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VEGETATIVE GROWTH AND SOME BIOCHEMICAL RESPONSES OF MATURE ALPHONSE MANGO TREES TO SOME FOLIAR SPRAYS WITH GA_3, PBZ AND UREA

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ABSTRACT

In 2001/ 2002 and 2002/2003 seasons, mature Alphonse mango trees received 4 foliar 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 1% , GA_3 20 ppm + urea 1% , PBZ 500 ppm + urea 1% and PBZ 1000 ppm + urea 1 %.

Clear responses in vegetative growth , expressed as shoot growth rate, number of leaves/ shoot, leaf area and leaf fresh and dry weights was obtained by all treatments implying GA_3, urea or both. However, the most effective treatment was (GA_3 20 ppm + urea 1%) . The leaf content of chlorophyll a & b , carotenoids, nitrogen, phosphorus and potassium were not altered by any of the tested treatments, except for the increment of leaf N% in the first season by PBZ 1000 ppm + urea 1% as well as in K % in the second season by PBZ 1000 ppm (with / or without urea) and PBZ 500 ppm + urea 1%.

INTRODUCTION

Mango (*Mangifera indica* L.) has a great importance in the Egyptian fruit production. Egypt ranks 10th among mango producing countries with total production of 232.000 m. ton (FAO, 2000).

Foliar sprays with GA_3, PBZ and urea was among the attempts to control floral malformation of mango trees (Ibrahim, 1977; Azzouz *et al.*, 1980 & 1984; Haggag , 1986; Das *et al.*, 1989; Oosthuyse, 1995 a & b; Mossak, 1996 ; Burondkar *et al.*, 1997 & 2000; Mohammad *et al.*, 1999; Thakur *et al.*, 2000; Mendonca *et al.*, 2001 and Murti *et al.*, 2001).

Therefore, the present work aimed mainly to investigate the effect of foliar sprays of both growth promotor (GA_3) and a growth inhibitor (PBZ), as well as a nitrogen source (urea) on the incidence of floral malformation in the mango cv. Alphonse. The treatments were applied once monthly from Oct. 15th to Jan. 15th in each of the considered two seasons. The effect of the tested treatments on panicle characteristics, particularly malformation, as well as flowering, fruiting and vegetative growth were assessed. The present paper is specified for the effect of tested treatments on vegetative growth of the trees.

In previous two papers (Sourial *et al.*, 2005 and Tewfik *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. Moreover, treatments implying GA_3 (with or without urea) increased number of set and retained fruits / panicle , number of harvested fruits and the yield / tree. On the other hand , treatments implying PBZ advanced panicle emergence, flowering and fruit set, increased number of panicles / tree and malformation %, number of male flowers / panicle, total number of flowers / panicle and sex ratio . On the other hand , the effect of all tested treatments (GA_3, PBZ, urea and their combinations) on fruit physical and chemical characteristics was generally slight.

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 structure 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 for 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 programme 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 at 1000 ppm; 6-Urea at 1% ; 7-GA_3 10 ppm + urea 1%; 8-GA_3 20 ppm + urea 1% ; 9-PBZ 500 ppm + urea 1% and 10 -PBZ 1000ppm +urea 1%. Each treatment comprised nine trees, chared between three replicates.

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

1.Seasonal changes in shoot length and number of leaves / shoot

In April of each season, twelve new shoots were tagged on each experimental tree. The shoot length and number of leaves per shoot were recorded monthly from May till Sept.

2.Leaf area and leaf fresh and dry weights

In late Dec. five leaves were detached from the medium portion of the tagged shoots starting from the third leaf, and the leaf area (cm^3) was estimated by a Ci - 203 area meter CID , Inc (USA). The same leaves were used to determine leaf fresh weight (g), then were dried at 70°C till constant weight to determine leaf dry weight (g).

3.Leaf photosynthetic pigments content

In August, leaf samples were collected from the middle of the current season shoots for photosynthetic pigments determination. The leaf

chlorophyll a & b and carotenoids were determined following the method described by Wettstein (1957) using a spectrophotometer at wave lengths of 662, 644 and 440.5 nm for chlor. A , chlor. B and carotenoids , respectively.

4.Leaf N, P and K contents

Leaf samples were taken in Dec. from the middle position of current season shoots for some macronutrients determinations. The leaves were cleaned then dried at 70°C till constant weight. The dried leaves were ground to a fine powder and digested with sulphuric and perchloric acids mixture (3: 1 v/v).

The leaf nitrogen (N) content was determined according to the micro kjeldahl method as described by Black (1965). The leaf phosphorus (P) content was determined spectrophotometically as described by John, (1970). The leaf potassium (K) content was flame photometerically determined according to the method of Jackson (1965). The leaf NPK contents were expressed as percentages on dry weight basis.

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.Seasonal changes in length of new shoots

Table (1) shows that the average shoot length , generally , ranged : 5.5-8.8 & 6.4-9.3 cm in May, 11.1 - 16.9 & 11.0-17.2 cm in June , 15.6-24.9 & 16.1-25.4 cm in July, 20.3-30.5 & 21.5-31.6 cm in Aug. and 21.8-31.9& 22.2-32.5 cm in Sept. in the first & second seasons, respectively, according to tested treatment. The differences between tested treatments were always statistically significant . The treatments that yielded significantly longer shoots compared to control in all measuring dates and in both seasons were: (GA_3 20 ppm + urea 1%) and (GA_3 10 ppm + urea 1%). By the end of active growth period (i.e. in Sept.), the increments over the control by the treatment (GA_3 20 ppm + urea 1%) were 30.7 & 27.4% in the first & second seasons, respectively. The corresponding values for the treatment (GA_3 10ppm + urea 1%) were : 27.4 & 23.1%, respectively . Worthwhile , the treatment of GA_3 20 ppm (alone) also clearly induced average shoot length in both seasons , but only in the last three measuring dates (i.e. July, Aug. & Sept.). The increase over the control in the ultimate shoot length with this treatment was 26.2 & 22.3% in the first and second seasons, respectively. Meanwhile, the other tested treatments failed to alter shoot length significantly through the considered measuring dates in one or both the experimental seasons.

2. Seasonal changes in number of leaves on the new shoot

The average number of leaves per shoot, generally, ranged : 3.5-5.6 & 3.9 - 5.9 in May, 5.3 - 10.1 & 6.4 - 10.6 in June , 9.8 - 16.4 & 10.2 - 16.8 in

July , 12.6-19.3 & 12.9-19.7 in Aug. and 12.7-19.6 & 13.0-19.9 in Sept. in the first & second seasons, respectively, according to tested treatment (Table , 2).

The differences between tested treatments were always significant. The treatments that enhanced significantly the number of leaves / shoot in all measuring dates and in both seasons were : (GA_3 20 ppm + urea) and (GA_3 10 ppm + urea) . By the end of active growth period (i.e. in Sept.), the increments over the control by the treatment of (GA_3 20 ppm + urea) were: 34.2 & 32.6% in the first and second seasons, respectively. The corresponding increments by the treatment (GA_3 10 ppm + urea) were : 30.8 & 29.3% over the control. Meanwhile, the other tested treatments failed to alter the number of leaves / shoot significantly through the considered counting dates in one or both the experimental seasons.

3. Leaf area and fresh & dry weights

The leaf area (Table, 3), generally, ranged from 59.7 to 89.3 cm^2 in the first season and from 58 to 91.7 cm^2 in the second season according to treatment. The leaf area was significantly increased by GA_3 (alone) at 10 & 20 ppm, by urea 1% (alone) and by GA_3 10 & 20 ppm + urea 1%. The increments (over the control) in leaf area by those treatments ranged from 28.5 to 49.6% in the first season and from 35.7 to 58.1% in the second season. However, the most effective treatment was (GA_3, 20ppm + urea 1%). The other tested treatments failed to alter leaf area significantly in both seasons.

The leaf fresh weight, generally, ranged from 1.80 to 3.10 g in the first season and from 1.81 to 3.23 g in the second season, according to tested treatment . The leaf fresh weight was significantly increased by the same treatments mentioned above for leaf area in addition to the treatment (PBZ 500 ppm + urea). The increments (over the control) in leaf fresh weight, by those treatments, ranged from 26.1 to 72.2% in the first season and from 29.8 to 78.5% in the second season. However, the uppermost increments were gained by the treatment (GA_3 20 ppm + urea), while the lowermost increments resulted from the treatment (PBZ 500 ppm + urea) . The other three treatments (i.e. PBZ alone at 500 & 1000 ppm and (PBZ at 1000 ppm + urea) failed to alter the leaf fresh weight significantly in both seasons as compared to control.

The leaf dry weight , generally , ranged from 0.58 to 1.53 g in the first season and from 0.64 to 1.43 g in the second season, according to tested treatment. The effect of tested treatments was statistically significant in both seasons and revealed the same trend as shown above for the leaf fresh weight . As such, six of the tested treatments clearly increased leaf dry weight in both seasons as compared with the control. Those treatments were : (GA_3 20 ppm + urea), (GA_3 10 ppm + urea), GA_3 (alone) at 20 ppm , GA_3 (alone) at 10 ppm . The increments in leaf dry weight by those treatments (over the control) ranged from 58.7 to 142.9% in the first season and from 41.4 to 104.3% in the second season. The uppermost increments came from the treatment (GA_3 20 ppm + urea) . Meanwhile, the other three treatments (i.e. PBZ alone at 500 & 1000 ppm and PBZ 1000 ppm + urea) failed to alter the leaf dry weight significantly in both seasons as compared to control.

Table (1) : Effect of some GA_3 , PBZ and urea foliar spray treatments on seasonal changes in length of new shoots (cm) of Alphonse mango trees (2001/ 2002 and 2002 / 2003 seasons).

Foliar spray treatments	May		June		July		Aug.		Sept.			
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	*+ / -%	2001/ 2003	*+ / -%
Cont.(water)	7.0	7.3	12.3	13.7	18.4	19.9	23.5	24.6	24.4	-	25.5	-
GA_3 10 ppm	7.9	8.2	15.2	15.4	23.5	23.8	28.6	28.9	29.5	+20.9	29.9	+17.2
GA_3 20 ppm	8.3	8.8	15.9	16.2	23.8	24.4	29.5	30.0	30.8	+26.2	31.2	+22.3
PBZ 500ppm	6.0	6.6	11.1	12.5	16.7	17.1	21.6	22.3	22.5	-7.8	23.6	-7.5
PBZ 1000ppm	5.5	6.4	10.8	11.0	15.6	16.1	20.3	21.5	21.8	-10.7	22.2	-13.0
Urea 1%	7.7	8.0	15.1	15.2	22.6	23.2	28.1	28.3	29.3	+20.0	29.1	+14.1
GA_3 10 ppm + urea1%	8.7	9.0	16.1	16.5	24.4	24.8	29.8	30.6	31.1	+27.4	31.4	+23.1
GA_3 20 ppm + urea1%	8.8	9.3	16.9	17.2	24.9	25.4	30.5	31.6	31.9	+30.7	32.5	+27.4
PBZ 500 ppm + urea 1%	6.8	7.0	12.5	13.2	17.6	18.2	22.6	23.1	32.2	-5.0	24.6	-3.6
PBZ 1000 ppm+urea 1%	6.0	6.9	11.2	12.3	16.6	17.0	21.8	22.2	22.3	-8.7	23.0	-9.9
L.S.D. 0.05	1.0	1.5	2.6	3.0	3.8	4.2	4.4	4.8	4.7	-	5.1	-

* Increase / or decrease in relation to control.

Table (2): Effect of some GA_3 , PBZ and urea foliar spray treatments on seasonal changes in number of leaves/ new shoot of Alphonse mango trees (2001 / 2002 and 2002 / 2003 seasons).

Foliar spray treatments	May		June		July		Aug.		Sept.			
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	*+ / -%	2002/ 2003	*+ / -%
Cont. (water)	4.2	4.5	7.2	7.7	11.4	11.7	14.5	14.9	14.6	-	15.0	-
GA_3 10 ppm	4.9	5.1	8.4	8.8	13.3	13.5	16.9	17.3	17.1	+17.1	17.5	+16.6
GA_3 20 ppm	5.1	5.4	9.0	9.5	14.4	14.6	17.6	18.0	17.8	+21.9	18.2	+21.3
PBZ 500ppm	3.8	4.2	6.9	7.3	10.8	11.1	13.2	13.7	13.3	-9.0	13.9	-7.4
PBZ 1000ppm	3.5	3.9	5.3	6.4	9.8	10.2	12.6	12.9	12.7	-13.1	13.0	-13.4
Urea 1%	4.6	4.9	8.8	9.3	13.9	14.0	17.4	17.6	17.5	+19.8	17.8	+18.6
GA_3 10 ppm + urea1%	5.3	5.5	9.4	9.8	15.0	15.3	18.8	19.2	19.1	+30.8	19.4	+29.3
GA_3 20 ppm + urea1%	5.6	5.9	10.1	10.6	16.4	16.8	19.3	19.7	19.6	+34.2	19.9	+32.6
PBZ 500 ppm + urea 1%	4.5	4.8	7.5	8.0	11.6	12.4	14.7	15.3	14.9	+2.0	15.5	+3.3
PBZ 1000 ppm+urea 1%	3.9	4.2	6.7	6.8	10.7	11.1	13.4	13.6	13.6	-11.0	13.8	-3.8
L.S.D. 0.05	0.8	0.9	1.1	1.3	2.0	1.9	3.0	3.1	3.3	-	3.6	-

* Increase / or decrease in relation to control.

Table (3): Effect of some GA_3 , PBZ and urea foliar spray treatments on area , fresh weight and dry weight of Alphonse mango leaf (2001 / 2002 and 2002 / 2003 seasons).

Foliar spray treatments	Av. leaf area (cm^2)				Av. leaf fresh wt (g)				Av. Leaf dry wt (g)			
	2001/2002		2002/2003		2001/2002		2002/2003		2001/2002		2002/2003	
	cm^2	*+/-%	cm^2	*+/-%	g	*+/-%	g	*+/-%	g	*+/-%	g	*+/-%
Cont. (water)	59.7	-	58.0	-	1.80	-	1.81	-	0.63	-	0.70	-
GA_3 10 ppm	76.7	+28.5	78.7	+35.7	2.47	+37.2	2.55	+40.9	1.10	+74.6	0.99	+41.4
GA_3 20 ppm	86.3	+44.6	85.7	+47.8	2.87	+59.4	2.63	+45.3	1.20	+90.5	1.21	+72.9
PBZ 500ppm	58.0	-2.8	53.0	-8.6	1.77	-1.7	1.74	-3.9	0.67	+6.3	0.61	-12.9
PBZ 1000ppm	57.5	-3.7	51.7	-10.9	1.72	-4.4	1.70	-6.1	0.58	-7.9	0.53	-24.3
Urea 1%	84.3	+41.2	86.0	+48.3	2.60	+44.4	2.69	+48.6	1.27	+101.6	1.21	+72.9
GA_3 10 ppm + urea1%	88.0	+47.4	89.3	+5.0	2.87	+59.4	2.98	+64.6	1.40	+122.2	1.33	+90.0
GA_3 20 ppm + urea1%	89.3	+49.6	91.7	+58.1	3.10	+72.2	3.23	+78.5	1.53	+142.9	1.43	+104.3
PBZ 500 ppm + urea 1%	69.3	+16.1	66.7	+15.0	2.27	+26.1	2.35	+29.8	1.00	+58.7	1.00	+42.9
PBZ 1000 ppm + urea 1%	60.7	+1.8	56.3	-2.9	1.76	-2.2	1.76	-2.8	0.67	+6.3	0.64	-8.6
L.S.D. 0.05	10.5	-	12.3	-	0.19	-	0.22	-	0.16	-	0.13	-

* Increase / or decrease in relation to control.

Table (4): Effect of some GA_3 , PBZ and urea foliar spray treatments on chiorophyll a & b and carotenoides contents (mg/100 g/ f.w.) in leaves of Alphonse mango trees (2001 / 2002 and 2002 / 2003 seasons).

Foliar spray treatments	chlorophyll a				chlorophyll b				Carotenoides			
	2001/2002		2002/2003		2001/2002		2002/2003		2001/2002		2002/2003	
	mg/100 g f.w.	*+/-%	mg/100 g f.w.	*+/-%	mg/100 g f.w.	*+/-%	mg/100 g f.w.	*+/-%	mg/100 g f.w.	*+/-%	mg/100 g f.w.	*+/-%
Cont. (water)	151.6	-	154.0	-	117.0	-	120.1	-	82.5	-	85.6	-
GA_3 10 ppm	156.0	+2.9	158.8	+3.1	119.9	+2.5	122.7	+2.2	79.1	-4.1	78.9	-7.8
GA_3 20 ppm	156.4	+3.2	159.1	+3.3	120.9	+3.3	123.9	+3.2	78.6	-4.7	77.8	-9.1
PBZ 500ppm	151.3	-0.2	152.4	-1.0	116.7	-0.3	119.8	-0.2	83.7	+1.5	86.3	+0.8
PBZ 1000ppm	150.2	-0.9	151.9	-1.4	116.2	-0.7	117.4	-2.2	84.5	+2.4	87.0	+1.6
Urea 1%	156.6	+3.3	160.0	+3.9	121.0	+3.4	125.3	+4.3	77.2	-6.4	77.2	-9.8
GA_3 10 ppm + urea1%	156.9	+3.5	162.5	+5.5	122.5	+4.7	125.9	+4.8	75.5	-85.0	75.4	-11.9
GA_3 20 ppm + urea1%	161.5	+6.5	166.4	+8.1	123.5	+5.6	128.0	+6.6	74.8	-9.3	74.8	-12.6
PBZ 500 ppm + urea 1%	154.1	+1.7	158.2	+2.7	119.3	+2.0	121.9	+1.5	81.2	-1.6	82.3	-3.9
PBZ 1000 ppm +urea 1%	152.2	+0.4	156.1	+1.4	117.9	+0.8	120.7	+0.5	81.9	-0.7	84.2	-1.6
L.S.D. 0.05	N.S	-	N.S	-	N.S	-	N.S	-	N.S	-	N.S	-

* Increase / or decrease in relation to control.

4.Leaf chlorophyll a & b and carotenoids contents

Data in Table (4) reveal that leaf chlorophyll- a content, generally , ranged from 150.2 to 161.5 mg/ 100 g f. w in the first season and from 151.9 to 166.4 mg/100 g. f.w. in the second season, according to treatment. However, no significant differences could be traced among the tested treatments.

The leaf chlorophyll -b content, generally, ranged from 116.2 to 123.5 mg/ 100 g f.w. in the first season and from 117.4 to 128.0 mg/100 g f.w. in the second season, according to treatments. However, differences between treatment did not reach the limit of significance .

The leaf carotenoids content, generally, ranged from 77.2 to 84.5 mg/100 g f.w in the first season, and from 74.8 to 87.0 mg / 100 g f.w. in the second season, according to treatment. However, all tested treatments were statistically equal in this respect.

5.Leaf N, P & K contents

From Table (5) it is clear that leaf nitrogen (N) content, generally, ranged from 1.4 to 1.55 % in the first season and from 1.4 to 1.61 % in the second season. However, the differences between tested treatments were statistically significant only in the first season, when PBZ 1000 ppm + urea 1% revealed higher leaf N % in comparison with the control; the increase was 10.7% . However, in the second season all tested treatments and the control showed statistically equal leaf N contents.

The leaf phosphorus (P) content, generally, ranged from 0.128 to 0.140% in the first season and from 0.125 to 1.43% in the second season without any significant differences between treatments in both seasons.

Leaf potassium (K) content, generally , ranged from 0.7 to1.1% in the first season and from 0.7 to 1.2% in the second season. However, the differences due to tested treatments were statistically significant in the second season only, when the treatments implying PBZ at 1000 ppm (i.e. PBZ 1000 ppm) (alone) and PBZ 1000 ppm + urea) increased K% over the control by 50% . In addition, the treatment of (PBZ 500 ppm + urea) also promoted leaf K % 37.5% in the second season.

Generally, the obtained results cleared significant promotions in shoot length , number of leaves/ shoot, leaf area, fresh & dry weights of the leaf with the treatments of GA_3 10 & 20 ppm + urea 1% . The treatment of GA_3 20 ppm (alone) also revealed a similar trend, but with a lower magnitude. On the other hand all PBZ treatments with / or without urea 1% failed to affect significantly the concerned morphological aspects of leaves and shoots. However, all tested treatments were statistically similar concerning the leaf pigments as well as the leaf N, P & K contents, except for the increments in leaf N % in the first season with PBZ 1000 ppm + urea 1% , and then increase in leaf K % with PBZ 500 & 1000 ppm + urea in the second season.

The promotion in vegetative growth indices by GA_3 treatments was in accordance with Das *et al.*, (1989) who sprayed GA_3 at 50 ppm on limbs of Langra mango trees on mid. June ; the treatment enhanced shoot length , number of leaves per shoot and leaf area.

Table (5): Effect of some GA_3 , PBZ and urea foliar spray treatments on N, P & K contents in leaves of Alphonse mango trees (2001 / 2002 and 2002 / 2003 seasons).

Foliar spray treatments	N (%)				P (%)				K (%)			
	2001/2002		2002/2003		2001/2002		2002/2003		2001/2002		2002/2003	
	mg/100 g f.w.	*	mg/100 g f.w.	*	mg/100 g f.w.	*	mg/100 g f.w.	*	mg/100 g f.w.	*	mg/100 g f.w.	*
Cont. (water)	1.40	-	1.44	-	0.131	-	0.139	-	0.9	-	0.8	-
GA_3 10 ppm	1.48	+5.7	1.45	+0.7	0.139	+6.1	0.143	+2.9	0.8	-11.1	0.8	±0.0
GA_3 20 ppm	1.45	+3.6	1.40	-2.8	0.140	+6.9	0.143	+2.9	0.8	-11.1	0.7	-12.5
PBZ 500ppm	1.52	+8.6	1.57	+9.0	0.134	+2.3	0.128	-7.9	0.9	±0.0	1.0	+25.0
PBZ 1000ppm	1.53	+9.3	1.61	+11.8	0.128	-2.3	0.125	-10.1	1.1	+22.2	1.2	+50.0
Urea 1%	1.44	+2.9	1.44	±0.0	0.137	+4.6	0.140	+0.7	0.7	-22.2	0.8	±0.0
GA_3 10 ppm + urea1%	1.48	+5.7	1.46	+1.4	0.138	+5.3	0.140	+0.7	0.7	-22.2	0.9	+12.5
GA_3 20 ppm + urea1%	1.44	+2.9	1.40	-2.8	0.139	+6.1	0.142	+2.2	0.8	-11.1	0.8	±0.0
PBZ 500 ppm + urea 1%	1.50	+7.1	1.52	+5.6	0.131	±0.0	0.130	-6.5	1.0	+11.1	1.1	+37.5
PBZ 1000 ppm +urea 1%	1.55	+10.7	1.58	+9.7	0.130	-0.8	0.127	-8.6	1.0	+11.1	1.2	+50.0
L.S D. 0.05	0.14	-	0.19	-	N.S	-	N.S	-	N.S.	-	0.2	-

*** N % g/ 100 g dry weight**

Also, Rajput and Singh (1989) sprayed GA_3 (15 & 30 ppm) and urea (3 & 6%) on Dashehari mango trees on 5 & 20 Jan; the treatment increased vegetative growth . In addition , Singh and Rajput (1990) sprayed GA_3 at 50, 100 or 150 ppm on Langra mango trees twice in Feb. and March; the treatments increased shoot length.

Many literature reports indicated that PBZ treatments (as foliar spray and /or soil application) suppressed vegetative growth (Winston, 1992; Burondkar *et al.*, 1993; Nunez-Elisea *et al.*, 1993; Werner and Schaffer , 1993; Salazar and Vazquez, 1997; Perez *et al.*, 2000 ; Phavaphut - Anon *et al.*, 2000 ; Zora *et al.* 2000; Hoda *et al.*, 2001 and Murti *et al.*, 2001). This was not supported by results of the present investigation, which might be due to time of application since most of the available literature reports were concerning PBZ application just prior vegetative flushing or during the following summer months while the present investigation applied PBZ in the fall and winter i.e. about 4-5 months before new flushing.

Generally, the determined shoot and leaf growth parameters, i.e. shoot length number of leaves/ shoot, leaf area and leaf fresh & dry weights, responded positively to treatments implying GA_3 and urea . The most effective were the combined treatments , i.e. GA_3 20 ppm + urea and GA_3 10 ppm + urea which increased shoot length and number of leaves on it by roundly one third (over the control), while increased leaf area by around one half and produced even higher increments in leaf fresh and dry weights. Significant promotions in shoot and leaf growth were also obtained by GA_3 (alone) at both tested concentrations and also by urea (alone). However, the leaf constituents of photosynthetic pigments (chlorophyll -a & b and carotenoides) and the major nutrient elements mostly indicated insignificant responses to all tested treatments.

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أستجابة النمو الخضرى فى الأشجار البالغة للمانجو صنف الفونس لبعض معاملات الرش الورقى لحمض الجبرليك (GA_3) والكلتار (PBZ) واليوريا

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أجريت هذه الدراسة فى موسمين متتاليين (٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣) على أشجار بالغة من المانجو صنف الفونس حيث تم رش الأشجار أربع مرات على فترات شهرية من منتصف أكتوبر حتى منتصف يناير وقد تم أختبار 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%.

وتظهر النتائج زيادة واضحة فى النمو الخضرى (فى صورة زيادة طول الأفرخ ، عدد الأوراق على الفرخ ، مساحة الورقة ، الوزن الطازج والجاف للورقة) نتيجة لكل المعاملات المحتوية على GA_3 أو يوريا أو كليهما وكانت أكثر المعاملات تأثيرا فى هذا المجال هى GA_3 ٢٠ جزء فى المليون + يوريا ١%.

ولم يكن لاى من المعاملات المختبرة تأثيراً واضحاً على محتوى الأوراق من كلوروفيل أ أوكلوروفيل ب أو الكاروتينات وكذلك محتوى الأوراق من الأزوت والفوسفوروالبوتاسيوم بأستثناء زيادة النسبة المئوية للازوت فى الأوراق المعاملة بالكلتار ١٠٠٠ جزء فى المليون + يوريا فى الموسم الأول فقط و زيادة النسبة المئوية للبوتاسيوم فى الأوراق المعاملة بالكلتار ١٠٠٠ جزء فى المليون (باضافة اليوريا أو بدونها) ومعاملة الكلتار ٥٠٠ جزء فى المليون + يوريا ١% وذلك فى الموسم الثانى فقط.