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Article

Effect of Ethereal and Nano fertilizers foliar application on yield and fruit quality of Al-phonse mango

Alaa El-dein Abo-El-Ez, Mahmoud Gad-Elkarim, Mohamed Hussein and Ahmed Abdul-Basser*

Department of Horticulture, Faculty of Agriculture, Sohag University, Sohag, 82524, Egypt
*Corresponding author: ahmed_mohamed1@agr.sohag.edu.eg

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Abstract

During the 2021 and 2022 seasons, Alphonse mango trees were sprayed once with 500 ppm Ethereal, 110 ppm Nano Carbon and 110 ppm Nano Si+110 ppm Nano Zn. Growth, some blooming characteristics, yield as well as chemical and physical characteristics of the fruits in response to foliar application of substances were Compared to the control treatment, single and combined applications of 500 ppm Ethereal, Nano Carbon, and 110 ppm Nano Si+110 ppm Nano Zn were very effective in improving the growth, blooming, yield, and physical and chemical characteristics of the fruits. Using Nano Si+ Nano Zn was preferable to using Ethereal and Nano Carbon to improve yield quantitively and qualitatively. The combined application of these materials surpassed the application of each material individually in this respect. One spray of Si (110 ppm) + Zn (110 ppm) treatment is responsible for producing higher yield and better fruit quality of Alphonse mongo trees. While the lowest values of yield and fruit quality were recorded on untreated trees in both seasons.

Keywords: Ethereal, Nano fertilizers, Yield, Alphonse mango.

1. Introduction

Mango (*Mangifera indica* L.) is one of the most important fruit crops in tropical and subtropical regions of the world that belongs to the Anacardiaceae family and ranks fifth in terms of fruit production and consumption worldwide (Xiuchong et al., 2001). Mango fruits are popular among consumers and have high commercial value (Rahayu et al., 2013). India, China, Mexico, and Thailand are the world's top mango producers (FAO, 2015). Furthermore, mangoes are a good source of dietary antioxidants such as ascorbic acid, carotenoids, and phenolic compounds (Ribeiro et al., 2007). Mango is one of the most important fruits in Egypt, and besides its delicious taste, excellent flavor, and attractive fragrance, it is rich in vitamins A and C. Mango fruit may be utilized at all stages of its development but is generally used at mature stages. In Egypt, the total area of mango trees reached 281153 fed. and the total fruiting area was about 212270 fed. (Yearly Book of Statistics and Agricultural Economic Dept., Ministry of Agric., Egypt, 2021). Ethrel is thought to be an effective floral promoter for some mango cultivars, such as Ewais and Sedik, which suffer from alternate bearing like the Zebda cultivar (Khattab et al, 2009).

Nanotechnology is now widely used in agriculture and horticulture as Nano fertilizer used to increase pollination, fertility in flowers and vegetative growth, resulting in improved product quality for fruit trees and increased yield (Zagzog et al., 2017; Zahedi et al., 2019). due to The unique properties of Nano fertilizer due to its small surface area with high absorption, which causes an increase in photosynthesis and leaf area (Sekhon, 2014). The spraying of mango trees with Nano zinc has also led to increasing the yield, increased fruit weight and number, as well as increasing the concentration of elements K, N, Zn, and P, and increasing the leaf content of carotene and chlorophyll (Zagzog and Gad 2017). Spraying zinc Nano-particles helps to release the required nutrients gradually in small amounts and improves the spraying efficiency of zinc than the sulfate or chelated forms, also using Nano form reduces the problems of soil pollution caused by the excess use of chemical fertilizers. (Rasha, E. A. El-Said, et al., 2019). The effect of nanoparticles in plants varies according to their composition, size, physical and chemical properties, as well as the plant species since the nanoparticles interact through enhancing production or inhibitory effects on plant growth in the different developmental stages (Ma et al., 2010). Carbon Nanomaterials have been used in agriculture to increase crop yield, mainly in the germination process, root growth, and photosynthesis. (Liu et al 2009). Carbon nanotubes can stimulate the growth, gene, and protein expression of aquaporin in cells (Khodakovskaya et al., 2012). Silicon is beneficial for alleviating nutrient imbalance stress and improving the growth, development, and yield of various plants. It improves organogenesis, embryogenesis, growth traits, and the anatomical, physiological, and morphological characteristics of leaves; enhances tolerance to chilling, freezing, drought, and salinity; prevents phenolic and oxidative browning and protects cells against metal toxicity; (Balakhnina, 2013; Sivanesan et al., 2014; Helaly et al., 2017; Artyszak, 2018 and Laane, 2018). The purpose of this study was to investigate the effect of foliar applications of Ethrel and Nano fertilizers on the yield and fruit quality of Alphonse mango trees grown in sandy soil.

2. Materials and Methods

This investigation was carried out during the 2021 and 2022 seasons on twenty-one 17- years old Alphonse mango trees onto seedling mango rootstock in the Horticulture research center located in El-Kwamel at Sohag University, Egypt. The selected and uniform vigor trees were planted at 6 × 6 meters apart and irrigated via a drip irrigation system. The texture of the soil is sandy. Soil analysis was done according to Wilde et al. (1985)

Table 1. Analysis of orchard experimental soil.

Physical Properties	Sand	Silt	Clay	CaCo3%	O.M%	Texture
	89.60	5.85	4.55	3.10	0.07	Sandy
Chemical composition	pHe	EC dSm-1	N%	P ppm	K ppm	SO4 meq/L
	8.70	1.20	0.05	0.80	185.0	3.90
	Na meq/L	K meq/L	Ca meq/L	Mg meq/L	Cl meq/L	HCO3 meq/L
	0.54	0.37	8.62	3.28	6.00	3.00

This study involved the following seven treatments:

(T1) Control. (T2) Spraying 110 ppm Nano Carbon. (T3) Spraying 500 ppm Etherl. (T4) Spraying 110 ppm Nano Si+ 110 ppm Nano Zn. (T5) Spraying 110 ppm Nano Carbon + 500 ppm Etherl.(T6) Spraying 110 ppm Nano Carbon+110 ppm Nano Si+110 ppm Nano Zn. (T7) Spraying 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn.

Each treatment was replicated three times, one tree per each.110 ppm Nano Carbon, 110 ppm Nano Silicon, 110 ppm Nano Zinc, and 500 ppm Ethrel were sprayed once individually during each growing season 110 ppm Nano Carbon was sprayed in the first week of January, 110 ppm Nano Silicon + 110 ppm Nano Zinc and 500 ppm Ethrel were sprayed in 50% flowering. Triton B as a wetting agent was added to all solutions at 0.05 %. Spraying was done till runoff (10 L water/ tree). The selected twenty-one trees received the same horticultural practices that were carried out in the orchard as usual.

Experimental Design Selected mango trees (21 bearing trees) of cultivar were alike in growth and set as a Randomized Complete Block Design (RCBD) with six treatments, and three replicates (one tree per replicate), besides three trees as a control for the cultivar.

Vegetative growth In both seasons, four branches of one-year-old were chosen on each tree, one toward each direction. Four shoots in the spring growth cycle, on each branch, were labeled for measuring shoot length (cm), the number of leaves per shoot, and leaf area (cm2) according to (Ahmed and Morsy 1999).

ProductivityTotal number of panicles per tree was counted at the end of flowering (in the second week of April).

Average panicle length measured at the end of flowering using 15 panicles from each replicate. The average number of secondary branches per panicle.

Perfect flower percentage is calculated as in equation (1).

$$F\ (\%) = \frac{\text{No.of perfect flowers}}{\text{total No.of flowers}} \times 100 \qquad (1)$$

The fruit retention percentage is calculated as in equation (2).

$$FR\ (\%) = \frac{\text{number of ultimate fruit set}}{\text{number of initial fruit set}} \times 100 \qquad (2)$$

Fruit set Ten shoots one-year-old per tree (replicate) were selected and tagged at random, the total number of flowers per panicle was counted at full bloom, and the fruit set was counted two weeks after the full bloom stage. The percent fruit set (FS %) was calculated by the following equation (3).

$$FS\ (\%) = \frac{\text{Number of fruitless/panicles at the time of the set}}{\text{number of flowers/panicles at full bloom}} \times 100 \qquad (3)$$

Yield expressed in weight (kg.) per tree was recorded in the middle of July in both seasons.

Fruit number per tree. At harvest time the number of fruits per tree was recorded for each treatment.

Physical and chemical characteristics of the fruits

namely fruit weight (g.), T.S.S %, total and reducing sugars %, and total acidity % (as g citric acid/ 100 g pulp) (according to A.O.A.C., 1995) were determined. Also, the ascorbic acid content in 100 g pulp was determined by using 2, 6 dichlorophenol indophenol dye (A.O.A.C., 1995).

Statistical analysis

All the obtained data were tabulated and statistically analyzed according to Mead et al. (1993) and using the new L.S.D test at 0.05 for made all comparisons among the investigated treatment means.

3. Results and Discussion

3.1. Blooming characteristics

The data in Table 2 show that single and combined foliar applications of ethereal and Nano-fertilizers significantly increased the total number of panicles per tree, average panicle length, secondary branches per panicle, and perfect flower percentage in comparison to the control treatment. It is worth mentioning that treatments with Ethrel and Nano fertilizers Foliar applications were superior to using each alone. The maximum values were recorded on the trees that received 110 ppm Nano Carbon + 500 ppm Etherl treatment in the first season. But, in the second season, the trees that received 110 ppm Nano Si+ 110 ppm Nano Zn treatment recorded the maximum value. Results revealed that the differences between treatments were significant in both seasons. The maximum values of Average panicle length were recorded on the trees that received 110 ppm Nano Si+ 110 ppm Nano Zn in the first season. While in the second season treatment with 500 ppm, Ethrel gives the maximum values of Average panicle length in the second season. A similar trend seemed to be occurring as regards Secondary branches per panicles the highest Secondary branches per panicles were obtained at 110 ppm Nano Carbon treatment in the first season and Ethereal (500 ppm) treatment in the second season. As for the treatment of 110 ppm Nano Si+ 110 ppm, Nano Zn recorded the maximum value of Perfect flowers percentage in the first season but in the second season treatment with 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn recorded the highest values.

This finding is in line with that reported by Hada et al. (2014); Maurya (2004); Singh and Maurya (2004); Nehete et al. (2011), Venu et al. (2014); Gurjar et al. (2015) they revealed that foliar application of 1% ZnSO4, 1% FeSO4 and 0.5% borax in combination had influenced flowering at pea stage and marble stage of alphonso mango and Zagzog and Gad (2017) they found that spraying Zebda and 'Ewasy' mango trees with nano-zinc at 1g/l before flowering improved sex ratio.

Table 2. Effect of Ethrel and Nano fertilizers Foliar Application on some blooming characteristics of Alphonso mango trees cv:

Treatments	Total number of panicles/ tree		Average panicle length		Secondary branches/ panicles		Perfect flowers percentage	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	46.00	70.00	21.50	21.33	10.00	9.67	7.50	9.00
110 ppm Nano Carbon	61.00	123.33	24.00	23.00	13.00	10.00	11.33	13.67
500 ppm Etherl	88.67	107.00	24.00	26.33	10.67	13.33	10.67	12.00
110 ppm Nano Si+ 110 ppm Nano Zn	96.33	168.67	25.67	25.67	11.67	12.67	12.67	14.00
110 ppm Nano Carbon + 500 ppm Etherl	97.50	155.33	24.50	24.67	11.50	10.67	9.00	11.33
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	49.00	130.00	23.00	25.67	11.00	12.67	12.00	10.67
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	75.67	76.33	24.67	25.00	12.67	9.67	9.67	14.33
New LSD at 5 %	N.S	6.18	1.87	1.48	2.51	2.97	1.82	2.84

3.2. Vegetative growth (shoot length and leaf area)

treatment data in Table 3 show that single and combined foliar applications of Ethrel and Nano fertilizers increase shoot length and leaf area significantly more than the Check treatment. It is worth mentioning that foliar application with Etherl and Nano fertilizers was superior to using each alone. Using 110 ppm Nano Carbon superior to using 500 ppm Etherl and 110 ppm Nano Si+

110 ppm Nano Zn to increase leaf area. The maximum values were recorded on the trees that were treated with 110 ppm Nano Carbon+110 ppm Nano Si+110 ppm Nano Zn in both seasons. The lowest values were recorded on untreated trees. These results were true during both seasons. The maximum value in the Leaf area was obtained at 110 ppm Nano Carbon treatment in the first season and 110 ppm Nano Carbon+110 ppm Nano Si+110 ppm Nano Zn treatment in the second season. The lowest values were recorded on untreated trees. These results are matched with those of Panwar et al. (2012); Sedghi et al. (2013); Rasha, E. A. El-Said, et al. (2019) who found that Nano-zinc oxide increased significantly the Leaf area.

Table 2. Effect of Ethrel and Nano fertilizers Foliar Application on Shoot length (cm), Leaf area (cm2), Fruit set (%), and Fruit retention (%) of Alphonso mango trees cv.

Treatments	Shoot length (cm)		Leaf area (cm2)		Fruit set (%)		Fruit retention (%)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	5.33	5.33	15.51	14.69	10.50	13.67	6.50	8.67
110 ppm Nano Carbon	8.00	7.33	25.66	31.61	16.33	21.00	9.33	12.33
500 ppm Etherl	8.00	8.00	16.44	19.82	15.67	15.33	10.33	9.33
110 ppm Nano Si+ 110 ppm Nano Zn	8.00	9.00	22.04	24.14	16.00	14.67	8.33	12.00
110 ppm Nano Carbon + 500 ppm Etherl	8.67	9.00	18.77	21.51	15.50	16.33	7.00	12.67
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	9.67	9.33	24.26	37.67	14.50	17.33	8.00	10.00
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	9.33	9.33	21.34	25.77	17.00	13.33	12.33	11.33
New LSD at 5 %	2.13	1.56	8.997	12.83	3.090	4.214	2.905	1.327

3.3. Fruit set (%) and Fruit retention (%)

The data in Table 3 show that single and combined foliar applications of Ethrel and Nanofertilizers significantly increased fruit set (%) and fruit retention (%) when compared to the control treatment. It is worth mentioning that foliar application with Etherl and Nano fertilizers was superior to using each alone. Using 110 ppm Nano Carbon superior to using 500 ppm Etherl and 110 ppm Nano Si+ 110 ppm Nano Zn to increase the Fruit set (%). The maximum values were recorded on the trees that were treated with 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn improved fruit set percentage in the first season but in the second season treatment with 110 ppm Nano Carbon give the maximum. The lowest values were recorded on untreated trees. These results were true during both seasons. A similar trend seemed to be occurring as regards Fruit retention percentage. The highest percentage was obtained in the first season at 500 ppm Etherl plus 110 ppm Nano Si plus 110 ppm Nano Zn treatment and in the second season at 110 ppm Nano Carbon plus 500 ppm Etherl treatment. The lowest values were recorded on untreated trees. This finding is in line with that reported by Maurya (2004); Singh and Maurya (2004); Nehete et al. (2011); Hada et al. (2014); Venu et al. (2014); Gurjar et al. (2015) revealed that foliar application of 1% $ZnSO_4$, 1% $FeSO_4$ and 0.5% borax in combination had influenced flowering at pea stage and marble stage of alphonso mango and Zagzog and Gad (2017) they found that spraying Zebda and 'Ewasy' mango trees with Nano-zinc at 1g/l before flowering improved sex ratio.

3.4. Yield

According to the data in Table 4, foliar application of ethereal and nano fertilizers, either alone or in combination, increased yield per tree significantly when compared to the control treatment. Foliar applications with Etherl and Nano fertilizers were superior to using each alone. Application of 110 ppm Nano Si+110 ppm Nano Zn was significantly preferable to using Ethereal (500 ppm) and 110 ppm Nano Carbon to increase yield. The maximum yield from the economical point of view was presented on the trees that received a spray of 110 ppm Nano Si+ 110 ppm Nano Zn treatment in the first season but in the second season sprayed trees with 110 ppm Nano Carbon+500 ppm Ethrel. Under such promised treatment, the yield reached 17.67 and 26.60 kg compared with 8.25 and 16.33 kg produced by untreated vines during both seasons. These results were true during both seasons. The effect of silicon and SA on enhancing the growth and nutritional status of the trees is surely reflected in improving the yield. These results are in agreement with those obtained by Eshmawy (2010); Saied (2011) and Ahmed (2011) on salicylic acid and Kanto (2002) and Gad El- Kareem (2012) on silicon. Concerning the beneficial effect of using combined zinc on mango fruiting, these results coincide with those obtained by Gurjar et al. (2015) and Singh et al. (2017) they found that significant maximum numbers of fruits per tree and fruit yield were recorded under the treatment at 1% spray of multi micronutrient Grade-IV of mango var. Amrapali. In similar studies of using zinc on citrus fruiting, Sajid et al. (2010); Khan et al. (2012); Baghdad et al. (2014); Venu et al. (2014); Ilyas et al. (2015); Gurung et al. (2016) they concluded that foliar application of GA3 at the rate of 15 ppm along with zinc at 0.5% and boron at 0.1% enhanced the fruit yield of Darjeeling mandarin.

Also, in similar studies of using combined zinc on guava fruiting, Hada et al. (2014) and Kumar et al. (2015) reported that the foliar fertilization of Pant Prabhat guava showed an increasing trend toward yield kg/tree with 0.01% Zn two weeks after fruit set while it showed a trend towards decreasing fruit drop with 0.03% Zn two weeks after fruit set. Several authors agreed that using combined zinc on fruiting was beneficial Sayyad-Amin et al. (2015) found that the most yield of olive was seen in the foliar spray of zinc sulfate at 2000 mg l-1 and boric at 2000 mg l-1 alone, respectively.

Table 4. Effect of Ethrel and Nano fertilizers Foliar Application on yield/tree (kg), Fruit weight (g), Fruit length (cm), and Fruit width (cm) of Alphonso mango trees cv.

Treatments	yield/tree (kg)		Fruit weight (g)		Fruit length (cm)		Fruit width (cm)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	8.25	16.33	140.40	174.00	8.05	7.27	6.45	4.93
110 ppm Nano Carbon	15.83	22.37	174.05	187.00	8.43	7.67	6.53	5.57
500 ppm Etherl	15.67	18.59	175.10	200.33	8.57	7.90	6.57	5.27
110 ppm Nano Si+ 110 ppm Nano Zn	17.67	23.80	178.69	195.33	8.33	7.57	6.60	5.13
110 ppm Nano Carbon + 500 ppm Etherl	10.50	26.60	148.42	238.67	7.45	8.20	6.70	5.53
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	10.50	18.67	159.26	211.00	8.25	8.13	6.55	5.63
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	16.50	23.50	170.91	200.67	8.27	8.10	7.03	5.20
New LSD at 5 %	4.347	6.228	25.30	20.63	0.81	0.09	0.06	0.59

3.5. Some Physical characteristics of berries

Data in Tables 4 and 5 revealed that fruit weight, fruit peel weight (g), fruit pulp weight (g), and fruit seed weight (g) were significantly affected by different Ethrel and Nano fertilizers in the foliar application in both seasons except for fruit specific gravity (g/cm3). The highest fruit weight (g) was obtained in the first season from a tree treated with 110 ppm Nano Si + 110 ppm Nano Zn, and in the second season from a tree treated with 110 ppm Nano Carbon + 500 ppm Ethrel. Trees treated with 110 ppm Nano Si+ 110 ppm Nano Zn and 110 ppm Nano Carbon + 500 ppm Etherl increased their fruit peel weight (g), seed weight (g), and pulp weight (g). The treated tree with Ethereal (500 ppm) improved fruit length (cm) in the first season, but in the second season, the treated tree with 110 ppm carbon plus 500 ppm Ethrel increased fruit length. A similar trend seemed to be occurring as regards fruit width (cm). The highest fruit width (cm) was obtained at 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn treatment (7.03) in the first season, but the tree was treated with 110 ppm carbon + 110 ppm Nano Si+ 110 ppm Nano Zn in the second season. While the untreated tree significantly induced the lowest values of these in both seasons. Concerning the beneficial effect of combining zinc and boron on fruit physical characteristics of mango, Similar outcomes were demonstrated by Anees et al. (2011), Nehete et al. (2011), Gurjar et al. (2015) and Singh et al. (2017) found that significantly maximum fruit weight and fruit volume were recorded under the treatment at 1% spray of multi micronutrient Grade-IV of mango var. Amrapali.

In similar studies using combined zinc, iron, and boron on fruit physical characteristics of citrus, Venu et al. (2014) and Gurung et al. (2016) concluded that foliar application of GA3 at the rate of 15 ppm along with zinc (0.5%) and boron (0.1%) improved fruit yield attributes of Darjeeling mandarin. Also, in similar studies of using zinc on fruit physical characteristics of guava, Kumar et al. (2015) reported that the foliar fertilization of Pant Prabhat guava showed an increasing trend toward fruit weight and volume with 0.03% B two weeks after fruit.

Table 5. Effect of Ethrel and Nano fertilizers Foliar Application on Fruit specific gravity (g/cm3), Fruit peel weight (g), Fruit pulp weight (g), and Fruit seed weight (g) of Alphonso mango trees cv.

Treatments	Fruit-specific gravity (g/cm3)		Fruit peel weight (g)		Fruit pulp weight (g)		Fruit seed weight (g)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	0.96	0.94	30.93	45.33	85.05	91.00	24.43	37.67
110 ppm Nano Carbon	0.97	0.94	41.67	39.00	108.48	105.33	23.90	42.67
500 ppm Etherl	0.99	0.98	42.02	49.33	111.50	102.33	21.58	48.67
110 ppm Nano Si+ 110 ppm Nano Zn	0.98	0.98	48.37	51.33	105.34	99.00	24.98	45.00
110 ppm Nano Carbon + 500 ppm Etherl	0.95	0.97	30.79	54.67	101.38	132.67	16.25	51.33
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	1.00	0.96	33.00	42.33	107.74	123.67	18.50	45.00
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	0.99	0.96	42.78	48.67	107.21	103.33	20.92	48.67
New LSD at 5 %	N.S	N.S	5.84	2.88	2.31	34.37	1.55	1.92

3.6. Fruit chemical characteristics

Data in Tables 9 and 10 shows that TSS, acidity, the TSS/acid ratio, and the ascorbic acid content of fruit were significantly affected by different Ethrel and Nano fertilizers Foliar Application in both seasons. The highest significant values of TSS and TSS/acid ratio, of fruit and the least significant value of acidity, were attained from trees treated with Ether (500 ppm) and Nano fertilizers (110 ppm carbon, 110 ppm zinc, and 110 ppm silicon). Except for acidity, which has opposite trends in both seasons, the untreated tree had the lowest values.

Whereas the highest ascorbic acid content (V.C. mg/100g juice) was obtained in the first season from treated trees with 110 ppm carbon, it was obtained in the second season from treated trees with 1110 ppm carbon plus 110 ppm zinc and 110 ppm silicon. These results are consistent with those reported by Anees et al., (2011); they revealed that mango cv. Dusehri trees treated with 0.4% FeSO4, 0.8% H3BO3 and 0.8% ZnSO4 produced the highest total soluble solids, ascorbic acid, and non-reducing sugars, along with low acidity in comparison to the rest of the treatments and the control. Baghdad et al. (2014), Ilyas et al. (2015), and Gurung et al. (2016) found that foliar application of 15 ppm GA3, along with 0.5% zinc and 0.1% boron, improved the fruit quality of Darjeeling mandarin. Ashraf et al., (2014) indicated that the application of zinc improves the quality of citrus fruits; this might be due to the involvement of zinc in photosynthesis, activation of enzyme systems, protein synthesis, and carbohydrate translocation. In addition, Patil et al., (2018) showed that the application of micronutrients, especially zinc, copper, and boron, may prove to be an effective tool for sustainable fruit production.

Table (6): Effect of Ethrel and Nano fertilizers Foliar Application on TSS %, total acidity%, TSS/Acid ratio, and ascorbic acid of Alphonso mango trees cv.

Treatments	TSS %		Total acidity percentage		TSS/acid ratio		Ascorbic acid content (V.C mg/100g juice)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	19.50	18.67	0.49	0.64	39.83	31.14	21.94	17.76
110 ppm Nano Carbon	21.67	21.33	0.53	0.54	41.23	39.30	30.81	29.81
500 ppm Etherl	22.00	22.00	0.39	0.41	57.11	53.42	24.02	22.45
110 ppm Nano Si+ 110 ppm Nano Zn	22.33	21.33	0.46	0.45	48.63	47.31	24.54	33.42
110 ppm Nano Carbon + 500 ppm Etherl	23.50	22.67	0.46	0.49	51.64	47.25	25.85	35.51
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	22.00	22.67	0.46	0.53	50.19	44.40	26.63	35.51
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	21.67	20.67	0.39	0.45	57.75	46.78	25.07	32.38
New LSD at 5 %	2.19	2.1	0.07	0.14	11.70	15.68	6.50	7.71

4. Conclusions

Application of 500 ppm Ethereal, Nano Carbon, and 110 ppm Nano Si+110 ppm Nano Zn was very effective in enhancing growth characteristics, blooming characters, yield as well as physical and chemical characteristics of the fruits compared to the control treatment. Using Nano Si+ Nano Zn was preferable to using Ethereal and Nano Carbon to improve yield quantitively and qualitatively. The combined application of these materials surpassed the application of each material alone in this respect. One spray of Si (110 ppm) + Zn (110 ppm) treatment is responsible for producing higher yield and better fruit quality of Alphonse mongo trees, while the lowest values of yield and fruit quality were recorded on untreated trees in both seasons.

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مقال

الملخص العربي

تأثير الرش الورقي الإيثريل والأسمدة النانوية على محصول وجودة ثمار مانجو ألفونس

علاء الدين أبو العز، محمود جاد الكريم، محمد حسين، احمد عبد البصير*

قسم البساتين، كلية الزراعة، جامعة سوهاج، سوهاج 82524، مصر
المؤلف المختص:ahmed_mohamed1@agr.sohag.edu.eg

تمت هذه الدراسة خلال موسمي 2021 و2022 في المزرعة البحثية لكلية الزراعة بالكوامل، جامعة سوهاج. تم رش أشجار المانجو ألفونس مرة واحدة بـ 500 جزء في المليون من الإيثريل و110 جزء في المليون من الكربون النانو و110 جزء في المليون من السليكون النانو +110جزء في المليون من الزنك النانو. تم فحص النمو وبعض صفات الإزهار والمحصول وكذلك الخصائص الفيزيائية والكيميائية للثمار استجابة للتطبيق الورقي للمواد. كان التطبيق الفردي والمركب لـ 500 جزء في المليون الإيثريل والكربون النانو و110 جزء في المليون من السليكون النانو +110جزء في المليون من الزنك النانو فعالاً للغاية في تعزيز خصائص النمو وخصائص التفتح والمحصول بالإضافة إلى الخصائص الفيزيائية والكيميائية للثمار مقارنة بمعاملة التحكم. كان استخدام السليكون النانو + الزنك النانو مفضلًا على استخدام الإيثريل والكربون النانو لتحسين الإنتاج كميًا ونوعيًا. تجاوز التطبيق المشترك لهذه المواد تطبيق كل مادة بمفردها في هذا الصدد. رش واحد من معالجة (110 جزء في المليون من السليكون النانو +110جزء في المليون من الزنك النانو) مسؤول عن إنتاج محصول أعلى وجودة أفضل لثمار أشجار مانجو ألفونس. بينما سجلت أدنى قيم للمحصول وجودة الثمار على الأشجار غير المعالجة في الموسمين.

الكلمات الأساسية: الإيثريل، الأسمدة النانوية، المحصول، مانجو ألفونس