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Effect of Salicylic Acid, Thidiazuron and Seaweed Extract on Some Vegetative, Quantitative and Quality Parameters of Olive

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Abstract: The study was conducted in an olive orchard in Jazira region in Ramadi city in Anbar Government in 2019. The treatment included salicylic acid (SA); 0, 100 and 200 mg l^{-1}, TDZ, 0, 3 and 6 mg l^{-1} and sea algae nano-extract 0,1 and 2 mg l^{-1}. Results showed that 200 mg l^{-1} of SA increased single leaf area, chlorophyll index, carbohydrates in leaves and recorded maximum olive yield (17.5 kg $tree^{-1}$) and oil percent (15.6%). Treatment of 6 mg l^{-1} of TDZ gave 17.1 kg $tree^{-1}$ olive fruits and 15.6 % olive oil. Sea algae nano-extract (2 ml l^{-1}) gave 18.1 kg/tree of olive and 16.1% olive oil as compared the control which gave14.8 kg/tree. The interactions showed significant differences in many studied traits.

Keywords**:** *Olea europaea* L., Nano-extract, Growth regulator

Olive cv. Khistawi is one of the landrace cultivars known in Iraq for years and are used for pickling. The fruits contain high percentage of oil depending on some management practices of these cultivars. Fruiting every other year is abundant in these cultivars while correlated to some growth variables. Many chemicals applied on trees to resolve the problem, Salicylic acid (SA), acts as growth regulator and usually act against ABA in leaves, chlorophyll and carotenoids. Thidiazuron (TDZ) is one of the cytokines belongs to group phenyl urea, and it is highly effective. The breakdown of apical meristem dominance promotes branching, and improve some other activities such as elements translocation, metabolism of elements, delays chlorophyll degradation, resist stresses, and increase fruit size (Nisler et al 2016). Sea algae extracts are considered one of the important organic source (Hegab et al 2005). The nano-extract of these algae could be helpful to protect genetic expressions in several crop plants (Singh et al 2016). This research aimed to study impact of SA, TDZ, and sea algae nano-extract (SG) on some vegetative and quantitative and quality parameters of olive trees.

MATERIAL AND METHODS

This experiment was conducted at Ramadi city Anbar Government during April-November 2019. Eighty-one 10 years old trees of khistawi variety were chosen. Three factors were, SA at 0, 100 and 200 mg l^{-1} which symbol S0, S1 and S2 respectively, thidiazuron (TDZ) at 0, 3, and 6 mg l^{-1} which symbol T0, T1 and T2 respectively and the third factor was sea algae nano-extract at 0, 1, and 2 ml l^{-1} which symbol N0, N1 and N2 respectively (Table 1). The experiment was in factorial arrangement with randomized complete block design (RCBD) with three replicates. Spraying times are shown in Table 2. Data obtained was analyzed by GenStat. The spray was done by using motor pump of 100 litters capacities. A nylon shed was used around each tree at spraying to control drift. All spraying was done at the evening while chipping.

Traits studied

Single leaf area ($cm^{2)}$ was estimated = LW×0.785.

L and W assigned to left length and width, respectively. Left chlorophyll was estimated using spectrophotometer at length 645-663nm (Goodwin (1976) and total soluble carbohydrates in the leaves were determined. Total olive fruits were weighed for each tree of each experimental unit. The olive oil olive was determined according to AOAC (1970) by using Soxhlet.

RESULTS AND DISCUSSION

Leaf area: The leaf area increased by applying SA, especially at 200 mg l^{-1} (S2) treatment (6.05 cm^2 $leaf^{-1}$). The application of TDZ at 6 mg l^{-1} (T2) has increased left area too without significant difference with 3 mg/l (T1). Sea algae nano-extract (N2) had a significant leaf area increases (Table 3). The combination of S2T2 gave higher leaf area (6.42 cm^2 $leaf^{-1}$) without significant difference with S2T1. The N2S2 provide higher mean 6.65 cm^2 $leaf^{-1}$. The N2T2 recorded higher mean 6.40 cm^2 $leaf^{-1}$ without significant difference with N2T1. The combination N2S2T1 gave a higher leaf area (7.30 cm^2 $leaf^{-1}$). Nisler et al (2016) also observed similar trend by spraying SA on vine trees. Aly et al (2017) explained that applying a growth regulator had a significant increase in

leaf area of pears, while Abd El-Aziz (2015) obtained significant increases when sprayed data palm trees with sea algae extract.

Chlorophyll: The chlorophyll contents in leaf increased by applying SA, especially at 200 mg l^{-1} (S2) treatment (38.35 mg 100 g^{-1} fw). The application of TDZ at 6 mg l^{-1} (T2) has also increased leaf chlorophyll. Sea algae nano-extract (N2) had a significant leaf chlorophyll increases (Table 4). The combination of S2T2 gave higher leaf chlorophyll (42.04 mg/100g fw). The N2S2 gave higher mean 47.62 mg 100 g^{-1} fw. The N2T2 recorded higher mean 45.41 mg 100 g^{-1} fw. The combination N2S2T1 indicated higher leaf chlorophyll (54.91 mg 100 g^{-1} fw) without significant difference with N2S1T2. These increases were attributed to the stimulating effect of these compared on some growth parameter and hormonal activities and translocation. Dey et al (2012) stated that the clear effects could be the prevention of chlorophyll degradation. This result is also in agreement with Salama (2015).

Carbohydrates: The carbohydrates contents in leaf increased by applying SA, especially at 200 mg l^{-1} (S2) treatment (8.14%). The application of TDZ at 6 mg l^{-1} (T2) also increased carbohydrates in leaf. Sea algae nano-extract (N2) resulted in significant increase in carbohydrates (Table 5). The combination of N2S2 gave higher mean of leaf carbohydrates (9.07%). The N2T2 recorded higher mean of 8.61%. The combination N2S2T1 indicated higher carbohydrates in leaf (9.85%). It can be concluded that these increases were attributed to the positive effects of these

Table 1. Components of the nano-extract (TDZ)

Parameters	Percent
Organic matter	21
Alginic acid	0.8
Gibberellic acid	0.02
Water soluble potassium oxide	5
pH range	8.8-10.8

Table 2. Spraying times on olive trees

No. of spraying	Nano-extract	TDZ	SA
First	March 23	Beginning of flowering buds March 10	March 22
Second	Complete flower April 23	April 10	April 2
Third	May 23	May 10	May 2

Table 3. Effect of salicylic acid (SA), thidiazuron (TDZ) and sea algae nano-extract (SG) on leaf area (cm^2 $leaf^{-1}$)

SG	SA	TDZ			N×S
		T0	T1	T2	
N_0	S0	4.79	5.29	5.21	5.10
	S1	5.35	5.59	5.54	5.49
	S2	5.49	5.41	5.60	5.50
N_1	S0	4.72	5.24	5.06	5.01
	S1	5.68	5.94	5.21	5.61
	S2	5.24	6.36	6.41	6.00
N_2	S0	5.43	5.21	5.74	5.46
	S1	5.43	5.50	6.18	5.70
	S2	5.38	7.30	7.27	6.65
SG		N×T			Mean (N)
N_0		5.21	5.43	5.45	5.36
N_1		5.21	5.85	5.56	5.54
N_2		5.41	6.00	6.40	5.94
SA		S×T			Means (S)
S_0		4.98	5.25	5.34	5.19
S_1		5.49	5.68	5.64	5.60
S_2		5.37	6.36	6.42	6.05
Means (T)		5.28	5.76	5.80	

LSD 5%

N	S	T	N×S	N×T	T×S	N×T×S
0.24	0.24	0.24	0.41	0.41	0.41	0.71

Table 4. Effect of salicylic acid (SA), thidiazuron (TDZ) and sea algae nano-extract (SG) on leaf chlorophyll (mg/100g fw)

SG	SA	TDZ			N×S
		T0	T1	T2	
N_0	S0	21.56	26.10	37.85	28.50
	S1	34.93	27.64	23.87	28.81
	S2	24.45	36.99	34.87	32.10
N_1	S0	35.04	32.27	35.06	34.12
	S1	35.94	35.01	33.32	34.76
	S2	32.67	37.00	36.34	35.34
N_2	S0	33.66	40.09	30.42	34.72
	S1	31.26	32.00	50.90	38.05
	S2	45.03	42.93	54.91	47.62
SG		N×T			Mean (N)
N_0		26.98	30.25	32.20	29.81
N_1		34.55	34.76	34.91	34.74
N_2		36.65	38.34	45.41	40.13
SA		S×T			Means (S)
S_0		30.09	32.82	34.44	32.45
S_1		34.04	31.55	36.03	33.88
S_2		34.05	38.97	42.04	38.35
Means (T)		32.73	34.45	37.50	
			LSD 5%		
N	S	T	N×S	N×T	T×S	N×T×S
2.10	2.10	2.10	3.64	3.64	3.64	6.30

Table 5. Effect of salicylic acid (SA), thidiazuron (TDZ) and sea algae nano-extract (SG) on carbohydrates in leaf (%)

SG	SA	TDZ			N×S
		T0	T1	T2	
N_0	S0	5.58	6.27	6.82	6.22
	S1	5.30	6.84	6.87	6.34
	S2	7.16	6.86	7.78	7.27
N_1	S0	7.23	7.51	7.44	7.40
	S1	7.44	7.55	7.69	7.56
	S2	7.62	8.43	8.20	8.08
N_2	S0	7.25	7.54	7.76	7.52
	S1	7.51	7.52	8.46	7.83
	S2	8.36	9.01	9.85	9.07
SG					Mean (N)
N_0		6.02	6.66	7.16	6.61
N_1		7.43	7.83	7.78	7.68
N_2		7.71	8.02	8.69	8.14
SA				S×T	Means (S)
S_0		6.69	7.11	7.34	7.05
S_1		6.75	7.31	7.67	7.24
S_2		7.71	8.10	8.61	8.14
Means (T)		7.05	7.50	7.87	
			LSD 5%		
N	S	T	N×S	N×T	T×S	N×T×S
0.23	0.23	0.23	0.40	0.40	N.S	0.69

Table 6. Effect of salicylic acid (SA), thidiazuron (TDZ) and sea algae nano-extract (SG) on tree fruit yield (kg/tree)

SG	SA	TDZ			N×S
		T0	T1	T2	
N_0	S0	6.20	16.33	11.33	11.29
	S1	12.02	17.20	10.33	13.18
	S2	17.79	13.50	15.76	15.68
N_1	S0	19.00	14.00	13.67	15.56
	S1	16.33	13.67	14.59	14.86
	S2	19.87	10.95	16.40	15.74
N_2	S0	11.00	13.00	21.33	15.11
	S1	12.88	16.76	25.00	18.21
	S2	18.00	19.55	25.50	21.02
	SG			N×T	Mean (N)
	N_0	12.00	15.68	12.48	13.39
	N_1	18.40	12.87	14.88	15.39
	N_2	13.96	16.44	23.94	18.11
	SA			S×T	Means (S)
	S_0	12.07	14.44	15.44	13.99
	S_1	13.75	15.88	16.64	15.42
	S_2	18.55	14.67	19.22	17.48
	Means (T)	14.79	15.00	17.10	
			LSD 5%		
N	S	T	N×S	N×T	T×S	N×T×S
1.95	1.95	1.95	N.S	3.37	N.S	N.S

Table 7. Effect of salicylic acid (SA), thidiazuron (TDZ) and sea algae nano-extract (SG) on olive oil (%)

SG	SA	TDZ			N×S
		T0	T1	T2	
N_0	S0	10.43	11.22	14.34	12.00
	S1	11.03	13.57	14.64	13.08
	S2	12.57	13.96	15.73	14.09
N_1	S0	13.14	13.08	13.47	13.23
	S1	13.92	14.66	14.03	14.20
	S2	15.37	15.53	15.90	15.60
N_2	S0	14.49	14.66	15.17	14.77
	S1	15.66	16.76	16.83	16.42
	S2	15.90	17.12	18.33	17.11
	SG	N×T			Mean (N)
	N_0	11.34	12.92	14.90	13.05
	N_1	14.14	14.42	14.46	14.34
	N_2	15.35	16.18	16.78	16.10
	SA	S×T			Means (S)
	S_0	12.69	12.99	14.33	13.33
	S_1	13.54	15.00	15.17	14.57
	S_2	14.61	15.54	16.65	15.60
	Means (T)	13.61	14.51	15.38	
			LSD 5%		
N	S	T	N×S	N×T	T×S	N×T×S
0.22	0.22	0.22	0.38	0.38	0.38	0.66

compounds in parameters some growth parameters in the trees which could be reflected on photosynthesis activity and better accumulation of carbohydrates. Al-Ahbaby (2016) also observed the same trend.

Tree fruit yield: The fruit yield increased by applying SA, especially at 200 mg l^{-1} (S2) treatment (17.48 kg $tree^{-1}$). The application of TDZ at 6 mg l^{-1} (T2) also increased tree fruit yield. Sea algae nano-extract (N2) had a significant increase in tree fruit yield (Table 6). The combination of N2T2 gave higher mean of tree fruit yield of 23.94 kg $tree^{-1}$. Sources-sink relationship has been improved by using any of these three compounds, and when applying two of them at a time or three of them the sink increases will much higher. This kind of effects is similar to those reported by Abd El-Raheem et al (2013) and Hussine (2017).

Olive oil: The Olive oil increased by applying SA, especially at 200 mg l^{-1} (S2) treatment (15.60%). The application of TDZ at 6 mg l^{-1} (T2) increased Olive oil too. Sea algae nano-extract (N2) indicated significant increase in olive oil (Table 6). The combination of S2T2 gave higher chlorophyll (16.65%). The N2S2 and N2T2 gave higher mean of 17.11 and 16.78%. The combination N2S2T1 resulted in higher olive oil (18.33%). These increases in oil percent in olive fruits could be due to the effect of these growth regulator in improving growth processes and efficiency of converting metabolites into oil. This result is in agreement with Chouliaras et al (2009).

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CONCLUSION

The SA at 200 mg l^{-1}, TDZ at 6 mg l^{-1} and sea algae nano-extract at 2 ml l^{-1} had a positive significant effect on the leaf area, leaf chlorophyll and leaf carbohydrates which were positively reflected on increase the tree fruit yield and olive oil.

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