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Effect of Microelements, Amino and Humic Acids on Growth, Flowering and Fruiting of Some Mango Cultivars

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Abstract: This investigation was carried out during two successive seasons 2008/2009 and 2009/2010 on 6 years old trees of two mango cultivars Keitt and Ewais. The trees were grown in sandy soil under drip irrigation system. Treatments of fertilization were: T1: 0.5 g/l Tradecorp AZll, T2: 0.5 g/l Tradecorp AZll + 40 cm/tree Helpstar, T3: 3cm/l Delfan, T4: 3cm/l Delfan + 40 cm/tree Helpstar, T5: 3cm/l Aton AZ plus, T6: 3cm/l Aton AZ plus + 40 cm/tree Helpstar, T7: 40cm/tree Helpstar, T8: control [water spraying]. The results indicated that Kiett and Ewais mango cultivars that sprayed by ½ g/l Tradecorp AZll with 40 cm/tree Helpstar soil supplementation produced the highest number of growth cycle comparing with other treatments used in the two seasons. Also, Kiett mango cultivar sprayed by ½ g/l Tradecorp AZll only or in combined with 40cm/tree Helpstar produced the lowest malformation percentage in the two seasons. Spraying Keitt mango cv. by 3cm/l Aton AZ plus + 40cm/tree Helpstar increased retained fruits percentage in the two seasons. Moreover, spraying ½ g/l Tradecorp AZll + soil supplementation by 40 cm/tree Helpstar significantly increased yield per tree of both cultivars during the study. Adding 40cm/tree Helpstar as soil supplementation only or with spraying 0.5g/l Tradecorp AZll improved weight, length, width, size, firmness of Keitt and Ewais mango fruits, in the two seasons. On the other hand, spraying 0.5g/l Tradecorp AZll with 40 cm/tree Helpstar soil supplementation on Ewais fruits gave the highest TSS and total sugar fruit content and the lowest acidity content comparing with other interactions used in both seasons.

Key words: Aton AZ plus · Delfan, Ewais · Fruiting · Growth · Helpstar · Keitt · Malformation · Mango and Tradecorp AZll

INTRODUCTION

Mango [*Mangifera indica* L.] is one of the most important fruits in the tropical and subtropical regions. In Egypt, the area of mango orchards reached 130000 Ha in 2009, producing about 450000 tons of fruits annually [1]. Many cultivars are grown in Egypt such as Keitt, Ewaise and Sedik and facing many problems i.e., poor fruit set, high fruit drop, irregular bearing, low productivity and malformation disease [2]. Improving yield and quality of mango cvs can be achieved through better cultural practices such as foliar fertilization, which contained some plant nutrition, some of these nutrition are known as micronutrients i.e., Zn, Fe, B, Cu and Mn or amino acids and humic acid that are essential for producing healthy mango trees as well as increasing the productivity of trees. In addition, they are responsible for improving physical and chemical parameters of fruits [3-5].

This research aimed to study the effect of some nutrients [microelements, amino and humic acids] on number of growth cycles, as well as flowering and fruiting of Keitt and Ewais mango cultivars. It also aimed at improving fruit quality of both mango cultivars under study.

MATERIALS AND METHODS

This investigation was carried out through two successive seasons of 2008/2009 and 2009/2010 on forty eight uniform trees in vigor budded Keitt and Ewais mango [*Mangifera indica*.L] trees grown in a sandy soil under drip irrigation system, at a private orchard in Alexandria Desert Road, Egypt. All trees spaced 2X3 meters apart for Keitt and 4X6 meters apart for Ewais mango cultivars.

Eight treatments with three replicates for each replicate were applied on the two cultivars as follows: T1:

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0.5 g/l Tradecorp AZll [complex EDTA, that contained 5% Fe, 2.48% Zn, 3.5% Mn, 1% Cu, 0.65% and 0.3% Mo]; T2: 0.5 g/l Tradecorp AZll + 40 cm/tree Helpstar [containing 12% humic acid, 3% fulvic acid and 16% organic material]; T3: 3cm/l Delfan [containing 10% free amino acids, 4.3% total N, 3% protein, 9% organic arpon and 20% organic matter]; T4: 3cm/l Delfan + 40 cm/tree Helpstar; T5: 3 cm/l Aton AZ plus [containing 5% free amino acids, 10% total N, 0.2% Fe, 5% Zn, 2.5% Mn, 0.1% B and 4% organic C]. T6: 3cm/l Aton AZ plus + 40 cm/tree Helpstar; T7: 40 cm/tree Helpstar; T8: control [sprayed with only distilled water].

All treatments were applied three times: firstly on October 2008, secondly on March 2009 and the third time was on June 2009 in the first season. The treatments were repeated, by the same rank, in the second season. Tradecorp AZll, Delfan and Aton AZ plus treatments were prepared in solution and sprayed on trees. Whereas Helpstar was a soil supplementation treatment.

Ten branches of both Keitt and Ewais mango cultivars were randomly chosen during September 2008 around canopy tree and tagged to record the number of growth cycles at the end of each season during October. Normal and malformation panicles per tree were counted to estimate the percentage of malformation during March of each season for each treatment. Retained fruits were calculated by the following equation:

$$\text{Retained fruits\%} = \frac{\text{Retained fruit number at harvest}}{\text{Initial number fruit set}} \times 100$$

At maturity stage of Keitt and Ewais mango fruits, described by Arafa [6], in both seasons, the yield [Kg/tree] was estimated by multiplying fruits number per tree by average fruit weight. In addition, fruit weight (g) , fruit length (cm), fruit width (cm), fruit size (cm^3), fruit firmness ($lp/inch^2$), fruit TSS (%), fruit acidity (%) and fruit total sugars (%) according to the methods in AOAC [7].

The obtained data were tabulated and statically analyzed according to Complete Randomized Blocks Design [8], using LSD method at 5% levels for identifying the significant differences between means. Cultivars was factor A and treatments factor B. the percentages were transformed to arcsine to find the binomial percentages according to Steel and Torrie [9].

RESULTS AND DISCUSSION

Effect of Microelements, Amino and Humic Acids on Growth Cycles Number of Keitt and Ewais Mango Cultivars: Data presented in Table 1 cleared that Ewais mango cultivar produced higher number of growth cycle than Keitt in the two seasons. Moreover, spraying ½ g/l Tradecorp AZll with soil supplementation by 40 cm/tree Helpstar gave the highest number of growth cycle comparing with other treatments used in the two seasons. Regarding to the interaction between treatments and cultivars, spraying ½g/l Tradecorp AZll with 40cm/tree Helpstar in the soil had improved number of growth cycles for both cultivars comparing with other interactions used. On the other hand, control treatment was the lowest in this respect in the two seasons.

Effect of Microelements, Amino and Humic Acids on Keitt Ewais Mango Malformations Percentage: Tabulated data in Table 2 cleared that, Keitt mango cultivar recorded lower malformations percentage than Ewais cultivar throughout the two seasons with significant differences. Moreover, in the first season, spraying ½g/l Tradecorp AZll + soil supplementation by 40 cm/tree Helpstar significantly decreased malformations percentage to 8.97% comparing with other treatments. On the other side, spraying 3cm/l Aton AZ plus and control treatment had the highest malformations percentage (15.58 and 15.42% respectively). During the second season of the study, control trees followed by treatment of spraying 3cm/l Aton AZ plus recorded the highest percentage of malformation comparing with other treatments used.

Results of the effect of the interaction between treatments and cultivars on malformations percentage revealed that spraying ½g/l Tradecorp AZll decreased malformations percentage of Keitt cultivar comparing with other interaction in the first season. In addition, the same treatment with soil supplementation by 40 cm/tree Helpstar decreased malformations percentage to the lowest value in Keitt cultivar in the second season. These results are agreement with finding of Thakur *et al*. [10]; Hammam *et al*. [11] and Mahrous [12] who stated that the incidence of floral malformation was higher in the untreated mango trees while, it was lowered with that treated by trace elements in Langra, Taimour and Mabrouka mango cultivars.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Retained Fruits (%): Results in Table 3 revealed that Keitt significantly achieved the higher retained fruits percentage than Ewais cv. during the two seasons. In addition, treatment of 3cm/l Delfan + 40cm/tree Helpstar and treatment of 3cm/l Aton AZ plus + 40cm/tree Helpstar significantly increased retained fruits% comparing with other treatments during the first and the second seasons. The effect of interaction

Table 1: Effect of microelements, amino and humic acids on growth cycles number of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	1.60	2.07	1.84	1.71	1.93	1.82
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	2.03	2.50	2.27	1.94	2.23	2.09
3 cm/l Delfan	1.64	2.13	1.89	1.73	2.09	1.91
3 cm/l Delfan + 40 cm/tree Helpstar	1.87	2.37	2.12	1.84	2.16	2.00
3 cm/l Aton AZ plus	1.73	2.29	2.01	1.77	2.03	1.90
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	1.76	2.24	2.00	1.75	2.10	1.93
40 cm/tree Helpstar	1.67	2.17	1.92	1.82	2.05	1.94
Control	1.57	2.03	1.80	1.43	1.90	1.67
Mean	1.73	2.23	-	1.75	2.06	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.60			0.08
Treatment [B]	=		0.11			0.16
A × B	=		0.16			0.22

Table 2: Effect of microelements, amino and humic acids on malformation (%) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	2.98	17.30	10.14	2.25	11.40	6.83
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	3.60	14.33	8.97	2.06	18.09	10.08
3 cm/l Delfan	4.34	15.52	9.93	3.18	20.43	11.81
3 cm/l Delfan + 40 cm/tree Helpstar	3.87	20.03	11.95	3.01	18.97	10.99
3 cm/l Aton AZ plus	6.43	24.73	15.58	4.33	21.03	12.68
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	4.58	22.87	13.73	4.66	15.33	10.00
40 cm/tree Helpstar	5.79	24.68	15.24	3.84	19.00	11.42
Control	6.27	24.57	15.42	6.65	24.03	15.34
Mean	4.73	20.50	-	3.75	18.54	-
LSD value at 0.05 for:						
Cultivar [A]	=		3.12			2.77
Treatment [B]	=		5.32			4.89
A × B	=		11.86			10.12

Table 3: Effect of microelements, amino and humic acids on retained fruits (%) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	66.64	47.72	57.18	72.72	64.91	68.82
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	70.81	54.87	62.84	68.18	59.31	63.75
3 cm/l Delfan	73.01	40.42	56.71	70.42	42.52	56.47
3 cm/l Delfan + 40 cm/tree Helpstar	64.88	61.65	63.27	75.53	47.75	61.64
3 cm/l Aton AZ plus	63.64	35.42	49.53	56.59	54.70	55.65
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	75.02	43.34	59.18	76.92	65.01	70.96
40 cm/tree Helpstar	64.88	53.13	59.01	76.76	40.96	58.86
Control	64.31	43.06	53.69	72.54	49.12	60.83
Mean	67.90	47.45	-	71.21	53.04	-
LSD value at 0.05 for:						
Cultivar [A]	=		3.94			7.14
Treatment [B]	=		7.88			14.72
A × B	=		11.15			20.82

Table 4: Effect of microelements, amino and humic acids on yield (kg/tree) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	11.01	7.56	9.28	16.26	9.80	13.03
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	14.62	9.60	12.11	18.75	12.50	15.63
3 cm/l Delfan	7.41	6.84	7.12	11.67	8.19	9.93
3 cm/l Delfan + 40 cm/tree Helpstar	9.20	7.11	8.15	12.01	9.50	10.76
3 cm/l Aton AZ plus	7.98	7.37	7.68	11.90	9.30	10.60
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	12.60	8.80	10.70	14.66	10.05	12.36
40 cm/tree Helpstar	8.80	6.35	7.57	13.42	9.52	11.47
Control	6.42	4.75	5.59	9.19	7.37	8.28
Mean	9.75	7.30	-	13.48	9.53	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.89			1.42
Treatment [B]	=		1.78			2.85
A × B	=		2.52			4.03

Table 5: Effect of microelements, amino and humic acids on fruit weight (g) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	1177.33	270.67	724.00	1221.67	300.67	761.17
½ g/l Tradecorp AZll + 40cm/tree Helpstar	1294.00	323.00	808.50	1250.00	312.67	781.34
3 cm/l Delfan	1167.33	270.00	718.67	1136.33	276.00	706.17
3 cm/l Delfan + 40 cm/tree Helpstar	1154.00	267.33	710.67	1064.33	307.33	685.83
3 cm/l Aton AZ plus	1136.33	280.33	708.33	1189.00	300.00	744.50
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	1261.67	304.67	783.17	1100.67	290.67	695.67
40 cm/tree Helpstar	1096.00	280.67	688.34	1221.00	284.00	752.50
Control	1064.33	230.33	647.33	950.00	260.67	605.34
Mean	1168.88	278.38		1141.63	291.50	
LSD value at 0.05 for:						
Cultivar [A]	=		6.30			10.12
Treatment [B]	=		13.56			21.28
A × B	=		18.48			29.31

between treatments and cultivars appeared that 3cm/l Aton AZ plus + 40 cm/tree Helpstar during the first and second seasons with Keitt cv. significantly raised the values of retained fruits comparing with other interactions during the study. These results are in line with those of Saleh and El-Monem [13], Dutta [14] and Ranjit *et al*. [15].

Effect of Microelements, Amino and Humic Acids on Yield of Keitt and Ewais Mango: Data in Table 4 cleared that cultivar Keitt recorded significant higher yield per tree than Ewais cultivar throughout 2008/2009 and 2009/2010 seasons. Also, during both seasons, spraying ½g/l Tradecorp AZll + soil supplementation by 40cm/tree Helpstar significantly increased mango tree yield comparing with other treatments and control. Regarding the interaction effect between treatments and cultivars the results cleared that spraying ½g/l Tradecorp AZll + soil supplementation by 40 cm/tree Helpstar significantly increased the yield per tree with Keitt and Ewais cvs. comparing to other interactions used during the study.

These results are in accordance with those obtained by El-Shenawy [16]; Hammam *et al.* [11] and Shinde *et al.* [17]. They indicated that highest yield of mango cvs. Sannianmang, Neelum, Macheso, Taimour, Mabrouka and Alphonso were obtained with trace element formulations Multiplex or spraying urea+Fe+Z+Mn+Cu and/or single or combined applications of B, Cu and NAA.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Weight (G): Data in Table 5 appeared that Keitt fruit weight increased significantly comparing with Ewais cultivar during the two

Table 6: Effect of microelements, amino and humic acids on fruit length (cm) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	17.77	11.23	14.50	18.03	11.47	14.75
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	19.23	11.93	15.58	18.73	12.33	15.53
3 cm/l Delfan	18.50	11.53	15.02	17.93	11.73	14.83
3 cm/l Delfan + 40 cm/tree Helpstar	18.03	11.27	14.65	18.37	11.77	15.07
3 cm/l Aton AZ plus	18.30	11.70	15.00	18.67	11.60	15.14
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	18.40	11.40	14.90	18.17	11.20	14.69
40 cm/tree Helpstar	18.40	11.97	15.19	18.53	12.10	15.32
Control	17.43	10.80	14.12	17.77	11.23	14.50
Mean	18.26	11.48	-	18.28	11.68	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.46			0.39
Treatment [B]	=		0.82			0.68
A × B	=		1.09			1.02

seasons of study. Moreover, spraying ½ g/l Tradecorp AZll + soil supplementation by 40cm/tree Helpstar gave significant increasing in fruit weight comparing with other treatments during the study. Concerning the effect of the interaction between treatments and cultivars, the results appeared that spraying ½g/l Tradecorp AZll + soil supplementation by 40 cm/tree Helpstar with Keitt and Ewais cvs. significantly increased fruit weight comparing to other interactions during the first and second seasons.

These results are in accordance with those obtained by Hammam *et al.* [11]; Ebeed *et al.* [18]; Dutta [14] and Vejendla *et al*. [19]. They found that, mango fruit weight of Dashehari, Himsagar, Fazli, Hindy Bisinnara, Mesk, Mallika and Amrapali cvs. increased with increasing the concentration of trace element foliar application of Fe, Zn, Cu, Mn and B or ascorbic acid.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Length: Table 6 cleared that results of fruit length were significantly affected by different treatments for Keitt and Ewais mango cultivars during the two seasons. Keitt produced higher fruit length than Ewais in the two seasons. Moreover, spraying ½ g/l Tradecorp AZll with soil supplementation by 40 cm/tree Helpstar gave the highest fruit length comparing with other treatments in the study. The interaction between treatments and cultivars cleared that spraying ½g/l Tradecorp AZll with soil supplementation by 40 cm/tree Helpstar had improved fruit length of Keitt in both seasons. Also, treatments of 40cm/tree Helpstar only or with spraying ½g/l Tradecorp AZll improved Ewais fruit length comparing with other interactions in the study.

These results are in line with findings of Banik *et al*. [20] on mango trees cv. Fazli; Dutta and Dhua [21] on mango cv. Fagri Kalan.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Width (cm): Illustrated results in Table 7 showed that fruit width of Keitt and Ewais mango cultivars was significantly affected by different treatments during the two seasons of study. Keitt mango cultivar recorded higher fruit width than Ewais mango cultivar during both seasons. In addition, spraying ½g/l Tradecorp AZll with soil supplementation by 40cm/tree Helpstar increased fruit width in the first season. While in the second season, treatment of 40cm/tree Helpstar had the highest value in this regard.

The interaction between treatments and cultivars cleared that spraying ½g/l Tradecorp AZll with soil supplementation by 40cm/tree Helpstar improved fruit width of Keitt cultivar, while treatment of 3cm/l Delfan and 40cm/tree Helpstar increased fruit width of Ewais cultivar in the first and second seasons comparing with other interactions used. Similar results were obtained by Saleh and El-Monem [13]; Dutta [14] and Ahmed *et al*. [22].

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Size (cm^2): It was noticed from data in Table 8 that fruit size was significantly affected by different treatments during the study for the two cultivars. Keitt mango cultivar had the higher values

Table 7: Effect of microelements, amino and humic acids on fruit width (cm) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	11.17	7.03	9.10	12.17	7.60	9.89
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	12.10	7.53	9.82	12.30	7.53	9.92
3 cm/l Delfan	11.63	7.60	9.62	11.73	7.70	9.72
3 cm/l Delfan + 40 cm/tree Helpstar	11.83	7.23	9.53	11.93	7.00	9.47
3 cm/l Aton AZ plus	11.80	7.53	9.67	11.93	7.23	9.58
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	11.32	7.33	9.33	11.47	7.43	9.45
40 cm/tree Helpstar	11.13	7.43	9.28	12.20	7.97	10.09
Control	10.93	6.80	8.87	11.30	6.93	9.12
Mean	11.49	7.31	-	11.88	7.42	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.29			0.25
Treatment [B]	=		0.49			0.40
A × B	=		0.84			0.70

Table 8: Effect of microelements, amino and humic acids on fruit size (cm^3) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	226.67	128.67	177.67	238.33	131.00	184.67
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	241.67	130.67	186.17	239.33	132.67	186.00
3 cm/l Delfan	225.00	127.33	176.17	230.00	125.00	177.50
3 cm/l Delfan + 40 cm/tree Helpstar	220.00	121.67	170.84	213.33	129.00	171.17
3 cm/l Aton AZ plus	215.00	130.00	172.50	235.00	127.67	181.34
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	240.00	130.00	185.00	225.00	126.67	175.84
40 cm/tree Helpstar	215.00	129.33	172.17	235.00	126.00	180.50
Control	213.33	120.33	166.83	208.33	125.00	166.67
Mean	224.58	127.25	-	228.04	127.88	-
LSD value at 0.05 for:						
Cultivar [A]	=		9.05			8.79
Treatment [B]	=		12.09			11.52
A × B	=		22.59			21.85

of fruit size than Ewais mango cultivar during both seasons. Also, spraying ½g/l Tradecorp AZll with soil supplementation by 40cm/tree Helpstar produced the highest fruit size compared with other treatments during the two seasons. The interaction between treatments and cultivars on fruit size, cleared that spraying ½g/l Tradecorp AZll with soil supplementation by 40 cm/tree Helpstar had significantly increased fruit size for both cultivars during the first and second seasons compared to other interactions used.

These results are in harmony with findings of Jitendra [23] and Hamdy *et al*. [4]. They found that the combination of zinc sulfate, ferrous sulfate, manganese sulfate, boric acid and citric acid recorded the greatest fruit size of mango cvs. Mallika and on Hindy Bisinara. On the other side, Lal and Zora [24] reported that there was no significant increases in fruit size of mango cv. Dusheri with any zinc sulfate treatments.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Firmness (lp/inch²): The obtained results Keitt cv. mango fruit firmness had differed significantly comparing with Ewais cultivar during the two seasons of the study (Table 9). Moreover spraying ½g /l Tradecorp AZll + soil supplementation by 40cm/tree Helpstar increased significantly fruit firmness

Table 9: Effect of microelements, amino and humic acids on fruit firmness (lp/inch²) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	23.00	15.67	19.34	23.00	15.67	19.34
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	25.00	16.00	20.50	23.00	16.00	19.50
3 cm/l Delfan	20.67	10.33	15.50	21.00	11.33	16.17
3 cm/l Delfan + 40 cm/tree Helpstar	21.33	11.00	16.17	22.00	12.33	17.17
3 cm/l Aton AZ plus	21.67	12.33	17.00	22.33	12.33	17.33
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	23.00	13.67	18.34	22.67	13.33	18.00
40 cm/tree Helpstar	22.67	12.33	17.50	22.67	13.33	18.00
Control	20.33	10.67	15.50	21.00	11.67	16.34
Mean	22.21	12.75	-	22.21	13.25	-
LSD value at 0.05 for:						
Cultivar [A]	=		1.31			1.35
Treatment [B]	=		2.61			2.13
A × B	=		3.69			3.81

Table 10: Effect of microelements, amino and humic acids on fruit TSS (%) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	7.55	10.15	8.85	8.05	10.98	9.52
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	8.15	11.02	9.59	8.32	11.32	9.82
3 cm/l Delfan	7.45	10.08	8.77	7.95	10.42	9.19
3 cm/l Delfan + 40 cm/tree Helpstar	7.82	10.95	9.39	8.32	11.25	9.79
3 cm/l Aton AZ plus	7.48	10.42	8.95	7.48	10.88	9.18
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	7.55	10.65	9.10	8.23	11.18	9.71
40 cm/tree Helpstar	7.35	9.48	8.42	7.38	10.48	8.93
Control	6.78	9.35	8.07	7.32	10.35	8.84
Mean	7.52	10.26	-	7.88	10.86	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.51			0.40
Treatment [B]	=		1.01			0.80
A × B	=		1.43			1.14

during the two seasons comparing with other treatments. The interaction between treatments and cultivars on fruit firmness cleared that spraying ½g/l Tradecorp AZll with soil supplementation by 40cm/tree Helpstar had significantly increased fruit firmness for both cultivars during the two seasons compared to other interactions.

In this respect, Mouco *et al*. [5] found that pulp firmness of mango cv. Tommy Atkins was not significantly affected by amino acid applications (0.0, 0.02, 0.04 and 0.06%).

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit TSS (%): Fruit TSS content increased significantly with Ewais than Keitt mango cultivar during the two seasons (Table 10). Moreover, spraying ½g/l Tradecorp AZll + soil supplementation by 40 cm/tree Helpstar gave the highest significant increasing in fruit TSS% comparing with other treatments in both seasons. The interaction between treatments and cultivars on fruit TSS% appeared that adding 40 cm/tree Helpstar with spraying ½g/l Tradecorp AZll produced the highest fruit TSS% of Ewais mango

Table 11: Effect of microelements, amino and humic acids on fruit acidity (%) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	2.80	1.27	2.04	2.83	1.33	2.08
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	2.60	1.13	1.87	2.40	1.13	1.77
3 cm/l Delfan	2.93	1.33	2.13	2.90	1.47	2.19
3 cm/l Delfan + 40 cm/tree Helpstar	2.70	1.17	1.94	2.60	1.24	1.92
3 cm/l Aton AZ plus	2.87	1.28	2.08	2.83	1.43	2.13
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	2.77	1.23	2.00	2.63	1.27	1.95
40 cm/tree Helpstar	3.07	1.37	2.22	2.94	1.48	2.21
Control	3.07	1.53	2.30	3.13	1.57	2.35
Mean	2.85	1.29	-	2.78	1.37	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.15			0.16
Treatment [B]	=		0.30			0.32
A × B	=		0.43			0.45

Table 12: Effect of different fertilization treatments on fruit total sugars (%) of the two mango cultivars during 2008/2009 and 2009/2010 seasons

	2008/2009 Season			2009/2010 Season		
	Cultivar			Cultivar		
Fertilization Treatments	Keitt	Ewais	Mean	Keitt	Ewais	Mean
½ g/l Tradecorp AZll	5.97	8.90	7.44	6.17	9.27	7.72
½ g/l Tradecorp AZll + 40 cm/tree Helpstar	6.67	9.57	8.12	7.47	10.10	8.79
3 cm/l Delfan	5.72	8.70	7.21	5.67	8.57	7.12
3 cm/l Delfan + 40 cm/tree Helpstar	6.33	9.37	7.85	6.47	9.30	7.89
3 cm/l Aton AZ plus	5.90	8.34	7.12	6.20	8.60	7.40
3 cm/l Aton AZ plus + 40 cm/tree Helpstar	6.23	9.17	7.70	6.37	9.17	7.77
40 cm/tree Helpstar	5.83	8.23	7.03	5.43	8.33	6.88
Control	5.27	7.73	6.50	5.20	8.07	6.64
Mean	5.99	8.75	-	6.12	8.93	-
LSD value at 0.05 for:						
Cultivar [A]	=		0.48			0.39
Treatment [B]	=		0.86			0.78
A × B	=		1.36			1.11

cultivars comparing with other treatments in both seasons in this study.

In this respect, Dutta and Dhua [21] found that Zn, Fe and Mn significantly improved the total soluble solids of Himsagar mango fruits. Also, Umesh *et al*. [25] reported that 1% borax caused marked improvement in total soluble solid of Amrapali mango fruits.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Acidity (%): Tabulated data in Table 11 showed that Ewais fruits appeared lower acidity content comparing with Keitt fruits during the study in the two seasons. In addition, spraying ½g/l Tradecorp AZll with soil supplementation by 40cm/tree Helpstar recorded the lowest acidity content in the two seasons. The interaction between treatments and cultivars cleared that, in the two seasons, fruit acidity of Ewais decreased to the lowest values by spraying ½g/l Tradecorp AZll+soil supplementation by 40cm/tree Helpstar comparing to other interactions used.

The above mentioned results are coincided with Dutta and Dhua [21]; Rashmi *et al.* [26] and Vejendla *et al*.

[19]. They reported that spraying Zn, Fe, B, Mn and Cu significantly decreased titratable acidity of Himsagar, Langra and Amrapali mango fruits.

Effect of Microelements, Amino and Humic Acids on Keitt and Ewais Mango Fruit Total Sugar (%): Fruit total sugar (%) of Keitt and Ewais was significantly affected by different treatments in the two seasons (Table 12). Ewais fruits contained the highest total sugar content comparing with Keitt fruits during the study. Moreover, spraying ½g/l Tradecorp AZll with soil supplementation by 40 cm/tree Helpstar gave the highest significant fruit total sugar% comparing with other treatments used in the two seasons. Concerning the effect of the interaction between treatments and cultivars, spraying ½g/l Tradecorp AZll with soil supplementation by 40cm/tree Helpstar with Ewais fruits recorded the highest total sugar percentage in both seasons comparing to other interactions used in this study.

These results are in line with those findings of Hammam *et al*. [11]; Dutta and Dhua [21]; Rashmi *et al*. [26] and Vejendla *et al*. [19]. They found that, fruits of mango cvs. Dashehari, Hindi Be-Sinnara and Taimour, Mabrouka, Himsagar, Langra and Amrapali fruits contained the highest total sugar content that sprayed by single or combined applications of different trace element foliar such as Zn, Fe, Mn, B and Cu.

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