Response of "Le Conte" cv. Pear Trees to Some Bio-Stimulants Foliar Applications

Rehab M. Awad*

*Department of Plant Production *(Horticulture- Pomology)*, Faculty of Agriculture, Saba-Basha, Alexandria University, Egypt.

* Corresponding author: Rehab M. Awad E. mail: rehab17menna@yahoo.com

DOI: 10.21608/JALEXU.2023.225142.1148

Article Information

Received:July25th2023

Revised:August11th2023

Accepted:August17th2023

Published:September30th2023

ABSTRACT: This study was carried out during 2021 and 2022 to investigate the role of spraying tryptophan, biozyme and fulvic acid on Le Conte pear cv. grown at a private orchard in Borg El- Arab, Alexandria, Egypt. The experiment design was a Randomized Complete Block Design (RCBD). Ten treatments with four replicates were applied three times; start of growing season, full bloom and one month after fruit set, the treatments were; control, tryptophan at 50, 100 and 150 ppm, biozyme at 2, 4 and 6 ppm and fulvic acid at 500, 1000 and 1500 ppm. The results showed that all treatments enhanced the shoot length and thickness, leaf area and total chlorophyll compared to the control, the highest value of shoot length was obtained by 1500 ppm fulvic acid in 2021 and 6 ppm biozyme in 2022, In the meantime, 1500 ppm fulvic acid caused significant increment, in shoot thickness, leaf area and total chlorophyll, fruit set (%), the number of fruits per tree, yield (kg/ tree) and the least fruit drop % in 2021 and 2022. All treatments enhanced the fruit physical and chemical properties and fulvic acid at 1500 ppm caused remarkable increment in fruit weight and length in the second season and fruit diameter in both seasons. Tryptophan at 150 ppm had the highest percentages of total soluble solids (TSS), total sugars and reducing sugars in the two seasons, while it caused the highest value of TSS/ acid in 2022 and non- reducing sugars % in the first season. In the meantime, fulvic acid at 1500 ppm significantly increased the TSS/ Acid in 2021 and 2022 seasons, in one side and reducing sugars % in the first season, on the other side. In contrast, all treatments reduced acidity (%) and ascorbic acid mg/100ml compared with control. The level of minerals improved by all treatments in comparison with the control, 6 ppm biozyme caused the highest value in phosphorus and potassium % and copper ppm in 2020 and 2021. 1500 ppm fulvic acid estimated the highest value in nitrogen (%), manganese and copper (ppm), whereas, the increase in leaf zinc ppm was obtained by 150 ppm tryptophan in the two seasons.

Keywords:*pear; bio- stimulants; yield; fruit quality; mineral content*

INTRODUCTION

Pear (*Pyrus communis* L.), belongs to family Rosaceae and is cultivated on an area of 1,379,387 hectares worldwide with the production of approximately 23,919,075 tons (**FAO, 2019**). In Egypt, pear cultivated area is 13439 Faddan produced 68407 Tons **(Agricultural Statistics Institute, 2019).** Pear is favored by consumers because of its distinctive scent, delicate aroma and sweetness, it is a common fruit found in temperate regions. *Pyrus Communis* and *P. Serotina* were crossed to create the hybrid known as Le-Conte, which is regarded as the primary pear cultivar farmed in Egypt, Le Conte pear trees, however, have difficulties in Egypt due to their poor fruit set and variable production. Environmental conditions, plant growth regulators, and nutrition are just a few of the many factors that have an impact on pear trees' fruit set and output. **(Mosa *et al.*, 2022; Jackson, 2003; Sanzol and Herrero, 2001)**.

Biostimulants considered to be a significant application in horticultural crops, these materials promote the plant growth under both optimal environmental conditions and when administered to species exposed to abiotic and biotic stresses (**Kisvarga *et al.*, 2022; Bashir *et al.*, 2021**). Recent years have seen a considerable increasing in soil fertility due to the use of biofertilization, improving the ability of plants to resist disease, as well as promoting growth, productivity, and fruit quality for a variety of fruit tree species (**Abd El Rahman and Bakr, 2022)**.

Amino acids significantly influence plants' capacity to withstand abiotic stress through a variety of mechanisms, including pH regulation, maintaining cellular water by cellular osmotic change, a reservoir of nitrogen and carbon is created by increased photosynthesis and suitable osmolytes, giving plant cells mechanical toughness, and organizing stomatal opening and closing, as reported by **Souri (2016) and Abd EL-Rahman (2022)**. Tryptophan is a fragrant amino acid produced by way of the shikimate pathway, which chorismate activates (**Maeda and Dudareva, 2012**), Having an α- amino group, an α-carboxylic acid group, side chains, Since it

participates in the manufacture of the natural auxin, indole acetic acid, it becomes a very significant amino acid necessary for plant growth which affect plant output, growth, and chemical compound content (**Mahdi *et al*., 2023**).

Commercial growth stimulant Biozyme is non-toxic and environmentally safe; reported to be abundant in cytokinins and auxin precursor, enzymes, and hydrolyzed protein which influences plants physiological system at low concentrations (**Sau *et al*., 2015**). Application of biozyme, a bio-stimulant that boosts a plant's ability to significantly increase its absorption capacity, which is vital for enhancing the behaviour of trees, combining the power of natural plant extracts with naturally occurring macro and micronutrients (**Mohammed and Naile, 2020**). It contains minerals, that are naturally chelated, promotes cell growth and division for superior chlorophyll and increased output (**Manna *et al*., 2012**). In addition to enhancing fruit physico-chemical features, it also markedly increased plant growth, development of fruits, and yield on guava (**Sau *et al*., 2015**).

Fulvic acid is very efficient, it has a lower molecular weight than humic acid, ranging from about 1.000 to 10.000, contains important and effective molecular bonds that cause minerals and elements to disintegrate and expand into active fulvic complexes (**Aiken *et al*., 1985**). It is crucial to organic and natural products in aquatic systems and very advantageous to both plants and soil because of crucial boosting microbial activity, also, it is regarded as a bio-stimulant for plant growth; as a chelating agent, it encourages nutrient uptake and improves vegetative traits, nutritional status, and leaf pigments (**Mostafa *et al*., 2017; El-Salhy*et al*., 2023**). The target in this study to determine the impact of spraying various concentrations of tryptophan, biozyme and fulvic acid on the behavior of Le Conte cv. Pear trees.

MATERIALS AND METHODS

1. Plant Material, Treatments, Experimental Site and Design

The following study was carried out during 2021 and 2022 seasons to investigate the role of spraying tryptophan, biozyme and fulvic acid on 12- year- old Le Conte pear cultivar grown at a private orchard in Borg El- Arab at 29.55 longitude and 30.90 latitude, Alexandria, Egypt. Forty trees (5 x 5 m apart) as uniform as possible grown in calcareous soil and budded on (*Pyrus communis* L.) rootstock with drip irrigation, were selected for this study. The trees were uniform in their size shape and diseases free as well as received the cultural practices that are recommended by Ministry of Agriculture and were trained to the central leader system. The experiment design was a Randomized Complete Block Design (RCBD), with four replicates. The trees were sprayed three times; at the start of growing season in February, at full bloom in March and one month after fruit set. The treatments were; control (water only), tryptophan at 50, 100 and 150 ppm, biozyme at 2, 4 and 6 ppm and fulvic acid at 500, 1000 and 1500 ppm, Triton B was added as wetting agent to all spraying solutions at 0.1 %. Before the applications, soil samples were taken at a depth of 0: 30 and 30: 60 cm from different experimental sites, to determine physical and chemical properties of soil according to **Piper (1950)** as shown in **Table (1).**

Table (1): Physical and chemical properties of experimental orchard soil

Depths (cm)	Sand	Silt	Clay	CaCo3	pH	EC	Anions (meq /L)			Cations (meq / L)				
	%			mg/L	ds/m		HCO^{-3}	CL^{-}	$SO^{2}_{4}{}^{-}$	$NH4^{+}$	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}
0- 30	70.8	12	17.2	39.01	8.2	2.1	8.71	12.05	3.5	0.07	6.30	1.71	6.9	1.4
30- 60	71.5	11.9	16.6	37.65	8.2	1.9	8.13	11.88	3.4	0.08	5.70	1.67	6.2	1.2
Average	71.15	11.95	16.9	38.33	8.2	2.0	8.42	11.96	3.45	0.07	6.0	1.69	6.5	1.3

The molecular formula of tryptophan is $C_{11}H_{12}N_2O_2$, L-Tryptophan reagent grade, ≥98% (HPLC) and its molecular weight is 204.23g mol-1 **(Taiz and Zeiger, 2002),** synonym(s): (S)-2-Amino-3-(3-indolyl) propionic acid, L-α-Amino-3-indolepropionic acid CAS Number: 73-22-3. PubChem Substance ID:24278135 -Sigma-Aldrich Company, India. Biozyme is produced by different agro-input agencies, the composition is more or less same and i.e. 78.7% biological active extracts of plant origin and growth regulators (32.2 ppm GA3, 32.2 ppm IAA and 82.2 ppm Zeatine), 1.88% plant micro-nutrients (0.49%Fe, 0.37% Zn, 0.12% Mn, 0.14% Mg, 0.30% B and 0.44% S),19.27% solvents and conditioners (https://www.agrogenial.com/)(**Hassan *et al*., 2009**). Fulvic acid at %70 was used (100% - water soluble powder - Humate (Tianjin) International Ltd., Tianjin, China)

2. Vegetative Parameters

In the spring of each season, 20 non –fruiting shoots of spring cycle were tagged at constant height and at all direction of each tree, in the end of September, the average shoot length was measured in cm and shoot thickness (cm) was determined using a Digital Vernier Caliper. In August, leaf area (cm^2) was estimated in fully mature leaves according to the formula: leaf area (cm^2) = LA = 0.70 (L × W) – 1.06; LA = leaf area,

L is the length, and W is the width of the leaves **(Demirsoy, 2009)**, while, total chlorophyll index was measured by chlorophyll meter (SPAD- 502, Minolta Co. Japan), an average of 4 measurements from different spots of leaf was considered as reported by **Yadava (1986)**.

3. Fruit set, drop and number and the Yield

Eight branches in different sides of each replicate were tagged for determining the fruit set (%) and fruit drop (%) according to formula:

Fruit set (%) = Number of developed fruitlets/ Total number of flowers at full bloom × 100.

Fruit drop (%) = Number of fallen fruits / Number of set fruitlets × 100

Fruit drop (%) was measured by counting the number of dropped fruits after fruit set (mid of March) till the harvesting time (August).

Yield (Kg/ tree) was determined by collecting the fruits at maturity stage late of August from each tree and yield was estimated by multiplying the number of fruits with average fruit weight.

4. Fruit Physical Parameters

For each tree, 20 fruits were selected for determining fruit weight (g/ fruit); fruit samples were weighed in grams, average fruit length (cm) and diameter (cm) were measured by using Hand caliper. Length was measured in maximum vertical point, while diameter was measured from the widest point. Firmness (Ib/inch^2) was estimated by the **Magness and Taylor (1925)** pressure tester of 5/16 inch plunger (mod. FT 02) (0–2 Lb., Via Reale, 63, 48011 Alfonsine, Italy).

5. Fruit Quality

The total soluble solids TSS (%) were determined in pear fruit juice using a hand refractometer (**A.O.A.C. 2005**). Acidity was measured colorimetrically based on estimated malic acid using five milliliters of the fruit juice of each fruit sample and titrated with sodium hydroxide solution of a known normality using phenolphthalein as an indicator **(A.O.A.C. 2005)**, the results of these titrations were converted to percent of titratable acidity, where: 0.067= mille equivalent factor of malic acid, then TSS/ Acidity ratio was calculated. Estimated ascorbic acid in mg/100 ml juice was measured by utilizing 2,6-dichlorophenol indophenols and 3% oxalic acid (**Malik and Singh, 1980)**. Finally, total sugars (%) colorimetrically measured using phenol and sulphuric acid extracted from 5-gram pulp (**Malik and Singh, 1980**), reducing sugars (%) using the Nelson arsenate molybdate colorimetric method (**Dubois *et al.*, 1956)**. The difference between total sugars and reducing sugars used to compute non-reducing sugar (%).

6. Foliage Minerals Composition

Samples of 20 leaves sited in the middle of the shoots (**Chuntanaperb and Cummings, 1981)**, were randomly chosen in each replicate during the last week of August, then cleaned, dried in oven at 70º C to a constant weight, grind and sample of 5 g was digested by H_2SO_4 and H_2O_2 according to **Cottenie (1980)**. Total nitrogen and phosphorus in the digested material were measured colorimetrically according to **Evenhuis and De waard (1980)** and **Jackson (1958),** respectively. Potassium content was estimated by flame photometer (SKZ International Co., Ltd., Jinan, China) according to **Estefan *et al.* (2013)**. Foliage Fe, Zn, Mn and Cu contents were identified by the atomic absorption (3300), **Johnson and Ulrich (1959)**. Leaf nutrient elements content were expressed as a ratio of the leaf dry weight, i.e., percentage for N, P, and K and as a part per million (ppm) for Fe, Zn, Mn and Cu.

7. Statistical Analysis

The experiments designed in randomized complete block (RCBD) with four replications was used. Using the MSTAT software (Microcomputer Statistical Package) for analysis of variance (ANOVA) by **Russel, (1986)**, the results of the measured parameters were subjected to computerized statistical analysis, and the means of the treatments were compared using LSD at 0.05, **Snedecor and Cochran (1990).**

RESULTS AND DISCUSSION

1. **Vegetative Growth Properties**

Tryptophan, biozyme, and fulvic acid application significantly improved the vegetative traits of Le Conte pear trees; shoot length and thickness, leaf area, and total chlorophyll content in both growing seasons **(Table 2)**. The highest significant value of shoot length was obtained by fulvic acid at 1500 ppm (50.05 cm) in the first season, and 6 ppm biozyme (56.41 cm) in the second season. It was clear that 1500 ppm fulvic acid caused significant increment, in shoot thickness (1.186 and 1.280 cm), leaf area (34.14 and 35.16 cm2) and total chlorophyll (49.41 and 52.09 SPAD) in 2021 and 2022, respectively.

El-Kenawy (2022), found that the increase in shoot length, leaf area, and leaf total chlorophyll of Red Roumy grapevines caused by the various amino acid treatments such as tryptophan, that may be due to the fact that as organic nitrogenous substances, amino acids, are used to create the structural building blocks for proteins, that is catalysed by ribosomes and results the polymerizing of amino acids to **Opik and Rolfe (2005)**. According to **Maeda and Dudareva (2012),** It has an impact on the synthesis of auxin. Spraying tryptophan acid enhanced vegetative development (**Abd Elkader *et al.*, 2020**) The major role that amino acid is promoting cell

division and elongation, glucose absorption, photosynthesis, nucleic acid synthesis, and protein synthesis, which improved vegetative growth and physiological state (**El Sese *et al*., 2020; Barghout and Mohammed, 2023**).

Using biozyme in plant has a favorable effect on the development and vigor to tree leading to increased nutrient uptake and accelerated plant metabolite movement; whereas, biozyme application significantly increased vegetative traits; shoot length (cm), the number of leaves, leaf area (cm2) and leaf total chlorophyll content (SPAD) of pear trees as compared to control treatment, **Sau *et al*. (2015)** found the same results in guava, with the application of biozyme, leaf pigments (chlorophyll A, chlorophyll B, and total chlorophyll) has greatly risen. Such bio stimulants increase the photosynthesis and nutrient uptake; Iron and magnesium (**Ries*et al*., 1978**), those are necessary ingredients for the production of chlorophyll.

Fulvic acid has a positive impact on the length of shoots, the size of leaves, and the amount of chlorophyll in leaves. It's competent of quickly bind minerals to its molecular structure, which causes them to dissolve and be mobilized (**Aiken *et al*.,1985;El-Salhy*et al*., 2023**). Additionally, **Chen *et al*. (2004)** showed, fulvic acid is one of the primary components of premium foliar spray fertilizers, due to its ability to promote substance penetration to plant tissues and sections. Antioxidants, hormones including IAA and GA3, and cytokines are all made more readily available by fulvic acid, including a number of vitamins, such as Vit. B, which may explain why it has a positive influence on vegetative growth (**Abd El-Hameed *et al*., 2014**). Fulvic acid energizes and balances cells, fostering the best conditions for growth and replication while accelerating cell division and elongation (**Mostafa *et al*., 2017**). In addition, increasing apple shoot length and leaf area was more successful when fulvic acid was applied topically **(Taha *et al*., 2016; Khan *et al*., 2019)**.

Table (2): Effect of tryptophan, biozyme and fulvic acid on shoot length(cm), shoot thickness, leaf area (cm^2) and total chlorophyll (SPAD) of " Le Conte" pear cv. during 2021 and 2022

Treatments	Shoot Length (cm)		Shoot Thickness (cm)		Leaf Area (cm^2)		Total chlorophyll (SPAD)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	42.23^{j}	45.18^{f}	0.880^{g}	0.933^{g}	24.13^{j}	27.22^{i}	40.12^{j}	43.55^{i}
Tryptophan (50 ppm)	44.49^{g}	48.68^{de}	0.936^{f}	0.980^{f}	27.7^{g}	29.87^{f}	42.39^{h}	45.30^{g}
Tryptophan (100 ppm)	46.28^{f}	50.10^{cd}	1.013^{d}	1.04^{e}	$29..08^{e}$	31.17^{e}	44.73^{f}	49.11^{c}
Tryptophan (150 ppm)	48.55^{c}	53.91^{b}	1.083^{c}	1.116^{d}	32.81^{c}	34.95^{b}	46.2^{e}	49.89^{b}
Biozyme (2 ppm)	44.4^{h}	48.24^{e}	0.94^{f}	0.983^{f}	26.97^{h}	29.15^{b}	42^{i}	44.93^{h}
Biozyme (4 ppm)	47.82^{d}	51.02^{c}	0.983^{e}	1.176^{c}	30.15^{d}	33.13^{d}	46.62^{c}	48.39^{e}
Biozyme (6 ppm)	49.51^{b}	56.41^{a}	1.166^{a}	1.250^{b}	33.65^{b}	35.15^{a}	46.53^{d}	48.65^{d}
Fulvic acid (500 ppm)	44.21^{i}	47.39^{e}	1^{de}	0.976^{f}	25.16^{i}	29.67^{g}	42.39^{h}	46.08^{f}
Fulvic acid (1000ppm)	46.81^{e}	50.06^{cd}	1.11^{b}	1.666^{c}	28.94^{f}	33.7^{c}	48.58^{b}	49.78^{b}
Fulvic acid (1500ppm)	50.05^{a}	51.65^{c}	1.186^{a}	1.280^{a}	34.14^{a}	35.16^{a}	49.41^{a}	52.09^{a}

Same letters within a separate column indicate non-significant difference among treatments in each season at 0.05 level of probability.

2. Fruit Set and Drop (%), Number of fruits /tree and Yield(kg/ tree)

Fruit set (%), yield as Kg/ tree significantly were enhanced and the percentage of fruit drop was reduced by the spraying of, tryptophan, biozyme and fulvic acid compared to the control, **Table (3)**. The greatest worth for fruit set (11.99 and 13.04 %), number of fruits/ tree (299.72 and 301.79) and yield (47.00 and 49.23 kg/ tree) and the least percentage of fruit drop was (88 and 86.95) for the 2021 and 2022, respectively. were obtained by the treatment of 1500 ppm fulvic acid. Productivity of pear was indeed dependent on proper conditions; especially temperatures, which negatively affect fruit set and yield, bio-stimulants may be crucial for increasing yield while lowering the ecological impact of fertilizer output and nutrient leaching into aquifer.

Spraying tryptophan enhanced yield, according to **Abd-Elkader *et al*. (2020)**. It enhances berry set by stopping the early flower and berry decline is crucial for the operation of the enzyme generation catalyses auxin synthesis response and as a result, berry set is improved (**Saburi *et al*., 2014**). Concerning the action of tryptophan, endogenous IAA is thought to prevent ethylene from initiating abscission processes **(Kim *etal*., 2001)**.

Consistent with the results of the current study, the collaborative effects of biozyme recorded an increase in fruit yield in apple cv. Red Delicious (**Ries*et al*., 1978; Sharma, 1990**). In the current study in Table (3), the reduction in flower dropping and fruit sets being more plentiful may result from the influence of cytokinins and auxins, which delays abscission by preserving the loss of pectin material in the middle lamella, (**Kachave and Bhosale, 2007)** and strengthen resilience to nutritional stress and water stress (**Fujioka and Sakurai, 1997**), This increased the blooms' metabolite mobilization and photosynthesis (**Bhatia and Kaur, 1997**), also, the favorable impact of using biozyme on the yield might be due to increase in number of leave shoot and shoot length, consequently, the plants could use more sunshine to produce more. photosynthesis (**Zubair *et al*., 2017**)

Harhash*et al.* (2021) demonstrated that humic acid or fulvic acid boosted vine output**.** In the meantime, the application of 75% mineral-N plus humic or fulvic acids significantly improved yield/vine (**El-Salhy*et al*., 2023**). Molecules of fulvic acid (FA) can easily infiltrate plant stems, leaves, and roots. They convey traces from surfaces into tissues of the plant as they enter these plant components. It can easily bond the minerals and others in to its molecular component, which causes them to decomposed and become mobilized in fulvic complexes cells, which in turn affects plant development and yield (**El-Salhy*et al*.**, 2023).

Table (3): Effect of tryptophan, biozyme and fulvic acid on fruit set (%), fruit drop (%), yield (kg/ tree) and the number of fruits/tree of " Le Conte" pear cv. during 2021 and 2022

Treatments	Fruit Set (%)		Fruit drop (%)		Yield (Kg/tree)		Number of Fruits/ tree	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	7.02^{j}	7.24^{j}	92.97^{a}	92.76^{a}	39.89^{h}	42.65^{f}	284.68^{j}	289.48^{i}
Tryptophan (50 ppm)	8.14^{h}	8.94^{i}	91.85^{c}	91.05^{b}	41.70^{g}	44.31^{e}	287.02^{i}	291.67^{h}
Tryptophan (100 ppm)	8.95^{g}	10.14^{f}	91.04^{d}	89.85^{e}	44.30^{d}	46.34^{d}	289.95^{f}	293.25^{f}
Tryptophan (150 ppm)	10.51^{d}	12.05^{c}	89.49^{g}	87.94^{h}	46.36^{c}	48.50^{b}	293.58^{c}	295.94^{e}
Biozyme (2 ppm)	8.95^{i}	9.28^{h}	91.94^{b}	90.72^{c}	41.62^{g}	44.20^{e}	287.46^{h}	292.73^{g}
Biozyme (4 ppm)	9.06^{f}	10.71^{e}	90.93^{e}	89.29^{f}	43.65^{e}	46.42^{d}	291.03^{e}	297.07^{c}
Biozyme (6 ppm)	11.15^{b}	12.91^{b}	88.84^{i}	87.08^{i}	46.68^{b}	48.65^{b}	298.85^{b}	300.06^{b}
Fulvic acid (500 ppm)	9.36^{e}	9.94^{g}	90.63^{f}	90.05^{d}	41.59^{g}	44.31^{e}	289.04^{g}	293.33^{f}
Fulvic acid (1000ppm)	10.73^{c}	11.57^{d}	89.26^{h}	88.43^{g}	43.02^{f}	46.71^{c}	292.21^{d}	296.82^{d}
Fulvic acid (1500ppm)	11.99^{a}	13.04^{a}	88^{j}	86.95^{j}	47.00^{a}	49.23^{a}	299.72^{a}	301.79^{a}

Same letters within a separate column indicate non-significant difference among treatments in each season at 0.05 level of probability.

3. Physical Characteristics of Fruits

Data in **Table 4**, showed a general improvement in fruit physical parameters; fruit weight (FW), length (FL), diameter (FD) and firmness (FF) by foliar tryptophan, biozyme and fulvic acid applications in compared to control. The application of tryptophan at 150 ppm resulted in a greatest increment of FW, FL and FD in the first season, and fruit FF in the two seasons. In the meantime, fulvic acid at 1500 ppm caused remarkable increment in both FW and FL in the second season and FD in both seasons.

L-tryptophan (TRP), an amino acid and a precursor of IAA, is used to promote citrus fruit set and size. Application of DL-TRP (10-7 M) on 'Frost' nucellar navel orange trees grown for commercial purposes at the end of cell division stage in fruit development (July), when fruit were at most peel thickness, greatly enhanced the 4-year cumulative total yield and yield of

commercially valuable large size fruit (6.9-8.8 cm), which is consistent with a positive effect of L-TRP on fruit set and size (**Pillitteri *et al.*, 2010**). **Mosa *et al.* (2021)** found a high increase in fruit hardness by treatment of tryptophan and glycine on apple fruits.

Biozyme regulates the plant bio-physiological activities, which maintained higher photosynthetic activity even during the period of fruit growth and development, resulting in higher yield and yield characteristics (**Zubair *et al.*, 2017**). Moreover, it might increase the uptake of elements along with water and thereby, raised the chlorophyll concentration, which in turn enhanced the production; a positive linear association was discovered between the total number of fruits per tree and the weight of the fruits with the total chlorophyll content (**Sau *et al.*, 2015**). The improve in size of fruits by biozyme treatment could attribute to cell divide and cell elongate in growth process due to auxins, indols and cytokinins (**Zubair *et al.*, 2017**).

75% mineral-N plus fulvic and humic acids mostly improved berry weight (**El-Salhy*et al.*, 2023**).

Table (4): Effect of tryptophan, biozyme and fulvic acid on fruit weight (g), length (cm), diameter (cm) and firmness (Ib/ inch^2) of " Le Conte" pear cv. during 2021 and 2022

Treatments	Fruit Weight (g)		Fruit Length (cm)		Fruit Diameter (cm)		Fruit Firmness (Ib/ inch^2)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	140.15^{i}	145.34^{i}	7.13^{h}	7.32^{h}	5.12^{f}	5.22^{g}	12.42^{f}	12.46^{h}
Tryptophan (50 ppm)	145.3^{g}	151.93^{g}	7.36^{e}	7.78^{e}	5.27^{d}	5.41^{e}	12.56^{e}	12.67^{e}
Tryptophan (100 ppm)	152.78^{d}	158.03^{d}	7.76^{bc}	7.93^{c}	5.4^{b}	5.61^{d}	12.71^{c}	12.77^{d}
Tryptophan (150 ppm)	157.91^{a}	163.91^{b}	7.87^{a}	8.18^{b}	5.47^{a}	5.69^{b}	12.93^{a}	13.01^{a}
Biozyme (2 ppm)	144.81^{g}	151.02^{h}	7.31^{f}	7.73^{f}	5.20^{e}	5.4^{e}	12.45^{f}	12.60^{f}
Biozyme (4 ppm)	150^{e}	156.27^{f}	7.77^{b}	7.81^{e}	5.31^{c}	5.59^{d}	12.58^{e}	12.84^{c}
Biozyme (6 ppm)	156.22^{c}	162.15^{c}	7.76^{bc}	8.17^{b}	5.41^{b}	5.65^{c}	12.72^{c}	12.95^{b}
Fulvic acid (500 ppm)	143.90^{h}	151.02^{h}	7.27^{g}	7.68^{g}	5.22^{e}	5.36^{f}	12.43^{f}	12.55^{g}
Fulvic acid (1000ppm)	147.24^{f}	157.39^{e}	7.63^{d}	7.88^{d}	5.31^{c}	5.59^{d}	12.63^{d}	12.79^{d}
Fulvic acid (1500ppm)	156.84^{b}	168.13^{a}	7.73^{c}	8.29^{a}	5.48^{a}	5.77^{a}	12.83^{b}	12.95^{b}

Same letters within a separate column indicate non-significant difference among treatments in each season at 0.05 level of probability.

4. Fruit quality

The results in Table (5) showed that, the foliar spray of tryptophan, biozyme and fulvic acid had a beneficial effect on the fruit biochemical parameters in comparison to control treatment. The exogenous application of tryptophan at 15 ppm considerably increased the total soluble solids (11.63, 11.74 %), total sugars (8.06, 8.23 %), reducing sugars (5.12 and 5.57 %) in 2021 and 2022, respectively, while had the highest significant increase in TSS/ Acid (50.73) in 2022 and non- reducing sugars (2.93%) in the first season. In the meantime, fulvic acid at 1500 ppm significantly increased the TSS/ Acid (40.62 and 50.48 in 2021 and 2022 resp.), in one side and reducing sugars 5.14 % in the first season, in the other side. Acidity (%) and ascorbic acid (mg/100 ml) showed a reduction pattern as a result of application with tryptophan, biozyme and fulvic acid compared with control. In 2021, the lowest significant value was 0.283 %, which obtained by 1500 ppm fulvic acid and 0.290 % obtained by the foliar application of 6 ppm biozyme, while the least value was 0.256 % obtained by tryptophan at 150 ppm and fulvic acid at 1500 ppm, in the second season. Whereas, in the first season, the least value in ascorbic acid was 13.18 and 13.20 mg/ 100 ml resulted from 150 ppm tryptophan and 6 ppm biozyme treatments respectively, while, the lowest value was14.07 mg/100 ml obtained by 1500 ppmfulvic acid in the second season.

Due to their vital role in producing chlorophyll molecules, which in turn had an impact on carbohydrates, amino acids had a promoting effect on the overall amount of carbohydrates (**Ahmed *et al.*, 2017**). Data reported by **Mosa *et***

***al*. (2021)** cleared that spraying glycine and tryptophan amino acids at 25, 50, and 100 ppm and their combinations over the course of two seasons significantly enhanced the fruit content of "Anna" apple as TSS %, total sugars, and reduced sugars, in contrast, they found a significant reduction in fruit acidity in comparison with control.

In the meantime, biozyme application stimulates the functioning of number of enzymes, higher TSS and total sugars content was the outcome of physiological mechanisms that hydrolyzed starch and assisted in the metabolic activity during the conversion of available starch into sugar, which had been cleared by **Jain (2006**). Our data showed that biozyme significantly improved the fruit quality (**Table 5**). Similarly, (**Sau *et al*., 2015**) revealed that biozyme application increased TSS, total sugars and ascorbic acid content in guava. The improved fruit quality in higher TSS, total sugars and ascorbic acid and lower fruit acidity possibly a result of the treated plants growing more vegetatively, which led to more photosynthates being produced (starch, carbohydrates etc.), the transfer to the fruits, raising the concentration of several fruit quality parameters (**Dutta *et al*. 2014**).

Utilizing fulvic acid increased SSC% and SSC/acidity ratio while lowering the proportion of total acidity (**Abd El-Hameed *et al*., 2014),** it resembles the auxin hormone in plants, which is important for potassium absorption and starch metabolism. In grapevines, fulvic acid significantly enhanced the percentages of total sugars (**El-Salhy*et al*., 2023)**. Like our findings, **Zancani*et al*. (2011)** found that fulvic acids can play a beneficial role in the transport of hormones within plants and can increase intercellular ATP and glucose-6-phosphate levels, which have a positive correlation with the promotion of Greek fir cell culture growth. It promotes specific physiological processes that increase the pH of juice, and the vitamin C content of lemons (Citrus limon).

Table (5): Effect of tryptophan, biozyme and fulvic acid on fruit TSS(%), acidity (%), TSS/Acidity, ascorbic acid (mg/ 100ml) and total, reducing and non-reducing sugars of " Le Conte" pear cv. during 2021 and 2022

Treatments	Total soluble solids TSS (%)		Acidity (%)		TSS/Acidity		Ascorbic acid (mg/ 100 ml)		Total sugars (%)		Reducing sugar (%)		Non- reducing sugars (%)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Control	10.64^{h}	10.73^{i}	0.453^{a}	0.426^{a}	23.48^{g}	29.21^{e}	13.93^{a}	14.89^{a}	7.14^{i}	7.23^{i}	4.80^{g}	4.90^{g}	2.34^{e}	2.33^{f}
Tryptophan (50 ppm)	10.95^{f}	11.07^{f}	0.416^{b}	0.380^{b}	26.29^{f}	33.35^{d}	13.62^{c}	14.76^{b}	7.35^{g}	7.46^{g}	4.89^{de}	5.13^{e}	2.45^{d}	2.32^{f}
Tryptophan (100 ppm)	11.25^{d}	11.29^{e}	0.383^{c}	0.330^{c}	29.36^{e}	38.72^{c}	13.37^{d}	14.52^{d}	7.75^{d}	7.83f	4.96^{c}	5.28^{d}	2.78^{b}	2.54^{d}
Tryptophan (150 ppm)	11.63^{a}	11.74^{a}	0.310^{f}	0.256^{e}	37.55^{b}	50.73^{a}	13.18^{f}	14.35^{e}	8.06^{a}	8.23^{a}	5.12^{a}	5.57^{a}	2.93^{a}	2.66^{b}
Biozyme (2 ppm)	10.87^{g}	10.92^{g}	0.390^{c}	0.386^{b}	27.90^{ef}	32..61^{d}	13.62^{c}	14.64^{c}	7.29^{h}	7.39^{h}	4.85^{ef}	5.05^{f}	2.44^{d}	2.34^{f}
Biozyme (4 ppm)	11.14^{e}	11.35^{d}	0.356^{d}	0.323^{c}	31.23^{d}	39.74^{c}	13.39^{d}	14.32^{e}	7.59^{e}	7.95^{e}	4.93^{cd}	5.34^{c}	2.65^{c}	2.60^{c}
Biozyme (6 ppm)	11.43^{c}	11.57^{b}	0.290^{g}	0.276d	39.47^{a}	46.88^{b}	13.20^{ef}	14.24^{f}	7.95^{b}	8.07^{c}	5.01^{b}	5.51^{b}	2.94^{a}	2.56^{d}
Fulvic acid (500 ppm)	10.94^{f}	10.87^{h}	0.413^{b}	0.390^{b}	26.50^{f}	32.21^{d}	13.74^{b}	14.66^{c}	7.45^{f}	7.37^{h}	4.82f^{g}	4.93^{g}	2.63^{c}	2.43^{e}
Fulvic acid (1000ppm)	11.26^{d}	11.50^{c}	0.333^{e}	0.336^{c}	33.82^{c}	38.02^{c}	13.41^{d}	14.27^{f}	7.80^{c}	8.02^{d}	4.97^{bc}	5.16^{e}	2.83^{b}	2.86^{a}
Fulvic acid (1500ppm)	11.49^{b}	11.61^{b}	0.283^{g}	0.256^{e}	40.62^{a}	50.48^{a}	13.24^{e}	14.07^{g}	7.98^{b}	8.12^{b}	5.14^{a}	5.51^{b}	2.84^{b}	2.61^{c}

Same letters within a separate column indicate non-significant difference among treatments in each season at 0.05 level of probability

5. Foliage Mineral Composition

The influence of tryptophan, biozyme and fulvic acid as foliar applications on minerals in leaf of Le Conte trees were shown in Table 6. In general, all treatments improved the levels of minerals in comparison with the control, biozyme at 6 ppm treatment had the increment and significant value in P (0.710 and 0.770 %), K (1.81 and 1.91 %) and Cu (10.44 and 11.41 ppm) respectively. in 2020 and 2021. Fulvic acid at 1500 ppm estimated the highest value of N (2.33 and 2.43 %), Mn (142.89 and 149.56 ppm) and Cu (10.84 and 11.73 ppm), the increment value in leaf Zn ppm (119.03 and 123.52) was obtained by 150 ppm tryptophan in the two seasons.

Tryptophan appeared to be beneficial in increasing the N, P, K and Mg (%) in leaves (**El-Kenawy**, **2022**). Tryptophan clearly improved the vegetative behavior and nutrient absorption, the plant uses acid ions quickly, allowing them to enter its cells where they activate the carbon-methane cycle and increase photosynthesis by allowing them to enter cells where they can install photosynthesis-specific enzymes (**Villarreal *et al*., 2012; Khalil *et al*., 2023**). According to **Souri and Hatamian (2019)**, most amino acids form chelates with certain nutrients and have an affinity for these nutrients. They added that these characteristics help them to improve the uptake and delivery of micronutrients, particularly Fe, in plants (**Basanth and Mahesh 2018; Souri*et al*. 2017**). According to **Radkowski *et al*. (2018)**, foliar applied with an amino acid preparation boosted the concentration of the investigated macro components. In the meantime, **Mosa *et al*. (2021)** treated Anna apple trees with 25, 50 and 100 ppm glycine or tryptophan and their combinations, and found a significant increase in N, P, K, Ca, Fe, Zn, Mn, and B.

Considering the findings of our study, the collaborative effects of biozyme as biostimulants in improving the macro and micro elements is shown in Table (5). Similar results were observed by **Sau *et al*. (2015)**, they noticed a significant increase in macro and micro-nutrient at guava leaves, the enhancement in leaf nutrient content as a result larger flow of these nutrients from the source to sink (**Mohammed and Naile, 2020**). Foliar spray of biozyme (bio growth regulators) merges the properties of natural extract from living organisms and mineral content improves the absorption of the plant to significantly boost its uptake capacity **(Kumar *et al*., 2021)**.

In comparison to the control, the foliar application of FA increased the leaf mineral content of nitrogen, phosphorous, potassium, zinc, manganese, and iron in apricot (**Haggag *et al*. 2016**), it typically contains 70 or more minerals and trace elements in its molecular complexes (**Aiken *et al*., 1985**), which increases nutritional status, and leaf pigments while acting as a chelating agent for nutrients (**Mostafa *et al*., 2017; El-Salhy*et al*., 2023**). According to **Bocanegra *et al*. (2006),** fulvic acid has the power to chelate nutrients like Fe and transport them through cell membranes. They also noted that it is more acidic overall, contains more carboxyl groups than humic acid, has stronger adsorption and cation exchange capabilities, and may act as a natural chelator in the movement and transfer of micronutrients.

Table (6): Effect of tryptophan, biozyme and fulvic acid on foliage macro (N, P and K %) and micro (Fe, Mn, Zn and Cu ppm) elements of " Le Conte" pear cv. tree during 2021 and 2022

Treatments	N(%)		P(%)		K(%)		Fe(ppm)		Mn(ppm)		Zn (ppm)		Cu (ppm)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Control	1.72^{g}	1.82^{h}	0.530^{f}	0.576^{e}	1.31^{h}	1.45^{h}	106.96^{j}	110.32^{h}	102.62^{h}	106.35^{i}	78.73^{g}	82.51^{i}	6.14^{d}	7.48^{d}
Tryptophan (50 ppm)	1.85^{f}	1.94^{f}	0.580^{def}	0.626^{d}	1.44^{g}	1.55^{g}	112.82^{i}	118.21^{g}	114.15^{g}	117.51^{h}	97.59^{c}	103.83^{e}	7.48^{c}	9.31^{c}
Tryptophan (100 ppm)	1.96^{e}	2.05^{d}	0.606^{bcde}	0.683^{c}	1.68^{d}	1.71^{d}	129.69^{f}	131.22^{e}	120.73^{e}	125.08^{g}	103.85^{b}	107.27^{d}	9.14^{b}	10.51^{b}
Tryptophan (150 ppm)	2.12^{c}	2.19^{c}	0.643^{bc}	0.720^{b}	1.73^{bc}	1.81^{c}	160.46^{a}	165.1^{b}	126.17^{d}	133.8^{d}	119.03^{a}	123.52^{a}	10.50^{a}	11.25^{a}
Biozyme (2 ppm)	1.86^{f}	1.89^{g}	0.560^{ef}	0.586^{e}	1.51^{f}	1.61^{f}	117.47^{h}	124.54^{f}	117.79^{f}	126.30^{f}	85.11^{f}	88.58^{h}	7.61^{c}	8.92^{c}
Biozyme (4 ppm)	2.04^{d}	1.97^{e}	0.660^{ab}	0.706^{b}	1.70^{cd}	1.78^{c}	144.93^{d}	157.72^{c}	125.19^{d}	133.37^{d}	91.80^{e}	96.88^{f}	9.05^{b}	10.62^{b}
Biozyme (6 ppm)	2.19^{b}	2.35^{b}	0.710^{a}	0.770^{a}	1.81^{a}	1.91^{a}	125.19^{g}	131.22^{e}	133.03^{c}	139.96^{c}	103.07^{b}	118.19^{b}	10.44^{a}	11.41^{a}
Fulvic acid (500 ppm)	1.86^{f}	1.92^{fg}	0.613^{bcde}	0.570^{e}	1.46^{g}	1.56^{g}	137.44^{e}	145.84^{d}	120.08^{e}	128.59^{e}	85.55^{f}	93.10^{g}	7.36^{c}	9.03^{c}
Fulvic acid (1000ppm)	2.07^{d}	2.17^{c}	0.600^{cde}	0.676^{c}	1.63^{e}	1.67^{e}	150.41^{c}	157.68^{c}	137.67^{b}	142.96^{b}	91.82^{e}	103.64^{e}	8.79^{b}	10.28^{b}
Fulvic acid (1500ppm)	2.33^{a}	2.43^{a}	0.636^{bcd}	0.766^{a}	1.74^{b}	1.85^{b}	157.36^{b}	166.86^{a}	142.89^{a}	149.56^{a}	95.79^{d}	110.25^{c}	10.84^{a}	11.73^{a}

Same letters within a separate column indicate non-significant difference among treatments in each season at 0.05 level of probability.

CONCLUSION

Tryptophan, biozyme and fulvic acid applications enhanced significantly the shoot length and thickness, leaf area and chlorophyll, as well as, fruit set (%), the number of fruits per tree, yield (kg/ tree) and decreased the fruit drop (%),in the meantime, they improved the fruit physical and chemical parameters, in addition to leaf mineral content compared to the control in 2021 and 2022. The most noticeable result was obtained by 1500 ppm fulvic acid, 6 ppm biozyme, and 150 ppm tryptophan comparing with other treatments and the control in the two experimental seasons.

REFERENCES

A. O. A. C .2005. Official method of analysis. 18th Edition, Association of Officiating Analytical Chemists, Washington DC, Method 935.14 and 992.24.

Abd El Hameed, M., A. Ali, A. Esis and R. Ahmed. 2014. Reducing mineral N fertilizer partially in Thompson seedless vineyards by using fulvic acid and effective microorganisms. World Rural Observ., 6(4): 36- 42.

Abd El Kader, H. H., Y. M. Hekmat, T.T. El-Baz, and M.A. ElErian. 2020. Effect of amino acids spray on growth, flowering and keeping quality of *Gerbera jamesonii* L. as a pot plant. J. Plant Prod., 11 (2): 201-206.

Abd El Rahman, M. M. A. and A. A. E. Bakr. 2022. Effect of using vermicompost and biofertilizers as partial alternatives for chemical fertilizers on growth and fruiting of Superior grapevines. Scientific J. Agric. Sci., 4(1): 23-32.

Abd ELRahman M.M.A. 2022. Effect of using bio-stimulants and foliar spraying of anti-stressors for counteract the negative effects of climate changes on growth and fruiting of Balady mandarin trees, SVU- Int. J. Agric. Sci., 4 (1): 153-167.

Agricultural Statisics Institute 2019. Agricultural Statistics Institute, summer and Nile crops, Egypt, 2(1): 334-339.

Ahmed, F. K., N. A. Hamed, M. A. Ibrahim and A. M. ELazazy. 2017. Effect of tryptophan and some nutrient elements foliar application on yield and fruit quality of Washington Navel orange. J. Hortic. Sci. Ornam. plants, 9 (2): 86-97. DOI: 10.5829/idosi.jhsop.2017.86.97

Aiken, G.R., D.M. McKnight and P. MacCarthy. 1985. Humic substances of soil, sediment and water. New York, Wildy-Interscience.

Barghout F A and K. H. Mohammed. 2023. Effect of spraying with tryptophan and glycine on some anatomical characteristics of kumquat and local lemon seedlings. Texas J. Agric. Biol. Sci., (14):92- 101. https://zienjournals.com/

Basanth N. and G.Mahesh. 2018. Bio-efficacy of Nova Nutri Boost for yield and yield components in paddy (Oryza sativa L.). Int. J. Curr. Microbiol. App. Sci. 7:2250–2253

Bashir, M. A., A. Rehim, H. M. Qurat-Ul-Ain Raza, A. Raza, L. Zhai, H. Liu, H. Wang, F. Ahmad and S. Muhammad (2021). Biostimulants as plant growth stimulators in modernized agriculture and environmental sustainability. 10.5772/intechopen.98295.

Bhatia, D. and J. Kaur. 1997. Effect of homobrassinolide and humicil on chlorophyll content, hill activity and yield components in mung bean (*Vigna radiata* L. Wilczek). Phytomorphol.,47(4): 421-426.

Bocanegra, M., J. C. Lobartini and G. A. Orioli. 2006. Plantuptake of iron chelated by humic acids of different molecular weights. Commun. Soil Sci. Plant Anal., 37(1-2): 239-248.

Chen, Y., M. De Nobili and T. Avid. 2004. Stimulatory effects of humic substances on plant growth. In: F. MAGDOFF, R. R. WEIL (Eds.): Soil Organic Matter in Sustainable Agriculture, 103-129 CRC Press, New York, USA.

Chuntanaperb, N. and G. Cummings. 1981. Seasonal trends in concentration of nitrogen, phosphorus, potassium, calcium and magnesium in leaf portions of apple, blueberry, grape and peach. J. Amer. Soc. Hort. Sci., 105(6): 933

Cottenie, A. 1980. Soils and plant testing as a basis of fertilizer recommendation. FAO Soil Bull., pp: 3812

Demirsoy, H.J.F. (2009). Leaf area estimation in some species of fruit tree by using models as a non-destructive method. Fruits, 64,45–51.

Dubois, M., K.A. Cilles, J.K.Hamilton, P.A. Rober and F. Smith. 1956. Colorimetric method for determination of sugar and related substances. Anal. Chem.., 28: 350-356.

Dutta, K., C.Y. Tsai, W.-H. Chen and J.G. Lin. 2014. Effect of carriers on the performance of anaerobic sequencing batch biofilm reactor treating synthetic municipal wastewater. Int. Biodeterior. Biodegradation, 95: 84-88. DOI:10.1016/j.ibiod.2014.04.021

El-Kenawy, M. A. 2022. Effect of tryptophan, proline and tyrosine on vegetative growth, yield and fruit quality of Red Roumy grapevines. Egypt. J. Hort. 49, (1): 1- 14.

El-Salhy A M., M M. Al-Wasfy, E H. Salem and O G.E.M. Abdalla. 2023. Minimizing mineral-N fertilization Superior Seedless grapevines by

using humic and fulvic acids. Assiut J. Agri. Sci., 54 (1): 227-238.

El-Sese, A.M., A.K.A. Mohamed, E.A.A. Abou Zaid and A.M.M. Abd-El-Ghanym. 2020. Impact of foliar application with seaweed extract, amino acids and vitamins on yield and berry quality of some Grapevine cultivar. SVU- Int. J. Agric. Sci., 2(1): 73-84.

Estefan, G., R. Sommer and J. Ryan. 2013. Methods of soil, plant, and water analysis: A manual for the West Asia and North Africa region. Int. Cent. Agric. Res. Dry Areas (ICARDA) 2013, 134299328.

Evenhuis, B. and B.W. De waard, 1980. Principles and practices in plant analysis.FAO Soils Bulletin, 38(1): 152-163.

F.A.O., 2019. The state of food security and nutrition in the world 2019: Safeguarding against Economic Slowdowns and Downturns; FAO: Rome, Italy, 2019; Licence: CC BY-NC-SA 3.0 IGO. Rome.

Fujioka, S. and A. Sakurai. 1997. Biosynthesis and metabolism of brassinosteroids. Physiol. Plant.,100 (3): 710-715.

Haggag, L. F., M. Fawzi, M. Shahin and E. S. EL-Hady. 2016. Effect of yeast, humic acid, fulvic acid, citric acid, potassium citrate and some chelated micro-elements on yield, fruit quality and leaf minerals content of "Canino" apricot trees. Int. J. Chem. Tech. Res., 9 (4): 07-15.

Harhash M. M., N.A. Abd EL-Megeed, A. S. Abaidalah and W. F. A. Mosa. 2021. Effect of the foliar spraying of fulvic acid, folic acid, and fruit quality of grape cv. Flame Seedless. Plant Arch., 21 (1): 482-492.

Hassan, H., E. Mostafa and M. Saleh. 2009. Effect of foliar spray with biozyme and sitofex on yield and fruit characteristics of Grand Nain banana. Green Farming, 2(10): 661- 663.

Jackson, J. E. 2003. Biology of apples and pears, 1st ed., Cambridge, 488p.

Jackson, N.L. 1958. Soil chemical analysis. Constable. Ltd. Co. London, pp: 498.

Jain, P. 2006. Fruit drop, yield and quality of mango as influenced by biozyme and urea sprays. Indian J. Hortic., 63(4): 453-454.

Johnson, C. M. and A. Ulrich. 1959. Analytical methods for use in plant analysis. Bulletin of the California Agricultural Experiment Station.

Kachave, D. and A. Bhosale. 2007. Effect of plant growth regulators and micronutrients on fruiting and yield parameters of Kagzi lime (*Citrus aurantifolia* Swingle) fruits. Asian J. Hortic., 2(2): 75-79.

Khalil, H Y, M. Ismail and Z. Kazem. 2023. Response of papaya seedlings to foliar application of tryptophan and agazone on some growth parameters. IOP Conf. Ser.: Earth Environ. Sci. 1158 042012. Fifth International Conference for Agricultural and Environment Sciences. doi:10.1088/1755-1315/1158/4/042012

Khan, O. A., J. A. Sofi, N. A. Kirmani, G. I. Hassan, S. A. Bhat, M. H. Chesti and S. M. Ahmad. 2019. Effect of N, P and K nano-fertilizers in comparison to humic and fulvic acid on yield and economics of red delicious (*Malus domestica*Borukh.), J. Pharmacogn. Phytochem., 8(2): 978-981

Kim, J.H., W.T. Kim and B.G. Kang. 2001. IAA and N6-benzyladenine inhibit ethylene-regulated expression of ACC oxidase and ACC synthase genes in mung bean hypocotyls. Plant Cell Physiol., 42: 1056-1061.

Kisvarga, S., D. Farkas, G. Boronkay, A. Neményi and L. Orlóci. 2022. Effects of Biostimulants in horticulture, with emphasis on ornamental plant production. Agron.,12(5): 1043.

Kumar, M., M. Tomar, R. Amarowicz, V. Saurabh, M. S. Nair, C. Maheshwari, M. Sasi, U. Prajapati, M. Hasan and S. Singh. 2021. Guava (*Psidium guajava* L.) leaves: nutritional composition, phytochemical profile, and health-promoting bioactivities. Foods 10(4): 752-772.doi: 10.3390/foods10040752

Maeda, H. and N. Dudareva. 2012. The shikimate pathway and aromatic amino acid biosynthesis in plants. Ann. Rev. Plant Biol., 63(1): 73-105.

Magness, J.R. and G.P. Taylor. 1925. An improved type pressure tester for the determination of fruit maturity. U.S. Dept. Agric. Circ., 350, 8p.

Mahdi, A. N., K. M. Abdullah and A. A.H. Almyali, 2023. Effect of spraying with amino acids (Tryptophan and glycine) and nano-potassium on some vegetative growth characteristics of stevia plant (*Stevia rebaudiana* Bertoni). IOP Conf. Series: Earth and Environmental Science 1158 (2023) 102004 doi:10.1088/1755-1315/1158/10/10200

Malik, C.P. and M.B. Singh. 1980. Plant enzymology and histoenzymology. A textmanual. Kalyani. Publishers, New Delhi.

Manna, D., A. Sarkar and T. Maity. 2012. Impact of biozyme on growth, yield and quality of chilli (*Capsicum annuum* L.). J. Crop Weed, 8(1): 40-43.

Mohammed, S. A. and M. H. Naile. 2020. Effect of mycorrhiza inoculation and biozyme spray on the content of leaves and fruits of nutrients elements of summer squash. Diyala Agric. Sci. J. (special Issue): 558-570.

Mosa, W F. A., H M. Ali and N R. Abdelsalam. 2021. The utilization of tryptophan and glycine amino acids as safe alternatives to chemical fertilizers in apple orchards. Environ. Sci. Pollut. Res., 28:1983–1991

Mosa, W.F.A., N.A. Abd EL-Megeed, N.A. Ali, H.S. Abada, H.M. Ali, M.H Siddiqui and L. Sas-Paszt. 2022. Preharvest foliar applications of citric acid, gibberellic acid and humic acid improve growth and fruit quality of 'Le Conte' pear (*Pyrus communis* L.). Hortic., 8: 507. https://doi.org/10.3390/horticulturae8060507

Mostafa, M. F. M., M. S. EL-Boray, E. L. El-Baz, and , A. S. Omar. 2017. Effect of fulvic acid and some nutrient elements on king ruby grapevines growth, yield and chemical properties of berries. J. Plant Prod., 8(2): 321-328. DOI: 10.21608/jpp.2017.39630

Öpik, H. and S.Rolfe. 2005. The physiology of flowering plants, Cambridge Univ. Press 5, Plant Growth hormones. 4th Ed.pp.:177-194.

Pillitteri, L.J., I. Bertling, T. Khuong, C.T. Chao, and C.J. Lovatt. 2010. Foliar applied tryptophan increases total yield and fruit size of Navel orange and Clementine mandarin. Acta Hortic. 884: 729-736. doi.org/10.17660/ActaHortic.2010.884.99

Piper, C. S. 1950. Soil and plant analysis. Univ. of Adelaide, Australia.

Radkowski A, I. Radkowska and D. Godyn. 2018. Effects of fertilization with an amino acid preparation on the dry matter yield and chemical composition of meadow plants. J. Elem., 23(3): 947-958. doi: 10.5601/jelem.2017.22.4.1511

Ries, S. K., T. L. Richman and V. F. Wert .1978. Growth and yield of crops treated with triacontanol. J. Am. Soc. Hortic. Sci.,103(3): 361-364.

Russel, D.G. (1986). MSTAT-C Package Program. Crop and Soil Science Department, Michigan State University, USA.

Saburi, M., R. Mohammad, H. Sayed, S. Mohammad and D.Taghi, 2014. Effects of amino acids and nitrogen fixing bacteria on quantitative yield and essential oil content of basil (*Ocimumbasilicum*). Agric. Sci. Dev., (8): 265-268

Sanzol, J. and M. Herrero. 2001. The effective pollination period in fruit trees, Sci. Hortic., 90(1-2): 1-17.

Sau, S., B. Ghosh, S. Sarkar and P. Deb. 2015. Effect of foliar application of biozyme on yield and physico-chemical properties of rainy season crop of guava (*Psidium guajava* L.) cv. Allahabad Safeda in alluvial soil of West Bengal, Int. J. Bio-res. Env. Agril. Sci., 1(4) :177-186. www.sbear.in // ISSN 2454-3551

Sharma, D.P. 1990. Effect of some bioregulators on growth, yield, fruit quality and nutrient status of apple. M.Sc. Thesis, Dr Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, India

Snedecor, G.W. and W.G. Cochran. 1990. Statistical methods. 7th ed, The Iowa State Univ. Press. Ames., Iowa, U.S.A., p. 593.

Souri M. K., F.Y. Sooraki and M. Moghadamyar. 2017. Growth and quality of cucumber, tomato, and green bean under foliar and soil applications of an amino-chelate fertilizer. Hortic. Environ. Biotechnol., 58:530–536

Souri, M. K. and M. Hatamian.2019. Aminochelates in plant nutrition: a review. J. Plant Nutr., 42(1): 67-78.

Souri, M.K. 2016. Aminochelate fertilizers: the new approach to the old problem, A review. Open Agriculture, 1(1): 118–123.

Taha, A. A., M. M. Omar, and M. A. Ghazy. 2016. Effect of humic and fulvic acids on growth and yield of lettuce plant. J. Soil Sci. Agric. Eng. 7(8): 517-522. DOI:10.21608/jssae.2016.39782

Taiz, L. and E. Zeiger. 2002. Plant Physiology, Third Ed. Sinauer Associates, Inc. Chapter, 10: 33-46.

Villarreal, S.Q., N. Hernandez, L. Romero, E. Lazcano and A. Dorantes. 2012. Assessment of plant growth promotion by rhizobacteria supplied with tryptophan as phytohormone production elicitor on Axon opus affinis, Agri. Sci. Res. J. 2(11): 574-580.

Yadava, U. L. 1986. A rapid and nondestructive method to determine chlorophyll in intact leaves. HortScience 21(6): 1449-1450.

Zancani, M., A. Bertolini, E. Petrussa, J. Krajňáková, A. Piccolo, R. Spaccini and A. Vianello. 2011. Fulvic acid affects proliferation and maturation phases in Abiescephalonica embryogenic cells. J. Plant Physiol., 168 (11): 1226-1233.

Zubair, M., F. Banday, U. I. Waida, J. A. Baba and S. Hussain. 2017. Effect of Bio-stimulants

on improving floral characteristics, yield and quality of apple cv. Red Delicious, Br. J. Appl. Sci Technol. 21(2): 1-9.

الملخص العربى

استجابة اشجار الكمثرى صنف ليكونت لمعاملات الرش ببعض المنشطات الحيوية

ريحاب محمد عوض

قسم الانتاج النباتى (البساتين– الفاكهه) كلية الزراعة – سابا باشا – جامعة الاسكندرية

تمت هذه التجربة خلال عامى 2021 و 2022 لدراسة دور الرش بالتربتوفان و البيوزيم وحامض الفولفيك على اشجار الكمثرى صنف الليكونت و المنزرعة فى مزرعة خاصة – يرج العرب – الاسكندرية. تصميم التجربة قطاعات عشوائية كاملة. تم تطبيق 10 معاملات بأربع مكررات فى ثلاث مواعيد: فى بداية موسم النمو– أثناء الازهار الكامل وبعد عقد الثمار بشهر. وكانت المعاملات هى: الكنترول– التربتوفان بتركيز 50 و 100 و 150 جزء فى المليون– البيوزيم بتركيز 2 و4 و6 جزء فى المليون– وحامض الفولفيك بتركيز 500 و 1000 و 1500 جزء فى المليون. وكانت النتائج كالاتى: أدت جميع المعاملات تحت التجربة الى تحسين طول وسمك الفرخ الخضرى (سم) والمساحة الورقية سم^2 و الكلوروفيل الكلى SPAD مقارنة بالكنترول. وكانت أعلى قيمة لطول الفرخ الخضرى نتجت من المعاملة 1500جزء فى المليون حمض الفولفيك فى عام 2021 و المعاملة 6 جزء فى المليون بيوزيم لعام 2022. كما أعطت المعاملة 1500 جزء فى المليون حمض الفولفيك أعلى قيم لسمك الفرخ (سم) – المساحة الورقية (سم^2) و الكلوروفيل الكلى (SPAD) –النسبة المئوية لعقد الثمارو عدد الثمار لكل شجرة و المحصول بالكجم/ شجرة بينما ادى الى اقل نسبة مئوية لتساقط الثمار خلال موسمى الدراسة. أدت جميع المعاملات الى تحسين الصفات الفيزيائية و الكيميائية: حيث أدت المعاملة 1500 جزء فى المليون حامض الفولفيك الى اعلى زيادة فى وزن (جم) وطول الثمار (سم) فى الموسم الثانى وقطر الثمار (سم) فى الموسمين. المعاملة 150 جزء فى المليون من التربتوفان ادت الى اعلى قيمة كنسبة مئوية للمواد الصلبة الذائبة الكلية و السكريات الكلية و المختزلة فى الموسمين و النسبة بين المواد الصلبة الذائبة الكلية الى الحموضة فى موسم 2022 و السكرات الغير مختزلة للموسم الاول. كما ادت المعاملة 1500 جزء فى المليون حامض الفولفيك الى اعلى زيادة معنوية لنسبة المواد الصلبة الذائبة الكلية الى الحموضة للموسمين من جانب وايضا كاعلى نسبة مئوية للسكريات المختزلة خلال الموسم الاول من جانب اخر. وعلى العكس: ادت جميع المعاملات الى انخفاض النسبة المئوية للحموضة وحمض الاسكوربيك (مجم/ 100 مل) مقارنة بالكنترول. ايضا جميع المعاملات عملت على تحسين محتوى الاوراق من العناصر مقارنة بالكنترول حيث ان اعلى محتوى من الفوسفور و البوتاسيوم و النحاس خلال الموسمين ناتجة من المعاملة 6 جزء فى المليون من البيوزيم كما ان اعلى قيمة من النيتروجين و المنجنيز و النحاس ناتجة من المعاملة 1500 جزء فى المليون حمض الفولفيك بينما اعلى قيمة لمحتوى الاوراق من الزنك كانت من المعاملة 150 جزء فى المليون تربتوفان خلال الموسمين.