Bionatura
Latin American Journal of Biotechnology and Life Sciences

Bionatura Issue 1 Vol 8 No 1 2023

Article

Effect of spraying with garlic extract and silicon on some physical, chemical, and productive characteristics of date palm *Phoenix dactylifera* L.

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Available from: http://dx.doi.org/10.21931/RB/CSS/2023.08.01.10

ABSTRACT

The experiment was conducted in Shatt Al-Arab District - Fourth Al-Jazirah District - Basrah Governorate during the 2020 growing season to investigate spraying with garlic extract and silicon solution on some physical, chemical, and productive properties of date palm fruits Umm al-Dahn variety. The garlic solution extract at a concentration (of 0, 200, 400 ml L^{-1}) and silicon at a concentration of (0, 250, 500, 750 mg L^{-1}) was used in two-time sprays, the first two weeks after pollination and the second three weeks after the first spray. The spray t with garlic extract at a concentration of 400 ml L^{-1} and silicon at a concentration of 750 mg L^{-1} was significant in the physical characteristics under study (fruit weight, length, diameter, and fleshy layer weight), and chemical characteristics (total soluble solids, reducing sugars, dry matter, and total protein) compared to the control treatment. The treatment of spray t with garlic extract at 400 ml L^{-1} and silicon at a concentration of 750 mg L^{-1} significantly decreased the percentage of sucrose in the fruits. It resulted in a significant increase in the weight of the fruit and the tree's yield. The spraying with garlic solution extract at a concentration of 400 ml L^{-1} with silicon spray treatment at a concentration of 750 mg L^{-1} resulted in the highest productivity of the palm (41.68 kg. $Palm^{-1}$). At the same time, the control gave the lowest productivity of 31.74 kg $Palm^{-1}$.

Keywords: Garlic extract, Silicon, Date palm, Productivity

INTRODUCTION

The date palm, Phoenix dactylifera L., is a monocotyledonous plant from the palm family Arecaceae. Its original home is in southern Iraq and the Arabian Gulf region, including 235 genera and 4000 species. The date palm is considered a vital wealth that characterizes Iraq and spreads in central and southern Iraq. The varieties vary in their growth, flowers, and fruits [1]. The area planted with date

palms in Iraq is estimated at 123,230 hectares. The number of fruit trees is about 7263472 palm trees, with a production rate of 676,111 tons [2].

The salinity (soil salinity or irrigation water) is one of the most critical problems, especially in arid and semi-arid areas. It affects more than 20% of the irrigated lands in the world [3]. The problem of salinity in Iraq has worsened in recent years. Iraq is at the forefront of Arab and Asian countries in terms of the total area affected by salinity due to the scarcity of water and water resources, deterioration of their quality and poor management, and the high levels of groundwater, which led to the salinization of the soil in the irrigated areas in central and southern Iraq [4].

Some management practices protect plants from stress, including silicon, the second most abundant element in the soil, and can stimulate plant growth and relieve many biotic and abiotic stresses, including heavy metal stress [5]. The research has explored several mechanisms by which silicon can reduce the toxicity of heavy metals at the plant and soil levels. These mechanisms were associated with plant species, genotypes, mineral elements, growth conditions, and duration of stress [6].

Garlic extracts encourage the vegetative growth of many plants because these extracts contain many natural chemical compounds that are a source of natural growth regulators and nutrients [7].

Due to the lack of studies dealing with the physiological interactions of chemical fertilization and plant extracts in the growth and yield of date palm fruits, this study was conducted to observe the effect of spraying with garlic extract and silicon on date palm fruits increase in the quantity and quality.

MATERIAL AND METHODS

The study was conducted in Shatt Al-Arab district, Al-Jazeera region, Basrah governorate, during the 2020 growing season. The orchard's soil was analyzed at a depth of (0-60) cm. Table 1 shows some physical and chemical properties of field soil, and Table 2 shows some of the chemical characteristics of the irrigation water for the orchard; six date palm trees of the Umm al-Dahn variety almost identical in age, height, and vegetative growth were selected which were free from disease. At the age of 14 years, six flowering inflorescences were left on each palm (so that each flowering inflorescence represents an independent treatment factor alone). The trees were sprayed on March 23 with Ghannami Akhdar male pollen. The inflorescences were sprayed with an aqueous solution of calcium silicate $CaSiO_3$ at 250, 500, and 750 mg L^{-1} and garlic solution at a 400, 200 ml L-1 hand sprayer early morning and at a rate of two sprays. The first spray is two weeks after pollination, and the second is three weeks after the first. The polyethylene bags were used to prevent contamination during the spraying process, and after the spraying process was over, the bags were lifted.

The bunches were marked with plastic marks. The diffuse substance Tween 20 0.1% concentration was added to the prepared solutions to reduce the water's surface tension and increase the substance's adhesion to the leaves. For the control treatment, distilled water was sprayed. The samples were taken for the fruits in the Khalal stage.

PARAMETER	VALUE
Electrical Conductivity (E.C.) dS m^{-1}	8.75
PH	7.22
Total nitrogen (gm.kg^{-1})	4.53
Available phosphorous (gm.kg^{-1})	0.868
Available potassium (gm.kg^{-1})	1.832
Organic matter (gm.kg^{-1})	12.89
Percent Soil separators	
Sand	4.50
Silt	63.00
Clay	32.50
Soil texture	Silty clay

Table 1: Physical and chemical properties of orchard soil at a depth of (0-60) cm for the growing season 2020

PARAMETER	VALUE
Electrical Conductivity (E.C.) dS m^{-1}	6.74
pH	7.52
Chloride ions - cl mmol. L^{-1}	29.48
Calcium ions ca mmol L^{-1}	14.76
Potassium ions k mmol. L^{-1}	0.23
Sodium ions Na mmol. L^{-1}	7.98

Table 2: Characteristics of irrigation water

Physical characteristics of the fruits:

Fruit weight and fleshy layer weight (gm): Twenty-five fruits were taken randomly from each repeater, and the weight was recorded using a sensitive electric scale, Sartorius type. The seeds were removed from the fruits, and the weight was recorded. The weight of the flesh of the fruit was calculated from the sum of subtracting the weight of the seed from the weight of the fruit.

Length and diameter of the fruit: The diameter and length of the same fruits were measured using the measuring foot (Vernier caliper) in cm unit.s

Seed weight (kg): The average weight of the seed was calculated for each palm in the khalal stage by cutting the seed for each repeat and weighing and then dividing the total sum of the seedling weight by its number.

The total yield of the palm (kg): After cutting the bunches for each palm, it was weighed to represent the weight of the total yield of each palm

Chemical properties:

Total soluble solids (%): The percentage of total soluble solids in the fruits was estimated using a Hand Refractometer, and the reading was adjusted at a temperature of (20 °C) (Horwitz and Latimer 2005).

Total and reduce sugars and sucrose in the fruit pulp (%) at the Khalal stage using Lane and Eynon method (Zerban, Hughes, and Nygren 1946).

Dry matter (%): It was measured according to the following equation: Dry matter = (dry weight of the sample / fresh sample weight) *100

Protein (%): The percentage of protein in the fruits was estimated after digesting the plant samples (Cresser and Parsons 1979). The nitrogen concentration in the plant samples was estimated by the Micro Kildhal steam distillation apparatus (AOAC. 2005) according to the following relationship: Protein in fruits (%) = nitrogen in fruits (%) x 6.25

Statistical analysis

The experiment was carried out using the factorial experiment and designing randomized complete block R.C.B.D. with three blocks where one palm tree is one experimental unit. The results were analyzed using the Genstat program.

RESULTS

The spraying treatment with garlic extract at 400 ml L^{-1} significantly improved the physical characteristics of the fruits (fruit weight, fruit length, fruit diameter, fleshy layer weight as 8.29 g, 3.45 cm, 1.57 cm, 7.39 g) compared to the control treatment (spraying with distilled water), which recorded the lowest values (7.81 g, 3.06 cm, 1.53 cm, 6.94 g respectively). The same treatment was significantly superior in the weight of the seed and the total yield of the tree d (5.94, 35.65 kg), while the comparison treatment recorded the lowest (5.75, 34.52 kg). Spray with silicon at 750 mg L^{-1} significantly improved the (8.91 g, 3.49 cm, 1.73 cm, 8.16 g) compared to the comparison treatment, which recorded the lowest values (7.27 g, 3.06 cm, 1.42 cm, 6.38 g), the weight of fruits and the total yield of the tree was also maximum in this treatment reached (6.62, 39.76) kg. In contrast, the control group recorded the lowest (5.36, 32.18) kg. The interaction between the two study factors significantly affected the physical and productive characteristics.

The spray with garlic extract and silicon and their interaction significantly affected the chemical properties Table 4. The spray treatment with garlic extract at 400 ml L^{-1} significantly recorded the highest values in chemical properties (soluble solids, reducing sugars, total sugars, dry matter, protein), amounting to 38.29, 32.94, 45.14, 55.80, 4.19 %, compared to the control treatment that recorded the lowest values amounted to 35.19, 29.26, 42.39, 53.37, 3.55%, respectively. While the same treatment significantly decreased the percentage of sucrose in the fruits to 12.16%, the control treatment recorded the highest percentage of 13.12%. It is shown from the same table that the treatment with silicon at a concentration of 750 mg L^{-1} significantly outperformed in recording the highest values in the above chemical properties, which amounted to 41.40, 34.75, 46.55, 56.80, and 4.13. In contrast, the control treatment recorded the lowest values of 33.59, 27.57, 41.61, 52.60, and 3.39%. The same treatment significantly decreased the percentage of sucrose in the fruits, amounting to 11.75%, while the control treatment recorded the highest percentage of 14.04%. The interaction between the study factors significantly affected most of the chemical properties under study.

GARLIC SOLUTION (ML L^{-1})	SILICON (MG L^{-1})	FRUIT WEIGHT (G.M.)	LENGTH OF THE FRUIT (CM)	DIAMETER OF THE FRUIT (CM)	LAYER WEIGHT ADENOIDS (G.M.)	TASTE WEIGHT (K.G.)	YIELD TOTAL (K.G.)
0	**0**	7.02	2.83	1.36	6.13	5.29	31.74
	250	8.01	3.08	1.53	7.15	5.56	33.40
	500	7.97	3.14	1.57	7.13	5.74	34.44
	750	8.25	3.22	1.68	7.38	6.42	38.52
200	**0**	7.44	3.15	1.43	6.57	5.41	32.46
	250	7.39	3.15	1.41	6.51	5.40	32.42
	500	8.33	3.37	1.59	7.49	5.83	35.02
	750	8.95	3.49	1.72	8.43	6.61	39.08
400	**0**	7.35	3.21	1.48	6.46	5.39	32.34
	250	8.40	3.41	1.55	7.54	5.79	34.78
	500	7.88	3.43	1.46	6.91	5.63	33.82
	750	9.35	3.78	1.79	8.68	6.94	41.68
L.S.D.		0.58	0.58	0.31	0.04	0.35	0.11
The average effect of garlic ex-tract	**0**	7.81	3.06	1.53	6.94	5.75	34.52
	200	8.02	3.29	1.54	7.25	5.79	34.74
	400	8.29	3.45	1.57	7.39	5.94	35.65
L.S.D.		0.29	0.29	0.15	0.02	0.17	0.05
The average effect of silicon	**0**	7.27	3.06	1.42	6.38	5.36	32.18
	250	7.93	3.21	1.49	7.06	5.58	33.53
	500	8.06	3.31	1.54	7.17	5.73	34.34
	750	8.91	3.49	1.73	8.16	6.62	39.76
L.S.D.		0.33	0.18	0.02	0.20	0.06	0.40

Table 3: Effect of spraying with garlic solution extract and silicon on some physical and productive characteristics of date palm fruits of Umm al-Dahn cultivar in the Khalal stage

GARLIC SOLUTION)ML L^{-1}(	SILICON (MG L^{-1})	SOLUBLE SOLIDS SUGARS%	REDUCTIVE %SUCROSE	% SUGARS	TOTAL %SUGARS	DRY %MATTER	PROTEIN %
0	**0**	30.60	26.23	14.80	3.33	51.92	3.33
	250	33.36	27.63	12.92	3.35	52.57	3.35
	500	37.27	30.23	12.54	3.72	53.96	3.72
	750	39.55	32.96	12.23	3.80	55.04	3.80
200	**0**	33.25	27.08	14.17	3.39	52.57	3.39
	250	35.27	29.91	13.06	3.71	54.03	3.71
	500	38.91	33.43	12.36	4.05	55.56	4.05
	750	42.62	34.64	11.85	4.41	56.77	4.41
400	**0**	36.93	29.39	13.14	3.47	53.31	3.47
	250	36.75	31.30	12.71	3.94	55.02	3.94
	500	40.84	34.43	11.61	4.25	56.27	4.25
	750	42.62	36.64	11.17	5.09	58.61	5.09
L.S.D.		3.16	1.36	0.97	1.58	0.24	0.24
The average effect of garlic extract	**0**	35.19	29.62	13.12	3.55	53.37	3.55
	200	37.37	31.27	12.86	3.89	54.73	3.89
	400	38.29	32.94	12.16	4.19	55.80	4.19
L.S.D.		1.58	0.68	0.48	0.79	0.12	0.12
The average effect of silicon	**0**	33.59	27.57	14.04	3.39	52.60	3.39
	250	35.13	29.62	12.09	3.67	53.87	3.67
	500	39.01	32.70	12.17	4.00	55.26	4.00
	750	41.40	34.75	11.75	4.13	56.80	4.13
L.S.D.		1.82	0.78	0.56	0.91	0.14	0.14

Table 4: Effect of spraying with garlic solution extract and silicon and the interaction between them on some chemical properties of date palm fruits of Umm al-Dahn cultivar in the Khalal stage:

DISCUSSION

The superiority of spraying with garlic extract in the physical characteristics and yield of the fruits may be due to the positive role of the hormonal nature of the garlic solution and the fact that this extract contains substances similar in their effect on growth regulators (auxins), which lead to increased cell division, side-stretching, and elongation [8]. The increase in the physical characteristics of the fruit when treated with silicon may be attributed to its positive role in improving the overall physiological activities within the plant cells, the most important of which is improving the effectiveness of photosynthesis as well as improving hormonal balance through an increase in hormones promoting growth and reducing growth-inhibiting hormones [9]. This can also be due to its role in reducing salinity damage by increasing the efficiency of the plant to absorb the necessary elements for growth, such as potassium and calcium, decreasing the concentration of Na+ and Cl- ions, and increasing the ratio of Na+: K+. This role leads to increased yield indicators and characteristics [10]. However, The increase in the chemical properties of fruits when spraying with garlic solution may be attributed to the influential role of garlic solution as it contains some essential salts and nutrients in vital activities and increases the efficiency of the photosynthesis process, and then increases the dry matter in the fruits and thus improve the qualitative characteristics of the fruits [11].

CONCLUSION

We conclude from this study that the treatment of date palm trees with garlic extract and silicon element improved most of the physical and chemical properties of the fruits, and this was reflected positively in the increase in the weight of the stems and, thus, the increase in the yield of the tree, especially with high concentrations. Therefore, we recommend using such extracts and elements on other types of trees. Date palms have positive effects on improving growth and productivity.

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Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023

Citation: Auda, M.S.; Gabash, H.M.; Resan, A.Z. Effect of Spraying with Garlic Extract and Silicon on Some Physical, Chemi-cal, and Productive Characteristics of Date Palm Phoenix dactylifera L. Revis Bio-natura 2023;8 (1) 10. http://dx.doi.org/10.21931/RB/CSS/2023.08.01.10