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EFFECT OF USING ORGANIC AND BIOFERTILIZERS ON GROWTH, YIELD AND FRUIT QUALITY OF "ANNA" APPLE TREES

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ABSTRACT

This investigation was undertaken to study the effects of different soil application of some biostimulants fertilizers on some vegetative growth, fruiting parameters and fruit quality as well as leaf nutrient content of "Anna" apple trees budded on MM106 rootstock grown under El-Kanater Horticultural Research Station conditions during 2013 and 2014 consecutive seasons.

The obtained data displayed obviously that all treatments in this study resulted in a positive increase in all investigated vegetative growth measurements i.e., shoot length, number of leaves/shoot, leaf dry weight and leaf area. Furthermore, fruiting parameters (fruit set %, tree yield in kg and yield increment (%) in relation to the control) were increased when trees treated with all studied treatments in the two experimental seasons. Moreover, fruit quality including both fruit physical characteristics i.e., fruit weight, volume, firmness, height, diameter and fruit shape index and fruit chemical properties such as TSS %, acidity % and TSS/acid ratio were improved by subjected trees to different biostimulants treatments as compared with the control. In addition to that, leaf nutrient contents of some macro-elements (N, P and K) and some micro-nutrients (Fe, Zn and Mn) were improved from the standpoint of statistic by all investigated treatments as compared the control during both 2013 and 2014 seasons of study.

In general, it could be concluded that, all investigated biostimulants treatments under study exhibited a significant and beneficial influences on most of parameters and characters of "Anna" apple fruit trees. However, the Humic acid treatment was the most effective for increasing both vegetative growth and fruiting parameters as well as improving majority of fruit quality and leaf nutrient contents of "Anna" apple trees.

INTRODUCTION

Apple is considered one of the major and most important deciduous fruit trees cultivated in Egypt. Increasing and improving both productivity and quality of apple fruits to fulfill locally demands as well as reducing either production costs or environmental pollution are the great important aims of researchers.

Nowadays, biofertilization of various fruit trees has called the attention of research workers as an alternative to chemical fertilizers. Biofertilization is very safe for human, animal and environmental to get lower pollution and reduce soil salinity via decrease using mineral fertilization as well as save fertilization costs.

Biofertilizers are the most importance for plant production and soil as they play an important role in increasing vegetative growth on apple. Also, Fathi *et al*. (2002); Eissa-Fawzia (2003) and Kabeel *et al*. (2008) showed that, all biofertilizers (Nitrobeine, Phosphorene, Biogein, Rhizobacterien and

Humic acid) are highly beneficial to increase microbial and mycrohizal activity a plant growth bio-stimulant, an active soil enhanced and very effective in improving nutritional status of trees through promote nutrient uptake (chelating agent) as well as increased crop yield of apple, apricot seedlings, peach and pear trees.

In addition, Nitrobeine has greater amount of synbiotic and non synbiotic bacteria responsible for fixation of nitrogen by atmosphere and application of it achieved the following merits: (a) Decrease the amount of mineral nitrogen by 25 % (Abd El-Fattah, 1998) and save half the normal field rate of inorganic nitrogen fertilizer. (b) Increase both the availability of various nutrients by plant and resistance of plants to root disease (Ahmed *et al*., 1997) (c) Reduce salinity problems and the environmental pollution produced by the application of chemical fertilizers.

Therefore, the main objective of this investigation is to study the most effective fertilization treatments of different biostimulants fertilizers through studying their impact on vegetative growth measurements, leaf mineral content and both fruit productivity and quality of "Anna" apple trees.

MATERIALS AND METHODS

The present investigation was carried out at El-Kanater Horticultural Research Station, Kalyubia Governorate, Egypt, during two successive of 2013 and 2014 seasons, on six year-old apple trees. "Anna" cv., budded on M.M. 106 rootstock, planted at 3.5 x 3.5 meters apart, grown in a clay loamy soil and flood irrigation was used. Trees were carefully selected healthy, nearly uniform in growth vigour and received regularly the same cultural practices used in that district. The different investigated treatments in this study were as follows:

1- Control (untreated treatment)
2- Rhizobacterine (Rhiz.) (100 gms) + humic acid (30 cm)/tree.
3- Nitrobeine (Nit.) (100 gms) + humic acid (30 cm)/tree.
4- Phosphorine (Phos.) (50 gms) + humic acid (30 cm)/tree.
5- Microbeine (Mic.) (100 gms) + humic acid (30 cm)/tree.
6- Humic acid (30 cm)/tree.

All treatments were applied on mid-February during both seasons. Eighteen trees were devoted and the complete randomized design was used whereas, each treatment was replicated three times and every replicate was represented by a single tree. On each tree four main scaffold (branches) well distributed around the periphery (one branch on each direction) were tagged and the following parameters were determined.

1- Vegetative growth.

Four main branches nearly similar in diameter were selected around the tree and tagged to measure the length of new shoots which developed on these branches. These measurements were conducted twice, firstly on third week of April and repeated secondly on mid-August when growth ceased then, shoot length increase was estimated as following equation:

Shoot length increase =Shoot length on (mid August)–Shoot length on (3rd week of April)

Also, on mid-August leaves of tagged shoots on each tree were counted and recorded then the average number of leaves/shoot was estimated and leaf area (cm^2) was measured by using portable leaf area meter [Moedl: YMI-A20110122-1]. In addition, samples of thirty mature leaves were collected and oven dried at 70 °C till constant weight then, leaf dry weight in (gm) was recorded.

2- Fruiting parameters:

Fruit set (%).

Number of flowers at full bloom and the initial number of fruits at the end of blooming stage on the labeled limbs in all treatments were counted and recorded then the percentage of fruit set was calculated as the following equation as follows:

$$\text{Fruit set (\%)} = \frac{\text{Number of fruitlets}}{\text{Total No. of flowers at full bloom}} \times 100$$

Tree yield (kg/tree and increment % in relation to the control).

The average yield as kg/tree, for each treatment was recorded at the picking time. Furthermore, yield increment percentage in comparison the control for each treatment was calculated to the following equation:

$$\text{Yield increment (\%)} = \frac{\text{yield/treatment - yield/control}}{\text{yield/control}} \times 100$$

3- Fruit quality: Samples of ten fruits from each replicate were collected at harvesting time and the following properties were determined as follows.

Fruit physical properties: including fruit weight (gm), fruit volume (ml^3), fruit dimensions (fruit height and fruit diameter in cm), fruit shape index (fruit height/fruit diameter ratio) and fruit firmness ($Ib/inch^2$) was measured by using pressure tester with 7/18 plunger (Magness and Taylor, 1925).

Fruit chemical properties:

- **Total soluble solids (TSS %):** Handy refractometer was used to determine the TSS % in fruit juice according to the method described in AOAC (1985).
- **Fruit titratable acidity (%):** Fruit juice acidity % as malic acid (gm/100 gms fruit juice) was measured according to the method described by Vogel (1968) and AOAC (1985).
- **TSS/acid ratio:** TSS/acid ratio was estimated by dividing the total soluble % over total acidity %.

4- Leaf mineral content: Leaf contents of some macro elements (N, P and K) and some micro nutrients (Fe, Zn and Mn) were determined. The following procedures were used:

- Total N was determined by modified micro-Kjeldahl method as described by Pregl (1945). While P determination was carried out colormeterically according to Murphy and Reily (1962). Moreover, K, Fe, Zn and Mn were determined using Atomic absorption spectrophotometer (3300) according to the method described by Jackson and Ulrish (1959) and Chapman and Pratt (1961).

All the obtained data during the two seasons of study were subjected to analysis of variance method according to Snedecor and Cochran (1990). Meanwhile, differences among means were compared using Duncan's multiple range tested at probability of 5 % level (Duncan, 1955).

RESULTS AND DISCUSSIONS

Vegetative growth measurements:

With respect to the vegetative growth measurements under study i.e., shoot length (cm), number of leaves per shoot, leaf dry weight (gm) and leaf area (cm^2) in response to the investigated treatments, data tabulated in Table 1 revealed obviously that, all biostimulants fertilizer treatments under study increased generally all the studied vegetative growth parameters in both 2013 and 2014 seasons of study as compared with untreated trees (control), which was statistically the inferior as exhibited the shortest shoot, the least number of leaves per shoot; the lightest dry weight of leaves and the smallest leaf area.

Table (1): Shoot length, number of leaves/shoot, leaf dry weight and leaf area of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons

Treatments	Shoot length (cm)		No. of leaf/ shoot		Leaf dry weight (g)		Leaf area (cm^2)	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	36.33B	37.27C	24.67C	25.67C	0.395C	0.390C	33.16 E	33.33E
Rhiz. + H.A.	45.78A	48.53A	33.56A	35.33A	0.432A	0.457A	44.50A	43.00A
Nit. + H.A.	45.56A	41.37B	32.11A	32.90AB	0.425AB	0.440A	39.50B	40.00B
Phos. + H.A.	37.12B	38.17BC	27.89BC	27.00C	0.410BC	0.407BC	34.50D	34.33D
Mic. + H.A.	39.45B	40.98BC	32.45A	31.33B	0.415AB	0.438A	37.33C	38.16C
Humic acid	38.23B	40.98BC	30.67AB	30.67B	0.410BC	0.418B	37.33C	38.33C

Rhiz = Rhizobacteriene   Nit. = Nitrobene   Mic. = Microbene
Phos. = Phosphorene   H.A. = Humic acid.

On the other hand, data indicated that both (Rhiz. +H.A.) and (Nit. + H.A.) treatments were statistically the superior and had more stimulating effect on vegetative growth parameters as compared to the other investigated treatments, where the longest shoot, the highest value of leaves number per shoot and the heaviest leaf dry weight as well as the largest leaf area were induced from them. Such trend was detected during both 2013 and 2014 seasons of study. Additionally, the other remain treatments were intermediate the abovementioned two extreme. The abovementioned results concerning all vegetative growth measurements can be explained as the enhancement of tree growth by the biostimulants application may be attributed to the performed effect of tree growth regulating substances produced by the effective micro-organisms or in improving the availability and acquisition of nutrients from the soil which promoted the vegetative growth. However, Martin *et al*., (1989) and Jagnow *et al*., (1991) they stated that, the bacteria associated with biofertilizers produce adequate amount of IAA and

Cytokinins which increase the surface area per unit root length and enhanced the root hair branching with an eventual increase in acquisition of nutrient from the soil. The present results are in a complete agreement with those reported by many researchers Eissa-Fawzia (2003), Kabeel *et al*. (2005), Shddad *et al*. (2005) and El-Naggar (2009) on apricot trees; Mansour (1998) and Kabeel *et al*. (2007) on apple trees; Mahmoud and Mahmoud (1999) on peach trees and Abou-Grah-Fatma (2004), Wahba (2007) and Darwesh (2012) on persimmon trees.

2- Fruit productivity:-

Fruit set percentage.

Data represented in Table 2 declared that the percentage of fruit set responded significantly to all studied treatments as compared to the control trees which was statistically the inferior as exhibited the least value of fruit set % during the two seasons of study. On the other hand, results showed that, (Humic acid), (Nit. + H.A.) and (Mic. + H.A) treatments exhibited statistically the highest values of fruit set % as compared to other investigated biostimulants treatments especially in the second season while, all biostimulants treatments were equally effective from the standpoint of statistic in the first one. The obtained data are in conformity with those previously mentioned by Kabeel *et al*. (2007) on apple trees; Kabeel *et al*. (2008) on pear; El-Naggar (2009) on apricot; Wahba (2007) and Darwesh (2012) on persimmon trees.

Tree yield and yield increment % in relation to control.

Data in Table 2 displayed obviously that, all used biostimulants treatments resulted in a significant increases in yield expressed as kg/tree as compared with the control. Moreover, the highest significant yield (kg/tree) was gained by Humic acid treatment while untreated trees (control) treatment exhibited statistically the lowest tree yield. Such trend was true during both 2013 and 2014 seasons of study. Additionally, the other biostimulants treatments were in between the abovementioned two extents during the two experimental seasons.

Table (2): Fruit set (%), yield (kg/tree) and yield increment % of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons.

Treatments	Fruit set (%)		Yield (kg/tree)		Yield increment (%)	
	2013	2014	2013	2014	2013	2014
Control	11.65B	11.60C	27.33D	24.83D	0.001D	0.0001E
Rhiz. + H.A.	13.85A	14.32B	32.33B	34.83AB	18.29B	25.70C
Nit. + H.A.	14.59A	15.94AB	32.33B	34.83AB	18.29B	40.27B
Phos. + H.A.	13.32AB	14.30B	30.00C	32.83C	9.70C	32.22D
Mic. + H.A.	14.30A	16.14A	32.33B	34.00BC	18.29B	40.27B
Humic acid	14.77A	14.64AB	34.33A	36.00A	25.64A	44.98A

Rhiz = Rhizobacteriene Nit. = Nitrobene Mic. = Microbene
Phos. = Phosphorene H.A. = Humic acid.

With respect to the yield increment % as compared to the control, data in the same Table showed clearly that, the response typically followed the same trend previously detected with the average tree yield estimated as kg per tree especially in the first season. However, the greatest percentage of yield increment over the control was always in concomitant to the treated trees with Humic acid treatment. On the contrary, treated trees with (phos. + H.A) treatment was the least effective biostimulants treatment regarding the response of both tree productivity parameters (yield and yield increment %) in the two seasons of study. Moreover, the other remain biostimulants, treatments were intermediate as compared to those of both abovementioned two extents. Such trend was detected during both the first and second seasons of study for both aforesaid parameters. The present results are in agreement with those previously reported by Kabeel *et al*. (2005), Shddad *et al*. (2005) and El-Naggar (2009) on apricot trees; Kabeel *et al*. (2007) on apple trees and Kabeel *et al*. (2008) on pear trees, Abou-Grah-Fatma (2004), and Sharaf *et al*. (2012) on persimmon trees.

3- Fruit quality.

Fruit physical properties.

Fruit weight and fruit volume.

With respect to the fruit weight (gms) and fruit volume (ml3) as influenced by different tested biostimulants treatments under study, data tabulated in Table 3 revealed clearly that, both studied characters were increased by all investigated soil applied treatments of biostimulants. However, those increase were significant (except as for Rhiz. + H.A. treatment) as compared to the control treatment during both the first and second seasons of study. Moreover, it could be noticed that, the heaviest weight of fruits (142.6, 140.8 and 137.8 gms) and (143.1, 143.0 and 139.1) were obtained from (Humic acid), (Nit. + H.A.) and (Mic. + H.A.) treatments in the two seasons, respectively. Meanwhile, all abovementioned treatments were equally effective as compared to each other from the standpoint of statistic. Furthermore, results concerning fruit volume followed nearly the same trend previously detected with fruit weight, where the greatest fruit volume was induced from (Humic acid), (Nit. + H.A.) and (Mic. + H.A.) treatments, respectively. While, differences between them were insignificant. Contrary to that, control treatment was induced significantly the lightest weight and the smallest volume of fruit, during both 2013 and 2014 seasons. Such trends were true throughout two seasons of study.

The present results are in accordance with those previously mentioned by Mansour (1998), Fathi *et al*. (2002), Shaddad *et al*. (2005), Kabeel *et al*. (2008); El-Naggar (2009) and Sharaf *et al*. (2012) on some deciduous fruit trees.

Fruit firmness.

Obtained data in Table 3 displayed clearly that both biostimulants soil applied treatments of (Phos. + H.A.) and (Humic acid) increased fruit flesh firmness and induced fruits heaving firmer flesh texture as compared to the other investigated treatments with no significant between each other whereas, both aforesaid treatments were equally effective from the standpoint of statistic during both the first and second seasons of study. On the other hand, the opposite trend was detected with (Nit. + H.A.) treatment which resulted statistically in increasing flesh softness of "Anna" apple fruits as compared with any other tested treatments under study during the two experimental seasons. In addition, the other remain treatments including control treatment were in between the abovementioned two extents. Such trend was true during both 2013 and 2014 seasons of study.

The concerned results were supported by findings of several researchers Akl *et al*. (1997) on grapevine, Kabeel *et al*. (2008) on pear, El-Naggar (2009) on apricot trees; Abou-Grah-Fatma (2004) and Sharaf *et al*. (2012) on persimmon trees.

Table (3): Fruit weight, fruit volume and fruit firmness of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons.

Treatments	Fruit weight (g.)		Fruit volume (cm^3)		F. firmness ($lb/inch^2$)	
	2013	2014	2013	2014	2013	2014
Control	124.4C	118.6C	115.0C	116.7C	12.00A	11.65B
Rhiz. + H.A.	128.2B	126.3B	118.7C	118.3C	11.06B	11.51B
Nit. + H.A.	140.8A	143.0A	130.0AB	132.7AB	10.69C	10.93C
Phos. + H.A.	136.7A	137.7A	127.5B	129.0B	12.30A	12.43A
Mic. + H.A.	137.8A	139.1A	131.7AB	131.7AB	11.17B	11.75B
Humic acid	142.6A	143.1A	135.5A	135.0A	12.16A	12.47A

Rhiz = Rhizobacteriene Nit. = Nitrobene Mic. = Microbene
Phos. = Phosphorene H.A. = Humic acid.

Fruit dimensions (fruit height and fruit diameter).

Regarding the effect of various investigated biostimulants treatments on fruit dimensions (fruit height and fruit diameter in cm). it is quite evident from data presented in Table 4 that, fruit height was increased significantly by all studied biostimulants soil applied treatments as compared to the control treatment which showed the least significant value in this respect during both 2013 and 2014 seasons of study. Whereas, the highest significant values of fruit height resulted from trees subjected to both (Humic acid) and (Nit. + H. A.) treatments, respectively, while the differences were insignificant between the two aforesaid treatments as compared to each other in the two seasons of study. On the other hand, other treatments were responded in between to both abovementioned extents from standpoint of statistic. Considering the fruit diameter, data in the same Table indicated that, all investigated treatments under study followed approximately a similar trend to that abovementioned and detected with fruit height during both the first and second experimental seasons.

The obtained results are in harmony with those stated by some investigators Mansour (1998) and Kabeel *et al*. (2007) on apple trees; Fathi *et al*. (2002), on apple and peach trees, Eissa-Fawzia (2003), Shddad *et al*. (2005), Kabeel *et al*. (2005) and El-Naggar (2009) on apricot fruit and Abou-Grah-Fatma (2004) and Sharaf *et al*. (2012) on persimmon trees.

Fruit shape index.

Regarding the fruit shape index (fruit height/fruit diameter ratio), data in the abovementioned Table indicates obviously that, the trend was not so firm to be the same during both 2013 and 2014 seasons of study. However, "Anna" apple trees treated with all biostimulants soil applied treatments under study induced fruits exhibited the greatest value in their fruit shape index as compared to the control. Moreover, it could be noticed that, the control treatment resulted the least value of fruit shape index in the two seasons of the experimental work.

The present results are in harmony with those previously reported by Mansour (1998), Fathi *et al*. (2002) and Kabeel *et al*. (2007) on apple and peach; Eissa-Fawzia (2003), Shddad *et al*. (2005), Kabeel *et al*. (2005) and El-Naggar (2009) on apricot and Sharaf *et al*., (2012) on persimmon trees.

Table (4): Fruit diameter, fruit height and fruit shape index of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons.

Treatments	Fruit height (cm)		Fruit diameter (cm)		F. shape index	
	2013	2014	2013	2014	2013	2014
Control	6.39D	5.83D	6.40C	6.09D	0.998B	0.957B
Rhiz. + H.A.	6.80C	6.93B	6.46C	6.68BC	1.052A	1.037AB
Nit. + H.A.	6.68C	6.53C	6.84A	7.00A	1.073A	1.039A
Phos. + H.A.	6.87AB	7.27A	6.42C	6.45C	1.004AB	1.038AB
Mic. + H.A.	6.90B	7.33A	6.54BC	6.54BC	1.050A	1.120A
Humic acid	7.28A	7.47A	6.78AB	6.83A	1.040A	1.020AB

Rhiz = Rhizobacteriene Nit. = Nitrobene Mic. = Microbene
Phos. = Phosphorene H.A. = Humic acid.

Fruit chemical properties.

Fruit juice TSS (%).

With regard to the effect of biostimulants investigated fertilizer treatments on Juice TSS % of "Anna" apple fruits, tabulated data in Table 5 revealed obviously the positive relationship between fruit juice TSS % and all soil applied fertilization treatments under study whereas, TSS % was responded significantly to the different biostimulants treatments as compared to the control during both the first and second seasons of study. Moreover, providing apple trees with (Humic acid and Mic. + H.A.) treatments treatment exhibited the richest fruits in their content of TSS % and produced fruits with the highest values in this respect. Furthermore, the opposite trend was observed with the untreated trees treatment, such subjected to control trees which produced the fruits lower in their fruit juice TSS %. Meanwhile, the other investigated biostimulants treatments were in between the abovementioned two extents during both 2013 and 2014 seasons of study.

Fruit juice acidity (%).

Data in Table 5 showed clearly the effect of biostimulants investigated treatments on fruit juice total acidity % . it indicates that, the highest total acidity % was always in concomitant to such produced by trees treated with treatment of (Phos. + H.A.) in both seasons of study, where this treatment resulted in the greatest values of fruit juice total acidity % as compared to the other treatments. On the other hand, the remain biostimulants treatments increased generally fruit juice total acidity % as compared to the control during both seasons of study whereas, these increases were so little to reach the level of significance especially in the second season of study.

TSS/acid ratio:

As for the effect of biostimulants soil applied treatment on TSS/acid ratio, its quite evident from data in the same Table that, providing apple trees with the (Humic acid), (Mic. + H.A.), (Rhiz. + H.A.) and (control) soil applied treatments were resulted in the highest values of TSS/acid ratio from the standpoint of statistic with insignificant differences between each other in the first season only. Meanwhile, this trend was observed with the treatment of (Mic. + H.A.) in the second one. On the other hand, the opposite trend was detected with that trees subjected to (Phos. + H.A.) treatment which induced statistically the least values of TSS/acid ratio in apple fruits during the first and second of experimental seasons compared to other biofertilizer treatments.

Obtained results with respect to the response of investigated fruit chemical properties to studied biostimulants treatments are supported by the findings of many researchers Fathi *et al*. (2002) and Kabeel *et al*. (2007) on peach and apple; Eissa-Fawzia (2003), Kabeel *et al*. (2005), Shddad *et al*. (2005) and El-Naggar (2009) on apricot and Abou-Grah-Fatma (2004) and Sharaf *et al*. (2012) on persimmon trees.

Regarding the increasing "Anna" apple productivity (tree yield and yield increment % in relation to the control) and improving fruit quality might be attributed to the increment of the amount of metabolites synthesized by the tree which in turn accelerate tree growth and resulted in improving total yield. On the other hand, it could be explained these data at the biostimulants were used in this investigation contains many groups and strains of micro-organisms which play a vital and important roles in orientation and translocation of metabolites from leaves into the productive organs.

Table (5): TSS, acidity and TSS/acid ratio of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons.

Treatments	TSS (%)		Acidity (%)		TSS/acid ratio	
	2013	2014	2013	2014	2013	2014
Control	12.22C	11.38F	0.515D	0.428B	23.73AB	26.59B
Rhiz. + H.A.	12.73AB	12.67D	0.543AB	0.497B	23.84A	25.49C
Nit. + H.A.	12.78A	13.00B	0.543AB	0.500B	23.54B	26.00BC
Phos. + H.A.	12.66B	12.20E	0.556A	0.600A	22.77BC	20.33D
Mic. + H.A.	12.82A	13.12A	0.527B-D	0.450B	24.33A	29.16A
Humic acid	12.78A	12.91C	0.518CD	0.447B	24.67A	28.88B

Rhiz = Rhizobacteriene Nit. = Nitrobene Mic. = Microbene
Phos. = Phosphorene H.A. = Humic acid.

4- Leaf mineral content.

Leaf macro elements (N, P and K) content.

Regarding the leaf N, P and K content, data tabulated in Table 6 obviously indicate that, trees subjected to (Humic acid), (Mic. + H.A.), (Nit. + H.A.) and (Rhiz. + H.A.) treatments exhibited generally the highest statistically values of leaf nitrogen content with insignificant differences between them during both 2013 and 2014 seasons whereas, the richest leaves in phosphorus content was statistically with both (Phos. + H.A.) and

(Rhiz. + H.A.) soil applied treatments in the two seasons of study. However, the richest and the highest value of leaf potassium content was statistically inclose relationship with trees treated with (Humic acid) treatment through the first and second seasons of study. On the other hand, all stimulants investigated treatments exhibited a considerable and significant increase in leaf N, P and K content as compared to the control treatment which resulted significantly in the poorest and the least values of N, P and K contents in leaves. Moreover, the other remain treatments exerted statistically an intermediate values in this concern.

Table (6): Leaf N, P and K contents of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons.

Treatments	N (%)		P (%)		K (%)	
	2013	2014	2013	2014	2013	2014
Control	2.22D	2.20B	0.34D	0.34D	1.41D	1.36D
Rhiz. + H.A.	2.52AB	2.50A	0.37AB	0.38AB	1.58C	1.79B
Nit. + H.A.	2.90A	2.70A	0.34D	0.35CD	1.63C	1.50C
Phos. + H.A.	2.40C	2.20B	0.39A	0.39A	1.89B	1.76B
Mic. + H.A.	2.90A	2.70A	0.36B-D	0.33B-D	1.78C	1.72BC
Humic acid	2.90A	2.70A	0.36B-D	0.36BC	2.04A	1.89A

Rhiz = Rhizobacteriene **Nit. = Nitrobene** **Mic. = Microbene**
Phos. = Phosphorene **H.A. = Humic acid.**

Leaf micro-nutrients (Fe, Zn and Mn) content.

Considering the leaf (Fe, Zn, Mn and Cu) contents, data in Table 7 displayed clearly that, there are a positive relationship between biostimulants treatments and leaf micro-nutrients under study. Moreover, leaf Fe, Zn and Mn contents were significantly responded to the effect all biostimulants treatments while, leaf micro-nutrient contents were increased as compared to the control. However, the highest leaf Fe, Zn and Mn contents were exhibited from trees treated with (Humic acid) treatment in the two seasons of study whereas, the opposite trend was observed with the control treatment which had the lowest leaves in Fe, Zn and Mn contents during both the first and second seasons of study. In addition to that, the other remain biostimulants treatments were in between as compared to the abovementioned two extents. Such trend was detected during both 2013 and 2014 seasons of study.

Table (7): Leaf Fe, Zn and Mn contents of "Anna" apple trees in response to organic and bio-fertilizers during both 2013 and 2014 seasons.

Treatments	Fe (ppm)		Zn (ppm)		Mn (ppm)	
	2013	2014	2013	2014	2013	2014
Control	205.0D	209.5D	35.40D	37.45D	120.3D	119.8D
Rhiz. + H.A.	232.4C	237.9C	35.80D	37.85D	122.1D	121.6D
Nit. + H.A.	231.2C	237.4C	39.40C	41.40AB	133.0BC	131.0C
Phos. + H.A.	245.3B	249.8B	41.30AB	42.50A	135.2B	134.7B
Mic. + H.A.	242.2B	247.8B	40.40C	40.50BC	134.2B	145.2A
Humic acid	290.0A	295.5A	42.40A	39.50C	146.1A	133.0BC

Rhiz = Rhizobacteriene **Nit. = Nitrobene** **Mic. = Microbene**
Phos. = Phosphorene **H.A. = Humic acid.**

Obtained results regarding the response of leaf some macro and micro-nutrient contents to investigated treatments under study are in accordance with those previously mentioned by Boutros *et al*. (1987), and Izquierdo *et al*. (1993) on citrus, Haggag *et al*. (1995) on guava, Ahmed *et al*. (1997) on grapevine, Abou-Grah-Fatma (2004) and Darwesh (2012) on persimmon trees; Rathi and Bist (2004) and Kabeel *et al*. (2008) on pear, Shddad *et al*. (2005) and El-Naggar (2009) on apricot fruit trees.

Obtained results regarding the leaf nutrient content, it could be explained as the promoting effects of biostimulants on the nutritional status of the leaves could be related to the role of the biostimulants under study in improving the availability nutrients and to tree modifications of root growth, morphology and/or physiology through hormonal exudates of biofertilizers bacteria resulting in more efficient absorption of available nutrients, Jagnow *et al*. (1991).

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تـأثير إضـافة الأسـمدة العضـوية والحيويـة علـى النمـو والمحصـول وجـودة الثمـار لأشجار التفاح صنف "آنا"

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- أجرى هذا البحث بهدف دراسة تـأثير الإضـافة الأرضـية للتسميد ببعض المخصبات الحيوية المختلفة على بعض قياسات النمو الخضرى وكذلك قياسات الإثمار وصفات جودة الثمار ومحتوى الورقة من العناصر الغذائية لأشجار التفاح صنف "آنا" المطعومة على أصل 106 والنامية تحت ظروف منطقة محطة بحوث البساتين بالقناطر الخيرية خلال موسمين متتاليين 2013، 2014.
- ولقد أشارت النتائج المتحصل عليها أن كل المعاملات المختبرة فى هذه الدراسة أدت إلى تـأثير إيجابى لكل قياسات النمو الخضرى المدروسة (طول النمو – عدد الأوراق/نمو خضرى – الوزن الجاف للورقة – مساحة الورقة). كذلك فإن القياسات الثمرية (النسبة المئوية لعقد الثمار - محصول الشجرة بالكجم – الزيادة فى النسبة المئوية للمحصول لكل معاملة مقارنة بمعاملة الكنترول (المقارنة)) ازدادت نتيجة معاملة الأشجار بالمعاملات المختلفة تحت الدراسة فى موسمى التجربة.
- وأشارت النتائج إلى أن صفات جودة الثمار والتى شملت كل من الصفات الطبيعية للثمار مثل (وزن وحجم الثمرة – صلابة الثمرة – ارتفاع وقطر الثمرة – معامل شكل الثمرة) والصفات الكيماوية للثمار مثل (النسبة المئوية للمواد الصلبة الذائبة الكلية – النسبة المئوية للحموضة الكلية – وكذلك النسبة بين كل منهما) قد تحسنت إحصائياً نتيجة معاملة الأشجار بالمعاملات المختلفة من المخصبات الحيوية تحت الدراسة وذلك عند مقارنتها بمعاملة المقارنة (الكنترول).
- هذا بالإضافة إلى أن محتوى الورقة من العناصر الغذائية سواء الكبرى (النتروجين – الفوسفور – البوتاسيوم) أو الصغرى (الحديد – الزنك – المنجنيز) قد تحسنت على المستوى الإحصائى نتيجة الإضافة الأرضية للمعاملات المختبرة إذا ما قورنت بمعاملة المقارنة (الكنترول) خلال موسمى التجربة 2013، 2014 من هذه الدراسة.
- وبصفة عامة يمكن الإشارة إجمالاً إلى أن كل معاملات الإضافة الأرضية للمخصبات الحيوية المختبرة تحت الدراسة أدت إلى تأثيرات معنوية ومفيدة على معظم القياسات والصفات المدروسة لأشجار وثمار التفاح "آنا" ولقد كانت المعاملة بحمض الهيوميك هى أفضل وأكثر المعاملات فعالية فى زيادة كل من القياسات الخضرية والثمرية وأيضاً تحسين غالبية صفات جودة الثمار وكذلك محتويات الورقة من العناصر الغذائية لأشجار التفاح صنف "آنا".