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EFFECT OF SPRAYING MORINCA LEAF EXTRACT AND POTASSIUM ON GROWTH AND YIELD OF DATE PALM FRUITS BREAM CLASS

Murtadha Shanan Auda [1], Nada abdulamer Obeid [2] and Khawla Hamza Mohammed [3]
Department of Horticulture and Landscape Design, College of Agriculture, University of Basrah, Iraq
murtadha.auda@uobasrah.edu.iq

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Abstract:

The experiment was conducted in one of the private orchards in the Shatt Al-Arab city Al-Jeazera Al-Rabah District - Basra Governorate during 2022 growing season. To study effect of spraying with Morinca leaf extract , potassium solution and the interaction between them in some physical, chemical and production characteristics of date palm fruits of the Bream class , The extract of the Morinka solution was used at a concentration of (0, 15, 30)% and potassium at a concentration of (0, 1, 2)%, in two sprays, the first two weeks after inoculation and the second three weeks after the first spray. The results showed that the spraying treatment with Morinca extract at a concentration of 30% and potassium at a concentration of 2% was significantly superior in the physical characteristics under study (fruit weight, length, diameter, and stromal layer weight). The above treatment also excelled in chemical properties (soluble solids, reducing sugars, total sugars, vitamin C, and protein) compared to the comparison treatment. While the same treatment significantly reduced the percentage of sucrose in the fruits, The same treatment gave a significant increase in the percentage of nitrogen, phosphorus and potassium. The interaction between the two study factors had a significant effect on most of the studied traits.

Keywords: Morinca Extract, Potassium, Date Palm, Bream

INTRODUCTION:

Palm trees belong to the Arecaceae family, to which several types belong, the most important of which is the date palm type (1993, Barreveld). dactylifera Phoenix L. The prevailing belief is that the original homeland of these trees is the Arabian Gulf and Iraq, For this reason, Iraq is considered one of the oldest countries for palm cultivation and production in the world (Al-Aqidi, 2010). The number of varieties grown in Iraq is estimated at approximately 600 (Al-Hamdani et al., 2022). An area estimated at (123230) hectares, a number of (17348741) and a production of (353735) tons per year (Agricultural Statistics Directorate, 2020). Modern agriculture has nowadays moved towards sustainable organic agriculture and environmentally friendly methods used to increase production and improve its quality. Consequently, the need emerged to reach safe and alternative sources that replace chemicals that often result in negative effects. Therefore, the need arose for researchers to turn to finding natural alternatives that do not leave an impact on human health and the environment, such as the use of biostimulants in the form of plant extracts containing a wide range of active compounds. Biologically, it is beneficial in that it contains mineral elements and organic acids, in addition to plant hormones, One of these alternatives is Moringa oleifera leaf extract, which is considered a natural growth stimulant because it contains many natural hormones such as Zeatin (Azra et al., 2013). Potassium plays many roles in plants, as it is considered an osmotic regulator under conditions of salt stress. It participates in metabolic processes that occur in plant cells and increases the effectiveness of cellular enzymes, as it activates or activates more than 50 enzymes and works to regulate the movement of ions, cell filling, and transport in the phloem. It controls some cellular interactions and regulation of osmotic potential, Ashraf and Harris, 2004; Mathis, 2009). Also, one of the important roles of potassium is transporting solutes in the plant through the phloem. Therefore, supplying the plant with potassium is essential in the functioning of the transport systems in the plant body (Karley and White, 2009; Mathis,2009). According to the recent increasing interest in using natural alternatives instead of artificial fertilizers and nutrients, to reduce the risks of environmental and health pollution, the lack of studies that address the physiological interactions of chemical fertilization and plant extracts together on the growth and yield of date palm fruits. This study was conducted for the purpose of knowing the effect of spraying with Morinca leaf extract and the element potassium on date palm fruits in order to reach the optimal concentration of those factors that achieve an increase in the quantity and quality of the yield.

MATERIALS AND WORKING METHODS

The study was conducted in one of the community orchards in the Shatt Al-Arab city Al-Jeazera Al-Rabah District - Basra Governorate during 2022 growing season. The orchard soil was analyzed by taking samples at a depth of (0-60) cm , Table (1) shows some of the physical and chemical characteristics of the field soil, Table (2) shows some of the chemical characteristics of the orchard's irrigation water. 27 date palm trees of the Breem variety were selected, almost identical in age, height, and vegetative growth as much as possible, and free of disease infection. for a period of 16 years, It left six pink inflorescences on each palm tree. The trees were vaccinated on 3/23 with AL¬Ghannami Akhdar ,The inflorescences were sprayed with an aqueous solution of potassium sulfate at a concentration of 0.1.2% and a nutrient solution of Morinka at a concentration of 0.15.30% using a 2-liter hand sprayer in the early morning, at a rate of two sprays, the first spraying two weeks after pollination and the second spraying three weeks after the first spraying. Add Tween 20, 0.1% concentration, to the prepared solutions . This is to reduce the surface tension of the water and increase the adhesion of the substance to the leaves. As for the comparison treatment, it was prepared from distilled water and the diffuser only. Fruit samples were collected at a rate of 25 fruits from each replicate to study some fruit characteristics at the khalal stage.

The measurements were as follows:

First - the physical characteristics of the fruits:

1 - Weight of the fruit and weight of the stromal layer **(garam)**: Twenty-five fruits were taken randomly from each replicate and the weight was recorded for them using a sensitive Sartorious electric balance. Then the seeds were removed from the fruits and the weight was recorded for them. weight of the stromal of layer was calculated by subtracting the weight of the seed from the weight of the fruit.

2 - **Length and diameter of the fruit:** . The diameter and length characteristics of the same fruits were measured using a measuring foot (Vernier Caliper) in cm.

Second: Chemical characteristics:

1 – Total dissolved solids (%)

The percentage of total soluble solids of the fruits was estimated using a hand refractometer, the reading was adjusted at a temperature of (20°C) based on the method of Shirokov (1968).

2 - Total sugars in fruit pulp (%). The percentage of sugars in the Khalal stage was estimated using the Lane and Eynone method as in Abbas and Abbas (1992).

3- Estimation of vitamin C in fruits (mg.100 g-1). Quantity of vitamin C was estimated at the Khalal stage according to what was stated in 1975. C.A.O.A.

4 - Soluble protein in fruits (mg. 100 g): Soluble protein in fruits was estimated at the Khalal stage according to the method described by (Herbert et al., 1971.(

Morinca leaf extract was prepared after collecting the leaves and their tender branches in the morning and air-dried them for several days. After complete drying, it was ground , Then collect the powder and soak it in distilled water for 24 hours at a rate of 100 grams per liter, then collect the extract in plastic containers after filtering it with a cloth, then take 150 mlm of the extract per liter of water to prepare a 15% concentration and 300 mlm of the extract per liter of water to prepare a 30% concentration (Bakhsh et al. al.,2020).

A molecular soil sample (sub-samples) was taken, distributed randomly at a depth of (0-60 cm). The sample was air-dried , gravel and impurities were removed from it. Then it was ground and sieved with a 2-mm sieve and kept in a plastic container for the purposes of laboratory analysis. The soil sample was analyzed in university laboratories. Basra - College of Agriculture - Department of Soil and Water Sciences , Some chemical and physical properties of the soil sample were estimated. As shown in Table 1, water samples were collected at the same time as soil samples and kept in plastic containers

After adding a few drops of coloring agent and 5% chalcone , It was stored in the refrigerator at a temperature of 4°C until chemical analyzes were carried out. Table (2) represents the average results of chemical analyzes of irrigation water.

Table (1) Some physical and chemical characteristics of orchard soil at a depth of (0-60) cm for the 2020 growing season

Type	Value
Degree of electrical conductivity (E.C) (decimens.m-1).	**9.05**
PH	**7.73**
Total nitrogen (g -kg -1)	**4.21**
Ready-made phosphorus (g.kg-1)	**0.822**
Ready-made potassium (g.kg-1)	**1.928**
Organic matter (g.kg-1)	**13.13**
Soil separations %	
Sand	**4.50**
Silt	**61.00**
Clay	**34.50**
Soil texture	**Alluvial clay**

Table (2) shows some water characteristics of the study site

Type	Value

Degree of electrical conductivity (E.C) (decimens.m-1).	**6.91**
PH	**7.05**
Chlorabide ions - Cl mmol.	**31.18**
Calcium ions ca mmol.	**13.79**
Potassium ions k mmol.	**0.47**
Sodium ions Na mmol.	**7.83**

The experiments were designed using a Randomized Complete Block Design (R.C.B.D), with a factorial experiment with three replications. The results were analyzed using the Genstat program and the means were compared using the Least Significant Differences Test (L.S.D) at the 5% probability level based on (Bashir, 2003).).

RESULTS AND DISCUSSION

The results in Table (3) indicated that there were significant differences in the effect of spraying with Morinka solution on the physical characteristics of the fruits, as the concentration exceeded 30% significantly by giving the highest rate of fruit weight, fruit diameter,stromal of layer weight, as it reached (7.71 g, 1.62 cm, 7.38 g) respectively. . As for the comparison treatment, the lowest average was recorded for the characteristics of fruit weight, fruit diameter, and stromal of layer weight, which amounted to (6.80 g, 1.53 cm, and 7.08 g), respectively. It is noted from the table that there are no significant differences between the concentrations of spraying with Morenca in the character of fruit length. While the results in the same table showed that spraying with potassium had a significant effect on the physical characteristics of the fruits, the 2% concentration was significantly superior in giving it the highest rate of fruit weight, reaching 8.30 grams, followed by the 1% concentration, which recorded a rate of 8.05 grams, compared to the comparison treatment, which recorded the lowest rate of 7.80 grams. As for the length of the fruit, the same concentration exceeded it by a rate of 3.21 cm, followed by the 1% concentration of 3.18 cm, which did not differ significantly compared to the comparison treatment, recording a rate of 3.01 cm. It was noted in the same table that the potassium concentration exceeded 2% by giving it the highest rate of diameter and fleshy layer, as it was recorded (1.69 cm, 7.37 g). While the comparison treatment recorded the lowest average for the mentioned characteristics, reaching (1.44 cm, 6.66 g). As for the interaction between the two study factors (Morinca + potassium), it has a significant effect on the average weight of the fruit, as the interaction treatment between the Morinka solution, 0 concentration, and potassium, 2% concentration, was significantly superior. By giving it the highest rate, which reached 8.48 grams, it was followed by the interaction treatment between Morinka zero concentration and potassium concentration 1%, which did not differ significantly from it, while the interaction treatment between Morenca 30% and potassium concentration zero recorded the lowest rate, reaching 7.75 grams. However, the interaction treatment between Morinka 30% and potassium 1% recorded the highest rate of fruit length, reaching 3.38 cm, compared to the interaction treatment between Morenca 15% and potassium zero concentration, which recorded the lowest rate, reaching 2.96 cm. While the interaction treatment between Morinca zero and potassium concentration 2% reached the highest rate for the two characteristics of the diameter of the fruit and the weight of the stromal of layer, 1.73 and 7.58 grams, respectively, compared to the interaction treatment between Morenca 30% and potassium zero, which gave the lowest rate for the two characteristics mentioned, 1.41 cm, 6.73 grams, respectively. I have shown Results of Table (3) for the physical characteristics of the fruits (fruit weight, length of the fruit, weight of the stromal of layer). There are significant differences between the concentrations of the Morinka solution, which has an effect in improving the physical characteristics of the fruits. The reason may be attributed to the extract containing the compound zeatin, which is one of the most common compounds of cytokinin. An important role in cell division and elongation and its antioxidant properties, as well as its role in regulating and distributing the products of the photosynthesis process and absorbing nutrients (Zhang and Ervin 2004, Anwer et al. 2007). This may be due to the fact that this extract contains gibberellins, auxins, also the amino acid tryptophan, which is considered the main initiator in the formation of indole acetic acid, in addition to the role of hormones in the movement of nutrients towards the fruit, thus increasing its weight, diameter, and size (Masny et al. 2004).

The results of previous data showed that spraying with potassium sulfate had an important role in improving the physical characteristics of the fruits, the reason may be due to the role of potassium in the formation of carbohydrates and protein.

It increases cell division and has a significant impact on the process of photosynthesis and respiration, and affects the activity of some nutrients (Al-Qatrani, 2010). This is similar to what was found by (Sherif et al., 2012) when treating the flowering inflorescences of date palms, the Halawi variety, with 1% and 2% potassium sulfate. Significant increase in fruit weight.

Table (3) The effect of spraying with Morinca extract and potassium solution and their interaction on some physical characteristics of date palm fruits of the Breem variety at the khalal stage.

Moringa solution (%)	Potassium (%)	Weight of fruit (gm)	Fruit length (cm)	Fruit diameter (cm)	Layer weight Adenoids (gm)
0	**0**	**7.91**	**3.08**	**1.48**	**7.06**
	1٪	**8.28**	**3.09**	**1.64**	**7.50**
	2٪	**8.48**	**3.24**	**1.73**	**7.58**

15٪	0	7.76	2.96	1.43	6.81
	1٪	7.89	3.07	1.57	7.27
	2٪	8.24	3.02	1.67	7.28
30٪	0	7.75	3.00	1.41	6.73
	1٪	7.98	3.38	1.50	7.26
	2٪	8.17	3.21	1.66	7.26
L.S.D		0.38	0.35	0.11	0.28
Average effect of moringa extract	0	8.22	3.14	1.53	7.08
	15٪	7.96	3.07	1.55	7.12
	30٪	7.97	3.20	1.62	7.38
L.S.D		0.22	0.20	0.06	0.16
Average effect of potassium	0	7.80	3.01	1.44	6.66
	1٪	8.05	3.18	1.57	7.34
	2٪	8.30	3.21	1.69	7.37
L.S.D		0.22	0.20	006	0.16

As for the spraying treatments with potassium solution, the 2% potassium treatment was significantly superior and recorded the highest rate of percentage of total dissolved solids, giving it a rate of 42.86%. As for 1% concentration, it was followed by the effect, which recorded a rate of 38.46% compared to the comparison treatment, which recorded the lowest rate of 35.18%. The same concentration recorded the highest rate of total sugars, 49.22%, followed by the 1% concentration, which recorded a rate of 47.06%, with which it differed significantly, while the comparison treatment recorded the lowest rate of 44.88%. The results also indicate that 2% potassium treatment was significantly superior, giving the highest rate of 12.24 mg. 100 gm, followed by 1% concentration, which recorded an average of 11.76 mg. 100 grams, which did not differ significantly compared to the comparison treatment, which recorded the lowest rate of 10.32 mg. 100 gm in vitamin C, and 2% concentration was also significantly superior to the rest of the treatments by giving it the highest rate of soluble protein, reaching 148.08 gm. The lowest rate was 130.35 g. 100 g-1. There was an overlap between the two factors

The solution of Morenca and potassium had a significant effect on the percentage of total dissolved solids, as the intervention treatment, the solution of Morenca 30% and potassium, 2% concentration, had a significant effect, reaching 44.38%, while the interaction treatment, solution of Morenca, concentration 30%, and potassium, 0% recorded the lowest rate, reaching 33.66%. While the interaction treatment between the 30% Morinka solution and the 2% potassium concentration significantly outperformed the percentage of total sugars by giving it the highest rate of 53.62%, while the interaction treatment of the 0 concentration Morinka solution and the 0 concentration potassium recorded the lowest rate of total sugars of 41.59%. It is noted from the table that the interaction treatment, Morinka solution, 30% concentration, and potassium, concentration 2%, was significantly superior to the rest of the treatments, recording the highest rate of vitamin C, amounting to 14.28 mg. 100 g compared to the control treatment. The intervention treatment, Morinka (30% concentration) and potassium (2% concentration), recorded the highest rate of soluble protein, 157.37 mg. 100 gm, while the interaction treatment, Morinka zero concentration and potassium zero concentration, recorded the lowest rate of 123.63 mg. 100 gm.

The results of Table (3) indicated that there were significant differences between the concentrations of Morinca extract, with the concentration exceeding 30% over the rest of the treatments in the chemical characteristics represented by total dissolved solids and total sugars, giving it the highest rate of 39.90% and 50.19%, respectively, while the comparison treatment recorded the lowest rate of 36.86%. , 43.92%. It was also noted that the same concentration was superior to vitamin C and soluble protein, recording the highest rate of 14.05, 146.91 mg. 100 gm fresh weight compared to the comparison treatment, which recorded the lowest rate, reaching 10.08 and 132.11 mg. 100 gm.

The results in the same table indicate that the increase in the chemical characteristics of date palm fruits of the Breem variety when sprayed with the extract in total dissolved solids, total sugars, vitamin C, soluble protein may be due to the extract containing plant hormones, which contributed to increasing the rate of these characteristics through the transfer of substances. Nutrition towards fruits (Al-Hamoud, 2019) , these results are consistent with the findings of Moustafa et al. (2018). When spraying palm trees of the Khadrawi variety with a 3% Morinka solution, it led to a significant increase in total dissolved solids and reduced and total sugars. The results in Table (4) showed that the use of potassium sulfate has an important role in improving chemical characteristics. The reason for this may be attributed to the fact that potassium has a major role in increasing the water content, which led to the dilution of the cell juice inside the fruits. It also contributes to the formation of carbohydrates in addition to activating enzymes in The process of photosynthesis, protein formation, and increased cell division, in addition to its role in the penetration of roots into the soil, and therefore its deficiency leads to a decrease in yield (Sherif et al. 2013).

Table (4) The effect of spraying with Morinca extract and potassium solution and their interaction on some chemical characteristics of date palm fruits of the Breem variety at the khalal stage.

Moringa solution (%)	Potassium (%)	Total dissolved solids (%)	Total sugars (%)	Vitamin C in fruits (mg. 100 g)	Soluble protein in fruits (mg 100g)
0	0	33.66	41.59	9.30	123.63
	1٪	36.21	44.50	9.99	133.13
	2٪	40.71	45.68	10.95	139.56
15٪	0	35.80	45.43	13.13	131.47
	1٪	39.93	47.34	11.94	140.72
	2٪	43.50	48.38	11.78	147.32
30٪	0	36.09	47.62	14.52	135.94
	1٪	39.23	49.35	13.34	147.42
	2٪	44.38	53.62	14.28	157.37
L.S.D		2.435	2.500	2.173	5.788
Average effect of moringa extract	0	36.86	43.92	10.08	132.11
	15٪	39.74	47.05	12.28	139.84
	30٪	39.90	50.19	14.05	146.91
L.S.D		1.406	1.443	1.255	3.342
Average effect of potassium	0	35.18	44.88	10.32	130.35
	1٪	38.46	47.06	11.76	140.43
	2٪	42.86	49.22	12.34	148.08
L.S.D		1.406	1.443	1.255	3.342

The numbers in Table (5) show that there are significant differences between the concentration of the Morenca solution in some chemical characteristics, namely total chlorophyll and the leaves' content of nutritional elements, namely nitrogen, phosphorus, and potassium. It achieved a concentration of 30% by giving it the highest rate of total chlorophyll of 3.98 g.100 g-1, while the control treatment gave the lowest rate of total chlorophyll of 2.96 g.100 g-1. The results in the same table also indicate that there are significant differences in the chlorophyll content of the leaves, where the 2% potassium treatment was significantly superior, giving it an average of 3.72 g.100 g-1 fresh weight, followed by the 1% concentration, which recorded 3.36 g.100 g-1 fresh weight. As for the interaction between the two factors The study had a significant effect on the quality of chlorophyll, as the interaction treatment between Morinka concentration 30% and potassium 2% was significantly superior by giving it the highest rate of 4.23 g.100 g-1 fresh weight compared to the comparison treatment, which recorded the lowest rate of 2.61 g.100 g-1 fresh weight. It was noted from the table. In the same way, the concentration of potassium has a significant effect on the content of the leaves of the nutrients nitrogen, phosphorus, and potassium, as the potassium treatment exceeded the 2% concentration by recording the highest rate for the aforementioned elements, as it reached (1.35, 0.33, 1.67)%, respectively, followed by the 1% concentration, which recorded the average for the leaves' content of the nutrients. It reached (1.23, 0.28, 1.44)%, respectively, while the zero concentration potassium treatment recorded the lowest rates (1.03, 0.21, 1.44)%. As for the interaction treatments between the extract and potassium sulphate, the Morinca 30% treatment and the 2% potassium treatment excelled, with the highest values reaching (1.42, 0.43, 1.78)%, while the comparison treatment recorded the least significant difference in the leaves' content of nutrients, amounting to (0.83, 0.16, 1.37)%.

The results of Table (5) indicated that there were significant differences between the concentrations of Morinca extract in some chemical characteristics of the leaves, represented by chlorophyll, nitrogen, phosphorus, and potassium. The reason may be due to Morinca leaves containing high percentages of elements, the most important of which are potassium, magnesium, iron, sulfur, calcium, vitamins, and organic acids, which caused A noticeable increase in the leaves' content of nutrients (uSDA, 2016). Or perhaps the reason is due to the extract containing zeatin, which is considered one of the main components in the formation of proteins and oils, and in turn works to stimulate cells to divide and absorb nutrients, which in turn improves the yield, in addition to containing amino acids and macro- and micro-nutrients (Nasir et al., 2016). It is clear from the same table that spraying with potassium sulfate has a significant effect in increasing the leaves' content of the nutrients nitrogen, phosphorus, potassium, and total chlorophyll. This may be due to the role of potassium in encouraging the transfer of phosphorus from the roots to the leaves, and it works to activate enzymes and root growth, as well as the movement of nutrients from the roots to the parts. Other plants (and power, Prasad, 1997). Or the reason may be attributed to the contribution of potassium to many physiological processes, such as the process of photosynthesis and nitrogen transformations in plants, as well as the activation of enzymes responsible for the movement of nitrogen from roots to leaves (Prasad,And Power, 1999).

Table (5) The effect of spraying with Morinca extract and potassium solution and their interaction on the content of chlorophyll and nutritional elements in date palm leaves of the Breem variety.

Moringa solution (%)	Potassium (%)	Chlorophyll	Nitrogen %	Phosphorus %	Potassium (%)
0	0	2.610	0.830	0.160	1.370

	1%	3.020	1.157	0.233	1.483
	2%	3.250	1.323	0.250	1.543
15%	0	2.820	1.103	0,210	1.453
	1%	3.130	1.220	0.253	1.513
	2%	3.680	1.307	0.310	1.683
30%	0	3.760	1.034	0.273	1.513
	1%	3.957	1.327	0.380	1.613
	2%	4.230	1.420	0.436	1.783
LSD		0.8578	0.2095	0.0864	0.0934
Average effect of moringa extract	0	2.960	1.103	0.214	1.466
	15%	3.210	1.210	0.257	1.550
	30%	3.982	1.306	0.363	1.637
LSD		0.4952	0.1210	0.0498	0.0539
Average effect of potassium	0	3.063	1.034	0.214	1.446
	1%	3.369	1.234	0.288	1.537
	2%	3.720	1.350	0.332	1.670
LSD		0.4952	0.1210	0.0498	0.0539

Sources

Bashir, Saad Zaghloul (2003). Your guide to the statistical program SPSS, tenth edition. Arab Institute for Training and Research in Statistics.

Al-Hamdani, Khaled Abdullah Sahu, Majed Hassan Muhammad, and Marwa Noman Hussein (2022). Date palm, first edition. Tikrit Press, 340 pages.

Al-Hamoud, Firas Mahdi Abbas (2019). The effect of spraying with some marine algae extracts, the Calmax nutrient solution, and the spraying method on some physical, chemical, and physiological characteristics of date palm fruits (Phoenix dactylifera L.) of the Breem and Halawi varieties. Master's thesis, College of Agriculture, University of Basra, Iraq, p. 131

Sharif, Hussein Jassim, Sabah Hassan Tarish, and Mahmoud Shaker Abdel Wahed (2012). The effect of potassium spraying on some fruit characteristics of date palm Phoenix dactylifera L., Halawi cultivar.

Abbas, Moayed Fadil and Mohsen Jalab Abbas (1992). Care and storage of practical fruits and vegetables. Dar Al-Hekma Press - Basra University - Iraq.

Al-Aqidi, Hassan Khaled (2010). The date palm is the lady of trees and the pearl of fruit. Second edition, Amman - The Hashemite Kingdom of Jordan. Safe for publication and distribution.

Basra Agriculture Directorate. (2022). Statistics of palm groves, number and area in Basra Governorate. Palm section. Department of Agriculture . Ministry Of Agriculture. Iraq.

A.O.A.C.(1975). Official Method of Analysis.Association of Official Method of Analytical chemists Washington,D.C.,910p.

Anwar, F., Latif, S., Ashraf, M., and Gilani, A. H. (2007). Moringa oleifera: a food plant with multiple medicinal uses. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 21(1), 17-25.

Ashraf, M. and P. J. C. Harris, (2004). Potental biochemical indicatros of Salinity tolerance in plants. Plant Sci., 166-3-16.

Azra, Y.، Basra, S. M. A., Muhammad, F., Nazim, H., and Habib-urRehman, A. (2013). Exogenous application of moringa leaf extract modulates the antioxidant enzyme system to improve wheat performance under saline conditions. Plant Growth Regul 69:225–233.

Bakhsh, A.، Javaad, H. W., Hussain، F., Akhtar، A., and Raza, M. K. (2020). Application of Moringa oleifera leaf extract improves quality and yield of peach (Prunus persica). Journal of Pure and Applied Agriculture, 5(2), 42-51.

Herbert,D.; Philips , P.J. and Strange , R.E.(1971). Methods in Microbiology . Chapter 3.Morris, J.R. and Robbins, D.W.(ed) . Academic Press, New York,U.S.A.

Karley, A. J. and P. J. White, .(2009). Moving cationic minerals to edible tissues: Potassium , magnesium, calcium. Current Opininon in Plant Biology, 12:291-298.

Masny, A.; Basak, A. and Zurawicz, E. (2004). Effect of foliar applications of Kelpak SL and Goemar BM 86 preparations on yield and fruit quality in two strawberry cultivars. Journal Fruit and Ornamental Plant Research, 12.

Mathis, F. J. M. (2009). Physiological function of mineral macronutrients.Curr. Opin. Plant Biol., 12:250-258.

Moustafa, A., Abdel-Hamid, N., Abd El-Hamid, A., El-Sonbaty, M., and Abd El-Naby, S.(2018). Improving Fruit Set, Yield and Fruit Quality of Khadrawi Date Palm Cultivar. Arab Universities Journal of Agricultural Sciences, 26(4), 1461–1470. https://doi.org/10.21608/ajs.2018.34126 .

Nasir , M,. Khan A.S, Basra, S.M.A,and Malik, A.U. (2016). Foliar application of moringa leaf extract, potassium and zinc Lnfluence yield and fruit quality of _Kinnow` mandarin. Scientia Hortic 210: 227-235.

Shirokov, E.P. (1968) . Practical course in storage and processing of fruit and vegetables . USDA / NSF .Washington , D.C. U.S.A .

Zhang, X., and Ervin, E. (2004). Cytokinin-containing seaweed and humic acid extracts associated with creeping bentgrass leaf cytokinins and drought resistance. Crop science, 44(5), 1737-1745.