Journal of Horticultural Science & Ornamental Plants 8 (1): 11-18, 2016
ISSN 2079-2158

DOI: 10.5829/idosi.jhsop.2016.8.1.1169

Enhancing Vegetative Growth of Young Mango Transplants *via* GA_3 and Humic Acid

M.A. El Kheshin

Department of pomology, Faculty of Agriculture, Cairo University, Giza, Egypt

Abstract: This study was carried out during two successive seasons 2013-2014 on young mango transplants of Keitt mango cultivar, to evaluate the effect of GA_3 and humic acid treatments alone or together GA_3 applied at the fourth week of March while humic acid were applied as soil application in two equal doses at the first week of April and the first week of July on vegetative growth of these treated transplants. Nine treatments of GA_3 at 75 ppm, GA_3 at 125 ppm, humic acid at 75 ml/treatments /season, humic acid at 150 ml/transplant/season, GA_3 at 75 ppm with humic acid at 75 ml/transplant/season, GA_3 at 75 ppm with humic acid at 150ml/transplant/ season, GA_3 at 125 ppm with humic acid at 75ml/transplant/season, GA_3 at 125 ppm with humic acid at 150 ml/transplant/season and control transplants (non- treated). Results indicated that application of GA_3 at 125 ppm with humic acid at 150 ml/transplant/season increased leaves number per shoot significantly. On the other hand all the interaction treatments increased flushes number per shoot with significant difference comparing to use both of GA_3 or humic acid alone. Application of GA_3 at 125 ppm increased leaf area significantly comparing to the other treatments. Numbers of shoots per transplant and trunk diameter increasing rate were increased significantly comparing to the other treatments by application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season. Moreover application of GA_3at 125 ppm with humic acid at 150 ml/transplant/season significantly increased flush length. Application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season was recorded the highest nitrogen, phosphorus, potassium, calcium and magnesium content in the leaves with significant difference. Also application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season increased the total sugars content in leaves of transplant with significant difference.

Key words: Mango · Keitt · Vegetative growth · GA_3 · Humic acid

INTRODUCTION

Mango (*Mangifera indica*) is considered one of the most important tropical and subtropical fruits in all over the world [1]. Egypt is considered one of the most important producers of mango in the Middle East. Moreover under Egyptian conditions there are many cultivars planted such as Ewais, Sedik and Zebda etc. in the last ten years there were many new mango cultivars start to be planted such as Keitt, Kent and Tommy Atkins.These new cultivars are considered very promising under reclaimed lands, they have a good yield more than old cultivars but these cultivars suffer from limitedvegetative growth in its early years. GA_3applied increases vegetative flushes leading to an increase in shoot length [2].Also GA_3applications increase positively shoots length, number of leaves and leaf area. Application of GA_3 at 20 or 40 ppm on mango trees cv. Sukkary Abiad under Egyptians conditions increased significantly shoot length, number of leaves per shoot and leaf area [3]. The role of GA3 in delaying bud break in mango is not known, but it is proposed that it may enhance or maintain the synthesis of endogenous auxin. It thereby maintains a high auxin / cytokinin ratio similar to response to GA_3that maintain apical dominance in other plant species [4].Nitrogen and potassium content in leaves significantly increased with GA_3application in mango trees [3].Improving vegetative growth for new mango cultivars transplants can be achieved through better cultural practices such as $GA_3$and humic acid applications, these applications are essential for producing healthy mango trees. In addition, they are responsible for improving productivity of new leaves and new flushes. Humic acid is complex substances derived from organic mater decomposition. Agricultural humic acid is reputed to enhance nutrient uptake, drought tolerance, seed germination and overall plant performance [5, 6]. Exogenously applied gibberellic acid (GA_3) delays initiation of bud break but does not determine whether the resulting flush of growth is vegetative or reproductive [7].

Corresponding Author: M.A. El Kheshin, Department of Pomology, Faculty of Agriculture, Cairo University, Giza, Egypt.

Humic acid application on mango trees induce its ability on uptake the elements which increase the vegetative growth such as number of leaves, leaves area and shoot length, also humic acid application increase flowering and fruiting attributes [5]. The combined effects of humic acid and GA_3 on mango transplants are not enough studied. This investigation aimed to study the effect of GA_3 and humic acid alone or together on enhancing vegetative growth of transplants of mango Keitt cultivar under Egyptian conditions.

MATERIALS AND METHODS

The present trail was conducted throughout two successive seasons of 2013-2014 on transplants mango cv. Keitt grafted on Sukkary rootstocks. These transplants were planted in September of 2012 in private orchard at Orabby region, Cairo-Ismailia desert road in a sandy soil at 3x3 meters apart. All investigated transplants received the same cultural practices. 270 transplants were chosen for this investigation, Keitt transplants were uniform as much as possible in year of 2013 and the same transplants were received the same treatments in the second season (2014). GA_3 were sprayed one time at the fourth week of March with three concentrations 0, 75 and 125 ppm, while humic acid were applied by two equal doses in two times at the first week of April and the first week of July with three doses 0 ml/ transplants/ season, 75 ml/ transplants/ season and 150 ml/ transplants/ season. Each treatment included 30 transplants, each 10 transplants as a replicate; five of them were used for morphological assessment and the other five transplants for chemical analysis. This investigation comprised the following treatments:

- Control (sprayed with water only in the same time of the other treatments)
- GA_3 at 75 ppm
- GA_3 at 125 ppm
- Humic acid at 75 ml/ transplant/ season
- Humic acid at 150 ml/ transplant/ season
- GA_3 at 75 ppm + Humic acid at 75 ml/ transplant/ season
- GA_3 at 75 ppm + Humic acid at 150 ml/ transplant/ season
- GA_3 at 125 ppm + Humic acid at 75 ml/ transplant/ season
- GA_3 at 125 ppm + Humic acid at 125 ml/ transplant/ season

The following attributes were measured:

Trunk diameter increase (cm): it was measured using avenging caliber in the end of each season.

Leaves area (cm^2) was measured by using 10 leaves from each replicateat the end of the season.

Number of leaves per shoot was determined with accounting the leaves for each shoot in the end of season.

Number of flushes per shoot was recorded at the end of the season.

Average flush length (cm) was carried out in November.

Number of shoots per tree was accounting at the end of vegetative growth in November.

Leaf mineral content:

Ten leaves were taken from each replicate from the fourth or fifth apical leaves at the end of vegetative growth in the third week of November. The samples were washed, dried, grounded and digested using sulphoric acid and hydrogen peroxide according to Chapman and Pratt [8].

N, P, K and Ca were determined in the digested solution as follows:

Total nitrogen was determined using the micro Keldahal method as described by Pregl [9].

Phosphorus was estimated calorimetrically by the stannous chloride method according to Truog and Meyer [10].

Potassium content was determined by flame photometer according to method of Jackson [11].

Calcium content was determined by titration against verse ate solution (Na- EDTA) according to Chapman and Pratt [8].

Mg content was determined according to Temminghoff and Houba [12].

Total sugars were determined according to Sadasivam and Manickam [13].

Analysis of variance: data were subjected to a normal analysis of variance of the randomized complete block design (RCBD) according to Snedecor and Cochran [14] for each season and over season if the homogeneity test was not significantly differenced; (LSD) at 0.05 was used to detect significance between treatments.

RESULTS AND DISCUSSION

Leaves Number/ Shoot: Results in Table (1) proved that both applications of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season and GA_3 at 125 ppm with humic acid at 150 ml/transplant/season were achieved the highest leaves number per shoot significantly comparing to the other treatments, moreover control transplants were

Table 1: Effect of GA_3, humic acid and interaction between GA_3 and humic acid on leaves number per shoot, flushes number per shoot and leaf area of Keitt mango cultivar seasons 2013 and 2014

Treatments	Leaves number / shoot		Flushes number / shoot		Leaf area (cm^2)	
	2013	2014	2013	2014	2013	2014
Control	15.36 e	13.90 g	1.83 d	1.74 e	83.23 d	84.15 f
$GA_3$75ppm	20.40 d	18.73.f	2.33 bc	233 d	100.16 b	98.61 c
$GA_3$125ppm	26.62 c	23.20 e	2.27 c	2.39 d	107.14 a	107.26 a
Humic acid 75 ml/transplant/season	27.62 c	25.53 d	2.53 ab	2.59 c	83.83 d	85.12 ef
Humic acid 150 ml/ transplant /season	29.48 b	27.63 c	2.67 a	2.64 bc	81.23 e	83.91 f
$GA_3$75ppm+ Humic acid 75 ml/ transplant /season	26.27 c	25.90 d	2.53 ab	2.62 bc	87.96 c	87.44 de
$GA_3$75ppm+ Humic acid 150 ml/ transplant /season	31.15 a	30.33 b	2.77 a	2.61 c	89.36 c	89.66 d
$GA_3$125ppm+ Humic acid 75 ml/ transplant /season	27.02 c	26.20 d	2.57 ab	2.81 a	101.16 b	101.90 b
$GA_3$125ppm+ Humic acid 150 ml/ transplant /season	32.31 a	33.40 a	2.63 a	2.75 ab	99.89 b	101.12 bc

Values shown are average and standard deviation, within each column; different letters indicate significant difference according to means of multiple Duncan range tests (p at 0.05)

recorded the lowest leaves number per shoot with significant difference in the first season. In the second season only application by GA_3 at 125 ppm with humic acid at 150 ml/transplant/season was recorded the highest significantly leaves number per shoot, followed by application with GA_3 at 75ppm with humic acid at 150 ml/transplant/season, also the other treatments were recorded the same line which found in the first season. From the previous results it is clear that interaction between both concentrations of GA_3 and humic acid at the highest concentration only were recorded the highest leaves number, these results may related to the positive effect of GA_3 which increased number of leaves [3]. Also humic acid may enhance positively the transplants ability for nutrient up take which led to produce healthy mango transplants which reflect to increase number of leaves as a natural result for healthy transplants. Moreover Wang *et al*. [15] confirmed that humic acid application on citrus treessignificantly increased leaves number per shoot.

Flushes Number / Shoot: As mention in Table (1) it was cleared that control transplants in the first season were recorded the lowest flushes number per shoot comparing to the other treatments with significant difference, also application of GA_3 at 75 ppm and 125 ppm significantly decreased number of flushes per shoot comparing to the other treatments but more than control transplants, on the other hand application of humic acid increased flushes number, also all interactions between GA_3 and humic acid increased significantly number of flushes per shoot. In the second season application of GA_3 at 125 ppm with both concentrations of humic acid was recorded the highest number of flushes per shoot with significant difference. These differences between first season and second season may relate to the accumulative effect of humic acid in the first and second season. The interaction between GA_3 at 125 ppm and humic acid was recorded the highest flushes number in both seasons, also explanation of results agree with those recorded by Davenport *et al*. [7] who reported that GA_3 had no effect on resulting flushes of mango transplants, so it most probably that this increasing in flushes number per shoot related to humic acid effect more than GA_3 effect, but the interaction between them highlights the former results, because of application of humic acid alone and GA_3 alone increased significantly flushes number, but the interactions recorded the highest values. According to increasing flushes number it reflect on increasing leaves number so application of GA_3 at 125 ppm with humic acid at 150 ml/transplant/season increased flushes number which led to increased leaves number.

Leaf Area (cm^2): As shown in Table (1) it was cleared that high concentration of GA_3 recorded the biggest leaf area in both seasons comparing to the other treatments, while control transplants in the first season were recorded the smallest leaf area, while in the second season control transplants and humic acid applications recorded the smallest leaf area. These results were in harmony with those found by Wahdan *et al*. [3] who reported that application of GA_3alonesignificantly increased leaf area. On the other hand the former results did not agree with Pablo Morales and William [5] how found that humic acid applications on papaya plants induce its ability on up take the elements which increased the vegetative growth such as leaf area. Moreover interaction applications between GA_3 and humic acid increased leaf area but application of high concentration of GA_3 was recorded the highest value which explains that interaction between GA_3 and humic acid not affect on this criterion. Also Wang *et al*. [15] reported that transplants of citrus medica which subjected to humic acid application showed that leaf area was significantly higher than those un-treated with humic acid.

Number of Shoots/Transplant: Results presented in Table (2) cleared that application of GA_3 at 75ppm with humic acid at 150 ml/transplant/season recorded the highest shoots number per transplant with significant difference, on the other hand control transplants recorded the lowest shoots number per transplant with significant difference. Moreover humic acid application regardless the concentration increased this criterion significantly comparing to GA_3 applications in the first season. Results of the second season were in the same line with those recorded in the first season, which confirm that. Humic acid and GA_3 alone increased this criteria and the interaction between them achieved highest increase of shoots number per transplant, with continue applications on transplants. The previous results was confirmed by Wahdan *et al*. [3] who reported that application of GA_3increased shoots number with significant difference, while Pablo Morales and William [5] pointed out that humic acid applications increased significantly number of shoots per transplant. Moreover increasing shoots number may reflect to increase leaves number, while the promising interaction between GA_3 and humic acid was achieved the highest number which increased leaves number, also this interaction caused to enhance vegetative growth of transplant more than application of GA_3 or humic acid alone.

Flush Length (cm): Data in Table (2) indicated that control transplants were recorded the lowest flush length comparing to the other treatments. On the other hand interaction between GA_3 and humic acid increased positively flush length with significant difference, but application of GA_3 at 125 ppm with humic acid at 150 ml/transplant/season was recorded the highest flush length with significant difference comparing to the other treatment in the first season. Results in the second season confirmed the previous results. These results were in agreed with those recorded by Wahdan *et al*. [3] who reported that exogenous application of GA_3 support and enhance vegetative growth of mango trees. Also Webb and Biggs [16] pointed out that humate resulted in citrus trees increased flushes number and extend of growth flushes. Application of GA_3 and humic acid alone increased flush length as reported in a previous results, but the interaction between them did not indicates before, these interaction applications enhance this criteria significantly more than use both of GA_3 and humic acid alone.

Trunk Diameter Increase (cm): Results in Table (2) reveled that application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season significantly increased transplant diameter in the first season. Also it was noted that GA_3 application alone decreased significantly transplants diameter compared to control transplants. Moreover humic acid applications by both concentrations increased this criterion with significant difference compared to control transplants and GA_3 applications. Results of second season confirmed those recorded in the first season. The previous results indicated that GA_3 had a negative effect on diameter transplants, thus GA_3 applications led to enhance elongation of shoots with decreasing the diameter, while application of humic acid did not affective too much on shoots elongation but humic acid applications had a positive effect on enhancing diameter, moreover use the interaction between GA_3 and humic acid had an advantage of each substance which led to improved transplant vegetative growth, this point achieved by interaction between them, thus increased shoot length, number of leaves, leaves area and transplant diameter. So it is very promising treatment which combined between advantage of $GA_3$and humic acid.

Nitrogen %: Data presented in Table (3) cleared that all applications of GA_3 and humic acid alone or together increased nitrogen level in the transplants leaves with significant difference comparing to control transplants in the first season. Also it was clear that humic acid applications increased significantly nitrogen level more than GA_3 applications. While the combine between GA_3 and humic acid was more effective than use both of them alone. Also application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season recorded the highest level of nitrogen in the leaves comparing to the other combinations with significant difference. The same trends of results were detected in the second season. Humic acid applications raised the ability of transplants for up take nitration [17].

GA_3 applications increased level of nitrogen in the leaves. So interaction between them may be a direct reason for increasing nitrogen level, thus leaf nitrogen level induce vegetative flushes of growth, mango trees promoted for vegetative growth when the level of nitrogen more than 1.4 [4]. So the interaction between GA_3

Table 2: Effect of GA_3, humic acid and interaction between GA_3 and humic acid on number of shoots per transplant, flush length (cm) and Trunk diameter (cm) rate of Keitt mango cultivar seasons 2013 and 2014

	NO. of shoots/transplant		AV. Flush length (cm)		Trunk diameter increase (cm)	
Treatments	2013	2014	2013	2014	2013	2014
Control	16.70 f	65.13 h	21.90 f	22.90 g	7.91 f	12.13 ef
GA_3 75ppm	18.63 e	72.26 g	26.77 e	26.71 f	6.57 g	10.59 g
GA_3 125ppm	19.57 e	78.10 f	32.53 b	31.23 bc	6.32 h	9.44 h
Humic acid 75 ml/transplant/season	27.00 d	86.56 e	27.83 de	28.77 e	8.92 e	13.50 d
Humic acid 150 ml/ transplant /season	35.73 c	96.50 d	28.67 cd	29.76 de	9.27 d	16.14 b
GA3 75ppm+ Humic acid 75 ml/ transplant /season	37.17 c	108.03 c	27.57 de	28.45 e	10.63 b	14.60 c
$GA_3$75ppm+ Humic acid 150 ml/ transplant /season	48.47 a	166.80 a	31.60 b	32.33 b	12.11 a	16.86 a
$GA_3$125ppm+ Humic acid 75 ml/ transplant /season	36.60 c	108.17 c	29.97 c	30.61 cd	9.62 c	11.98 f
$GA_3$125ppm+ Humic acid 150 ml/ transplant /season	45.47 b	139.33 b	34.93 a	34.60 a	10.76.b	12.30 e

Values shown are average and standard deviation, within each column; different letters indicate significant difference according to means of multiple Duncan range tests (*p* at 0.05)

Table 3: Effect of GA_3, humic acid and interaction between GA_3 and humic acid on nitrogen, phosphorus and potassium content of Keitt mango cultivar seasons 2013 and 2014

	N%		P%		K%	
Treatments	2013	2014	2013	2014	2013	2014
Control	1.49 g	1.64 h	0.103 f	0.113 h	0.39 i	0.57 g
$GA_3$75ppm	1.57 f	1.75 g	0.115 e	0.124 g	0.46 h	0.61 f
$GA_3$125ppm	1.68 e	1.79 f	0.115 e	0.125 f	0.48 g	0.60 f
Humic acid 75 ml/transplant/season	1.73 d	1.87 e	0.123 d	0.135 e	0.54 f	0.71 e
Humic acid 150 ml/ transplant /season	1.81 c	2.03 d	0.126 c	0.139 d	0.59 e	0.77 d
$GA_3$75ppm+ Humic acid 75 ml/ transplant /season	1.84 bc	2.32 b	0.131 b	0.153 b	0.66 c	0.84 c
$GA_3$75ppm+ Humic acid 150 ml/ transplant /season	1.95 a	2.46 a	0.137 a	0.159 a	0.74 a	0.91 a
$GA_3$125ppm+ Humic acid 75 ml/ transplant /season	1.87 b	2.28 c	0.122 d	0.153 b	0.64 d	0.84 c
$GA_3$125ppm+ Humic acid 150 ml/ transplant /season	1.81 c	2.32 b	0.125 c	0.145 c	0.69 b	0.87 b

Values shown are average and standard deviation, within each column; different letters indicate significant difference according to means of multiple Duncan range tests (p at 0.05)

and humic acid increase this level more than 1.8 which means reflections of increasing vegetative growth. More over Moshtaghi *et al*. [18] found that interaction application between GA_3 and humic acid increased significantly the content of nitrogen in the leaves of Olive cuttings. Also our results are in harmony with those reported by Barakat *et al*. [19] who cleared that humic acid improved leaves nutritional status through increasing their contents of nitrogen.

Phosphorus %: It is evident from Table (3) that application of GA_3 and humic acid alone in the first season raised phosphorus content in the leaves with significant difference comparing to control transplants. Also humic acid application increased this contentsignificantly comparing to GA_3applications. While interaction between GA_3 and humic acid was binary application for increasing phosphorus, also application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season increased phosphorus level in leaves with significant difference comparing to control transplants and the other combinations treatments. Increasing in phosphorus level of the leaves may due to humic acid improvement of transplants up take the elements which explain the increasing in phosphorus level in the leaves. Until now the role of GA_3 in increasing phosphorus contentunknown so this increase may be related to the interaction between GA_3 and humic acid, which was better than use each of them alone. Moreover, Abd El- Razek *et al*. [20] reported that humic acid applications increased significantly Phosphorus content in the leaves of florida prince peach tree, meanwhile, humic acid concentrations increased this level, the beneficial effect of humic acid on increase uptake of different nutrients and availability of soil nutrients particularly in calcareous soil, as a result to use humic acid, uptake of Phosphorus were increased and reflected surely on stimulating nutritional status of the trees which improved vegetative growth. Also El-Shazly and Mustafa [21] confirmed that potassium humate at (20gm) increased Phosphorus content in the leaves of Washington Navel orange, the role of humic in enhancing leaves content of Phosphorus could be attributed to its effect in increasing root vitality, improving nutrient uptake.

Potassium %: According to Table (3) it was cleared that control transplants were recorded the lowest potassium content in the leaves in the first season compared to the other treatments. Moreover all humic acid applications alone recorded potassium level more than GA_3 applications with significant difference. Also all interaction applications between GA_3 and humic acid improved this level more than GA_3 or humic acid alone, these interaction application increased potassium content significantly. Application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season recorded the highest potassium level in the leaves compared to all treatments with significant difference. In the second season the same line of results was observed. The increasing in potassium level in the leaves may relate to humic acid which enhances the ability of transplants on uptake elements and its role in increasing the element level in the plant. Also there was no clear relation between GA_3 application and increasing in potassium level, but the binary application of humic acid with GA3 enhances the potassium level in the leaves. These results were confirmed by Hassan *et al*. [22] who reported that Olive young trees which treated by humic acid and microelements increased significantly the level of potassium content in the leaves comparing to those treated by GA_3 and microelements. In this respect Stevenson [23] reported that positive action of humic acid on plant growth is attributed to increase water holding capacity, increase drought resistance, enhance aeration of soil, cheated nutrients, increase percentage of potassium in soil and increase buffering properties of soil.

Calcium %: As revealed in Table (4) in the first season it was noted that control transplants were recorded the lowest calcium level in the leaves with significant difference, while GA_3 applications alone increased this level more than control transplants significantly but less than humic acid applications with significant difference. The interaction between GA_3 and humic acid increased this criterion with significant difference compared to use both of GA_3 and humic acid alone. Application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season recorded the highest calcium content in the leaves with significant difference comparing to the other treatments. On the other hand these results were confirmed by the results of the second season. From the previous results it was cleared that the effect of humic acid by influential with GA_3 than use it alone, while the role of GA_3 in increasing calcium content in the leaves was not clear until now, moreover there is no previous researches explains the role of GA_3 in this criterion, but the role of humic acid can explains as its ability for increasing elements uptake from the soil as mention before which reflect on increasing level of calcium by humic acid applications, may be use GA_3 with humic acid raised elements uptake more than use humic acid alone. In vegetative cycle low concentration of calcium may limit their stature growth. These results confirmed by El-Shazly and Mustafa [21] who reported that potassium humate at (20gm) increased calcium content in the leaves of Washington Navel orange comparing to control trees, the role of humic in enhancing leaves content of calcium could be attributed to its effect in increasing root vitality, improving nutrient uptake.

Magnesium %: As shown in Table (4) it was cleared that GA_3 concentrations raised magnesium content in the leaves more than control transplants with significant difference in the first season, but humic acid applications increased this content significantly compared to GA_3applications. All interaction applications raised magnesium content significantly, moreover application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season recorded the highest magnesium level comparing to the other interactions with significant difference. GA_3 has a slight effect on this criterion, while humic acid has an influential effect on Mg content, moreover the combination between GA_3 and humic acid gave the very influential effect on this criterion, this increasing in magnesium level may relate to the combined influence between them. Increasing in magnesium level may reflect on increasing vegetative growth. Moreover the low endogenous concentration led to decrease the spread of transplants roots which reflect on decreasing the strength of vegetative growth, also the low content of magnesium led to decrease uptake of nutrients and water. The former results are in the same line with those reported by Shaaban *et al*. [24] who cleared that treated of humic acid on apricot increased magnesium content in the leaves significantly. Also Shaddad *et al*. [25] confirmed these results.

Total Sugars %: Results in Table (4) cleared that control transplants recorded the lowest total sugars in leaves compared to the other treatments with significant difference, moreover GA_3 applications alone increased this criterion in the first season significantly compared to

Table 4: Effect of GA_3, humic acid and interaction between GA_3 and humic acid on calcium percentage, magnesium percentage and total sugars percentage of Keitt mango cultivar seasons 2013 and 2014

	Ca %		Mg %		Total sugars%	
Treatments	2013	2014	2013	2014	2013	2014
Control	2.42 h	2.71 h	0.21 f	0.24 d	11.48 f	12.66 h
$GA_3$75ppm	2.67 g	2.89 g	0.19 g	0.24 d	11.82 e	13.09 g
$GA_3$125ppm	2.71 g	2.90 g	0.21 f	o.25 d	11.93 e	13.25 f
Humic acid 75 ml/transplant/season	2.98 f	3.28 f	0.24 e	0.27 c	12.89 d	15.13 e
Humic acid 150 ml/ transplant /season	3.10 e	3.62 b	0.26 d	0.29 c	13.84 c	15.88 c
$GA_3$75ppm+ Humic acid 75 ml/ transplant /season	3.45 c	3.90 b	0.28 c	0.32 b	13.71 c	15.61 d
$GA_3$75ppm+ Humic acid 150 ml/ transplant /season	3.90 a	4.20 a	0.31 a	0.54 a	15.80 a	18.40 a
$GA_3$125ppm+ Humic acid 75 ml/ transplant /season	3.23 d	3.53 e	0.28 c	0.32 b	13.78 c	15.67 d
$GA_3$125ppm+ Humic acid 150 ml/ transplant /season	3.56 b	3.78 c	0.29 b	0.33 b	14.82 b	16.58 b

Values shown are average and standard deviation, within each column; different letters indicate significant difference according to means of multiple Duncan range tests (p at 0.05)

control transplants, but humic acid alone increased total sugars content significantly. The interaction between GA_3 and humic acid increased total sugars content comparing to use GA_3 or humic acid alone with significant difference. On the other hand application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season was recorded the highest total sugars content with significant difference. In the second season the same line of results observed. From the previous results it was cleared that increasing in nitrogen, phosphorus, potassium, magnesium and calcium may becorrelated with increasing in total sugars in the leaves. Also there is no information about the single role of GA_3 on this criterion but the combination between GA_3 and humic acid had a trusted relationship on this criterion.

CONCLUSION

It could be concluded that application of GA_3 at 75 ppm with humic acid at 150 ml/transplant/season is considered a superior application to enhance the vegetative growth especially with the cultivars which suffered from weakness on vegetative growth such as Keitt mango cultivar.

REFERENCES

1. Nave, P.S., C.S. Malhi and R.C. Sharma, 2005. Effect of foliar feeding of N, P and K on vegetative and fruiting characters of mango cv. Dusehri. International conference on mango and Date palm: culture and Export 20th to 23th June 2005, university of Agriculture, Faisalabad, pp: 27-31.
2. Das, G.S., S.C. Sahoo and D.P. Ray, 1989. Studies on effect of gibberellic acid and urea either alone or in combination of the growth and flowering behavior of on and off year shoots in Langara mango. Acta Hort., 231: 495-499.
3. Wahdan, M.T., S.E. Habib, M.A. Bassal and E.M. Qaoud, 2011. Effect of some chemicals on growth, fruiting, yield and fruit quality of Succary Abiad mango cv. Journal of American Science, 7(2): 651-658.
4. Davenport, T.L., 2003. Management of flowering in three tropical and subtropical fruit tree species. HortScience, 38: 1331-1335.
5. Pablo Morales, J.P. and M.S. William, 2003. Effect of substrates, Boron and humic acid on the growth of papaya transplant. Proc. Fla. State Hort. Soc., 116: 28-30.
6. Sánchez-Andréu, J., J. Jordá and M. Juárez, 1994. Humic substances: Incidence on crop fertility. Acta Hort., 357: 303-316.
7. Davenport, T.L., D.W. Pearce and S.B. Rood, 2000. Correlation of endogenous gibberellic acid with initiation of mango shoots growth. Journal plant Growth Regul., 19: 445-452.
8. Chapman, H.D. and P.F. Pratt, 1961. Methods of Analysis for soil, Plant and Waters. University of California, Division of Agriculture Science.
9. Pregl, F., 1945. Quantities organic micro analysis 4th Ed. J. A. Churchill Ltd., London, pp: 126.
10. Truog, E. and A.H. Meyer, 1929.Improvement in the denige? s colorimetric method for phosphorus and arsenic. Eng. Anal. Ed, 1: 481-488.
11. Jackson, M.L., 1958. Soil Chemical Analysis, Prentice-Hall, Inc. Englewood Cliffs, New Jersey.
12. Temminghoff, E.J.M. and J.G.V. Houba, 2004. Plant Analysis Procedures Second Edition. Wageninger University, pp: 179.
13. Sadasivam, S. and A. Manickam, 1996. Biochemical methods, 2nd edn. New Age International (P) Ltd., Publishers, New Delhi, ISBN8-0976-224-81.

14. Snedecor, G.W. and W.G. Cochran, 1967. Statical methods. 6th Ed., Iowa State Univ., Press, Ames, Iowa, USA.
15. Wang, L.L., X.M. Chen, Y.Y. Dang and H.F. Lu, 2010. Effect of humic acid on the growth and quality of citrus medica. Acta Agriculture Zhejiangensis, 22: 229-233.
16. Webb, P.G. and R.H. Biggs, 1988. Effect of humate amended soils on the growth of citrus. Proc. Fla. State Hort. Soc., 101: 23-25.
17. El-Kosary, S., I.E. El-Shenawy and S.I. Radwan, 2011. Effect of microelements, amino and humic acids on growth, flowering and fruiting of some mango cultivars. Journal of Horticultural Science and Ornamental Plants, 3(2): 152-161.
18. Moshtaghi, E.M., J.A.T. Da Silva and A.R. Shahssavar, 2011. Effect of foliar application of humic acid and gibberellic acid on mist-rooted olive cuttings. Fruit, vegetable and cereal science and Biotechnology, 5: 76-79.
19. Baraka, M.R., T.A. Yehia and B.M. Sayed, 2012. Response of Newhall navel orange to bio-organic fertilization under newly reclaimed area conditions. Đ: vegetative growth and nutritional status. Journal of Horticultural Science and Ornamental Plants, 4(1): 18-25.
20. Abd El-Razek, E., A.S.E. Abd-allah and M.M.S. Saleh, 2012. Yield and fruit quality of Florida prince peach trees as affected by foliar and soil applications of humic acid. Journal of Applied Sciences Research, 8(12): 5724-5729.
21. El-Shazly, S.M. and N.S. Mustafa, 2013. Enhancement yield, fruit quality and nutritional status of Washington navel orange trees by application of biostimulants. Journal of Applied Sciences Research, 9(8): 5030-5034.
22. Hassan, H.S.A., L.F. Hagag, M. Abou-Rawush, H. El-Wakeel and A.Abdel-Galel, 2010. Response of Kalamata olive young trees to mineral, organic nitrogen fertilization and some other treatments. Journal of American Science, 6(12): 338-343.
23. Stevenson, F.J., 1982. Humic chemistry, genesis, composition and reaction.2th Ed., Wily, New York.
24. Shaban, F.K.M., M.M. Morsey and Sh.M. Mahmoud, 2015. Influence of spraying yeast extract and humic acid on fruit maturity stage and storability of Canino apricot fruits. International Journal of Chemtech Research. 8(6): 530-543.
25. Shadded, G., A. Khalil and M.A. Fathi, 2005. Improving growth, yield and fruit quality of canino apricot by using bio mineral and humate fertilizers. Minufiy. J. Agric. Res., 30: 317-328.