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EFFECT OF SOME GA_3, PBZ AND UREA FOLIAR SPRAY TREATMENTS ON FRUIT SET, FRUIT RETENTION, YIELD AND FRUIT QUALITY OF ALPHONSE MANGO TREES

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ABSTRACT

In 2001/2002 & 2002/2003 seasons, mature Alphonse mango trees received 4 sprays at monthly intervals from mid Oct. to mid Jan. The tested treatments were: Cont. (water), GA_3 (alone) at 10 ppm, GA_3 (alone) at 20 ppm, Paclobutrazol (PBZ) (alone) at 500 ppm, PBZ (alone) at 1000 ppm, urea (alone) at 1%, GA_3 10 ppm + urea, GA_3 20 ppm + urea, PBZ 500 ppm + urea and PBZ 1000 ppm+ urea. GA_3 at both tested concentrations, with/or without urea, tended to increase number of fruits retained till harvest/panicle, number of harvested fruits/trees, the yield / tree, the hypothetic yield/fed. and TSS/acid ratio in the pulp juice. In addition, the treatments implying PBZ failed to affect significantly number of fruits/tree, the yield (per tree/or fed.), physical fruit characteristics and chemical constituents of the pulp juice.

INTRODUCTION

Mango trees suffer from colossal losses due to malformation (Singh, 2000). This disease disturbs the natural orientation of shoots and panicles and causes excessive and abnormal growth in them, thereby adversely affecting fruiting (Ram, 1991). It is estimated that mango malformation causes yearly losses in Egypt of at least 35 million LE. Azzouz *et al.* (1989).

Many previous reports revealed the beneficial effect of some growth regulators and nutrients to control floral malformation of mango. The most frequently used were GA_3, PBZ and urea. Therefore the present study aimed mainly to investigate the effect of foliar spraying a growth promoter (GA_3) and a growth inhibitor (PBZ), as well as a nitrogen source (urea) on the incidence of floral malformation in the mango cultivar Alphonse. The treatments were applied once monthly from Oct. 15th to Jan. 15th in each of the considered two seasons (2001/2002 and 2002/ 2003). The effects of tested treatments on panicle characteristics, particularly malformation, as well as flowering, fruiting and vegetative growth were assessed.

In a previous paper (Sourial *et al.*, 2005), results of the present investigation cleared that GA_3 (with or without urea) delayed panicle emergence, flowering and fruit set, while increased number of perfect flowers/ panicle and panicle length. The same treatments promoted the number of healthy panicles and total number of panicles / tree while obviously depressed number of malformed panicles /tree and malformation percentage. On the other hand, treatments implying PBZ at both tested concentrations (500 & 1000 ppm) with or without urea tended to advance panicle emergence , flowering and fruit set. Thus PBZ treatments clearly increased number of panicles / tree with parallel increase in number and percentage of malformed panicles. In addition, treatments implying PBZ increased number

of male flowers and total number of flowers/ panicle and promoted the sex ratio. The present paper is specified for the effect of tested treatments on fruit set, fruit retention, the yield/tree as well as fruit quality.

MATERIALS AND METHODS

The present investigation has been carried out during the two consecutive seasons of 2001/2002 and 2002/2003 on mature Alphonse mango trees *(Mangifera indica* L.) grown in the experimental orchard of El-Kassasin Horticultural Research Station, Ismailia Governorate. The soil of the orchard was sandy and the trees were under drip irrigation system using a moderately saline irrigation water (890 ppm).

Before the beginning of each experimental season (i.e. in late summer of the previous season) 90 mature Alphonse mango trees were selected to be of nearly similar size and being in their off- bearing year. Experimental trees of the second season were other than those used in the first season. The trees received a uniform orchard management practices concerning irrigation, soil fertilization, pruning, pests and weeds control following the usual management program applied in the region. Meanwhile, the experimental trees received different monthly foliar spray treatments during autumn- winter months from mid-Oct. to mid-Jan. The tested ten foliar spray treatments were; 1- Control (water); 2- Gibberellic acid (GA_3) at 10 ppm; 3- GA_3 at 20 ppm; 4- Paclobutrazol (PBZ) at 500 ppm; 5- PBZ 1000 ppm; 6- Urea at 1%; 7- GA_3 10 ppm + urea, 8- GA_3 20 ppm + urea; 9- PBZ 500 ppm + urea and 10- PBZ 1000 ppm + urea. Each treatment comprised nine trees, chared between three replicates.

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

1. Fruit **set and fruit retention:** 24 healthy and 24 malformed panicles were labeled on trees of each replicate. The number of set fruitlets were first counted on each labeled panicle at the beginning of fruit set (i.e. when the fruit were at pin- head stage). Later- on, the number of fruits retained on the same panicles were re- counted at monthly intervals (i.e. from the first halve of April) up till the date of harvesting (i.e. first week of Aug.). The average number of fruits retained per panicle was calculated for each replicate and treatment.

2. The yield/tree

Harvesting mango fruits began in the first week of Aug. in each season; the fruits were harvested in many successive pickings according to their reaching maturity. Later on the total number of fruits per tree and their weight in kg (i.e. the yield/ tree) were calculated. Moreover, the hypothetic yield per fed. was calculated considering that 85 trees are grown per fed. (planting distance = 7 x 7 m).

3. Fruit quality

Samples of 15 mature fruits per tree were randomly taken and kept in laboratory till the ripe stage. The following physical and chemical fruit properties were determined and recorded.

-Fruit dimensions, i.e. length and diameter (cm); the shape index (length/diam.) was calculated.
-Fresh weights of fruit, pulp, peel and seed (g).
-Fruit volume (cm^3).
-The pulp juice was obtained using a blender and the following constituents were determined.
*Total soluble solids content (TSS) percentage using a hand refractometer.
* Juice acidity (as g citric acid per 100 ml juice) was determined by titration against 0.1 N sodium hydroxide in presence of the phenol phthalene dye as indicator (A.O.A.C., 1975).
*Ascorbic acid content (Vit. C) was determined as mg/100 g of fresh juice according to the method described by Jacobs (1951).
*Total, reducing and non– reducing sugars contents were determined according to Ranganna (1979).

Experimental design and statistical analysis

The complete randomized block design with three replicates was followed throughout the whole work. Each replicate was represented by three trees; as such the total number of experimental trees was 90 (10 treatments x 3 replicates x 3 trees/ replicate) . The obtained data were subjected to analysis of variance and the LSD method was used for comparison between means (Snedecor and Cochran , 1980).

RESULTS AND DISCUSSION

1. Fruit set and fruit retention

Table (1) shows that the number of set fruitlets per healthy panicle (pin-head stage), generally ranged from 25.8 to 46.6 in the first season and from 26.2 to 48.1 in the second season. The corresponding values for malfo-rmed panicles were: 2.3–8.9 in the first season and 3.2–10.1 in the second season according to tested treatment.

The number of set fruitlets was affected by the tested treatments in both experimental seasons. Thus, in both healthy and malformed panicles considerable increases were obtained by three treatments: GA_3 20 ppm (alone), (GA_3 10 ppm + urea 1%) and (GA_3 20 ppm + urea 1%). With healthy panicles, the increments (over the control) due to those treatments were: 34.5, 29.7 & 37.4%, respectively in the first season and 22.2, 16.8 & 24.6% , respectively in the second season. With malformed panicles, the increments (over the control) due to the same abovementioned treatments were: 94.4, 100 & 122.2 % respectively in the first season and 57.1, 60.7 & 80.3% respectively in the second season. However, most of the set fruitlets on malformed panicles were dropped in later dates.

From table (2) it is clear that the number of fruits retained on healthy panicles in the first season, ranged: 5.8 – 13.4 at 30 days, 1.0 – 3.7 at 60 days, 0.14 – 0.37 at 90 days and 0.12 – 0.28 at 120 (at harvest) according to treatment. The corresponding values in the second season were: 6.0 – 14.4, 1.5 – 4.3, 0.20 – 0.39 and 0.18 – 0.31, respectively.

Table (1): Effect of GA_3, PBZ and urea foliar spray treatments on number of set fruits/panicle of Alphonse mango trees (2000/2002 and 2001/2002)

Foliar spray treatments	Number of set fruitlets / panicle**							
	2001 / 2002				2002 / 2003			
	Healthy panicles		.0		Healthy panicles		Malformed panicles	
	No.	* +/-%	No.	* +/-%	No.	* +/-%	No.	* +/-%
Cont. (water)	33.9	-	3.6	-	38.6	-	5.6	-
GA3 10 ppm	40.3	+18.8	5.5	+52.7	46.8	+21.2	8.2	+46.4
GA3 20 ppm	45.6	+34.5	7 0	+94.4	47.2	+22.2	8.8	+57.1
PBZ 500 ppm	28.2	-16.9	2.5	-30.6	28.5	-26.2	3.7	-34.0
PBZ 1000 ppm	25.8	-23.9	2.3	-36.2	26.2	-32.2	3.2	-42.9
Urea 1 %	37.3	+10.0	5.0	+38.8	38.6	0.0	5.5	-1.8
GA3 10 ppm	44.0	+29.7	7.2	+100.0	45.1	+16.8	9.0	+60.7
GA3 20 ppm	46.6	+37.4	8 9	+122.2	48.1	+24.6	10.0	+80 3
PBZ 500 ppm	34.6	+20	3.8	+5.5	35.4	-8 3	4.3	-23.3
PBZ 1000 ppm	31.0	-8.6	3.1	-13.9	31.8	-17.7	3.8	-32.2
L.S.D. 0.05	7.60	-	2.18	-	8.25	-	2.96	-

* Increase/or decrease in relation to control. ** The fruitlet were counted at the size of pin=head stage.

Table (2): Effect of GA_3 , PBZ and urea foliar spray treatments on number of fruits retained on healthy and malformed Alphonse mango panicles at monthly intervals after fruit set (2001 / 2002 and 2002 / 2003 seasons).

Foliar sprays treatments	Av. number of fruits retained on the panicle at :																	
	Days after fruit set :												At harvest 120					
	30				60				90									
	Healthy		Malformed		Healthy		Malformed		Healthy		Malformed		Healthy				Malformed	
	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	*+/-%	2002/ 2003	*+/-%	3001/ 2002	2002/ 2003
Cont (water)	10.8	10.4	1.1	1.7	1.6	1.7	0.5	0.6	0.19	0.23	0.00	0.00	0.16	-	0.21	-	0.00	0 00
GA_3 10 ppm	11.6	11.9	2.4	3.0	2.3	3.1	0.5	0.7	0.29	0.30	0.04	0.05	0.24	+50.0	0.25	+19.0	0.00	0.00
GA_3 20 ppm	12.4	12.8	3.1	4 2	3.2	3.6	0 6	0.8	0.31	0.33	0.06	0.08	0.26	+62.5	0.27	+28.6	0.017	0.03
PBZ 500ppm	6.6	7.6	0.9	1.3	1.2	1.8	0.4	0.5	0.18	0.22	0.00	0.00	0.15	-6.3	0.21	+0.0	0.00	0.00
PBZ 1000ppm	5.8	6.0	0.8	1.1	1.0	1.5	0.2	0.3	0.14	0.20	0.00	0.00	0.12	-25.0	0.18	-14.3	0.00	0.00
Urea 1%	11.5	11.5	1.9	2.2	2.0	2.9	0.7	0.8	0.26	0.30	0.02	0.04	0.20	+25.0	0.24	+14.3	0.00	0.00
GA_3 10 ppm + urea1%	12.6	13.9	3 1	4.7	3.3	3.9	0 8	0 8	0.34	0.35	0.06	0.06	0.27	+68.8	0.27	+28.6	0.00	0.00
GA_3 20 ppm + urea1%	13.4	14.4	4.3	5.6	3.7	4 3	0.9	1.0	0.37	0.39	0.07	0.09	0.28	+75.0	0.31	+47.6	0.02	0.03
PBZ 500 ppm + urea 1%	8.6	9.7	1.5	2 1	2.0	2.6	0.5	0.5	0.19	0.25	0.00	0.03	0.16	+0.0	0.22	+4.8	0.00	0.00
PBZ 1000 ppm + urea 1%	6.9	7.9	1.3	1.8	1.4	1.7	0.4	0.3	0.18	0.21	0.00	0.00	0.14	-12.5	0.19	-9 5	0.00	0.00
L.S.D. 0.05	1.72	1.78	0.80	0.83	0.66	0.89	0.16	0.14	0.06	0.08	0.017	0.019	0.050	-	0.054	-	0.012	0.020

* Increase/ or decrease in relation to control.

The values recorded at harvest are, generally, low which might be due to the relatively poor quality of the artesian irrigation water in the region (Kassasin, Ismailia Gov.). With malformed panicles, the corresponding values ranged: 0.8 – 4.3, 0.2 – 0.9, 0 – 0.7 and 0- 0.02 in the first season and: 1.1 – 5.6, 0.3 – 1.0, 0 – 0.09 and 0 – 0.03 in the second season. As such, fruit yield from malformed panicles is scarse.

The effect of tested treatments on number of retained fruits per panicle was clear and significant throughout the whole counting period. The healthy panicles consistently gave higher numbers of fruits with three treatments, i.e. GA_3 at 20 ppm (alone), (GA_3 at 10 ppm + urea 1%) and (GA_3 at 20 ppm + urea 1%). Such a trend was always clear in all counting dates and in both seasons. At time of harvesting, the three abovementioned treatments increased the number of fruit retained/ panicle by: 62.5, 68.7 & 75%, respectively over the control in the first season and by: 28.5, 28.5& 47.6%, respectively in the second season. The other tested treatments revealed insignificant differences in comparison with the control in both seasons. The role of malformed panicles in fruiting process was meager.

The increase in fruit set and retention by GA_3 foliar spray was in line with Rajput and Singh, (1989) on Dashehari cv., Oosthyse, (1995) on Tommy Athins & Heidi cvs. and Turnbull *et al.*, (1996) on Early Gold cv.

However, literature reports on the effect of PBZ on fruit set and fruit retention of mangoes indicated variable trends. Thus, Burondkar *et al.*, (1997) found that PBZ soil application (7.5 g/tree) to Alphonse mango trees, Zora *et al.*, (2000) on PBZ soil application (10- 60 g/tree) on Dusehri mango trees and Hoda *et al.*, (2001) on PBZ soil application (5 & 10 g /tree) and foliar spray (500. 1000 & 2000 ppm) on Langra mango trees, they found that PBZ treatments increased fruit set. On the other hand, Kurian and Lyer, (1993) applied PBZ at 2.5, 5 & 10 g/ tree to the soil under mango trees and found that the 2.5 g dose enhanced fruit set but did not affect fruit retention, while the dose of 10 g/ tree depressed both fruit set and fruit retention. Moreover, Phavaphut - Anon *et al.*, (2000) on Nam Dok Mai mango cv. declared that soil PBZ application in June depressed the number of fruits retained on the panicle till harvesting time. The contradictions between reports regarding PBZ effect on fruit set and retention might be due to varietal differences and/ or to the difference in method of application (i.e. soil drench/or foliar spray) as well as to the rate and number of applications.

As for the effect of urea (alone) on fruit set and fruit retention, Shabaan (1987) found that spraying urea at 1.5 % in the autumn on Hindy Bi – Sinnara mango trees enhanced the number of set fruitlets / panicle from 22.2 & 22.4 in the two seasons (on & off – years, respectively) for the control to reach 27 & 24, respectively with urea 1.5%. In addition, Sharma *et al.*, (1990) found that urea spray (2 or 4%) on mango trees at flowering time (20 Feb.) increased fruit set percentage. In addition, Sharma *et al.*, (1990), Shawky *et al.*, (1982) and Singh *et al.*, (1994), found that urea foliar sprays increased the number of fruits retained till harvesting time per panicle.

Yield component

2.1. Number of fruits per tree

The number of fruits retained till harvest, generally, ranged from 45.7 to 133.3 in the first season and from 70.8 to 151.8 in the second season according to the tested treatment (Table 3).

The data show significant promotions in number of fruits retained till harvest per tree by GA_3 (alone) at both concentrations (10 & 20 ppm), urea 1% (alone) and the combined treatments: (GA_3 10 ppm + urea 1%) & (GA_3 20 ppm + urea 1%). The increments in number of fruits/ tree compared to the control were: (36.6 & 18.6) with urea alone, (69.6 & 34.6%) with GA_3 10 ppm (alone), (105.8 & 53.8%) with (GA_3 10 ppm + urea 1%), (101.7 & 60.3%) with GA_3 20 ppm (alone) and (128.2 & 90.4%) with (GA_3 20 ppm + urea 1%). The other tested treatments were statistically equal to the control in this respect.

2.2. Average fruit weight

The fruit weight, generally, ranged from 316.7 to 329.2 g in the first season, and from 320.6 to 331.7 g in the second season without any significant differences between treatments (Table, 3).

2.3. The yield per tree

The yield per tree, generally ranged from 15.0 to 42.2 kg in the first season and from 23.1 to 48.8 kg in the second season, according to the tested treatment. Trees sprayed with GA_3 at both concentrations (10 & 20 ppm) with /or without urea gained significant increase in their yield in both seasons. The highest increments over the control (120.9 & 84.8% in the two seasons) were gained by the combined treatment (GA_3 20 ppm + urea 1%), descendingly followed by both GA_3–20 ppm alone (99.4 & 55.3% in the two seasons) and (GA3 10 ppm + urea 1%) (104.7 & 53.4%), then GA_3 10 ppm (alone) (70.6 & 31.4% in the two seasons). All other tested treatments failed to induce significant differences in comparison with the control.

2.4. Hypothetic yield/fed.

The values, generally, ranged from 1.28 to 3.59 tons/fed. in the first season and from 1.96 to 4.15 tons/fed. in the second season, according to tested treatments.

The effect of tested treatments revealed a trend nearly similar to that of the yield/tree, except for the significant increase over the control in both seasons gained by the treatment of urea (alone) which increased the yield /fed. by 37.6 & 14.2% over the control in the two seasons.

The increase in number of fruits / tree by GA_3 agreed with Rajput and Singh (1989) who sprayed GA_3 (15 & 30 ppm) and urea (3 & 6%) on Dashehari mango trees twice (5 & 20 Jan.). Similar result was reported by Ooshysea (1995) who applied one GA_3 spray (40 ppm) on Tommy Atkins and Heidi mango trees at the pea – marble stage, the increment in number of fruits/tree was 63% with Tommy Atkins and 39% with Heidi cv. Analogical results were also reported by Turnbull *et al.*, (1996), on Early Gold mango trees and Sant *et al.* (1997) on Amrapali mango trees.

Table (3) Effect of GA_3 , PBZ and urea foliar spray treatments on yield comonts of alphonse mango trees (2001 / 2002 and 2002 / 2003 seasons).

Foliar spray treatments	Number of fruits / tree				Av. fruit weight (g)		Yield / tree (kg)				Hypothetic yield / fed. ** (ton)			
	2001/ 2002	*+/-%	2002/ 2003	*+/-%	2001/ 2002	2002/ 2003	2001/ 2002	*+/-%	2002/ 2003	*+/-%	2001/ 2002	*+/-%	2002/ 2003	*+/-%
Cont (water)	58 4	-	79.7	-	327.8	331 7	19.1	-	26.4	-	1.62	-	2.24	-
GA_3 10 ppm	99 1	+69.6	107.3	+34.6	328.9	323.7	32.6	+70.6	34.7	+31.4	2.77	+70.9	2.95	+31.6
GA_3 20 ppm	117.8	+101.7	127.8	+60.3	322.6	320 6	38.1	+99.4	41.0	+55.3	3.24	+100.0	3.49	+55.8
PBZ 500ppm	58.1	-0.8	84 5	+6.0	329.2	328.0	19.1	+0.0	27.7	+4.9	1.62	+0.0	2.36	+5.3
PBZ 1000ppm	45.7	-21.8	70.8	-11.2	328.6	326.6	15.0	-21.5	23.1	-12.5	1.28	-21.0	1.96	-12.5
Urea 1%	79.8	+36.6	94.6	+18.6	327.7	318.6	26.2	+37.1	30.1	+14.0	2.23	+37.6	2.56	+14.2
GA_3 10 ppm + urea1%	120.2	+105.8	122 6	+53.8	325.1	330.6	39.1	+104.7	40.5	+53.4	3.32	+104.9	3.44	+53.5
GA_3 20 ppm + urea1%	133.3	+128 2	151 8	+90.4	316.7	321.6	42.2	+120.9	48.8	+84.8	3.59	+121.6	4.15	+85.2
PBZ 500 ppm + urea 1%	63.8	+9.2	90.5	+13.5	327.0	326.9	20.9	+9.4	29.6	+12.1	1.78	+9.8	2.52	+12.5
PBZ 1000 ppm + urea 1%	53.4	-8.6	74.7	-6.3	317.2	328.0	16.9	-11.6	24.5	-7.2	1.44	-11.2	2.08	-7.2
L.S.D 0.05	18.95	-	14.37	-	N.S	N.S	6 57	-	4.64	-	0.32	-	0.31	-

* Increase/ or decrease in relation to control.
**The hypothetic yield / fed. was calculated on basis of 86 tree / fed. (the trees spaced at 7 x 7m).

Table (4) : Effect of GA_3 , PBZ and urea foliar spray treatments on some physical fruit characteristics at harvest in Alphonse mango (2001/2002 and 2002/2003 seasons)

Foliar spray treatments	Fruit weight (g)		Fruit volume (cm^3)		Fruit shape index (length / diam.)		Peel weight (g)		Pulp weight (g)		Seed weight (g)	
	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003	3001/ 2002	2002/ 2003
Cont. (water)	327.8	331.7	313.1	308.7	1.45	1.47	47.9	49.7	221.9	232.9	58.0	49.1
GA_3 10 ppm	328.9	323.7	318.7	301.8	1.53	1.54	49.7	51.4	236.0	235.3	43.2	37.0
GA_3 20 ppm	323.6	320.6	313.6	305.7	1.55	1.56	45.2	52.8	233.9	228.6	44.5	39.2
PBZ 500ppm	329.2	328.0	323 4	310.1	1.46	1.46	50.0	48.6	233.8	242.6	45.4	36.8
PBZ 1000ppm	328.6	326.6	316.3	306.5	1 43	1.44	47.5	46.6	232.7	243.6	48.4	36 4
Urea 1%	327 7	318.6	324.1	316.0	1.48	1.48	50.3	50.1	230.4	227.9	47.0	40.6
GA_3 10 ppm + urea1%	325.1	330.6	314.9	324.9	1.52	1.52	45.6	56.0	228.8	234.4	50.7	40.2
GA_3 20 ppm + urea1%	316.7	321 6	307.7	310.8	1.55	1.54	44.5	46.8	220.9	234.6	51.3	40 2
PBZ 500 ppm + urea 1%	327.0	326.9	317.5	311.6	1.47	1.47	53.2	50.2	220.6	236.3	53.2	40.4
PBZ 1000 ppm + urea 1%	317 2	328.0	305.8	306.4	1.46	1.45	47.4	47.3	228.2	245.2	41.6	35.5
L.S D 0 05	N.S	N.S	N.S	N.S	N.S.	N.S	N.S	N.S	N.S	N.S	N S	N.S

Many literature reports indicated that PBZ treatments to mango trees increased number of fruits and /or the yield / tree (Singh and Dhillon, 1992; Winston, 1992; Burondkar *et al.*, 1993 & 1997; Kulkami *et al.*, 1997; Burondkar *et al.*, 2000; Shinde *et al.*, 2000; Zora *et al.*, 2000; Hoda *et al.*, 2001 and Mendonca *et al.* 2001). This was not supported by results of the present work.

The increments in number of fruits/tree and/or the yield /tree by urea spray (alone) were in agreement with Sharma *et al.*, (1990 a & b), Singh *et al.*, (1994) and Banik *et al.*, (1997).

3.Fruit physical and chemical properties

3.1. Fruit physical characteristics

As shown in Table (4) the fruit weight, generally, ranged: 316.7 – 329.2 & 318.6 - 331.7 g in the first & second seasons respectively, without any significant differences between treatment. Also, fruit volume, generally, ranged: 305.8 – 324.1 & 301.8 – 316.0 cm^3 in the first & second seasons, respectively, without any significant differences between treatments in both seasons.

The fruit shape index ($\frac{\text{L. ength}}{\text{diam.}}$), generally, ranged: 1.43 – 1.55& 1.44 – 1.56 in the first & second seasons, respectively, without significant differences between treatments in both seasons.

The fruit peel weight, generally, ranged: 44.5 – 53.2 & 46.6 - 56.0 g in the first & second seasons, respectively, without, significant differences between treatments in both seasons.

The fruit pulp weight, generally, ranged: 220.6 – 236.0 & 227.9 – 245.2 g in the first & second seasons, respectively, without any significant differences between treatments in both seasons.

The fruit seed weight generally, ranged: 41.6 – 58.0 & 35.5 – 49.1 g, in first & second seasons, respectively without any significant differences between treatments in both seasons.

3.2. Main juice constituents

The data in Table (5) show that TSS (%) generally ranged : 15.5 – 16.8 & 16.0 – 17.0% in the first & second seasons, respectively. All treatments and the control were of statistically equal effect in both seasons.

The total acid content of the fruit pulp juice, generally, ranged 0.30 – 0.38 and 0.29 – 0.34% in the first and second seasons, respectively. All tested treatments and the control indicted statistically similar effect in this concern.

The TSS / acid ratio, generally, ranged: 40.8-56.0 and 47.9-58.6 in the first and second seasons, respectively. The data indicated significant differences between treatments in this respect; the treatments that gave significant increments over the control in the two seasons were: GA_3 20ppm with /or without urea and $GA_3$10 ppm + urea. The increments were: 37.2& 20.3% over the control with (GA_3 20 ppm +urea), 30.3&11.1% with (GA_3 10 ppm +urea) and 24.7&11.1%with GA_3 20ppm (alone), in the first & second seasons, respectively. The other tested treatments revealed insignificant differences in comparison with the control in both seasons.

Table (5): Effect of GA_3 , PBZ and urea foliar spray treatments on some chemical constituents in pulp juice of Alphonse mango fruits at harvest (2001/ 2002 and 2002/2003 seasons)

Foliar spray treatments	TSS(%)		Acidity (%)		TSS/ acid ratio				Reducing sugars (%)		Non-reducing sugars (%)		Total sugars (%)		Ascorbic acid (mg/100 g juice)	
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	*+/-%	2001/ 2002	*+/-%	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003
Cont (water)	15.5	16.0	0.38	0.33	40.8	-	48.5	-	3.9	3.9	8.1	7.3	12.0	11.2	22.4	23.8
GA_3 10 ppm	16.0	16.6	0.34	0.32	47.1	+15.4	51.9	+7.9	4.2	3.5	7.6	7.1	11.8	10.6	23.2	23.1
GA_3 20 ppm	16.3	16.7	0.32	0.31	50.9	+24.7	53.9	+11.1	4.1	3.4	7.5	6.9	11.6	10.3	25.5	24.9
PBZ 500ppm	15.7	16.3	0.36	0.34	43.6	+6.8	47.9	-1.3	3.8	4.0	8.3	7.0	12.1	11.0	23.9	25.9
PBZ 1000ppm	15.5	16.3	0.37	0.34	41.9	+2.6	47.9	-1.3	3.8	3.7	8.1	6.7	11.9	10.4	21.9	23.3
Urea 1%	15.9	16.4	0.33	0.32	48.2	+18.1	51.3	+5.7	3.7	4.3	8.0	6.4	11.7	10.7	22.7	21.4
GA_3 10 ppm + urea1%	16.5	16.7	0.31	0.31	53.2	+30.3	53.9	+11.1	4.1	3.4	7.8	7.9	11.9	11.3	24.0	22.0
GA_3 20 ppm + urea1%	16.8	17.0	0.30	0.29	56.0	+37.2	58.6	+20.8	4.0	4.4	7.7	6.0	11.7	10.4	22.6	21.3
PBZ 500 ppm + urea 1%	15.9	16.5	0.35	0.33	45.4	+11.2	50.0	+3.0	4.1	3.7	7.7	7.3	11.8	11.0	22.0	21.8
PBZ 1000 ppm + urea 1%	15.7	16.4	0.35	0.33	44.9	+10.0	49.7	+2.4	3.9	4.2	7.9	7.1	11.8	11.3	23.4	22.2
L.S.D. 0.05	N.S	N.S	N.S.	N.S	4.3	-	5.1	-	N.S	N.S.	N.S	N.S.	N.S.	N.S.	N.S	N.S.

* Increase/ or decrease in relation to control.

The reducing sugars content ranged : 3.7 – 4.2 & 3.4 – 4.4 % in the first & second seasons, respectively. All treatments and the control were statistically equal in this respect.

The non-reducing sugars content ranged : 7.5 – 8.3 & 6.0 – 7.9% in the first & second seasons, respectively. The differences between all tested treatments including the control were statistically insignificant .

The total sugars content, generally, ranged: 11.6-12.1 & 10.3 – 11.3% in the first & second seasons, respectively. No significant differences were observed between all tested treatments.

Ascorbic acid content, generally, ranged : 22.0 – 25.5 & 21.3-25.9 mg /100g juice in the first & second seasons, respectively. In both seasons, the differences between all treatments were insignificant.

The effect of GA_3 foliar spray on quality of mango fruit was rarely discussed in the available literature reports; however, Rajput and Singh (1989) mentioned that GA_3 (15 & 30 ppm) + urea (3 & 6%) foliar sprays on Dashehari mango trees improved fruit quality. Anyhow, this effect might be due to urea since urea sprays (alone) on mango trees at 2 & 4% on 20 Feb. increased TSS , non- reducing sugars, total sugars and ascorbic acid contents while decreased juice acidity (Sharma *et al.* 1990 b) . The same effects of urea (alone) were reported by Singh *et al.*, (1994) . Also, Banik *et al.*, (1997) concluded that urea sprays (1%) on Fazli mango trees increased TSS and total sugars contents .

The effect of PBZ on fruit quality indicated variable trends in the related literature reports. Thus, Burondkar *et al.*, (1993) applied soil and foliar PBZ sprays treatments to Alphonse mango trees and revealed that no clear effect on fruit quality could be detected . On the other hand, Singh and Dhillon, (1992) and Kulkami *et al.*, (1997) found that PBZ treatments improved quality of mango fruits. Also, Salazar and Vesquez, (1997) applied PBZ at 2.5- 40 g to soil under Tommy Atkins mango trees and found that juice TSS was increased by 10 g PBZ / tree. In addition, Vijayalakshimi and Srinivasan, (2000) applied 10 g PBZ to the soil under Alphonse mango trees; the treatment increased juice TSS, reducing sugars, total sugars and ascorbic acid content . In the same direction , Hoda *et al.* (2001) applied foliar spray and soil application of Cultar to Langra mango trees; the treatments increased juice TSS, reducing sugar and ascorbic acid contents .

The slight effects of the tested growth regulators and urea on fruit quality in the present work might be due to their application in the fall, i.e. about 9 months before fruit harvesting .

Generally, the most promising treatments to increase fruit set, fruit retention, number of fruits / tree and the yield were GA_3 20 ppm with or without urea. The treatment of GA_3 20 ppm + 1 % urea nearly doubled the number of fruits and the yield / tree as compared with the control. However, the effect of such treatments on fruit physical and chemical properties was meager. In addition, the tested PBZ treatments failed to reveal any beneficial effects on yield and fruit quality of Alphonse mango trees under Ismailia condition.

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تأثير بعض معاملات الرش بالجبرلين (GA_3) والكلتار (PBZ) واليوريا على عقد وبقاء الثمار والمحصول وجودة الثمار فى المانجو صنف الفونس

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أجريت هذه الدراسة فى موسمين متتاليين (٢٠٠١/٢٠٠٢، ٢٠٠٢/٢٠٠٣) على أشجار مانجو بالغة صنف الفونس حيث تم رش الأشجار أربع مرات على فترات شهرية من منتصف أكتوبر حتى منتصف يناير وقد تم اختبار عشر معاملات هى : المقارنة(الرش بالماء) ، GA_3 بمفردة بتركيز ١٠ جزء فى المليون ، GA_3 بمفردة بتركيز ٢٠ جزء فى المليون، كلتار (PBZ) بمفردة بتركيز ٥٠٠ جزء فى المليون، كلتار بمفردة بتركيز ١٠٠٠ جزء فى المليون، يوريا منفردة بتركيز ١%، GA_3 بتركيز ١٠ جزء فى المليون + يوريا ١% ، GA_3 بتركيز ٢٠ جزء فى المليون + يوريا ١%، كلتار بتركيز ٥٠٠ جزء فى المليون + يوريا ١% ، كلتار بتركيز ١٠٠٠ جزء فى المليون + يوريا ١%.

وقد نتج عن رش الجبرلين بأى من التركيزين (مع اليوريا أو بدونها) زيادة فى عدد الثمار العاقدة على الشماريخ وعدد الثمار حتى القطف على الشماريخ وعدد الثمار المتبقية على الشجرة عند القطف ومحصول الشجرة (كجم) والمحصول التقديرى للفدان وكذلك نسبة المواد الصلبة الذائبة الكلية : الحموضة فى عصير لب الثمار.

أما المعاملات المحتوية على كلتار فلم تؤثر معنويا على عدد الثمار على الشجرة عند القطف أو محصول الشجرة أو المحصول التقديرى للفدان. كما لم يلاحظ تأثير معنوى لمعاملات الكلتار على الصفات الطبيعية للثمار أو المحتوى الكيماوى لعصير لب الثمار.