GA_3 at 100 PPm, kinetin and BAP each at 10 PPm gave the higher pulp weight than the high level of GA_3 at 200 PPm mixed with 20 PPm from the two substances (kinetin and BAP).

4-Stone weight.

Regarding stone weight, it was noticed opposite trend, when the high concentration (200PPm) of GA_3 gave lowest weight than the lower concentration (50 or 100 PPm) either sprayed only or when mixed at 100 or 200 PPm with high concentration of kinetin and BAP at 20 PPm.

Table (2): Effect of some growth regulators treatments on physical properties of seedless fruit of mango Ewais cv. Development during 2007 and 2008

treatment	2007								2008							
	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit shape L/D	Pulp weight (g)	Stone weight (g)	Pulp/ stone ratio	Pulp Thickness (mm)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit shape L/D	Pulp weight (g)	Stone weight (g)	Pulp/ stone ratio	Pulp thickness (mm)
Control	234.00	9.50	4.70	2.02	134.2	40.90	3.28	8.00	229.0	9.00	4.00	2.25	136.00	39.00	4.28	7.00
50PPm GA_3	40.58	100.000	6.40	1.62	38.93	1.61	24.20	5.40	35.58	9.00	6.00	1.50	37.30	1.55	24.06	4.40
100 PPm GA_3	400.000	6.40	4.06	1.58	36.14	1.60	21.80	4.80	35.00	5.40	3.77	1.43	35.10	1.50	19.80	3.80
200 PPm GA_3	37.84	6.00	3.90	1.52	32.70	1.50	21.27	4.30	32.84	5.00	3.70	1.35	30.20	1.40	19.27	3.30
*10 PPm kinetin	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
*20 PPm kinetin	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
*10 PPm BAP	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
*20 PPm BAP	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
100 PPm GA_3+10 PPm kinetin+10 PPm BAP	37.50	8.50	6.20	1.37	36.00	1.50	24.00	5.10	33.00	7.00	6.00	1.17	34.50	1.52	22.61	4.10
100 PPm GA_3+20 PPm kinetin+20 PPm BAP	35.00	6.50	3.20	2.03	28.96	1.40	19.53	4.70	300.000	6.00	3.00	2.00	27.00	1.20	17.53	3.70
200 PPm GA_3+10 PPm kinetin+10 PPm BAP	39.20	5.80	3.60	1.61	24.90	1.30	19.15	4.50	34.20	5.50	3.50	1.57	23.50	1.20	17.15	3.50
200 PPm GA_3+20 PPm kinetin+20 PPm BAP	35.00	5.63	3.50	1.66	24.20	1.20	11.00	3.90	300.000	5.33	3.20	1.66	22.00	1.10	100.00	2.90
New L.S.D	2.64	1.18	0.58	0.02	2.54	0.48	1.67	0.98	2.64	1.26	0.76	0.05	2.08	0.27	1.67	0.98

** ovaries retained green color and start developing but soon dropped during the first week of May when spraying kinetin and BAP at 10 or 20 PPm

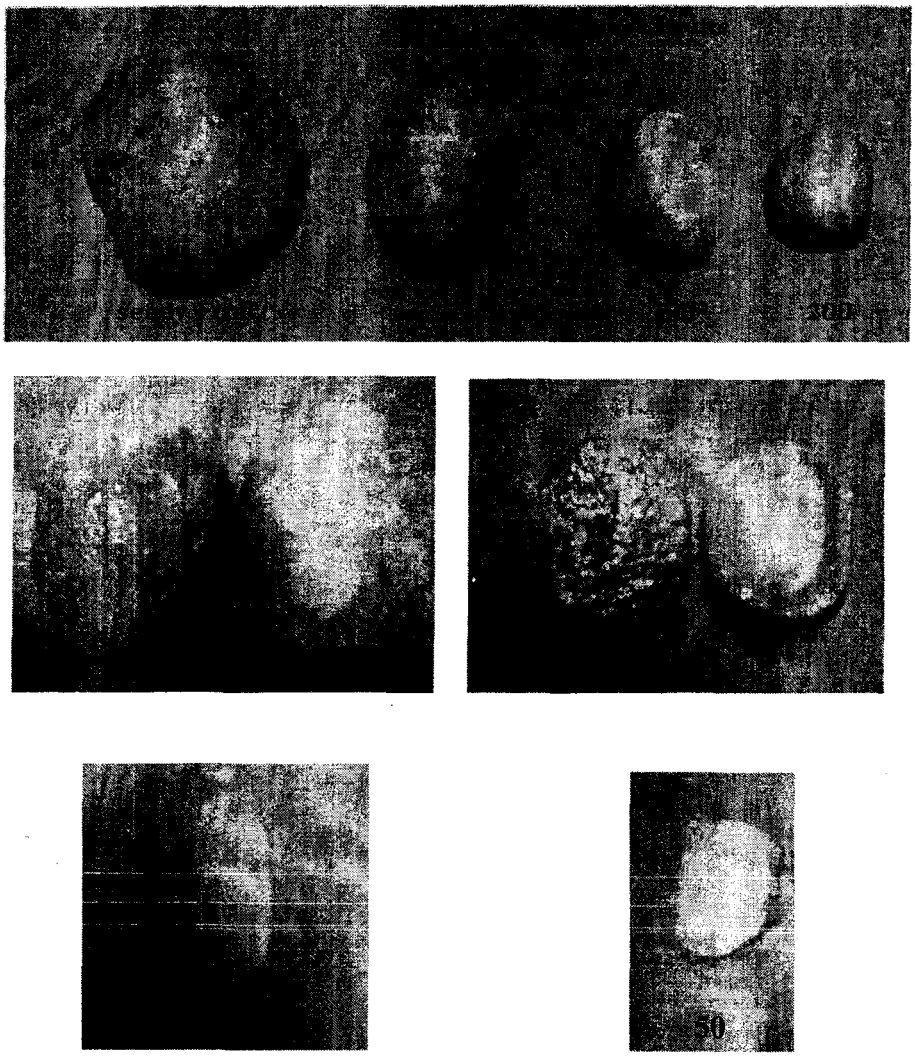

Fig (1): Effect of GA3 at 50, 100 and 200 PPm on weight, length, pulp and stone ratio of seedless fruit of mango Ewais cv.

5-Pulp/stone ratio.

Concerning pulp/stone ratio, the low concentration of GA3 (50 PPm) gave higher ratio (24.2 and 24.06) than the two concentrations (100 and 200 PPm) followed by sprayed GA3 at 100 PPm mixed with low concentration of kinetin and BAP (10 PPm) (24.0 and 22.6) which is similar with GA3 at 50 PPm, while the lowest ratio was noticed in treatment mixture of GA3 at 200 PPm and kinetin and BAP both at 20 PPm (11.0 and 100.00)

6-Pulp thickness.

As for pulp thickness the highest pulp thickness was obtained with GA_3 at 50 PPm followed by combination of GA_3 at 100 PPm, kinetin and BAP at 10 PPm , while the lowest pulp thickness was obtained with GA_3 at 200 PPm combined with kinetin and BAP at 20 PPm. Also it was noticed that, increasing the concentration of GA_3 from 50 to 200 PPm decreased the pulp thickness while, combining GA_3 at 100 or 200 PPm with kinetin and BAP at 20 and 10 PPm has nearly similar in pulp thickness. These results go in parallel with that obtained by Roa *et al.,* (1963) and Ezzat *et al.,* (1972) on loquat, reported that, seedless fruits which resulted from spraying flowers with GA3 were smaller in size, lowest in weight than seeded fruits.

Chemical properties.

Chemical properties of fruits as affected by growth regulators treatments in the two seasons of investigation are presented in Table (3) it is clear from data that, seedless fruits have statistically has high value of Indole/Phenol ratio than seedy ones (control). Increasing GA_3 from 50 to 200 PPm led to increase in this ratio. It also shows that, combining of GA3 at 200 PPm + kinetin and BAP at 10 or 20 PPm gave higher in ratio than GA3 at 100 PPm mixed with kinetin and BAP at 10 or 20 PPm. The highest values were obtained with application of GA_3 at 200 PPm + kinetin and BAP at 20 PPm followed by application of GA3 at 200 PPm only.

Concerning total sugar, all treatments have higher value except treatment of GA3 at 50 PPm which was similar with control. It also noticed that, application of GA3 at 200 PPm combined with kinetin and BAP at 10 or 20 PPm gave higher value of total sugar. Moreover, the other treatments gave nearly similar value.

As for T.S.S, it is clear that, T.S.S were low in seedy ones (control), while seedless fruits produced by GA_3 at 50 PPm contained statistically nearly the same T.S.S% value as control fruits. Fruits of GA_3 at 100 and 200 PPm had less T.S.S values than that of GA_3 at 50 PPm treatment. It is also evident that, combining GA_3 at 100 PPm with kinetin and BAP at 10 or 20 PPm had more T.S.S value than application of GA3 at 200 PPm combined with kinetin and BAP 10 or 20 PPm. The highest value of T.S.S was obtained by treatment of GA_3 at 100 PPm + kinetin + BAP at 10 PPm followed by GA3 at 200 PPm +

kinetin + BAP at 20 PPm. It is also evident that, acidity of parthenocarpic fruits was higher than seedy ones. Fruits of all treatments, however, had more acidity than control. T.S.S/ acidity ratio decreased significantly by growth regulators treatments as compared with control. Seedless fruits however, had higher ratio of T.S.S to acidity than seedy fruits. The obtained results were in harmony with the finding of Ehab (2005) who showed that, Ewais mango cv. fully developed parthenocarpic fruits were obtained using combination of BA and GA_3 , Nubbin fruits were greater in pulp/stone ratio and total soluble solids (T.S.S%). Singh and Shuklo (1978) and Galila *et al.,* (1991) on loquat, as GA3 treatment reduced TSS and increased fruit acidity than control. From these results it can be concluded that GA_3 at 50 PPm is the most effective growth regulator for production of parthenocarpy Ewais mango cv. when sprayed for 5 times starting when flower opening.

Table (3): Effect of some growth regulators treatments on chemical properties of seedless fruits of mango Ewais cv. Development during 2007 and 2008

treatment	2007							2008						
	Total Indole	Total Phenol	Indole/phenol ratio	Total soluble sugar	TSS %	Acidity %	TSS/ Acidity ratio	Total Indole	Total Phenol	Indole/ phenol ratio	Total soluble sugar	TSS %	Acidity %	TSS /Acidity ratio
Control	12.5	7.3	1.70	2.00	18.0	2.56	7. 03	12.17	6.83	1.78	2.40	18.00	2.20	8.18
50PPm GA_3	12.7	5.0	2.54	2.00	18.50	3.00	6.20	12.37	5.33	2.32	2.40	18.83	3.00	6.28
100 PPm GA_3	24.0	4.9	4.89	2.13	16.00	3.13	5.11	23.67	5.23	4.52	2.44	17.00	3.00	5.67
200 PPm GA_3	25.0	4.7	8.30	2.32	16.00	3.20	5.00	25.33	5.03	5.03	2.52	16.00	3.20	5.00
*10 PPm kinetin	00.0	0.0	00.00	0.00	00.00	00.00	00.00	00.00	00.00	0.00	0.00	00.00	0.00	0.00
*20 PPm kinetin	00.0	0.0	00.00	0.00	00.00	00.00	00.00	00.00	00.00	0.00	0.00	00.00	0.00	0.00
*10 PPm BAP	00.0	0.0	00.00	0.00	00.00	00.00	00.00	00.00	00.00	0.00	0.00	00.00	0.00	0.00
*20 PPm BAP	00.0	0.0	00.00	0.00	00.00	00.00	00.00	00.00	00.00	0.00	0.00	00.00	0.00	0.00
100 PPm GA_3+10 PPm kinetin+10 PPm BAP	24.6	3.2	5.86	2.31	22.40	2.60	14.0	24.27	3.53	6.87	2.51	24.07	2.50	9.63
100 PPm GA_3+20 PPm kinetin+20 PPm BAP	25.1	3.5	6.78	2.41	22.0	2.96	11.22	24.77	3.83	6.47	2.61	22.50	3.00	7.50
200 PPm GA_3+10 PPm kinetin+10 PPm BAP	28.2	3.7	8.06	3.03	20.50	3.20	6.41	27.12	4.03	6.73	3.13	22.00	3.20	6.87
200 PPm GA_3+20 PPm kinetin+20 PPm BAP	34.8	4.2	10.54	4.01	20.50	3.84	5.34	31.33	4.53	6.91	3.90	22.00	3.54	6.21
New L.S.D	1.342	0.519	0.095	0.065	0.538	0.154	0.505	1.285	0.519	0.041	0.059	1.168	0.196	0.123

** ovaries retained green color and start developing but soon dropped during the first week of May when spraying kinetin and BAP at 10 or 20 PPm

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تأثير المعاملة ببعض منظمات النمو على أنتاج ثمار المانجو بكرية العقد

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الملخص العربي

أجريت التجربة فى موسمى ٢٠٠٧-٢٠٠٨ على أشجار المانجو صنف عويس فى حديقة التجارب بمعهد بحوث البساتين بهدف دراسة تأثير بعض منظمات النمو مثل الجبرالين بتركيز ٥٠ و١٠٠ و٢٠٠ جزء فى المليون والكينتين والبنزيل امينو بيورين كل بتركيز ١٠و٢٠ جزء فى المليون ومخلوط من الجبرالين والكينتين والبنزيل امينو بيورين بتركيزات مختلفه وذلك بالرش ٥ مرات من بداية التزهير حتى تمام العقد على فترات أسبوعية.

وقد وجد أن الرش بالجبرالين بتركيز ٥٠ و١٠٠ و٢٠٠ جزء فى المليون وكذلك الرش بمخلوط من الجبرالين والكينتين والبنزيل أمينوبيورين بتركيز ١٠ أو ٢٠ جزء فى المليون أدى إلى أنتاج ثمار لابذرية ووجد أن الرش بالجبرالين بتركيز ٥٠ جزء فى المليون أدى إلى زيادة العقد وتقليل التساقط للثمار العاقدة كما أدى إلى زيادة نسبة اللب إلى البذرة.