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Improving Yield Qualitatively and Quantitively of Ewasy mango by Using Ethrel and Nanofertilizers foliar application

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Abstract

This study was carried out during the 2021and 2022 seasons, Ewasy mango trees were sprayed once with 500 ppm Ethrel, 110 ppm Nano Carbon, and 110 ppm Nano Si+110 ppm Nano Zn to investigate the effect of Ethrel, Nano Carbon, and (Nano Si+ Nano Zn) on Growth, some blooming characteristics, yield, and chemical and physical characteristics of the fruits. Single and combined application of 500 ppm Ethrel, 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 Carbon and Nano Carbon+ Nano Si+ Nano Zn was preferable to using Ethrel and Nano Si+ Nano Zn to improve yield quantitively and qualitatively. The combined application of these materials surpassed each material alone in this respect. One spray of Nano Carbon treatment is responsible for producing higher yield and better fruit quality of Ewasy mongo trees. At the same time, the lowest values of yield and fruit quality were recorded on untreated trees in both seasons.

Keywords:
Ethrel; Nanofertilizers; Yield; Ewasy

INTRODUCTION

Mango (Mangifera indica L.) cultivation is widespread throughout tropical regions of the world.. However, its distinct flavors, mouthwatering flavor, and great nutritional content have made it equally popular worldwide. More than 4000 years have passed since its cultivation (Mukherjee, 1949; Islam et al. et al., 2016). India, Thailand, Mexico, and China are the world's leading mango-producing nations (FAO, 2015). Nutritionally, it has a significant amount of vitamin C, dietary fiber, and β carotene (Pal, 1998), in addition to various minerals and soluble sugars that the body can easily absorb and use as good sources of readily available nutrition (Singh, 1960). As a result, they can help prevent several deficiency diseases (Samad et al., 1975; Purohit, 1985). Furthermore, phenolic compounds, ascorbic acid, and carotenoids are among the dietary antioxidants (Ribeiro et al., 2007). Mango is one of the most popular fruits in Egypt, and in addition to its great flavor, mouthwatering sweetness, and lovely aroma, it also contains a lot of vitamins A and C. Although mango fruit can be used at any stage of development, it is usually used when it is fully developed. The total area under mango trees in Egypt was 28,1153 fed. A total of 212270 fed people were in the fruiting area. (Ministry of Agriculture, Egypt, Yearly Book of Statistics and Agricultural Economic Dept., 2021). It's thought that ethrel helps certain mango cultivars bloom more profusely, such as Ewais and Sedik, which suffer from alternate bearing as the Zebda cultivar (Khattab et al., 2009). Nanotechnology is extensively applied in horticulture and agriculture as a nano fertilizer to boost flower fertility, pollination, and vegetative growth, increasing fruit tree yield and quality (Zagzog et al., 2017; Zahedi et al., 2019). Because of its small surface area and high absorption, nano fertilizer has unique qualities that increase photosynthesis and leaf area (Sekhon, 2014). According to recent studies, fertilizers with nano-size (or nano-particle) have also drawn a lot of attention for plant nutrition (Zhu et al., 2008). Materials that fit inside the nanometric scale and have at least one dimension smaller than a few hundred nanometers are referred to as nanoparticles. (Kamiab et al., 2016) When almond varieties were sprayed with a mixture of nano fertilizer called ZFM, which contained Mn, Fe, and Zn, the results showed an increase in the concentration of the elements Mn, Zn, Cu, and Fe in the leaves as well as a significant decrease in the percentage of fruit precipitation. This means that ZFM spraying has improved fruit qualities and increased productivity. Mango trees sprayed with Nano zinc have also produced more fruit, both in weight and quantity, increasing yield. Additionally, the amount of elements N, P, K, and Zn and the amount of chlorophyll and carotene in the leaves have increased (Zagzog & Gad, 2017). According to Song et al. (2016), loquat fruits treated with nano silicon displayed reduced weight loss, preserved the T.S.S. ratio, increased glucose and fructose content, and improved resistance to cold. These characteristics all contributed to the fruits' ability to be kept in refrigerated stores for longer periods of time while maintaining their quality. In addition to improving zinc spraying efficiency over sulfate or chelated forms, nanoparticles aid in gradually releasing necessary nutrients in small amounts. Using nanoparticles also lessens the issues associated with soil pollution brought on by the overuse of chemical fertilizers. El-Said, E. A. Rasha, et al., 2019. Since nanoparticles interact with plants by either depending on the composition, size, physical and chemical characteristics, and species of the plant, their effects can either enhance production or have inhibitory effects on plant growth in different developmental stages (Ma et al., 2010). For the purpose of boost crop yield, carbon nanomaterials have been applied to photosynthesis, root growth, and germination processes. Liu and colleagues, 2009). According to Khodakovskaya et al. (2012), Carbon nanotubes have the ability to stimulate the expression of the aquaporin gene, protein, and growth in cells. Silicon lessens the stress brought on by nutrient imbalances and aids in the growth, development, and yield of plants. (Balakhnina, 2013; Sivanesan et al., 2014; Helaly et al., 2017; Artyszak, 2018 and Laane, 2018) It prevents phenolic and oxidative browning, strengthens resistance to cold, freezing, drought, and salinity, and shields cells from metal toxicity. Additionally, it enhances the anatomical, physiological, and morphological traits of leaves as well as organogenesis, embryogenesis, and growth traits. In this study, the yield and fruit quality of Alphonso mango trees planted in sandy soil were examined in relation to the foliar application of ethylene and nano fertilizers.

MATERIALS AND METHODS

In the Horticulture Research Center at El-Kwamel, Sohag University, Egypt, twenty-one seventeen-year-old Ewasy mango trees were the subjects of this investigation in the 2021 and 2022 growing on seedling mango rootstock. The trees with consistent vigor that were chosen were planted six meters apart and given drip irrigation. Sand makes up the soil's texture. It was determined by soil analysis, per Wilde et al. (1985)

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 was added to each solution at a rate of 0.05 percent as a wetting agent. Up until runoff (10 L water/tree), spraying was done. In the orchard, the twenty-one trees that were chosen were subjected to the same gardening techniques.

Experimental Design

A selection of mango trees (21 bearing trees) with similar cultivar growth. In addition to three trees serving as a cultivar control, they configured it as a Randomized Complete Block Design (RCBD) with six treatments and three replicates (one tree per replicate).

Vegetative growth

In both seasons, For every tree, four one-year-old branches were selected, one in each direction. To measure shoot length (cm), number of leaves per shoot, and leaf area (cm2), four shoots on each branch during the spring growth cycle were labeled (Ahmed & Morsy, 1999).

Leaf area (cm2).

Leaf aria during growth cycles spring growth cycle, summer growth cycle and autumn growth cycle Ahmed and Morsy (1999)

Leaf area (cm2) = 0.70 (L x W) -1.06

Productivity

At the conclusion of flowering (during the second week of April), the total number of panicles on each tree was counted.

Average panicle length measured at the end of flowering using 15 panicles from each replicate.

The mean quantity of secondary branches in each panicle.

Perfect flowers percentage calculated as in equation (1).

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

Fruit retention percentage calculated as as in equation (2).

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

Fruit set

At full bloom and two weeks after fruit set, the total number of flowers per panicle was counted. Ten shoots, one year old per each tree (replicate), were chosen and tagged at random. The following formula (3) was used to determine the percent fruit set (FS %).

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

Yield

In both seasons, the middle of July marked the recording of yield, which was expressed in kilograms (kg) per tree.

Fruit count for each tree.

The number of fruits on each tree at harvest time was noted for each treatment.

Fruit weight (g), T.S.S. %, total and reducing sugars %, and total acidity % (as g citric acid/100 g pulp) (per A.O.A.C., 1995) were measured as physical and chemical characteristics of the fruits.

Moreover, 2, 6 dichlorophenol endophenol dye was used to measure the ascorbic acid content of 100 g of pulp (A.O.A.C., 1995).

Statistical analysis

The collected data were all tabulated and subjected to statistical analysis in accordance with Mead et al. (1993). A new L.S.D test was employed at 0.05 to facilitate comparisons between the treatment means under investigation.

RESULTS AND DISCUSSION

1. Blooming characteristics

The information in Table (2) makes it evident that both the singular and combined application of Ethrel and Nano fertilizers Foliar Application significantly accompanied with stimulating Total panicle count for each tree expected first season, average panicle length, Secondary branches per panicles and Perfect flowers percentage in relative to the Check treatment. Treatments with Ethrel and Nano fertilizers Foliar Application applications were better than utilizing each one separately. The trees that were treated with 110 ppm Nano Carbon, 110 ppm Nano Si, and 110 ppm Nano Zn during the first season had the highest values. However, in the second season, the trees that received 110 ppm Nano Carbon treatment recorded the maximum value. Results revealed that In both seasons, there were notable variations in the various treatments. The trees that were given the maximum values of average panicle length were noted 500 ppm Etherl and 110 ppm Nano Si+ 110 ppm Nano Zn treatments in the first season. Treatment with 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn gives the maximum values of Average panicle length in the second season. A similar trend is occurring regarding secondary branches per panicles. The highest Secondary branches per panicle were obtained at 110 ppm Nano Si+ 110 ppm Nano Zn treatment in the first season and 110 ppm Nano Carbon treatment in the second. As for treating 110 ppm Nano Carbon and 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn, the maximum value of Perfect Flowers percentage was recorded in both seasons. According to Hada et al. (2014), Maurya (2004), Singh and Maurya (2004), Nehete et al. (2011), Venu et al. (2014), Gurjar et al. (2015), and Zagzog and Gad (2017), sex ratio was improved by spraying Zebda and 'Ewasy' mango trees with nano-zinc at 1g/l prior to flowering. This result is consistent with their findings.

Table (2): Effect of Ethrel and Nano fertilizers Foliar Application on some blooming characteristics of Ewasy 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	47.50	76.67	27.00	25.33	11.50	15.00	8.00	9.67
110 ppm Nano Carbon	65.50	211.33	27.00	30.00	12.50	19.67	20.00	17.67
500 ppm Etherl	67.00	191.00	27.33	25.00	12.00	13.33	12.00	13.67
110 ppm Nano Si+ 110 ppm Nano Zn	76.67	91.67	27.33	26.00	14.00	12.67	13.67	16.33
110 ppm Nano Carbon + 500 ppm Etherl	56.67	194.00	27.00	28.33	11.67	12.33	13.67	15.00
110 ppm Nano Carbon+110 ppm Nano Si+110 ppm Nano Zn	85.00	126.50	27.00	31.00	10.50	17.50	15.00	17.50
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	49.00	198.67	25.00	26.67	9.00	13.33	20.00	17.67
New LSD at 5 %	18.20	57.44	1.085	3.279	11.60	3.762	5.588	3.922

2. Vegetative growth (shoot length and leaf area)

The information in Table (3) makes it evident that both the single and combined foliar application of Ethrel and Nano fertilizers is significantly accompanied by stimulating shoot length and leaf area relative to the Check treatment. It is worth mentioning that foliar application with Etherl and Nano fertilizers was superior than using each alone. Using 110 ppm Nano Carbon is superior than using 500 ppm Etherl and 110 ppm Nano Si+ 110 ppm Nano Zn to increase leaf area. The highest values were noted on the trees that received 110 ppm Nano Carbon and 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn in both seasons. The trees that were left untreated had the lowest values. These results were accurate during both seasons. The maximum value in the Leaf area was obtained at 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn treatment in both seasons. The trees that were left untreated had the lowest values. These The findings are consistent with those of Panwar et al. (2012), Sedghi et al. (2013), and Rasha, E. A. El-Said, et al. (2019), who discovered a significant increase in leaf area due to nano-zinc oxide.

Table (3): Effect of Ethrel and Nano fertilizers Foliar Application on Shoot length (cm), Leaf area (cm2), Fruit set (%), and Fruit retention (%) of Ewasy mango trees cv.

Treatments	Shoot length (cm)		Leaf area (cm2)		Fruit set (%)		Fruit retention (%)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	6.00	5.33	27.40	27.52	9.00	10.33	4.00	8.00
110 ppm Nano Carbon	9.33	8.67	32.04	38.61	14.00	22.33	12.50	14.00
500 ppm Etherl	7.00	6.00	33.92	36.97	12.00	14.67	5.00	12.00
110 ppm Nano Si+ 110 ppm Nano Zn	8.00	6.67	35.81	39.54	15.00	16.33	10.67	10.00
110 ppm Nano Carbon + 500 ppm Etherl	8.00	7.17	29.13	31.61	13.00	14.67	5.50	12.00
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	9.33	8.67	44.64	46.77	17.33	17.50	9.67	11.50
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	7.00	7.33	27.86	29.97	18.00	14.00	7.00	9.00
New LSD at 5 %	2.15	1.944	14.72	16.42	4.006	4.18	4.182	2.345

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

The information in Table (3) makes it evident that both the single and combined Foliar Application of Ethrel and Nano fertilizers significantly was accompanied by stimulating Fruit set (%) and Fruit retention (%) relative to the Check treatment. It is worth mentioning that foliar application with Etherl and Nano fertilizers was superior than using each alone. Using 110 ppm Nano Carbon is superior than 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 treated with 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn improved fruit set percentage in the first season. However, in the second season, treatment with 110 ppm Nano Carbon gave the maximum. The trees that were left untreated had the lowest values. Both seasons yielded the same results. A similar trend is occurring regarding fruit retention percentage. The highest percentage was obtained at 110 ppm Nano Carbon treatment in both seasons. Untreated trees showed the lowest values. The current investigation's findings are in line with those of studies by Singh and Maurya (2004), Nehete et al. (2011), Hada et al. (2014), Venu et al. (2014), Gurjar et al. (2015), and Maurya (2004), which found that sex ratio was improved by spraying Zebda and 'Ewasy' mango trees with Nano-zinc at 1g/l prior to flowering.

4. Yield

Data in Table 4, clear that the yield per tree was significantly improved by using the Foliar Application of Ethrel and Nano fertilizers alone or in combinations when compared with the check treatment. Foliar applications with Etherl and Nano fertilizers were superior than using each alone. Application of 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn was significantly preferable than using Ethereal (500 ppm) to increase yield. The maximum yield from the economic point of view was presented on the trees that received a spray of 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn treatment in the first season but in the second season spray trees with 110 ppm Nano Carbon. Fruit number/tree: The maximum yield from the economic 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, spray trees with 110 ppm Nano Carbon. The effect of silicon and SA on enhancing the growth and nutritional status of the trees is indeed reflected in improving the yield. These findings concur with those of Eshmawy (2010), Saied (2011), Ahmed (2011), Kanto (2002), and Gad El-Kareem (2012) regarding salicylic acid and silicon, respectively. These results corroborated the findings of Gurjar et al. (2015) and Singh et al. (2017) regarding the advantageous effects of combining zinc with mango fruiting. They discovered that maximum fruit yield and number of fruits per tree were recorded under treatment at 1% spray of multi-micronutrient Grade-IV mango var. Amrapali. et al., Sajid (2010). Similar studies on the effects of zinc on citrus fruiting were carried out by Khan et al. (2012), Baghdad et al. (2014), Venu et al. (2014), Ilyas et al. (2015), and Gurung et al. (2016). They came to the conclusion that applying GA3 topically at a rate of 15 ppm, in addition to 0.5% zinc and 0.1% boron, increased the Darjeeling mandarin fruit yield. Similar studies on the effects of combined zinc on guava fruiting were reported by Hada et al. (2014) and Kumar et al. (2015). Foliar fertilization of Pant Prabhat guava showed an increasing trend towards yield kg/tree with 0.01% Zn two weeks after fruit set. Sayyad-Amin et al. (2015) found that a foliar spray containing only 2000 mg l-1 of boric and 2000 mg l-1 of zinc sulfate produced the maximum yield of olive. The advantageous impact of utilizing combined zinc on fruiting was confirmed by multiple writers.

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 Ewasy mango trees cv.

Treatments	yield / tree (kg)		Number of fruits/ tree		Fruit length (cm)		Fruit width (cm)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	8.00	13.83	50.50	92.00	9.65	8.87	6.00	4.57
110 ppm Nano Carbon	13.50	26.83	65.50	135.33	10.55	9.43	6.70	4.90
500 ppm Etherl	10.67	24.67	61.67	126.33	10.13	9.13	6.73	4.60
110 ppm Nano Si+ 110 ppm Nano Zn	16.17	20.00	104.67	103.33	9.63	9.53	6.43	5.00
110 ppm Nano Carbon + 500 ppm Etherl	9.75	20.83	54.00	121.13	9.90	9.67	6.70	4.70
110 ppm Nano Carbon+110 ppm Nano Si+110 ppmNanoZn	18.67	19.00	94.67	119.50	10.53	9.90	6.33	5.00
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	15.50	20.50	99.00	103.33	9.90	9.30	6.30	4.73
New LSD at 5 %	3.013	6.723	20.06	33.22	0.574	0.481	0.394	0.656

5. Some Physical characteristics of berries

Data in Tables 4 and 5 revealed that fruit Weight, fruit pulp weight (g), Fruit seed weight (g), Fruit specific gravity (g/cm3), Fruit length (cm), and Fruit width (cm) were significantly affected by different Ethrel and Nano fertilizers

Foliar Application in both seasons. The highest fruit weight (g) was obtained at the treated tree with 110 ppm Nano Carbon in the first season and 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn in the second season. Treated tree with 110 ppm Nano Si+ 110 ppm Nano Zn and 110 ppm Nano Carbon + 500 ppm Etherl increased fruit seed weight (g) and fruit pulp weight (g), but Treated tree with 110 ppm Nano Carbon improved fruit length (cm) in the first season but in the second season treated tree with 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn increase fruit length. A similar trend is occurring regarding fruit width (cm). The highest Fruit width (cm) was obtained at 500 ppm Etherl treatment in the first season but treated tree with 110 ppm Carbon + 110 ppm Nano Si+ 110 ppm Nano Zn and 110 ppm Nano Si+ 110 ppm Nano Zn in the second season. Meanwhile, the untreated tree significantly induced the lowest values in both seasons. The Anees (2011). Significant maximum fruit weight and fruit volume were observed under treatment at 1% spray of multi-micronutrient Grade-IV of mango var. Amrapali, according to Nehete et al. (2011), Gurjar et al. (2015), and Singh et al. (2017). The positive effects of zinc, iron, and boron combination on the physical properties of mango fruit are corroborated by these studies. Comparable research on the impact of combining zinc, iron, and boron on the physical properties of citrus fruit by Venu et al. (2014) and Gurung et al. (2016) found that foliar application of GA3 at a rate of 15 ppm along with zinc (0.5%) and boron (0.1%) improved Darjeeling mandarin fruit yield attributes. Similar investigations into the effects of zinc on the physical characteristics of guava fruits were also carried out by Kumar et al. (2015), who discovered that foliar fertilization of Pant Prabhat guava showed an increasing trend toward fruit weight and volume with 0.03% B two weeks after fruiting.

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 Ewasy mango trees cv.

Treatments	Fruit specific gravity(g/cm3)		Fruit weight (g)		Fruit pulp weight (g)		Fruit seed weight (g)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	0.97	0.96	158.83	152.00	96.45	71.33	22.13	35.33
110 ppm Nano Carbon	0.99	0.98	199.02	196.67	126.57	97.00	30.51	47.67
500 ppm Etherl	1.01	0.96	173.18	193.67	105.52	105.67	25.97	42.67
110 ppm Nano Si+ 110 ppm Nano Zn	0.99	0.93	153.91	193.00	101.05	90.67	21.59	45.67
110 ppm Nano Carbon + 500 ppm Etherl	0.97	0.96	181.04	171.00	116.64	85.33	24.79	41.67
110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn	0.98	0.94	198.16	160.00	133.27	94.50	26.52	30.00
500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn	0.96	0.99	156.60	201.67	97.63	101.67	21.48	46.67
New LSD at 5 %	0.016	0.006	13.44	24.69	8.386	24.63	4.411	9.271

6. Fruit chemical characteristics

Data in Table 6 shows that TSS, acidity, TSS/acid ratio, and fruit ascorbic acid content were significantly affected by different Ethrel and nano fertilizer Foliar applications in both seasons. TSS's highest values were attained from trees treated with 110 ppm Nano Carbon in both seasons. Meanwhile, 110 ppm Nano Si+ 110 ppm Nano Zn treatment resulted in the lowest total acidity in both seasons. The highest significant TSS/acid ratio values were attained from trees treated with 500 ppm Etherl + 110 ppm Nano Si+ 110 ppm Nano Zn in the first season but in the second season obtained at treated trees with 110 ppm Nano Carbon treatment. However, the juice with the highest ascorbic acid content (V.C mg/100g) was found at the treated tree with 110 ppm Nano Carbon+110 ppm Nano Si+ 110 ppm Nano Zn treatment in the first season but in the second season obtained at the treated tree with 110 ppm Nano Carbon treatment. These results are consistent with those reported by Anees et al. (2011), who discovered that mango cv. Dusehri trees treated with 0.4% $FeSO_4$, 0.8% H_3BO_3, and 0.8% $ZnSO_4$ clearly showed the maximum total soluble solids, ascorbic acid, non-reducing sugars, and low acidity compared to the control and other treatments. Researchers Baghdady et al. (2014), Ilyas et al. (2015), and Gurung et al. (2016) found similar results when they examined the impact of foliar GA3 application at a rate of 15 ppm along with zinc at (0.5%) and boron at 0.1% on the quality of Darjeeling mandarin fruit.

Citrus fruits with zinc applied have higher quality (Ashraf et al., 2014). This could be as a result of zinc's roles in protein synthesis, photosynthesis, enzyme system activation, and carbohydrate translocation. Moreover, Patil et al.'s (2018) study showed that utilizing micronutrients—specifically, boron, zinc, and copper—may be a useful tactic for fruit production that is sustainable.

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

Treatments	TSS %		total acidity percentage		TSS/acid ratio		Ascorbic acid content(V.Cmg /100gjuice)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	24.50	22.00	0.43	0.51	57.16	44.78	20.37	12.53
110 ppm Nano Carbon	29.50	26.33	0.35	0.40	85.95	66.02	28.20	26.64
500 ppm Etherl	25.00	25.33	0.41	0.47	60.84	57.05	25.07	21.41
110 ppm Nano Si+ 110 ppm Nano Zn	25.33	23.67	0.30	0.23	85.18	105.9	27.68	24.02
110 ppm Nano Carbon + 500 ppm Etherl	26.25	25.00	0.34	0.47	80.11	54.61	30.55	21.93
110 ppm Nano Carbon+110 ppmNanoSi+110ppmNanoZn	27.00	26.00	0.44	0.55	61.46	49.53	33.42	25.07
500ppmEtherl+110ppm NanoSi+110ppmNano Zn	27.00	23.67	0.31	0.40	87.10	60.70	25.07	21.41
New LSD at 5 %	1.678	2.302	0.05	0.17	14.30	21.88	7.080	6.389

CONCLUSION

Applying 500 ppm Ethrel, Nano Carbon, and 110 ppm Nano Si+110 ppm Nano Zn enhanced the fruits' growth characteristics, blooming characteristics, yield, and physical and chemical char-acteristics compared to the control treatment. Using Nano Carbon+ Nano Si+Nano Zn was pref-erable to using Ethrel to improve yield quantitively and qualitatively. The combined application of these materials surpassed each material alone in this respect. One spray of 110 ppm Nano Carbon+110 ppm Nano Si+, 110 ppm Nano Zn, and 110 ppm Nano Carbon treatments produces higher yield and better fruit quality of Ewasy mongo trees. At the same time, the lowest values of yield and fruit quality were recorded on untreated trees in both seasons.

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تحسين إنتاجية المانجو العويس كمياً ونوعياً باستخدام اسمدة النانو و الإيثريل

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الملخص العربي

تناولت هذه الدراسة خلال موسمي 2021 و 2022في المزرعة البحثية لكلية الزراعة بالكوامل، جامعة سوهاج تم رش أشجار المانجو العويس مرة واحدة بـ 500 جزء في المليون من الإيثريل و 110 جزء في المليون من الكربون النانو و 110 جزء في المليون من السليكون النانو +110جزء في المليون من الزنك النانو. تم فحص النمو و بعض صفات الإزهار و المحصول وكذلك الخصائص الفيزيائية والكيميائية للثمار استجابة للتطبيق الورقي للمواد. كان التطبيق الفردي والمركب لـ 500 جزء في المليون الإيثريل و الكربون النانو و 110 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 الكربون النانو + السليكون النانو + الزنك النانو ومعاملة الكربون النانو مفضلًا على استخدام الإيثريل و السليكون النانو + الزنك النانو لتحسين الإنتاج كميًا ونوعيًا. تجاوز التطبيق المشترك لهذه المواد تطبيق كل مادة بمفردها في هذا الصدد. رش واحد من معالجة (الكربون النانو + السليكون النانو + الزنك النانو) ومعاملة الكربون النانو مسؤول عن إنتاج محصول أعلى وجودة أفضل لثمار أشجار مانجو العويس . بينما سجلت أدنى قيم للمحصول وجودة الثمار على الأشجار غير المعالجة في الموسمين.

الكلمات المفتاحية: الإيثريل ,الأسمدة النانوية ,المحصول, مانجو العويس.