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Effect of Amino Acids and Chitosan Foliar Application on Yield, and Fruit Quality of Mango "Alphonse"

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Abstract: Proper nutritional condition is essential for the fruiting phase of mango trees. In this regard, plant bio-stimulants are substances that improve nutritional and physiological changes, hence boosting production. This study assessed the impact of bio-stimulants, specifically amino acids (tryptophan, cysteine, and methionine) at concentrations of 50, 100, and 200 ppm, and chitosan at 0.05, 0.1, and 0.2%, applied foliarly both singly and in combination, on the productivity and fruit quality of 'Alphonse' mango trees. The experiment was place in a private orchard situated near Tunah Al-Jabal Village, Mallawi Centre, Minia Governorate, spanning two consecutive years, 2021 and 2022. Bio-stimulant leaf treatments were administered in three phases: at the onset of vegetative growth, post-fruit set, and after a one-month. The results indicated no influence between the two greatest concentrations. Foliar application of chitosan was more efficacious than amino acids, particularly at a concentration of 0.2%, followed by 0.1%. The highest mean values for yield, fruit quality, and reduction in total acidity were obtained with 200 ppm amino acids combined with 0.2% chitosan, followed by 100 ppm amino acids with 0.1% chitosan, with no significant difference between the two. Thus, it can be stated that the application of 100 ppm amino acids combined with 0.1% chitosan through foliar spraying three times is the most cost-effective approach for enhancing yield and fruit quality of Alphonse mango.

Key words: Amino acids, Chitosan, Yield, Fruit quality and Mango.

1. Introduction

The mango (*Mangifera indica* L.), belonging to the Anacardiaceae family, is considered one of the main important fruits in tropical and subtropical regions worldwide (**Lal *et al.*, 2022**). It flourishes in a variety of climatic and soil conditions (**Mohamed *et al.*, 2016**). Mango is the second most cultivated fruit in Egypt, following citrus, with productive orchards covering an area of approximately 294100 fed. Producing an estimated 766128 ton of fruit (**Egyptian Ministry of Agriculture, 2021**). The decrease in yield of mango trees grown in the Minia region is considered substantial. The main challenges facing mango growers include a decrease in fruit set percentage, lower yields, and inferior fruit quality. A key factor leading to low yield is inadequate pollination and decreased fertilization, which results in a reduced fruit set and heightened fruit loss. The application of bio-stimulants effectively improved fruit set, quality, and yield. A variety of studies have focused on enhancing the production and quality of mangoes through foliar treatments with different amino acids and chitosan, aimed at increasing the resilience of mango trees against various challenges that lead to reduced yield.

Bio-stimulants are organic compounds consisting of peptides and amino acids that are readily available to plants **(Lobo *et al.*, 2019**). Previous studies have shown the substantial influence of several bio-stimulant compounds on mango yield, fruit quality, and post-harvest shelf life (**Momin *et al.*, 2016; Rana *et al.*, 2023; El-Hoseiny *et al.*, 2024**). Insufficient nutrition levels can lead to reduced crop yield, as plants are deprived of vital nutrients. The application of appropriate nutrient content can significantly improve crop yields by supplying essential minerals (**Mousavi *et al.*, 2022**). Alongside essential macronutrients, bio-stimulants—either natural or synthetic compounds—have attracted attention for their potential to enhance crop yield and quality.

Amino acids serve as bio-stimulants, enhancing plant growth and elevating the nutritional status and quality of plants (**Rouphael and Colla, 2018**). Amino acids enhance abiotic stress alleviation (**Khan *et al.*, 2019**), serve as hormone precursors (**Calvo *et al.*, 2014; Rouphael and Colla, 2018**), facilitate specific physiological signaling factors, modulate nitrogen uptake, promote root growth and development (**Weiland *et al.*, 2015**), and support metabolism of antioxidant (**Teixeira *et al.*, 2018**). The shikimate route, which is initiated by chorismate, is used to synthesise tryptophan, an aromatic amino acid (**Tzin and Galili, 2010**). According to **Maeda and Dudareva (2012),** tryptophan acid is a critical factor in the regulation of auxin production and the promotion of plant development. **Abd-Elkader *et al.* (2020**) demonstrated that the addition of tryptophan acid through spraying found in increased production and enhanced vegetative growth. The plants' total content of chlorophyll and carotenoids increased when tryptophan was administered to the leaves. Tryptophan is essential for the prevention of premature abscission in flowers and fruits. Cysteine is an essential amino acid characterized by the presence of an amino group, a thiol group, and a carboxylic acid group, which serve as reactive centers. The unique structure of Cysteine allows it to function as an effective antioxidant and a proficient scavenger ROS. A thiol side chain reduces oxidative damage caused by biotic and abiotic stimuli through the facilitation of smooth oxidation (**Álvarez *et al.*, 2012 and Genisel *et al.*, 2015)**. Cysteine is essential for the synthesis of various important protective compounds, including glutathione, proteins, phytoalexins, glucosinolates, phytochelatins, thionins, and metallothioneins (**Rausch and Wachter, 2005; Takahashi *et al.*, 2011 & Terzi and Yıldız, 2021**). Methionine is a vital amino acid that plays a significant role in various biological processes. Proteins and carbon metabolism rely on it, with its sulfur-bound methyl group activating S-adenosylmethionine to produce methane (**Lenhart *et al.*, 2015**). The biosynthesis of chlorophyll, cell wall components, polyamines, cellular energy, glucosinolates, and various secondary metabolites is essential. Furthermore, DNA methylation relies on it (**Mekawy, 2019**).

One naturally occurring component is chitosan, industrially produced from crab shells **(Maleki *et al.*, 2022**). This material improves the growth and yield of vegetables and fruits while acting as a protective barrier against viruses, bacteria, and fungi. Chitosan, a biopolymer, has received considerable attention owing to its notable biocompatibility, biodegradability, and bioactivity, suggesting its potential for widespread applications in agriculture. Chitosan serves as an inducer in various plant taxa. It enhances crop yields and stimulates the immune system of plants. Chitosan improved plant efficacy by mitigating the negative impacts of challenging conditions and facilitating growth (**Kazimi and Saxena, 2023).**

The objective of this study is to improve the productivity of Alphonse mango by investigate the impact of varying concentrations of amino acids (tryptophan, cysteine, and methionine) and chitosan, either individually or in combination, on the physiochemical quality and yield of the fruits under Minia conditions.

2. Materials and Methods

2.1. Experimental site and conditions

On 30 Alphonse mango trees with 15-years old grafted onto polyembryonic mango seedling rootstock and planted a spacing of 7 x 7 meters apart in clay soil with a surface irrigation system from Nile in a private orchard in Tunah Al-Jabal Village, Mallawi Center, Minia Governorate was chosen across 2021 and 2022 seasons, to improving its productivity by using some amino acids (tryptophan, cysteine, and methionine) and chitosan at various concentrations. The basal recommended fertilizer was applied to the chosen 30 trees, and they were subjected to annual agricultural practices. The trees that were selected were in good health and exhibited a nearly uniform vigor. Analysis of the orchard soil's physical and chemical properties (Table A) according to **Wilde *et al.* (1985).**

Table (A). Analysis of the orchard soil's physical and chemical properties

Soil characters		**2021/2022**
Particle size distribution (%)	**Sand**	2.29
	Silt	37.11
	Clay	60.60
	Texture class	Clay
EC ppm (1:2.5 extract)		292
pH (1:2.5 extract)		7.37
Organic matter %		2.15
$CaCO_3$ %		2.27
Soil nutrients	**Total N (%)**	0.18
	Available P (ppm)	5.29
	Available K (ppm)	501.5
	Zn (ppm)	2.6
	Fe (ppm)	2.9
	Mn (ppm)	3.7
	Cu (ppm)	0.11

2.2. Examined designs and treatments

This study employed in a Randomized Complete Block Design with three duplicates, one tree per each. This study encompassed 10 treatments utilizing amino acids (tryptophan, cysteine, and methionine) and chitosan at varying doses, applied either singly or in combination three times; firstly, in the beginning of vegetative, secondly after fruit set, then month interval. The applying was lay out using a hand sprayer, ensuring that the fruits were treated until they ran off, as follows:

1. Control (spray with tap water).
2. Amino acid (50 ppm).
3. Amino acid (100 ppm).
4. Amino acid (200 ppm).
5. Chitosan (0.05%).
6. Chitosan (0.1%).
7. Chitosan (0.2%).
8. Amino acid (50 ppm) + chitosan (0.05%).
9. Amino acid (100 ppm) + chitosan (0.1%)
10. Amino acid (200 ppm) + chitosan (0.2%)

Triton B was incorporated as a wetting agent at a concentration of 0.1%. A small quantity of 0.1 N NaOH was introduced to the measured amounts of chitosan to enhance its solubility. The spraying was conducted until there was runoff observed.

2.3. Data collection

The parameters listed below were assessed for each season:

1. **Yield and its components:** At the mid-July harvest in both seasons, the tree produce was collected, the fruits number/ tree was counted, and the average fruit weight (g) was recorded, followed by the measurement of tree yield in Kg/tree.
2. **Fruit quality:** At harvest season, a sample of 15 fruits from each tree was collected to determine their physio-chemical characteristics. The following properties have been determined:
3. **Fruits physical characteristics:** Fruit height (cm), width (cm) and Pulp/fruit ratio.
4. **Fruit's chemical characteristics according to A.O.A.C. (1995)*:***

- The percentage of total soluble solids (TSS %) was determined using a handheld refractometer**.**
- Total acidity (%): assessed by titrating the juice with 0.1 N sodium hydroxide in the presence of phenolphthalein.
- TSS/acid ratio was calculated by dividing the percentage of total soluble solids (TSS) by the percentage of total acidity.
- Vitamin C (mg per 100g) in the juice was quantified by titration using 2,6-dichlorophenol indophenol.
- Sugar content (total, reducing, and non-reducing): Utilizing the volumetric method outlined by **Lane and Eynon (1965**).

2.4. Data analysis

The data were organized into tables and analyzed statistically, with treatment means compared using the New L.S.D. test at a significance level of 5% (**Mead *et al.*, 1993**).

3. Results and Discussion

3.1. Characteristics of the yield and its components

The results obtained and displayed in Table 1 revealed a notable change in fruit number, weight and yield kg/tree across the foliar treatments of amino acids or chitosan at different levels. Results showed that amending Alphonse mango trees with chitosan spraying the trees had significant promotion on fruit number, weight and yield kg/tree than the amino acids. The outstanding results with fruit number, weight and yield kg/tree were obtained when the trees received treatment with 0.2% followed by 0.1% chitosan without significant difference between them. Positive impacts on the fruit's number, weight and yield kg/tree noted on the trees treated with combination between treatments. For both seasons, the same results remained true. As a result, spraying the Alphonse mango trees with amino acids (200 ppm) + chitosan (0.2%) produced the greatest results in fruit number, weight and yield kg/tree. From an economic standpoint, as there was no discernible improvement in production or fruit number, weight and yield kg/tree when the spraying concentration was increased, the greatest results for mentioned traits from economical point was obtained by spraying amino acids (100 ppm) + chitosan (0.1%).

The utilization of amino acid bio-stimulants through foliar sprinkling has the potential to increase crop production. This improvement can be linked to the stimulation of root growth and the increased proliferation of root filaments, and enhanced assimilation of nutrients and water (**Sadak *et al.*, 2023)**. Foliar sprinkling of amino acids has been demonstrated to have a beneficial impact on plants in numerous studies. This encompasses an enhancement in crop productivity through the improvement of chlorophyll content and photosynthetic efficiency, which leads to the accumulation of proteins, polysaccharides, and other nutrients in the edible portions of the plants (**Sadak *et al.*, 2015). Aly *et al.* (2019)** detected that mango treated with a combination of amino acids exhibited the highest yield per vine, fruit number, and weight. The foliar spray of various amino acids at varying concentrations resulted in enhancement of fruit number and superior yield kg/trees of various mango varieties, as observed by **Kheir *et al.* (2021); Abd-Elall (2022) and Hussein and Abd EL-all (2024).**

Chitosan had a beneficial effect on the number and weight of fruits, as well as the total yield kg per tree. This is likely the result of chitosan's capacity to mitigate the loss of water from the outer membrane of berries. **Shiri *et al.* (2013)** asserted that chitosan-based coatings assist in the regulation of respiration rate and ethylene production, which in turn reduces transpiration, regulates weight loss, slows down maturation, and extends the shelf life. **Gad *et al.* (2021), Aly *et al.* (2022), and Mishra *et al.* (2023**) have all reported an increase in mango fruit yield and fruit quality as a result of the administration of chitosan.

Table (1). Alphonse mango tree's fruit number/tree, fruit weight (g) and yield (kg)/tree as affected by foliar spraying with mixture of amino acid and chitosan across 2021 and 2022 seasons

Characteristics / Treatments	Fruits number/tree		Fruit weight (g)		Yield/tree (kg)	
	2021	**2022**	**2021**	**2022**	**2021**	**2022**
Control	520.0	530.5	195.0	192.0	101.4	101.9
Amino acid (50 ppm)	550.5	555.0	197.5	194.0	108.7	107.7
Amino acid (100 ppm)	570.5	570.0	198.2	194.8	113.1	111.0
Amino acid (200 ppm)	585.5	580.5	198.5	195.1	116.2	113.3
Chitosan (0.05%)	570.0	570.0	198.0	194.7	112.9	112.3
Chitosan (0.1%)	589.0	586.0	198.8	195.2	117.1	114.4
Chitosan (0.2%)	604.0	595.0	199.0	195.6	120.2	116.5
Amino acid (50 ppm) + chitosan (0.05%)	594.0	587.0	198.7	195.3	118.0	114.6
Amino acid (100 ppm) + chitosan (0.1%)	616.0	598.0	199.2	195.9	122.7	117.1
Amino acid (200 ppm) + chitosan (0.2%)	630.0	608.0	199.4	196.1	125.6	119.2
New LSD at 5%	**17.0**	**11.0**	**0.4**	**0.5**	**3.2**	**2.4**

3.2. Fruits physical characteristic

It is clear from the result in Table (2) 2 that spraying addition of amino acids and chitosan single or mixed on fruit height, width and pulp/fruit ratio of 'Alphonse' mango trees. The results demonstrated that all treatments were significant at ($P \leq 0.05$) increased of fruit height, width and pulp/fruit ratio as relative to the control treatment trees. A gradual increase in the parameters were observed with the foliar application of chitosan compared to the amino acids, particularly at 0.2%, followed by 0.1%, with no notable change between the two levels. The combination of treatments resulted in a positive increase in fruit physical quality when compared to the solo addition. The maximum fruit height, width and pulp/fruit ratio were (9.1 cm for both seasons), (7.3 & 7.8 cm) and (3.3 & 3.4), respectively achieved with a treatment of amino acids at 200 ppm combined with 0.2% chitosan. This was closely followed by trees that received a foliar application of amino acids at 100 ppm along with 0.1% chitosan, which measured (8.9 cm for both seasons), (7.2 & 7.7 cm) and (3.2 & 3.3), for fruit height, width and pulp/fruit ratio, respectively with no notable difference observed between the two treatments in either season.

The findings are in alignment with the findings of prior research by **Kheir *et al.* (2021), Abd-Elall (2022) and Hussein (2023)** on different varieties of mango. These investigations indicated that the applying of amino acids to the trees improved the physical properties of the fruits, such as length and width. The increased chlorophyll concentration in the leaves accounts for this enhancement, as it augments photosynthesis and the overall health of the studied Alphonse mango. Consequently, these improvements augment the physical attributes of the fruits.

The influence of chitosan on the fruits physical characteristics, as reported by **Gad *et al.* (2021), Soliman *et al.* (2021)** and **Almutairi *et al.* (2023),** indicates that foliar application of chitosan resulted in enhanced physical parameters of Alphonse mangoes, including fruit length, width, and pulp-to-fruit ratio.

Table (2). Alphonse mango tree's fruit height, fruit width and pulp/fruit ratio as affected by foliar spraying with mixture of amino acid and chitosan across 2021 and 2022 seasons

Characteristics / Treatments	Fruit height (cm)		Fruit width (cm)		Pulp/fruit ratio	
	2021	2022	2021	2022	2021	2022
Control	7.2	7.1	5.7	5.9	2.1	2.2
Amino acid (50 ppm)	7.6	7.6	6.2	6.3	2.4	2.5
Amino acid (100 ppm)	8.0	8.1	6.6	6.7	2.7	2.8
Amino acid (200 ppm)	8.2	8.3	6.8	6.9	2.8	2.9
Chitosan (0.05%)	8.1	8.1	6.5	6.8	2.6	2.7
Chitosan (0.1%)	8.4	8.6	6.8	7.2	2.9	3.0
Chitosan (0.2%)	8.5	8.9	6.9	7.4	3.0	3.1
Amino acid (50 ppm) + chitosan (0.05%)	8.5	8.5	6.9	7.3	2.9	3.0
Amino acid (100 ppm) + chitosan (0.1%)	8.9	8.9	7.2	7.7	3.2	3.3
Amino acid (200 ppm) + chitosan (0.2%)	9.1	9.1	7.3	7.8	3.3	3.4
New LSD at 5%	**0.3**	**0.4**	**0.3**	**0.4**	**0.2**	**0.2**

3.3. Chemical quality of fruits

Table 3 demonstrated that the addition of both amino acids and chitosan at varying levels significantly increased the fruit Vitamin C, TSS, TSS/acidity and sugar content (total, and reducing) and decreased total acidity, relative to untreated trees. Additionally, foliar application of amino acids and/or chitosan did not impact the non-reducing sugar in either season. The impact of the highest concentrations surpassed that of the lowest for both seasons. Additionally, the application of 0.2% chitosan enhanced the fruit Vitamin C, TSS, TSS/acidity and sugar content (total, and reducing) and decreased total acidity, with 0.1% following closely, compared to the amino acid concentrations observed across the two seasons. Furthermore, the fruit chemical was notably impacted by the implementation of the combination of treatments, as opposed to the individual application and the unsprayed trees. The highest mean value of fruit Vitamin C, TSS, TSS/acidity and sugar content (total, and reducing) and decreased total acidity were recorded at 200 ppm amino acids combined with 0.2% chitosan, followed closely by 100 ppm amino acids with 0.1% chitosan. However, the differences in these effects were minimal and not statistically significant across the two seasons.

Amino acids are vital components in the production of proteins. Additionally, they serve a vital function in enhancing crop productivity, fruit attributes, and the general growth and development of the trees. **Abd-Elall (2022), Hussein (2023) and Hussein and Abd-Elall (2024)** indicated that the external use of amino acids can increase the chemical quality of mango fruits, including total soluble solids, vitamin C, total sugars, reducing sugars, and fiber content.

The acquired data about the influence of chitosan on fruit chemical quality of mango as (TSS, total acidity, TSS/TA, sugar content and vitamin C) align with those obtained by **Almutairi *et al.* (2023)** demonstrated that the foliar applying of chitosan once, twice, or thrice affected on TSS, carotene, vitamin C, total sugars, reducing sugars, and non-reducing sugars) of mango cultivar, which were increased, and the total acidity % was decreased. **Mishra *et al.* (2023)** demonstrated that the treatment of chitosan at 250 ppm excelled in T.S.S., ascorbic acid, and reducing sugar, along with the lowest titratable acidity.

Table (3). Alphonse mango tree's fruits V.C (mg/100g FW), T.S.S%, total acidity, and T.S.S/acidity as affected by foliar spraying with mixture of amino acid and chitosan across 2021 and 2022 seasons

Charact. / Treatments	V. C mg/100g FW		TSS%		Total acidity%		TSS/acidity ratio		Total sugar%		Reducing sugar %		Non-reducing sugar %	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Control	45.5	45.8	16.4	16.5	0.320	0.330	51.3	50.0	11.4	11.5	4.0	4.1	7.4	7.4
Amino acid (50 ppm)	47.7	48.1	17.0	17.2	0.300	0.306	56.7	56.2	12.0	12.0	4.4	4.5	7.6	7.5
Amino acid (100 ppm)	49.0	49.3	17.4	17.6	0.278	0.283	62.6	62.2	12.4	12.4	4.7	4.8	7.7	7.6
Amino acid (200 ppm)	50.0	50.4	17.6	17.9	0.260	0.264	67.7	67.8	12.6	12.7	4.8	4.9	7.8	7.8
Chitosan (0.05%)	48.9	49.4	17.5	17.6	0.280	0.284	62.5	62.0	12.3	12.5	4.6	4.9	7.7	7.6
Chitosan (0.1%)	50.2	50.8	17.8	18.1	0.258	0.263	69.0	68.8	12.7	12.9	4.9	5.2	7.8	7.7
Chitosan (0.2%)	51.1	51.8	18.0	18.3	0.241	0.245	74.7	74.7	12.9	13.2	5.0	5.4	7.9	7.8
Amino acid (50 ppm) + chitosan (0.05%)	50.2	50.6	17.9	18.0	0.257	0.262	69.6	68.7	12.7	13.1	4.9	5.4	7.8	7.7
Amino acid (100 ppm) + chitosan (0.1%)	51.3	51.9	18.3	18.5	0.235	0.242	77.9	76.7	13.1	13.5	5.2	5.7	7.9	7.8
Amino acid (200 ppm) + chitosan (0.2%)	52.2	52.9	18.5	18.8	0.217	0.223	85.3	84.3	13.3	13.8	5.3	5.9	8.0	7.9
New $LSD_{at\ 5\%}$	1.1	1.2	0.3	0.4	0.019	0.020	7.8	8.0	0.3	0.4	0.2	0.3	N.S	N.S

4. Conclusion

The most favorable outcomes in terms of yield and fruit quality were achieved by treating Alphonse mango trees grown under Minia climatic conditions with 200 ppm amino acids + 0.2% chitosan three times at the onset of growth, once immediately following setting, and again one month later. There were no discernible differences with the next lower concentrations. So, the most cost-effective treatment under Minia conditions was the application of 100 ppm amino acids and 0.1% chitosan to Alphonse mango three times.

References

A.O.A.C. (1995). Association of official Agricultural Chemists, Official methods of analysis, 16th Ed., Washington, DC, USA.

Abd-Elall, E. E. (2022). Amino acids application improves Mango Ewaise (*Mangifera indica* L.) trees growth and fruit quality. Journal of Sohag Agriscience (JSAS), 7(2), 239-248.

Álvarez, C., Ángeles Bermúdez, M., Romero, L. C., Gotor, C. and García, I. (2012). Cysteine homeostasis plays an essential role in plant immunity. New Phytologist, 193(1), 165-177.

Aly, M. A., Abd Elbadea, R., & Awad, R. M. (2022). The Role of Some Growth Stimuli on Mango Growth Performance. Journal of the Advances in Agricultural Researches, 27(4), 710-722.

Aly, M., Harhash, M. M., Mahmoud, R. I. and Kabel, S. A. (2019). Effect of foliar application of potassium silicate and amino acids on growth, yield and fruit quality of 'Keitte' mango trees. Journal of the Advances in Agricultural Researches, 24(2), 238-251.

Calvo, P., Nelson, L. and Kloepper, J. W. (2014). Agricultural uses of plant biostimulants. Plant and soil, 383, 3-41.

Egyptian Ministry of Agriculture (2021). Annual Reports of Statistical Institute and Agriculture Economic Research (Ministry of Agric. and Reclamation), Egypt.

El-Hoseiny, H. M., Helaly, M. N., Elsheery, N. I. and Alam-Eldein, S. M. (2020). Humic acid and boron to minimize the incidence of alternate bearing and improve the productivity and fruit quality of mango trees. HortScience, 55(7), 1026-1037.

Gad, M., Abdel-Mohsen, M. and Zagzog, O. (2021). Improving the yield and fruiting characteristics of Ewais Mango Cultivar by spraying with Nano-chitosan and Nano-potassium silicate. Scientific Journal of Agricultural Sciences, 3(2), 68-77.

Genisel, M., Erdal, S. and Kizilkaya, M. (2015). The mitigating effect of cysteine on growth inhibition in salt-stressed barley seeds is related to its own reducing capacity rather than its effects on antioxidant system. Plant Growth Regulation, 75, 187-197.

Hussein, A. M. (2023). Effect of Amino Acids, Mono-Potassium Phosphate, and Calcium Foliar Application on Flowering, Yield, and Fruit Quality of Mango “Ewaise” Cultivar. Alexandria Science Exchange Journal, 44(2), 225-235.

Abd-Elkader, H. H., Massoud, H. Y., El-Baz, T. T. and El-Erian, M. A. (2020). Effect of amino acids spray on growth, flowering and keeping quality of Gerbera jamesonii L. as a pot plant. Journal of Plant Production, 11(2), 201-206.

Hussein, H. M. and Abd EL-all, E. H. (2024). Influence of Spraying Vermicompost Tea and Amino Acids Enriched by different Nutrients on Growth and Fruiting of Ewaise Mango Trees. Journal of Plant Production, 15(9), 551-559.

Kazimi, R. and Saxena, D. (2023). Significance of chitosan foliar spraying on the growth and yield of vegetable crop under protected cultivation: A Review. Plant Science Today, 10(3), 140-148.

Khan, S., Yu, H., Li, Q., Gao, Y., Sallam, B. N., Wang, H., Liu, P. and Jiang, W. (2019). Exogenous application of amino acids improves the growth and yield of lettuce by enhancing photosynthetic assimilation and nutrient availability. Agronomy, 9(5), 266.

Kheir, A. M., Ding, Z., Gawish, M. S., Abou El Ghit, H. M., Hashim, T. A., Ali, E. F., Eissa, M.A., Zhou, Z., Al-Harbi, M.S. and El-Gioushy, S. F. (2021). The exogenous application of micro-nutrient elements and amino acids improved the yield, nutritional status and quality of mango in arid regions. Plants, 10(10), 2057.

Lal, N., Chandola, J. C., Kumar, A., Ramteke, V., Chack, S., Kumar, P., Swaroop, J., Kumar, V. and Diwan, G. (2022). Pharmaceutical and Nutraceutical values of fruit crops for human health: An overview. *Agricultural Mechanization in Asia, Africa & Latin America, 59, 9631-9644*.

Lane, J. H. and Eynon, L. (1965). Determination of reducing sugars by means of Fehlings solution with methylene blue as indicator AO AC. Washington DCUSA, 490-510.

Lenhart, K., Althoff, F., Greule, M. and Keppler, F. (2015). Methionine, a precursor of methane in living plants. Biogeosciences, 12(6), 1907-1914.

Lobo, J. T., Cavalcante, Í. H. L., Lima, A. M. N., Vieira, Y. A. C., Modesto, P. I. R. and da Cunha, J. G. (2019). Biostimulants on nutritional status and fruit production of mango ‘Kent’in the Brazilian semiarid region. HortScience, 54(9), 1501-1508.

Maeda, H. and Dudareva, N. (2012). The shikimate pathway and aromatic amino acid biosynthesis in plants. Annual review of plant biology, 63(1), 73-105.

Maleki, G., Woltering, E. J. and Mozafari, M. R. (2022). Applications of chitosan-based carrier as an encapsulating agent in food industry. Trends in Food Science & Technology, 120, 88-99.

Mead, R., Currnow, R. N. and Harted, A. M. (1993). Statistical Methods in Agricultural and Experimental Biology. 2nd Ed. Chapman and Hall, London pp. 10-44.

Mekawy, A. Y. (2019). Response of Superior Seedless Grapevines to Foliar Application with Selenium, Tryptophan and Methionine. Journal of plant production, 10(12), 967-972.

Mishra, R., Mishra, S. and Tripathi, R. (2023). Effect of nano chitosan and nano micronutrients on fruit drop, yield and quality of guava (*Psidium guajava* L.). Biological Forum – An International Journal 15(10), 1244-1249.

Mohamed, A. Y., Roshdy, K. A. and Badran, A. F. M. (2016). Evaluation study of some imported mango cultivars grown under Aswan Governorate conditions. Alexandria Science Exchange Journal, 37(April-June), 254-259.

Momin, S. K., Gaikwad, S. S., Patel, R. J., Amarcholi, J. J. and Sharma, K. M. (2016). Effect of Foliar Application of Chemicals on Fruiting Parameters of Mango (*Mangifera indica* L.) cv. Kesar. Research Journal of Agricultural Sciences, 7(1), 143-144.

Mousavi, S. M., Jafari, A. and Shirmardi, M. (2024). The effect of seaweed foliar application on yield and quality of apple cv.'Golden Delicious'. Scientia Horticulturae, 323, 112529.

Rana, V. S., Sharma, V., Sharma, S., Rana, N., Kumar, V., Sharma, U., Almutairi, K.F., Avila-Quezada, G.D., Abd_Allah, E.F. and Gudeta, K. (2023). Seaweed extract as a biostimulant agent to enhance the fruit growth, yield, and quality of kiwifruit. Horticulturae, 9(4), 432.

Rausch, T. and Wachter, A. (2005). Sulfur metabolism: a versatile platform for launching defence operations. *Trends in plant science*, *10*(10), 503-509.

Rouphael, Y. and Colla, G. (2018). Synergistic biostimulatory action: Designing the next generation of plant biostimulants for sustainable agriculture. Frontiers in plant science, 9, 1655.

Sadak, M. S., Bakry, B. A., Abdel-Razik, T. M. and Hanafy, R. S. (2023). Amino acids foliar application for maximizing growth, productivity and quality of peanut grown under sandy soil. Brazilian Journal of Biology, 83, e256338.

Sadak, Sh, M., Abdelhamid, M. T. and Schmidhalter, U. (2015). Effect of foliar application of aminoacids on plant yield and some physiological parameters in bean plants irrigated with seawater. Acta biológica colombiana, 20(1), 141-152.

Shiri, M. A., Bakhshi, D., Ghasemnezhad, M., Dadi, M., Papachatzis, A. and Kalorizou, H. (2013). Chitosan coating improves the shelf life and postharvest quality of table grape (*Vitis vinifera*) cultivar Shahroudi. Turkish journal of agriculture and forestry, 37(2), 148-156.

Takahashi, H., Kopriva, S., Giordano, M., Saito, K. and Hell, R. (2011). Sulfur assimilation in photosynthetic organisms: molecular functions and regulations of transporters and assimilatory enzymes. Annual review of plant biology, 62(1), 157-184.

Teixeira, W. F., Fagan, E. B., Soares, L. H., Soares, J. N., Reichardt, K. and Neto, D. D. (2018). Seed and foliar application of amino acids improve variables of nitrogen metabolism and productivity in soybean crop. Frontiers in Plant Science, 9, 396.

Terzi, H. and Yıldız, M. (2021). Proteomic analysis reveals the role of exogenous cysteine in alleviating chromium stress in maize seedlings. Ecotoxicology and Environmental Safety, 209, 111784.

Tzin, V. and Galili, G. (2010). New insights into the shikimate and aromatic amino acids biosynthesis pathways in plants. Molecular plant, 3(6), 956-972.

Weiland, M., Mancuso, S. and Baluska, F. (2015). Signalling via glutamate and GLRs in Arabidopsis thaliana. Functional Plant Biology, 43(1), 1-25.

Wilde, S.A., Corey, R.B., Lyer, J.G. and Voigt, G.K. (1985). Soil and Plant Analysis for tree culture. Published by Mohan Primlani, oxford, IBH, Publishing Co., New Delhi, 1-142.

تأثير الرش الورقى بالأحماض الأمينيه والشيتوزان على المحصول وصفات الجودة لأشجار مانجو "ألفونس"

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الموجز

تغذية أشجار المانجو ضرورية وخاصة خلال مرحلة الإثمار ولذلك تعتبر المحفزات الحيويه ضرورية لتعزيز الحالة الغذائية و الفسيولوجية وبالتالى تحسين الإنتاجية. لذلك أجريت الدراسة الحالية لتقييم تأثير المحفزات الحيوية مثل الأحماض الأمينية (تربتوفان، سيستين ، ميثيونين) بتركيزات (٥٠، ١٠٠ ، ٢٠٠ جزء فى المليون) والشيتوزان بتركيزات (٠,٠٥، ٠,١، ٠,٢%) عن طريق الرش الورقى إما بصوره فردية أو مركبه على الإنتاجية والمحصول وصفات الجودة لأشجار المانجو "ألفونس". أجريت التجربة بقرية تونه الجبل – مركز ملوى – محافظة المنيا خلال موسمى الدراسه ٢٠٢١ و ٢٠٢٢م. تم الرش ثلاث مرات "بداية النمو، بعد العقد مباشرة ، وبعدها بشهر". أظهرت النتائج عدم وجود فرق معنوي بين أعلى تركيزين متتاليين ، وكان الرش بالشيتوزان أكثر فعالية عن الرش بالأحماض الأمينية وخاصة عند تركيز ٠,٢% يليها ٠,١% . وسجلت أعلى القيم من صفات المحصول وصفات الجودة مع إنخفاض الحموضة الكلية عند الرش المزدوج بتركيز ٢٠٠ جزء فى المليون أحماض أمينية + ٠,٢% شيتوزان يليها ١٠٠ جزء فى المليون أحماض أمينية + ٠,١% شيتوزان دون وجود فرق معنوي بين المعاملتين. لذلك يمكن التوصية بالرش بتركيز ١٠٠ جزء فى المليون أحماض أمينية + ٠,١% شيتوزان ثلاث مرات على أشجار المانجو "ألفونس" حيث تعتبر المعامله الأكثر فعالية من حيث التكلفة فى زياده المحصول وتحسين صفات الجوده تحت نفس ظروف التجربة.

الكلمات المفتاحية: أحماض أمينية، شيتوزان، محصول، صفات جوده، مانجو.

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