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Effect of foliar application of some nutrients on growth, yield and fruit quality of Keitt mango trees

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Abstract

The present study was conducted during the two consecutive seasons of 2020 and 2021 in a private mango orchard situated at Ballana, Aswan governorate Among various macro and micronutrients. Therefore, balanced application and uptake of K, Ca, B, Zn and Mo can improve the quality and yield of mango trees. So, a field study was conducted with the hypothesis that combined application of these nutrients would be effective to increase the vegetative growth and improve yield and quality of Keitt Mango trees. Two sources of Ca (Ca plus Zn & Ca plus B) and of K (K plus citric & K plus S) and molybdenum (Mo) spring were studied. All Ca, K and Mo (where B and Z) sources were applied at the rate of 1.5 ml/L. These treatments significantly improved the shoot length, leaf area and leaf chlorophyll, N, P, K and Ca as well as panicle length and number /tree, fruit retention, yield, total soluble solids and sugar contents. Data indicated that Ca plus Zn and K-citrate were effective than other treatment and control. Moreover, Ca plus Zn was found more effective in growth traits, while K-citrate was found more efficacious of quality and yield of Keitt mango trees. It is concluded that to improve the growth, yield and quality of Keitt Mango trees would to spray calcium or potassium beside zinc and boron or molybdenum.

Keywords: Keitt; Foliar application; Nutrients; Quality; Yield

Introduction

Mangoes is one of the most popular and favorite fruits in world. It has been considered the King of fruits and is widely cultivated in the tropical and subtropical regions. Mango cultivated areas in Egypt reached 321040 fed. with a total production about 766128 tons (2021) **[1].**

Climatic variables are seriously effects on fruit trees growth and fruiting. Tropic and sub-tropic areas of the world are facing many challenges regarding mango productivity. Due to changing climatic conditions. Mango phenological stage cycle may be affected by a change in temperature, precipitation, light, humidity and greenhouse gases **[2].** The anticipated climate changes and increasing CO_2 levels with global warming can result in greater changes in mango flowering and ultimately low yields of mangoes. The climate, especially high temperature during the flowering season induces erratic flowering in mango **[3].** To obtain higher yields, it is necessary to improve nutrient supply and fertilizer use efficiency to minimize emissions of greenhouse gases. Due to high temperature in summers, mango gets vigorous vegetative growth and in winter early flowering issue becomes the reason for low yield. Increasing nutrients application will increase mangoes yield but will not halt the decline in flowering or fruit drop, which is directly influenced by climatic factors. So, under changing climate, the management of natural resources like nutrients and water are a possible solution to the upcoming menace.

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Potassium (K) is involved in quality-related characteristics of fruit and is called a quality element. It is crucial for many biochemical reactions that are essential for enzyme activation and physiological processes in a cell. To trigger flowering in mango potassium nitrate is being applied generally by mango growing farmers to enhance productivity. It increases the tolerance of plants for many stresses: drought, excessive water, salt stress, high and low-temperature stresses **[4, 5]**. Calcium is one of the most important elements determining the quality of fruit. It is required for cell division and elongation **[6].**

It is very important in controlling fruit disorders, deficiency of Ca is low due to calcic parent material of soil. The problem in plants may be due to poor distribution after uptake **[7].** Also, micronutrients play a vital role in macronutrients translocation and functions of many metabolic processes in plants as respiration, cell wall development, formation of chlorophyll, photosynthesis, hormone synthesis, fixation of nitrogen and enzyme activities **[8].** Zinc is an important trace element in many enzymatic reactions, in regulating the protein and carbohydrate metabolism, plant growth and development **[9].** In fruits many disorders are relevant to B deficiency, even when B is in ample supply, suggesting these disorders are physiological in nature and related to the mobility of B in the plant tissues **[10].** Also, molybdenum is a crucial part of two major enzymes in plant, nitrate reductase and nitrogenase, which are required for normal absorption of nitrogen **[11].**

Therefore, the objective of the current study was designed with to examine the effects of foliar application of some macro and micronutrients various sources on growth, yield and quality of Keitt mango trees.

Materials and Methods

The present study was conducted during the two consecutive seasons of 2020 and 2021 in a private mango orchard situated at Ballana, Aswan governorate where the texture of the soil is clay with a water table depth not less than two meters and the orchard soil analysis according to **[12].** was shown in Table (1). Ten-year old Keitt mango trees budded on mango seedling rootstocks and planted at 3x4 meters apart were selected for this study. Six nutrition treatments were applied and executed in a randomized complete block design (RCBD) with three replications, three trees per each. The details of the nutrition treatments are given in Table 2. Three foliar applications of nutrition were applied for the two seasons in 1st March at the growth stage, 15th April at fruit setting stage, and in the 1st June. All mango trees received the regular agricultural and horticultural practices, which were already followed in the mango orchard including pruning, hoeing, irrigation with Nile water as well as pests, pathogens, and weed control.

Generally, the following measurements were recorded during the two studied seasons.

- Growth aspect measurements:

Ten secondary branches with 1.5 cm diameter were labeled in February for each tree. From the ten labeled branches, twenty new shoots in the growth flush were chosen to measure shoot length (cm), the number of leaves/ shoot and leaf area (cm^2) was measured according to the following equation reported by **[12].** L.A. = 0.70 (L x W) – 1.06 Where L.A. = leaf area (cm^2), L and W= maximum leaf length and width (cm), respectively. Also, leaf chlorophyll contents were measured.

Table 1: The physical and chemical properties of the experimental site.

Physical properties	Clay%		Coarse sand %	Fine sand%	Silt %	Soil texture
	38.25		9.25	18.30	34.20	Clay loam
Chemical properties	EC (dS/m^{-1})	pH (1:2.5)	OM%	Organic C %	Total N %	C/N ratio
	1.65	7.75	1.85	1.40	0.14	10.0
	Soluble cations meq l^{-1}					
	Ca $^{++}$	Mg++	Na^{+}		K^{+}	
	5.25	3.30	4.30		0.13	
	Soluble anions meq l^{-1}					
	CO^{--}	HCO$_3^{-}$	Cl^{-}		SO4^{--}	
	00	2.50	6.30		4.18	

Table 2. Details of the experimental nutrition treatments for the field application as foliar spray of mango cv. Keitt.

Treatments	Nutrition	
T1	Ca (6%) + Zn (0.9%) at 1.5cm^3/ 1 L	(InCa) Inca
T2	Ca (7.5%) + B (2.5%) at 1.5cm^3/ l L	(ALGAGROW)
T3	$K_3C_6H_5O_7$ (K 48%) at 1.5 g/ l L	(CITRO-K)
T4	K_2SO_4 (K 50% + S 18%) at 1.5 g/ l L	(SOLUPOTASSE)
T5	Mo (0.5%) + B (10%) at 1.5cm^3/ l L	(AGRO BORON)
T6	Control (Spray water)	

Measurements of leaf content of N, P, K and Ca (as %):

Ten tagged leaves from each tree were collected carefully at random at the end of September in (2020 and 2021) seasons, as soon as the leaf samples were picked, they were cleaned with a cloth damp to remove any residues that might affect the results. The leaves were oven-dried at 70^{o}C for 48 hours, ground, and stored in small pockets before analysis. Plant material (0.5 g) was digested using hydrogen peroxide plus sulfuric acid as recommended by **[13].**

Flowering aspect measurements:

At full bloom stage in April 2020 and 2021, number of panicles/tree was determined. Also, ten panicles were taken from each replicate to measure number of male flower/panicle, number of hermaphrodite/ panicle, sex ratio (%), and panicle length (cm).

Yield and physical characteristics:

At harvest time, number of fruits per tree was counted, and ten fruits were randomly taken from each replicate for determination the physical and chemical parameters. The physical characteristics namely average fruit weight (g), average fruit length (cm), average fruit diameter (cm), flesh thickness (cm), flesh weight (g), peel weight (g), and stone weight (g).

Chemical characteristics:

1- Fruit total soluble solids (TSS %) using hand Refractometer.

2- Total reducing sugars (%).

3- Total sugars (%).

4- Total acidity (%) as citric acid content according to **[14]**

Statistical analysis:

All obtained data for the tested treatments were tabulated and statistically analyzed according to the procedure of **[15]** The individual comparisons between the studied parameters were compared by using new L.S.D. at 5%.

Results

1- Vegetative growth as well as leaf total chlorophylls, N, P, K and Ca:

Tables (3 to 6) show the effect spraying macro and micronutrient on the shoot length, leaf area and total chlorophylls as well as leaf N, P, K and Ca contents of Keitt mango trees during 2020 and 2021 seasons. It is obvious that the results showed a similar trend during the two studied seasons. Such results indicate that spraying of any of the nutrition significantly increased these traits compared to spray water (control). The highest values of such growth traits were obtained due to spray calcium 6% plus zinc 0.9% (T_1). On other hand, the lowest values of the growth traits were recorded for the trees that were sprayed with water (control, T_6). The recorded leaf area was 76.5, 74.0, 71.7, 59.7, 61.8 and 46.8 cm^2, total chlorophyll 49.8, 43.2, 41.2, 39.4, 38.5 & 33.5 SPAD and N%, 1.52, 1.38, 1.42, 1.35, 1.37 & 1.25% due to spray with InCa (T_1), Algagrow (T_2), Citro-K (T_3), Solupotase (T_4), Agro-boron (T_5) and water sprayed control (T_6), respectively. Then, the attained increment of the leaf area was 57.08, 51.95, 47.23, 22.58 & 26.90 and leaf-N % 21.60, 10.40, 13.60, 8.00 & 9.60% due to T_1 to T_5 compared to T_6 (check treatment), respectively. Therefore, spraying with any nutrition significantly increased the total leaf surface area, nutritional status and vegetative growth of mango trees.

Table (3). Impact of spraying of various calcium and potassium sources and molybdenum on shoot length and leaf number of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Shoot length(cm)			Leaf number		
	2020	2021	Mean	2020	2021	Mean
T_1	18.0	16.3	**17.2**	12.3	10.7	**11.5**
T_2	15.0	14.0	**14.5**	11.3	10.7	**11.0**
T_3	16.3	15.3	**15.8**	11.7	10.7	**11.2**
T_4	14.5	13.6	**14.1**	10.9	9.4	**10.2**
T_5	15.1	14.0	**14.6**	11.1	10.0	**10.6**
T_6	12.7	11.3	**12.0**	9.2	8.3	**8.8**
New LSD 5%	**1.65**	**1.82**		**1.18**	**0.82**	

Table (4). Impact of spraying of various calcium and potassium sources and molybdenum on leaf area and total leaf/shoot of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Leaf area $(cm)^2$			Total leaf/shoot $(cm)^2$		
	2020	2021	Mean	2020	2021	Mean
T_1	83.3	69.7	**76.5**	1024.6	857.3	**941.0**
T_2	82.9	65.0	**74.0**	936.8	695.5	**816.2**
T_3	78.0	65.3	**71.7**	912.6	698.7	**805.7**
T_4	63.5	55.8	**59.7**	692.2	524.5	**608.4**
T_5	64.6	58.9	**61.8**	717.1	589.0	**653.1**
T_6	50.6	46.8	**48.7**	465.5	388.4	**427.0**
New LSD 5%	**5.58**	**4.82**		**42.68**	**40.11**	

Table (5). Impact of spraying of various calcium and potassium sources and molybdenum on total chlorophyll and leaf-N of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Total chlorophyll (SAPD)			Leaf-N (%)		
	2020	2021	Mean	2020	2021	Mean
T_1	48.2	51.4	**49.8**	1.48	1.56	**1.52**
T_2	41.6	49.8	**43.2**	1.35	1.44	**1.38**
T_3	39.6	42.7	**41.2**	1.38	1.46	**1.42**
T_4	37.8	40.9	**39.4**	1.31	1.39	**1.35**
T_5	37.1	39.9	**38.5**	1.32	1.41	**1.37**
T_6	32.6	34.3	**33.5**	1.21	1.28	**1.25**
New LSD 5%	**3.22**	**3.10**		**0.06**	**0.07**	

Table (6). Impact of spraying of various calcium and potassium sources and molybdenum on leaf P, K and Ca% of Keitt mango trees during 2020 and 2021 seasons.

Treatment	P (%)			K (%)			Ca (%)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	0.21	0.23	**0.22**	0.96	1.02	**0.99**	3.88	3.23	**3.56**
T_2	0.19	0.22	**0.21**	0.88	0.95	**0.92**	3.22	3.28	**3.25**
T_3	0.19	0.21	**0.20**	0.93	0.98	**0.96**	3.05	2.78	**2.92**
T_4	0.17	0.18	**0.18**	0.85	0.91	**0.88**	2.56	2.35	**2.46**
T_5	0.15	0.18	**0.17**	0.86	0.91	**0.89**	3.31	2.96	**3.13**
T_6	0.11	0.13	**0.12**	0.75	0.79	**0.77**	0.38	0.25	**2.32**
New LSD 5%	**0.02**	**0.02**		**0.05**	**0.06**		**0.15**	**0.22**	

2- Flowering performance:

Data in Table 7 show the effect of different nutrition foliar application on flowering traits namely number of panicles/tree and sex ratio of Keitt mango trees during two studied seasons. Data pointed out that there were significant differences in these flowering traits as result of implementation of different treatments. Spraying different nutrition significantly increased number of panicles/tree, panicles length and six ratios compared to control. Maximum values of these traits were recorded due to spray with InCa (T_1) followed spray with Citro-K (T_3). The highest panicles/tree (34.8 & 33.2) panicles length (42.0 & 38.8 cm) and sex ratio (80.3 & 78.7% as an av. of studied seasons) due to T_1 and T_3 compared the least values (25.4, 31.4 & 64.8%) due to spray water (control, T_6). Hence, the increment percentage of panicle number attained (37.01 & 30.71), panicles length (33.76 & 23.57) and sex ratio (23.91 & 21.45%) due to T_1 and T_3 compared to T_6, respectively.

Table (7). Impact of spraying of various calcium and potassium sources and molybdenum on flowering traits of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Panicle length (cm)			No. panicles/tree			Sex ratio (%)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	43.0	41.0	**42.0**	32.7	36.8	**34.8**	78.6	81.9	**80.3**
T_2	38.0	36.7	**37.4**	30.3	34.2	**32.3**	77.9	80.8	**79.4**
T_3	39.7	37.9	**38.8**	31.0	35.3	**33.2**	76.9	80.4	**78.7**
T_4	36.8	35.8	**36.3**	27.3	30.5	**28.9**	70.8	73.9	**72.4**
T_5	37.7	35.3	**36.5.**	26.3	30.5	**28.4**	71.5	74.9	**73.2**
T_6	31.7	31.0	**31.4**	24.3	26.5	**25.4**	63.4	66.2	**64.8**
New LSD 5%	**3.1**	**3.4**		**2.18**	**2.55**		**5.63**	**5.88**	

3- Yield

It is clear from Table (8) that the spraying of Keitt mango trees with the macro and micro-nutrition significantly increased the fruit retention, number of fruit/tree and hence yield/tree compared to spray water (check treatment). The maximum these yield components was recorded on the trees that were spray In Ca (T_1), followed by Citro-K (T_3), while minimum one was with the comparison treatment (T_6). The recorded yield/tree was 21.77, 19.20, 19.40, 16.82, 16.39 and 12.27 kg/tree as an average of two studied due to use T_1, T_2, T_3, T_4, T_5 and T_6, respectively. The obtained increment of yield/tree as averages of two seasons was 77.42, 56.48, 58.11, 37.08 and 33.58% as a result of using T_1, T_2, T_3, T_4, and T_5, compared to T_6 (check treatment) respectively. Therefore, it is clear that the spraying of these nutrients on mango trees has beneficial effects.

Table (8). Impact of spraying of various calcium and potassium sources and molybdenum on fruit retention, fruit number and yield of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Fruit retention (%)			Fruit number/tree			Yield/tree(kg)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	2.73	3.10	**2.92**	34.8	35.9	**35.4**	21.54	22.00	**21.77**
T_2	2.65	2.92	**2.79**	32.7	35.4	**34.1**	18.51	19.89	**19.20**
T_3	2.63	2.95	**2.79**	32.5	34.4	**33.5**	18.92	19.88	**19.40**
T_4	2.56	2.84	**2.70**	31.7	33.2	**32.5**	16.48	17.15	**16.82**
T_5	2.48	2.75	**2.62**	31.5	32.7	**32.2**	16.10	16.68	**16.39**
T_6	2.25	2.48	**2.37**	26.7	28.0	**27.4**	12.18	12.36	**12.27**
New LSD 5%	**0.18**	**0.21**		**1.95**	**2.36**		**1.18**	**1.33**	

4- Fruit Quality

It is evident from Tables (9 to 12) that application of the different nutrition significantly improved the fruit quality in terms of increasing the fruit weight, pulp %, T.S.S.% and sugar contents as well as, vitamin C content and decreasing the total acidity and total crude fiber (g) compared spray water one (control). The highest values of fruit traits were recorded on the trees that were treated with 6% Ca + 0.9 Zn at 1.5 ml/L (In Ca, T_1), K3 C6H5O7 at 1.5 g/L (Citro-K, T_3) followed by 7.5% Ca + 2.5% B (Algarow, T_2), respectively. The recorded average fruit weight of mango was 615.6, 564.4, 580.4, 518.7, 509.7 and 449.1 g for the trees that treated with T_1, T_2, T_3, T_4, T_5 and T_6, respectively. The respective TSS was 17.4, 16.9, 17.3, 17.1, 17.2 & 15.3%. Hence, the average increment percentages of the fruit weight were attained 37.07, 25.67, 29.24, 15.50 & 13.49% due to using T_1, T_2, T_3, T_4 and T_5 treatments, compared to T_6 (check treatment) respectively. In addition, the respective average increment of TSS was attained 13.73, 10.46, 13.07, 11.76 & 12.42, respectively.

Table (9). Impact of spraying of various calcium and potassium sources and molybdenum on fruit weight and flesh % of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Fruit weight (g)			Flesh (%)		
	2020	2021	Mean	2020	2021	Mean
T_1	618.9	612.2	**615.6**	81.35	82.32	**81.85**
T_2	566.8	561.9	**564.4**	79.86	78.91	**79.39**
T_3	582.3	578.5	**580.4**	80.45	80.56	**80.51**
T_4	520.7	516.7	**518.7**	77.86	77.11	**77.49**
T_5	509.2	510.2	**509.7**	77.87	77.18	**77.53**
T_6	456.5	443.6	**450.1**	72.35	71.58	**71.97**
New LSD 5%	**46.8**	**45.5**		**5.11**	**4.75**	

Table (10). Impact of spraying of various calcium and potassium sources and molybdenum on TSS and acidity of Keitt mango trees during 2020 and 2021 seasons.

Treatment	TSS (%)			Acidity (%)		
	2020	2021	Mean	2020	2021	Mean
T_1	17.3	17.4	**17.4**	0.258	0.250	**0.254**
T_2	16.9	16.8	**16.9**	0.273	0.215	**0.244**
T_3	17.4	17.2	**17.3**	0.262	0.250	**0.256**
T_4	17.1	17.0	**17.1**	0.262	0.258	**0.260**
T_5	17.1	17.3	**17.2**	0.270	0.254	**0.262**
T_6	15.3	15.2	**15.3**	0.327	0.311	**0.319**
New LSD 5%	**0.71**	**0.52**		**0.015**	**0.018**	

Table (11). Impact of spraying of various calcium and potassium sources and molybdenum on sugar contents of Keitt mango trees during 2020 and 2021 seasons.

Treatment	Reducing sugars (%)			Total sugars (%)			Non-Reducing sugars (%)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	4.38	4.30	**4.34**	12.18	11.95	**12.07**	7.80	7.65	**7.73**
T_2	4.25	4.18	**4.22**	11.83	11.60	**11.72**	7.58	7.42	**7.50**
T_3	4.38	4.31	**4.35**	12.18	11.93	**12.06**	7.80	7.62	**7.71**
T_4	4.30	4.22	**4.26**	11.90	11.70	**11.80**	7.60	7.48	**7.54**
T_5	4.30	4.34	**4.32**	11.95	11.75	**11.85**	7.65	7.41	**7.53**
T_6	3.86	3.78	**3.82**	10.71	10.45	**10.58**	6.85	6.67	**6.76**
New LSD 5%	**0.21**	**0.18**		**0.9**	**0.76**		**0.19**	**0.22**	

Table (12). Impact of spraying of various calcium and potassium sources and molybdenum on V.C. (mg/100g) and total crude fiber of Keitt mango trees during 2020 and 2021 seasons.

Treatment	V.C. (mg/100g)			Total crude fiber (g)		
	2020	2021	Mean	2020	2021	Mean
T_1	42.6	43.5	**43.1**	0.45	0.98	**0.97**
T_2	41.8	42.6	**42.2**	0.99	0.97	**0.98**
T_3	42.8	43.0	**42.9**	0.96	0.98	**0.97**
T_4	41.9	42.6	**42.3**	0.93	0.94	**0.94**
T_5	42.3	43.1	**42.7**	0.97	0.99	**0.98**
T_6	39.6	40.4	**40.0**	1.13	1.17	**1.15**
New LSD 5%	**1.53**	**1.75**		**0.04**	**0.04**	

Discussion

Growth and fruiting characteristics could be effective due to spray nutrients, i.e. P, K, Z, B and Mo. Calcium having an important role in determining the growth in plants, since it is required for cell elongation and division**.** The increment in the growth parameters by calcium application could be attributed to the role of calcium in cell formation and its prevention of cellular degeneration **[16, 17, 18, 19].** The obtained results were in agreement with **[20].** on Keitt and Ewais mango cultivars. The different levels of $ZnSO_4$ improved the shoot length, number of leaves/ shoot and leaf area of mango tree suggested that Zn promoted vegetative growth in terms of plant height, trunk girth and spread of plants **[21, 22].**

Potassium is the prevalent cation in the plant and playing a vital role in maintenance of ionic balance in the cell as well as it bounds ionically to the enzyme pyruvate kinase, which is the essential

in respiration and carbohydrate metabolism **[23].** Moreover, citric acid chelating these free radicals and protecting plant from injury could result in prolonging shelf life of plant cells and enhancing growth characteristics **[24, 25].** These effects might be due to the role of chlorophyll and this element in enhancing photosynthesis and their role in improving growth traits. The positive effect of potassium citrate in this study might be related to the important role of citric acid. It is an antioxidant which has anti-stress effect leading to the protection of photosynthetic pigments and photosynthesis systems of the leaves **[26].**

Our results also pointed out that foliar spraying with Ca + B and Mo + B led to improved growth traits as compared to the control. The beneficial effects of spraying boron on the of Keitt mangoes might be due to its positive effect on the synchronizing release of boron and preventing undesirable nutrient losses to the soil, water and air via direct internalization by plants and avoiding the interaction between nutrients with the microorganisms of water, soil and air as well as improving their efficiency and decreasing soil toxic **[27, 28].** Moreover, the important regulatory effect of boron in biosynthesis and translocation of sugars, activating metabolism enzymes, building of IAA, cell enlargement and division, water absorption and nutrient transport give other explanations **[29, 30].** Meanwhile, the positive influence on the growth of mango Keitt cv. sprayed by molybdenum is related to its crucial role in the major enzymes in plants, nitrate reductase and nitrogenase, which are required for nitrogen absorption **[11].**

As Zn is required for the synthesis of tryptophan, which is a precursor of IAA, it also has an active role in the production of an essential growth hormone auxin. Also, may be related to the essential role of Zinc in many enzymes for plant metabolism, protein synthesis and energy transfer **[31].**

The integration effect of citric acid as antioxidants with micronutrients especially Zn on fruit yield parameters were due the auxinic action and synergistic effect of antioxidants on flowering and fruiting of most fruit trees **[32].** Also, it has synergistic effect on improving growth, flowering, yield and fruit quality of fruit crops **[33, 34, 35, 36].**

The positive effect of potassium in enhancing fruit might be due to its function in improving synthesis of photosynthates and their transport to fruit. Also, the effect of K on the fruit quality can be also indirect due to its positive interaction with other nutrients especially with N and production practices. So, potassium application enhanced fruit quality of mango **[37, 38, 39, 40].**

Conclusion

These investigations indicated that the different foliar spraying treatments resulted in increase and improve all of the studied traits compared to control. Then, it could be concluded, applying 1.5 cm^3/ l Ca + Zn, $K_3C_6H_5O_7$ at 1.5 g/ l or Ca + B at 1.5 cm^3/ l, three times to give the highest yield with good fruit quality of Keitt mango trees.

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تأثير رش بعض العناصر علي نمو و محصول وخصائص ثمار الاشجار المانجو (الكيت)

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الملخص

أجريت هذه الدراسة خلال موسمي 2020 ، 2021 بمزرعة خاصة تقع في قريه بلانه – محافظة أسوان – مصر. لدراسة تأثير رش بعض العناصر الغذائيه علي النمو الخضري والحالة الغذائية والمحصول وخصائص ثمار المانجو الكيت . حيث تم استخدام خمسه معاملات من مخلوط العناصر الغذائيه اضافه الي معامله (الكنترول) التي تم رشها بالماء وقد صممت التجربه بنظام القطاعات كامله العشوائيه ذات ثلاثه مكررات وشجره واحده لكل منها.

وقد أظهرت النتائج ما يلي:

- أظهر الرش بالعناصر المختلفه زياده معنويه لكل من طول الفرع وعدد الاوراق ومساحه الورقه ومحتواها من الكلوروفيل والعناصر مقارنه بمعامله (الكنترول) التي تم رشها بالماء.
- أدت جميع معاملات الرش إلي زيادة المحصول وتحسين خصائص الثمار من حيث زيادة وزن الثمرة ونسبة اللب وكذلك محتواها من المواد الصلبة الذائبة الكلية والسكريات وفيتامين (ج). مقارنة بالرش بالماء.
- ارتبطت زيادة النمو الخضري والحالة الغذائية للأشجار وبالتالي المحصول وخصائص الثمار نتيجه الرش بمخلوط الكالسيوم والزنك يليه الرش بمخلوط سترات البوتاسيوم ثم رش خليط الكالسيوم والبورون.

من نتائج هذه الدراسة يمكن التوصية بأهمية رش مخلوط العناصر الغذائيه ثلاثه مرات خلال موسم النمو خاصه خليط الكالسيوم والزنك بمعدل 1.5ملي لكل لتر او خليط الكالسيوم والبورون 1.5ملي لكل لتر او سترات البوتاسيوم بتركيب 1.5جم لكل لتر حيث يؤدي ذلك إلي تحسين النمو الخضري والحالة الغذائية لأشجار المانجو الكيت مع إنتاج محصول عال ذو خصائص ثمرية جيدة.