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Response of Date Palm Trees *Phoenix dactylifera* L. Bream Cultivar to the Two Biostimulants Agazone and Amalgerol and the Method of Their Application.

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Abstract

This study was conducted in private orchards located in Abu Al-Khaseeb district, south of Basrah Governorate, to evaluate the response of date palm trees (Bream cultivar) to biostimulant treatments. Two biostimulants, Amalgerol and Agazone, were tested at concentrations of 0, 6, and 12 mg.L⁻¹, using two application methods: foliar spray and soil drench. Results showed significant effects of these treatments on several fruit traits. Foliar spray application improved fruit length, size, weight, fleshy layer weight, dry matter percentage, maturity, and total and reducing sugars compared to soil application. The 12 mg.L⁻¹ Agazone treatment significantly enhanced fruit length, size, weight, fleshy layer weight, and sugar content, outperforming the control treatment, which had the lowest values. The 6 mg.L⁻¹ Agazone treatment was superior in increasing fruit diameter compared to the control treatment. Interaction effects between biostimulant concentration and application method were significant for most measured traits.

Keywords: Biostimulants, application method, Bream cultivar, fruit quality, physiological traits

Introduction

The date palm is a tree of great economic significance, valued for its highly nutritious and economically beneficial fruits that contribute to both local and global development (Iqbal *et al*., 2004). It is recognized as the most important food-producing tree in desert regions, often referred to as "the fruit of the desert." In the Arab world, date palm cultivation is distributed across oases, interior regions, coastal areas, and riverbanks (Lemlem, 2018). Foliar fertilization is a widely adopted method to reduce soil pollution, minimize fertilizer loss, and lower application costs, thereby improving nutrient use efficiency (Saquee *et al*., 2023). The incorporation of growth-promoting substances, such as seaweed extracts, enhances soil physical and chemical properties, stimulates root and shoot growth, and boosts yield (Chen *et al*., 2021). Seaweed extracts serve as biostimulants, significantly influencing plant physiological processes and functioning as organic fertilizers when applied to soil or as foliar sprays (Turan and Kose, 2004). Modern agriculture faces the dual challenge of meeting the growing global demand for food while mitigating the negative environmental impacts of some agricultural practices (Senthuran *et al*., 2019). In order to meet the above challenges, there is a tendency on a wider scale to resort to natural compounds, in particular plant extracts, as substitutes for chemicals. This shift is beneficial because it ameliorates the impacts that stem from the use of synthetic inputs and enhances eco-friendliness (Zamani *et al*., 2013). The utilization of natural fertilizers offers numerous advantages, including increased crop yields, enhanced product quality, and the preservation and enhancement of plant physiological functions. Additionally, nutrient-dense solutions derived from natural extracts reduce the energy required for plant production, effectively meeting a substantial portion of their nutritional needs (Taiz and Zeiger, 2006). The adverse effects of chemical fertilizers on both the environment and human health have led to a growing interest in the utilization of natural products, which are becoming more prevalent in agricultural practices (Khan *et al*., 2024). Due to their non-toxicity, environmental friendliness, lack of hazardous residues, and affordability, seaweed-based fertilizers are very beneficial and may be used in underdeveloped nations (Lateifa, 2012; Zamani *et al*., 2013). Biostimulants, especially those derived from seaweed extracts, serve as valuable tools not only for safeguarding plants against environmental stressors but also for improving the yield and quality of horticultural crops (Szabo and Hrotko, 2009). These extracts are made using specific techniques, preserve the inherent qualities of seaweed, and are used as soil supplements or foliar sprays to enhance rather than replace conventional fertilizers (Craigie, 2012). Liquid fertilizers derived from seaweed are considered natural organic fertilizers, rich in highly effective nutrients (Baliah *et al*., 2017). These fertilizers are classified as biostimulants due to their content of plant growth regulators and essential nutrients (Szabo and Hrotko, 2009). They also act as antioxidants, enhancing enzymatic activity, such as superoxide dismutase and glutathione reductase, and increasing leaf chlorophyll content due to the presence of betaine (Zodape *et al*., 2010). Furthermore, they are abundant in salicylates, plant hormones, and growth promoters (Calvo *et al*., 2014). A study by Omar *et al*. (2017) on the Sukary date palm cultivar demonstrated that foliar application of seaweed extracts significantly improved fruit length, diameter, and size. The current study aims to evaluate the effectiveness of selected biostimulants (Agazone and Amalgerol), and their application methods in enhancing the physical, chemical, and physiological characteristics of date palm cv Bream fruits.

Materials and Methods

Experimental Site

The study was conducted in a private orchard located in Abu Al-Khaseeb district, south of Basrah Governorate. A total of thirty date palm trees (Bream cultivar) at 10-year-old and as uniform in size as possible, were chosen. Six bunches remained on each tree following thinning after all trees were pollinated with green Ghannami pollen on 22-25/3/ 2021.

The experiment consisted of two factors. The first factor involved two methods of application: foliar spraying and soil application. The second factor involved five levels of biostimulant concentrations, with no interaction between the stimulants. The biostimulants used were Agazone, produced by Al-Joud Company for Modern Industry and Agriculture Technology-Iraq. It is a natural blend composed of 30 natural compounds, 10% free nitrogen, natural growth regulators (auxin, gibberellin, cytokinin), and trace elements (Mn, Mg, Ca, Zn, B, Fe, S, Cu). The second biostimulant, Amalgerol, was produced by Cosmocel Mexico and provided by Agrimatico for Agricultural Supplies Trading, Iraq-Erbil. It is an organic natural blend containing 18% organic matter, equivalent to 10% organic carbon, vegetable and mineral oils, and seaweed. Amalgerol stimulates plant growth, strengthens immunity, and helps plants resist various stress conditions due to its amino acids, including arginine and proline, and improves production quality. Two concentrations were prepared for each biostimulant: 6 and 12 mg L^{-1}. For comparison, the trees were sprayed only with distilled water. A 0.01% cleaning solution was used to reduce surface tension of the spraying solutions. Foliar spraying was performed on the trees until they were fully wet, early in the morning to ensure maximum absorption of the sprayed solutions and avoid midday sunlight heat. For soil application, the required concentrations of biostimulants were prepared at a rate of 30 liters per replicate of the soil application treatment, with irrigation suspended two days before and after each application. Both foliar spraying and soil application started on 15/4/2021, and were repeated four times with a ten-day interval between each application. Samples were collected during the rutab stage, and the required measurements were taken. Laboratory analyses were conducted at the Date Palm Research Centre at the University of Basrah. The following traits were measured and evaluated:

Fruit weight, pulp weight, and seed weight:

The fruit weight was calculated by randomly selecting 10 fruits from each experimental unit, which were weighed using a sensitive electronic balance. The fresh weight of each fruit was then determined by dividing the total weight by the number of fruits. The average seed weight was calculated in the same manner after removing the seeds from the same fruits. The pulp weight was calculated by subtracting the seed weight from the total fruit weight.

Fruit volume:

Ten fruits were randomly selected from each experimental unit, and the fruit volume was measured using the water displacement method. A graduated glass cylinder was filled with water to a certain level, and then the fruits were placed into the cylinder. The average fruit volume was calculated according to the following equation:

$$\text{Fruit volume (cm}^3\text{)} = \frac{\text{volume of displaced water}}{\text{number of fruits}}$$

Fruit length and diameter:

The length and diameter of the fruits, which were previously used to measure volume, were measured using a vernier Caliper.

Fruit moisture content:

The moisture content of the fruits at the rutab and tamr stages was determined by weighing 25 g of chopped fruit flesh, randomly sampled from the replicates of each treatment. The samples were placed in a vacuum oven at 70°C for 72 hours until a constant weight was achieved. The dried samples were then weighed using a sensitive balance. The percentage of moisture content and dry matter was calculated according to the following equation:

$$Water\ content\ (\%) = \frac{\text{Wt. of Fresh fruit} - \text{Wt. of dry fruit}}{\text{Wt. of fresh fruit}} x100$$

Total sugars, reducing sugars, and sucrose:

Total sugars, reducing sugars, and sucrose in the fruits were determined using the Lena and Eynon method as described by Howrtis (1975).

Fruit ripening percentage:

The percentage of fruit ripening was calculated after the fruits reached the rutab stage. Five bunches were taken from each replicate for each treatment, and the number of ripe fruits was counted. The percentage of ripe fruits was calculated by dividing the number of ripe fruits by the total number of fruits in the sample, as shown in the following equation:

$$Water\ content\ (\%) = \frac{\text{Wt. of Fresh fruit} - \text{Wt. of dry fruit}}{\text{Wt. of fresh fruit}} x100$$

Statistical Analysis

The experiment was conducted according to a Randomized Complete Block Design (R.C.B.D.) as a factorial experiment with two factors. The first factor involved two methods of application, and the second factor consisted of five levels of biostimulant concentrations, with three replications per treatment. The results were statistically analyzed using the Gen Stat statistical software, and the means were compared using the Least Significant Difference (L.S.D.) test at a significance level of 0.05.

Results

Table 1 illustrates the effects of application methods and biostimulant concentrations on some physical traits of Bream date palm fruits. The results show that the foliar spray method significantly surpassed soil application in fruit length, volume, weight, and fleshy layer weight, recording the highest values of 3.10 cm, 6.35 cm^3, 6.34 g, and 5.27 g, respectively, compared to soil application, which recorded lower values of 3.07 cm, 6.31 cm^3, 6.31 g, and 5.25 g, respectively. Regarding biostimulant concentrations, the 12 $mg.L^{-1}$ Agazone treatment significantly surpassed the control in fruit length, volume, weight, and fleshy layer weight, achieving the highest values of 3.19 cm, 6.67 cm^3, 6.84 g, and 5.80 g, respectively, compared to the control, which recorded the lowest values of 2.83 cm, 5.18 cm^3, 4.35 g, and 3.18 g, respectively.

The findings showed the significant effect of Agazone at 6 $mg.L^{-1}$ on increasing the fruit diameter compared to control treatment, where this treatment achieved the highest value 2.17 cm, whereas the lowest value was 1.93 cm recorded in the control treatment.

The results of interaction between study factors (application method and biostimulants) revealed that the foliar spray of Agazone at 6 $mg.L^{-1}$ resulted in a significant increase in physical fruit characteristics compared to control treatment. When foliar spraying with Agazone at 6 $mg.L^{-1}$, the fruit's length, diameter, volume, weight, and weight of the fleshy layer were 3.19 cm, 2.13 cm, 6.73 cm3, 6.89 g, and 5.83 g, respectively. In contrast, the control treatment's values were 2.83 cm, 1.94 cm, 5.48 cm3, 4.35 g, and 3.18 g. Because they contain a variety of macro and micronutrients, such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), and molybdenum (Mo), biostimulants have been shown to improve the physical characteristics of fruits. These nutrients are all necessary for enhancing the nutritional profile of the plant (Spinelli *et al*., 2009; Craigie, 2012). A variety of growth-promoting substances, including proteins, amino acids, cytokinins, auxins, and antioxidants, are also included in biostimulants. Together, these elements improve the plant's nutritional status, improve photosynthetic efficiency, encourage root growth, and make it easier for nutrients to be absorbed. This leads to more vegetative growth and better yields in terms of both quantity and quality (Zamani *et al*., 2013). The increase in the weight of fruit and their pulp may associated with auxins, which facilitate the translocation of nutrients towards the fruit, thereby contributing to an increase in its mass (Ozaga and Reinecke, 2003).

The increase in size, length and diameter of the fruits is due to the activity of some chemical substances capable of induction of reorganization of enzymes in the cells of plant tissues. This act encourages cell division and elongation that contributes to the general increase in size of the fruit (Zhang *et al*, 2006). The nitrogenous compounds in the plant extracts may have promoted cell division and structural

Table 1. Effect of Biostimulants and Application Methods on Physical characteristics of Date Palm Fruits Bream cultivar.

Application method	Biostimulant concentration (mg·L⁻¹)	Fleshy layer weight (g)	Seed weight (g)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cm^3)
Foliar spray	0	1.17	4.35	2.83	1.94	1.94	5.18
	Agazone 6	1.06	6.89	3.19	2.31	2.31	6.73
	Agazone 12	1.05	6.82	3.19	2.03	2.03	6.62
	Amalgerol 6	1.01	6.83	3.15	2.03	2.03	6.62
	Amalgerol 12	1.07	6.83	3.15	2.02	2.02	6.58
Soil Drench	0	1.17	4.35	2.83	1.94	1.94	5.18
	Agazone 6	1.04	6.78	3.11	2.02	2.02	6.53
	Agazone 12	1.05	6.87	3.18	2.03	2.03	6.72
	Amalgerol 6	1.04	6.76	3.11	2.01	2.01	6.52
	Amalgerol 12	1.04	6.81	3.14	2.03	2.03	6.60
LSD (0.05)		0.024	0.042	0.039	0.015	0.110	0.068
Mean effect of application method	Foliar spray	1.07	6.34	3.10	2.07	2.07	6.35
	Soil Drench	1.06	6.31	3.07	2.01	2.01	6.31
LSD (0.05)		0.011	0.019	0.016	0.014	0.103	0.031
Mean effect of Biostimulant	0	1.17	4.34	2.81	1.93	1.93	5.17
	Agazone 6	1.05	6.83	3.15	2.17	2.17	6.63
	Agazone 12	1.05	6.84	3.19	2.05	2.05	6.67
	Amalgerol 6	1.02	6.87	3.13	2.02	2.02	6.57
	Amalgerol 12	1.05	6.82	3.14	2.03	2.03	6.59
LSD (0.05)		0.017	0.030	0.028	0.022	0.163	0.048

Table 2 displayed the effects of application methods and biostimulant concentrations on the percentages of maturity, dry matter, and water content in date palm fruits. According to the results, the foliar spray application led to increase in maturity percentage and dry matter percentage significantly than soil drench, recording values of 75.74% and 76.17%, respectively, while the soil application, which recorded lower values of 74.09% and 75.62%, respectively. However, there was no significant variation in the percentage of fruit water content between the two application methods. Also the results indicated that, compared to control treatment, all biostimulant treatments significantly reduced the water content. The lowest water content percentages recorded were 24.46%, 24.10%, 23.34%, and 23.27% for Agazone at 6 and 12 $mg.L^{-1}$, and Amalgerol at 6 and 12 $mg.L^{-1}$, respectively, while the control treatment recorded the highest value of 26.27%. Regarding the results of maturity percentage, the biostimulant Amalgerol at 12 $mg.L^{-1}$ had a significant effect in increasing the maturity percentage, as it recorded the highest percentage and reached 83.53%, whereas the control which recorded the lowest percentage and reached 60.05%. The interaction between the study factors revealed that the application of Agazone at 12 $mg.L^{-1}$ to the soil significantly reduced the fruit water content, decreasing it from 26.27% in control treatment to 23.03%. On the other hand, foliar spray of Amalgerol at 12 $mg.L^{-1}$ resulted in a significant increase in the fruit maturation percentage, rising it from 60.05% in control treatment to 84.05%. While, the foliar spraying of Agazone at 6 $mg. L^{-1}$ led to a significant increase in the percentage of dry matter of date palm cv. Bream from 72.33% in control treatment to 79.92%. The increased maturity percentage can be attributed to the effect of biostimulant extracts, and the active compounds they contain, which enhance fruit ripening by stimulating the activity of enzymes like invertase and cellulase that are crucial to the ripening process. Furthermore, these extracts influence cellular solutes, especially sugars (Hopkins and Hunter, 2004). Another possible explanation for the observed enhancement may be related to the auxins, which when applied as foliar spray could induced ethylene production by 8 to 10 times. In addition, some cytokinins present in biostimulants can help increase the levels of ethylene, which also helps to the maturation of the fruit (Calvo *et al.*, 2014). However, the increment of the percentage of dry matter in the different phytomer stages can be inferred with the action of biostimulants, which stimulates the photosynthetic products transport for fruits. which breaks down fat faster and absorbs nutrients through polysaccharides, organic acids, and a range of essential nutrients and minerals. (Giovannoni, 2004).

Table 2. Effect of Biostimulants and Application Methods on Maturity, Dry Matter, and Water Content of Date Palm Fruits Bream cultivar

Application method	Biostimulant concentration (mg L^{-1})	Maturity (%)	Dry matter (%)	Water content (%)
Foliar spray	0	60.05	72.33	26.27
	Agazone 6	78.65	78.92	23.11
	Agazone 12	77.32	76.36	23.51
	Amalgerol 6	78.79	76.00	23.81
	Amalgerol 12	84.05	76.98	24.69
Soil Drench	0	60.05	72.33	26.27
	Agazone 6	74.76	75.67	23.56
	Agazone 12	77.95	78.64	23.03
	Amalgerol 6	74.52	75.08	25.11
	Amalgerol 12	83.01	76.50	23.51
LSD (0.05)		1.041	0.623	1.946
Mean effect of application method	Foliar spray	75.74	76.15	24.35
	Soil Drench	74.09	75.62	24.22
LSD (0.05)		0.456	0.279	0.870
Mean effect of Biostimulant	0	60.05	72.33	26.27
	Agazone 6	76.77	77.30	23.34
	Agazone 12	77.63	77.50	23.27
	Amalgerol 6	76.66	75.54	24.46
	Amalgerol 12	83.53	76.74	24.10
LSD (0.05)		0.736	0.441	1.376

Effect of application methods and biostimulant concentrations in the percentages of total sugars, reducing sugars, and sucrose in date palm cv. Bream fruits, were presented in table 3. Overall, the foliar spray method had significantly higher reducing sugars than soil application, with values of 42.38% and 42.05% respectively. However, the two methods did not significantly differ in the percentages of total sugars and sucrose. Among biostimulant concentrations, the 12 $mg.L^{-1}$ Agazone treatment howed significantly higher in the percentages of total sugars and reducing sugars than the control with 52.11% and 42.96% compared to control showed the minimum values with 51.13% and 40.83% respectively. In contrast of this, the 12 $mg.L^{-1}$ Agazone treatment reduced the sucrose percentage compared to the control, recording the lowest value of 9.16%, while the control recorded the highest value of 10.30%. In terms of interaction effects, the combination of foliar spray and 6 $mg. L^{-1}$ Agazone significantly outperformed the control in total sugars and reducing sugars, recording the highest values of 52.64% and 43.34%, respectively, compared to the control, which recorded values of 51.13% and 41.08%, respectively. On the other hand, the interaction between foliar spray and 6 $mg.L^{-1}$ Amalgerol significantly reduced the sucrose percentage, recording the lowest value of 8.69% compared to the control, which recorded the highest value of 10.30%. Growth-promoting substances, especially auxins, which are crucial for directing photosynthetic products towards the fruits, are responsible for the increase in total and reducing sugars in fruits. Additionally, by increasing the activity of certain cytoplasmic enzymes that control these physiological processes, auxins may help convert organic acids into sugars. Additionally, by increasing the activity of ripening-related enzymes like invertase and cellulase, which raise the concentration of solutes, including sugars, within the cells, biostimulant extracts could promote the ripening process (Hopkins and Hunter, 2004). Some of the auxins and cytokinins present in the biostimulant may also be partially responsible for the decrease in sucrose level by stimulating the production of ethylene, the plant hormone responsible for ripening. During the physiological ripening of the fruits, it is thought that ethylene can modulate gene expression and thus affect invertase enzyme activity (White, 2002; Giovannoni, 2004), which catalyses the breakdown of sucrose into reducing sugars.

Table 3. Effect of Biostimulants and Application Methods on Reducing sugars, Sucrose, and Total sugars of Date Palm Fruits Bream cultivar

Application method	Biostimulant concentration ($mg \cdot L^{-1}$)	Reducing sugars (%)	Sucrose (%)	Total sugars (%)
Foliar spray	0	41.08	10.30	51.13
	Agazone 6	34.34	9.30	52.64
	Agazone 12	42.76	9.00	51.75
	Amalgerol 6	42.63	8.69	51.32
	Amalgerol 12	42.07	9.68	51.74
Soil Drench	0	40.83	10.30	51.13
	Agazone 6	42.24	9.20	51.44
	Agazone 12	43.15	9.32	52.47
	Amalgerol 6	41.85	9.65	51.41
	Amalgerol 12	42.43	9.06	51.49
LSD (0.05)		0.480	0.778	0.863
Mean effect of application method	Foliar spray	42.38	9.42	51.80
	Soil Drench	42.05	9.47	51.51
LSD (0.05)		0.215	0.348	0.386
Mean effect of Biostimulant	0	40.83	10.30	51.13
	Agazone 6	42.79	9.25	52.04
	Agazone 12	42.96	9.16	52.11
	Amalgerol 6	42.24	9.17	51.37
	Amalgerol 12	42.25	9.37	51.62
LSD (0.05)		0.340	0.550	0.610

Conclusion

This study concludes that foliar application of biostimulants is more effective than soil drenching in enhancing the physical, chemical, and physiological traits of Al-Brim date palm fruits. Among the biostimulants tested, Agazone at concentrations of 6 $mg \cdot L^{-1}$ and 12 $mg \cdot L^{-1}$ demonstrated superior efficacy, particularly in improving fruit weight, size, and sugar content. Both Amalgerol and Agazone present significant potential as environmentally friendly alternatives to chemical fertilizers, contributing to sustainable agricultural practices. Future research should investigate the long-term effects of these biostimulants on various date palm cultivars and evaluate their economic viability for large-scale implementation.

References

Baliah, T. N.; P. Lega and V. Raja (2017). Beneficial effect of self of *sargassum wightii* on the growth and biochemical characteristics of okra. J. Recent Scientific Research 8(9): 787-792.

Calvo, P.; L. Nelson and J.W. Kloepper (2014). Agricultural uses of plant biostimulants. Plant Soil 383, 3–41. https://doi.org/10.1007/s11104-014-2131-8

Chen, D.; W. Zhou ; J. Yang ; J. Ao ; Y. Huang ; D. Shen ; Y. Jiang ; Z. Huang and H. Shen (2021). Effects of Seaweed Extracts on the Growth, Physiological Activity, Cane Yield and Sucrose Content of Sugarcane in China. *Front. Plant Sci.* 12:659130. doi: 10.3389/fpls.2021.659130

Craigie, J. S. (2012). Seaweed extract stimuli in plant science and agriculture. March 2010, 371-393. https://doi.org/10.1007/s10811-010-9560-4.

Giovannoni, J. (2004). Genetic regulation of fruit development and ripening. Plant Cell Review, 20: 1-11.

Hopkins, W.G. and Hunter, N.P. (2004). Introduction to Plant Physiology, 3rd Edition. Published by John Wiley & Sonc, Inc. Hopkin, New Jeresy.

Howrtiz, W. (1975). Official Method of Analysis Association of Official Analytical chemists. Washington, D.C.

Iqbal, M.; A. Hafoor and S. Rehman (2004). Effect of pollination times on fruit characteristics and yield of date palm cv. Dhakki. Int. J. Agric. Biol., 6: 96–99.

Khan, M.T.; J.Aleinikovienė and L.M.Butkevičienė (2024). Innovative Organic Fertilizers and Cover Crops: Perspectives for Sustainable Agriculture in the Era of Climate Change and Organic Agriculture. Agronomy, 14(12), 2871. https://doi.org/10.3390/agronomy14122871

Lateifa, S. A. (2012). Biofertilizer and its role in reducing water pollution problems with chemical fertilizers. Libyan Agriculture Research Center Journal international. 3(2):1457-1466.

Lemlem, A.; M. Alemayehu, and M. Endris (2018). Date palm production practices and constraints in the value chain in Afar Regional State, Ethiopia. Advances in Agriculture 2018. doi: https://doi.org/10.1155/2018/6469104

Omar, A.E.; M.H. Ahmed and A.M.Al-Saif (2017). Influences of seaweed extract and potassium nitrate foliar application on yield and fruit quality of Date palm (Phoenix dactylifera L. cv. Sukary). Advances in Agri. Sci., 5(3): 16-22.

Ozaga, T.A. and D.M. Reineck (2003). Hormonal interactions in fruit development. J. Growth Reg. Plant, 31: 1-15.

Saquee, F. S.; S. Diakite ; N.J. Kavhiza ; E. Pakina and M. Zargar (2023). The Efficacy of Micronutrient Fertilizers on the Yield Formulation and Quality of Wheat Grains. *Agronomy*, *13*(2), 566. https://doi.org/10.3390/agronomy13020566

Senthuran, S.; W.K. Balasooriya; S.J. Arasakesary and N. Gnanavelrajah (2019). Effect of seaweed extract (Kappaphycus alvarezii) on the growth, yield and nutrient uptake of leafy vegetable (Amaranthus polygamous). Tropical Agricultural Research., 30(3):81-88. https://www.researchgate.net/publication/337081619.

Spinelli, F.; G. Fiori ; M. Noferini ; M. Sprocatti and G. Costa (2009). Perspectives on the use of a seaweed extract to moderate thenegative effects of alternate bearing in apple trees. J. Hort. Sci. Bio., 84(6) :131 – 137.

Szabo, V. and K. Hrotko (2009). Preliminary results of biostimulator treatments on crategus and prunus stockplant. bull uasvm horticulture, 66 (1): 223–228.

Taiz, L. and E. Zeiger (2006). Plant Physiology. 4th ed. Sinauer Associates, Inc., U.S.A.

Turan, M. and C. Kose (2004). Seaweed exracts improve copper uptake of grapevine. Soil & Plant Science., 54(4):213-220.

White, P.J. (2002). Recent advances in fruit development and ripening: an overview. J. Exp. Bot., 53: 1995 – 2000.

Zamani, S.; S. Khorasaninejad and B. Kashefi (2013). The importance role of seaweeds of some characters of plant. International Journal of Agriculture and Crop Sciences. 5(16):1789-1793.

Zhang, C.; K. Tanabe ; S. Wang ; F. Tamura ; A. Yoshida and K. Matsumoto (2006). The impact of cell division and cell enlargement on the evolution of fruit size in *Pyrus pyrifolia*. Annals of botany, 98(3), 537–543. https://doi.org/10.1093/aob/mcl144

Zodape, S.T.; M. Soumit ; K. Eswaran ; M.P. Reddy and J. Chikar (2010). Enhanced yield and nutritional quality in green gram (Phaseolus radiate L.) treated with seaweed (*Kappaphycus alvarezii*) extract. J. Sci, Ind. Res., 69:468-471.

استجابة اشجار نخيل التمر .Phoenix dactylifera L صنف البرمي للمنشطين الحيويين Agazone و Amalgerol وطريقة اضافتهما

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الخلاصة

اجريت هذه الدراسة في احد البساتين الاهلية الواقعة في قضاء ابو الخصيب، جنوب محافظة البصرة–العراق. بهدف تقييم استجابة اشجار نخيل التمر .Phoenix dactylifera L صنف البريم للمعاملة بالمنشطات الحيوية. تم اختبار منشطي النمو Agazone و Amalgerol بعدة تراكيز (0 و 6 و 12) ملغم.لتر$^{-1}$، باستخدام طريقتين للتطبيق: الرش الورقي والاضافة الأرضية. أظهرت النتائج تأثيرات معنوية لهذه المعاملات على صفات الثمار الفيزيائية والكيميائية والفسلجية. أدى تطبيق الرش الورقي إلى تحسين طول الثمرة، وحجمها، ووزنها، ووزن الطبقة اللحمية ونسبة المادة الجافة ونسبة النضج ومحتوى السكريات الكلية والمختزلة مقارنة بالتطبيق الأرضي. كما حسن المحفز الحيوي Agazone بتركيز 12 ملغ/لتر بشكل كبير من طول الثمرة، وحجمها، ووزنها، ووزن الطبقة اللحمية، ومحتوى السكريات، متفوقًا على معاملة المقارنة التي سجلت أدنى القيم. وكان المحفز Agazone بتركيز 6 ملغ/لتر الأفضل معنويا في زيادة قطر الثمرة مقارنةً بمعاملة المقارنة. وأظهرت التداخل بين نوع المنشط وطريقة التطبيق تأثير معنوي في معظم الصفات المدروسة.

الكلمات المفتاحية: الرش الورقي، الصفات الفيزيائية، جودة الثمار، صنف البريم، منشطات النمو.