Effect of Spraying "Anna" Apple Trees with Moringa and Seaweed Extracts to Alleviation of Heat Stress and Improving of Its Yield.

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ABSTRACT: This study was conducted to evaluate the efficacy foliar application of moringa leaf extract (MLE) and seaweed extract (SWE) as a natural crop growth enhancer to alleviation of heat stress and improving growth and yield of "Anna" apple trees (Malus domestica L.), under normal and heat stress conditions during 2015 and 2016 seasons successively. The study included 3 levels of heat [low (T1), medium (T2) and high (T3)] and in each temperature level 7 treatments were done as follows: control treatment moringa extract at dilution (10,20 and 30 time) and Seaweed extract at (1, 2 and 3ml/ L.).Results revealed that there was significant effect on all studied traits form the two factors except in shoot thickness where the interaction was not significant and in leaf area where the heat and interaction were not significant too. Results indicated positive effects on vegetative growth and yield. In general the best results for all applied treatments were in (T2). MLE10 treatment caused the best results of vegetative growth parameters (except in shoot thickness where SWE3 gave the highest value), fruit drop% and the yield. MLE20 treatment gave the highest values of initial fruit set%, final fruit set%. The study recommended that foliar application of MLE 20 at full bloom and MLE10 at month after full bloom and at two month after full bloom to get the best results.
Keywords: Apple, Anna, moringa, seaweed, vegetative growth, yield, heat stress.

INTRODUCTION

Apple (*Malus domestica* L.) is a fruit of temperate climate and native in many parts of world and the first five countries in the apple production are China, United States, India, Turkey and Poland, respectively while, Egypt is ranked 22 globally (FAOSTAT, 2013). Apples are wonderful fruits because their components are essential for optimal growth, development and overall wellness. Apple production is not only important for the fresh fruit market, but it also develops favorable conditions for fruit processing industry.

Temperature stress can reduce the yield of major crops (Sabir *et al.,* 2014) because it effect on flowering, blooming time, color, size and shapes of apple (Slingo, 2009). Since sexual reproduction is substantially more sensitive to heat stress than vegetative processes (Zinn *et al.,* 2010). Crop production is affected in addition to the threats to food security as an impact of climate change (Miraglia *et al.,* 2009). Thus, there is need to improve crop productivity under changed climate and abiotic stresses in addition to meet the needs of increasing world populations.

Improve abiotic stress tolerance in plants through conventional breeding, (Athar and Ashraf, 2009) but to develop crop plants for these traits are laborious and time consuming (Javid *et al.,* 2011). The alternative approaches are management practices including exogenous application of various antioxidants, mineral elements and plant growth regulators (PGRs). Among different natural

sources used to extract PGRs and antioxidants moringa (*Moringa oleifera*) and seaweed (Ascophyllum nodosum) are gaining a lot of attention these days (Foidle *et al.,* 2001). Moringa leaf extract (MLE), being rich in amino acids, K, Ca, Fe, ascorbate, and growth regulating hormones like zeatin, is an ideal plant growth enhancer (Basra *et al.,* 2009 a, b). Moreover, MLE has the potential to promote plant growth; hence, it is used as a natural plant growth enhancer. As noted tests on several crops under stress conditions In addition, to the improving of leaf mineral content, yield, physical and chemical characteristics of "Le-Conte" pear plants (Abd El–Hamied and El-Amary, 2015). On the other hand, studies suggest that seaweed products elicit abiotic stress tolerance in plants and that the bioactive substances derived from seaweeds impart stress tolerance and enhance plant performance. As well seaweeds contain various trace elements, vitamins, amino acids and plant growth hormones (IAA, IBA and Cytokinins) which cause many beneficial effects on plant growth and development (Abdel-Mawgoud *et al.,* 2010). In addition, stress improved crop yield of some fruit crops such apple (Spinelli *et al.,* 2009). Therefore, this product would be recommended to use for alleviating the adverse effects of such abiotic stress condition for sustainable grape production (Sabir *et al.,* 2014).

Therefore, in the present study, moringa and seaweed extracts as a natural crop growth enhancer was exogenously applied to assess up to what extent it can improve temperature stress tolerance especially at the reproductive stage and improve growth and yield of "Anna" apple tree.

MATERIALS AND METHODS

The present study was carried out during two successive seasons 2015 and 2016 in a private orchared located at Rosetta area, Beheira, Governorate, Egypt. On 105 " Anna " apple trees (*Malus domestica* L.), ten years old, similar to a large extent, budded on Balady rootstock, with planting space 4×3.5 m apart and grown on sandy soil under surface irrigation system. The experimental was conducted under normal and heat stress conditions in control chambers and field conditions.

Preparation of moringa and seaweed extract:

For preparation MLE, young shoots (leaves and tender branches) of moringa were brought from farm (clay soil) in Rosetta area and grinding with a pinch of water (1 L / 10 kg fresh material) in a locally fabricated extraction machine. After sieving through cheese cloth the extract was centrifuged for 15 min. Various dilutions MLE10, MLE20 and MLE30 (diluted to 10, 20 and 30 times with water respectively) of the extract were prepared with distilled water then used in experiments for as foliar spray.

For preparation SWE, composite trading (Algae foll) contains the type *Ascophyllum nodosum* used in the preparation of three solutions of a concentration at 1ml/ liter (SWE1), 2ml/ liter (SWE2) and 3ml/ liter (SWE3) then used in experiments for as foliar spray.

The layout of experimental treatments:

The experiment was established at split plot design with two factors, the main factor is the temperature in three levels (Low (T1), Medium (T2) and High (T3)) and sub main factor is moringa (*moringa olefira*) and seaweed (*Ascophyllum nodosum*)extracts spraying (seven treatments) as follows: tr1(control), tr2(MLE10), tr3(MLE20), tr4(MLE30), tr5(SWE3), tr6(SWE2), tr7(SWE1).

The evaluations were carried out both in the field, outside and inside a polyethylene cage, as controlled temperature chambers. Such a system has been shown to be a valuable method to increase temperature in the field without negatively affecting other parameters (Hedhly *et al*., 2003). Temperature inside and outside the plastic cages was monitored throughout the periods of experiment (Tables 1 and 2) as maximum/minimum, where the maximum occurring 6 h into the main photosynthetic light period and the minimum, 6 h into the dark period according to (Warrington *et al*., 1999).

Table (1). Average temperature [℃] data throughout flowering and fruit set period inside and outside the plastic cage during 2015 season.

Period	HC Air temperature [℃] 2015					
	Low level (T1)		Medium level (T2)		High level (T3)	
	Min	max	min	max	min	max
0 DAFB	6.10	13.10	9.50	18.00	11.00	32.00
1-10 DAFB	6.41	15.91	11.00	24.00	14.00	35.00
11-40 DAFB	8.28	20.30	13.50	27.00	15.00	38.00
41-80 DAFB	11.18	23.55	14.00	29.00	17.50	40.00
81- Harvest(128)	15.59	27.74	15.59	27.74	15.59	27.74

Table (2). Average temperature [℃] data throughout flowering and fruit set period inside and outside the plastic cage during 2016 season.

Period	HC Air temperature [℃] 2016					
	Low level (T1)		Medium level (T2)		High level (T3)	
	Min	max	min	Max	min	max
0 DAFB	8.40	18.00	10.00	20.00	11.50	33.00
1-10 DAFB	7.88	21.05	11.50	24.00	14.50	36.00
11-40 DAFB	9.52	22.50	13.50	27.00	15.50	38.50
41-80 DAFB	12.30	24.90	14.00	29.00	18.00	41.00
81- Harvest(122)	17.06	28.98	17.06	28.98	17.06	28.98

The trees were divided to three sections, each section contains 35 trees in the form of blocks (5 blocks) each block component of **7** trees (as replicates). Two of the sections chosen as warm treatment and the third one (normal climatic) were

left as a cool treatment. When flowers were at balloon stage, four branches from every tree were chosen and marked. At full bloom, one of the warm sections (high level) covered with 0.180-mm-thick polyethylene film as a green house with number of windows of every side. The other warm section (medium level) covered by polyethylene sheets from the up to half every side only, This day date was recorded as zero day after full bloom (0 DAFB) and all applications were applied three times separated by a month the first one at full bloom (80% flowering+) randomly on the replicate of each block. The covers were removed at 80 DAFB. The effect of the previous treatments was studied by evaluating their influence on the following parameters:

Vegetative growth:

Shoot length (cm):

In the spring of each season, 20 non –fruiting shoots of spring cycle were tagged at constant height and at all direction of each tree. In May, the average length of tagged shoots was measured.

Shoot thickness (cm):

At late May in both seasons, shoot thickness for twenty shoots was measured by hand caliber.

Leaf area (cm^2):

Leaf area was examined during the second half of May on fully developed mature leaves by portable area meter LI-COR model LI-3000A No.PAM 1671 (Bioletti, 1938).

Total chlorophyll (reading):

It was determined by chlorophyll meter apparatus in ten leaves from each plot at 60 and 75 DAS, according to the method that described by (Moran, 1982).

Fruit set and drop (%):

In the spring, four branches were chosen from each tree and marked. The number of flowers, number of fruits on these branches and the remained fruits on these branches were counted then the initial and final fruit set and fruit drop percentages were calculated according to the proper equation.

Initial fruit set (%):

On each replicate tree five shoots distributed on different sides were chosen randomly and tagged at the beginning of the growing season. All inflorescences on each shoot were counted and recorded. Three weeks after flowering initial fruit set percentage on replicate trees of the studied treatments was calculated from the following formula:

Initial fruit set (%) = FR * 100/AVF * NF

FR= Number of fruits/ shoot

AVF= Average number of flowers/ inflorescence

NF= Number of inflorescences/ shoot

Final fruit set (%):

Sixty days after flowering, final fruit set percentage was calculated in the same sequence mentioned above for the initial fruit set percentage according to this formula (Westwood, 1978):

$$\text{Final fruit set (\%)} = \frac{No\ of\ \ fruit\ lets}{No\ of\ \ opened\ \ flowers} \text{X}\ 100$$

Fruit drop (%):

Fruit drop %: was calculated by counting the number of dropping fruits from the middle of June till the commercial harvesting time under experimental conditions (Middle of July), then expressed as a percentage from the whole number of fruits remained on the tree at the middle of June according to this formula:

$$\text{Fruit drop (\%)} = \frac{No\ of\ \ dropped\ \ fruits}{No\ of\ \ set\ \ fruit\ lets} \text{X}\ 100$$

Yield: The produced yield (Ton/feddan) was expressed by multiply the weight of fruits/ tree (kg) which was attained at harvest stage X number of trees/feddan.

Statistical analysis:

Results of the measured parameters were subjected to computerized statistical analysis using COSTAT package for analysis of variance (ANOVA) and means of treatments were compared using LSD at 0.05 level of possibility using Split plot design according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

The results obtained from the present investigation of two successive seasons of 2015 and 2016 to study the effect of foliar application of different concentrations of moringa and seaweed extracts at three times with month interval starting at full bloom in different temperature level on some vegetative growth parameters, setting and drop of fruits and yield Tables (3 and 4).

1. Effect of spraying different MLE and SWE concentrations on the vegetative growth:

Results of the effects of foliar application of different MLE and SWE concentrations in different temperature level on some vegetative growth parameters on "Anna" apple trees during 2015 and 2016 seasons are presented in Table(3).The data revealed that MLE10 treatment had the significantly highest shoot length value as compared with the rest treatments. As temperature effect, T2 level in both seasons gave significantly higher than T3 and T1 levels, respectively. Regarding the interaction between treatments and heat data showed that apple treated with MLE10 under T2 level recorded the significantly greatest value in both seasons. However, control at T1 level gave considerable lowest in both seasons. These results are in agreement with Zavala *et al*. (2004) as for effect of temperature on shoot growth. On the other hand with regard to effect of extracts

spraying, the result above came on line with Al-Rawi *et al*. (2016) they showed that the sprayed seaweed extract at levels 4ml.L-1 on Peento peach trees gave highest average of branches length in both seasons.

Data analysis showed a significant effect of temperature level and spraying different rates of MLE and SWE on shoot thickness but the interaction was not significant. Data cleared that, (T2) gave the highest values of shoot thickness (cm) followed by (T1) then (T3) in both seasons. Also, the data clearly indicated that foliar application of SWE 3ml/L recorded highest value of the shoot thickness and MLE10 recorded the second value. Generally, control treatment gave the lowest values of shoot thickness compared with all treatment in both seasons. The same result showed by Fuglie (2000), who found that all the growth parameters were positively influenced by the spray with moringa leaf extract, and Foidle *et al*. (2001) come on same line. Also Al-Rawi (2016) found that; spray Peento peach trees with seaweed increase stem diameter in both seasons.

On the other hand, data illustrated show effects of different rates of MLE and SWE concentrations in different temperature level on leaf area. Data analysis showed that the effects of spray extracts were significant unlike the effect of temperature level was not significant and interaction between them was not significant too in both seasons. All applied treatments significantly increased leaf area comparing with control treatment, especially MLE10 treatment that gave the highest leaf area comparing with all remainder treatments under each temperature level in both seasons. This results supported by the result from Sabir *et al.* (2014) they showed that seaweed had non-significant effect in leaf area on grapevines. Also Abd El–Hamied and El-Amary (2015) showed that MLE treatments were significantly effective on “Le-Conte" pear leaf area.

The effects of applying different rates of MLE and SWE in different temperature level on total chlorophyll (reading), data showed significant effect of temperature level, foliar application of different rates of MLE and SWE and interaction between them on total chlorophyll (reading)in both seasons. From data, (T2) gave the highest values of total chlorophyll (reading) followed by (T1) then (T3) in both. For the application with different rates of extracts data indicated that, increasing concentration led to increase total chlorophyll as compared with control in both experimental seasons in each temperature level. Generally, control treatment gave the lowest values of Total chlorophyll, while spraying MLE10 gave the highest values of Total chlorophyll. These results in line with what has been recorded by Abd El–Hamied and El-Amary (2015) on "Le-Conte" pear and Al-Rawi (2016) on Peento peach trees.

Table (3). Effect of foliar application with different moringa leaf and seaweed extracts on vegetative growth characters in different temperature level of "Anna" apple trees during 2015 and 2016 seasons.

Character	Factor	Spray treatments								L.S.D 0.05
	Heat	tr1	tr2	tr3	tr4	tr5	tr6	tr7	Average	
Shoot length (cm): 2015	T1	28.17	35.47	37.40	38.60	37.73	37.43	36.07	35.83	Heat =0.139
	T2	29.07	36.80	38.07	40.07	39.77	39.23	37.40	37.20	Treatment =0.233
	T3	28.93	36.07	37.87	39.21	38.80	38.70	37.00	36.65	Averages = 0.349
	Average	28.72	36.11	37.78	39.29	38.77	38.46	36.82		
Shoot length (cm): 2016	T1	28.27	35.53	37.20	38.53	37.80	37.47	36.27	35.87	Heat=0.0989
	T2	29.07	36.80	38.20	40.13	39.93	39.47	37.33	37.26	Treatment =0.171
	T3	28.80	35.93	37.93	39.13	38.87	38.67	37.17	36.64	Averages = 0.344
	Average	28.71	36.09	37.78	39.27	38.87	38.53	36.92		
Shoot thickness (cm): 2015	T1	0.73	0.77	0.79	0.83	0.85	0.79	0.75	0.79	Heat =0.008
	T2	0.73	0.78	0.81	0.83	0.87	0.80	0.77	0.80	Treatment =0.012
	T3	0.71	0.75	0.77	0.79	0.83	0.75	0.74	0.76	Averages =0.0198
	Average	0.72	0.77	0.79	0.82	0.85	0.78	0.75		
Shoot thickness (cm): 2016	T1	0.72	0.77	0.79	0.82	0.85	0.78	0.75	0.78	Heat=0.007
	T2	0.73	0.78	0.82	0.83	0.86	0.80	0.76	0.80	Treatment = 0.01
	T3	0.71	0.75	0.77	0.79	0.83	0.74	0.73	0.76	Averages =0.0160
	Average	0.72	0.76	0.79	0.81	0.85	0.77	0.75		
Leaf area (cm2) 2015	T1	27.67	35.27	36.73	37.33	36.87	35.87	33.93	34.81	Heat=0.507
	T2	27.87	35.60	36.80	37.67	37.07	35.87	35.60	35.21	Treatment= 0.587
	T3	28.07	35.73	36.93	37.80	37.13	36.03	34.07	35.11	Averages = 1.08
	Average	27.87	35.53	36.82	37.6	37.02	35.92	34.53		
Leaf area (cm2) 2016	T1	27.83	35.53	36.53	37.37	36.80	35.97	34.30	34.9	Heat =0.42
	T2	27.93	35.63	36.87	37.73	37.13	35.90	35.63	35.26	Treatment =0.24
	T3	28.13	35.80	37.00	37.87	37.13	36.07	34.13	35.16	Averages = 0.873
	Average	27.97	35.66	36.80	37.66	37.02	35.97	34.68		
Total chlorophyll (reading) 2015	T1	48.33	48.93	52.93	55.93	55.47	53.80	53.23	52.66	Heat=0.267
	T2	49.07	51.80	54.53	58.20	57.13	54.53	54.33	53.56	Treatment =0.257
	T3	47.33	48.13	52.07	54.13	54.07	51.93	48.33	50.86	Averages = 0.456
	Average	48.24	49.62	53.18	56.09	55.56	53.42	51.97		
Total chlorophyll (reading) 2016	T1	46.53	48.63	52.13	54.87	54.60	53.13	52.60	51.79	Heat=0.252
	T2	48.63	51.20	54.07	56.60	56.17	54.20	54.07	53.56	Treatment =0.282
	T3	47.07	48.07	51.80	54.07	54.00	51.63	48.00	50.66	Averages = 0.418
	Average	47.41	49.30	52.67	55.18	54.92	52.99	51.56		

T1: Low level of heat, T2: Medium level of heat, T3: High level of heat
tr1 (Control), tr2 (MLE 30), tr3 (MLE 20), tr4 (MLE 10), tr5 (SWE3), tr6 (SWE2), tr7 (SWE1)

2. Effect of spraying different rates of MLE and SWE concentrations on fruit set and drop percentages:

Results of the effects of different rates of MLE and SWE on fruit set% and drop% in different temperature level of "Anna" apple trees during 2015 and 2016 seasons are presented in Table (4).

Regarding the effects of spraying different rates of (MLE) and (SWE) in different temperature level on initial fruit set%, data revealed that there was a significant effect of temperatures level and spraying extracts on initial fruit set % in both season. Besides having a significant effect for spraying extracts on the impact of temperatures on initial fruit set % in both season too. As the temperature level

data showed that, (T2) gave the highest values of initial fruit set % in both season. Furthermore, the data revealed that foliar application with MLE20 gave the highest values of initial fruit set % and control treatment in both growing seasons gave the lowest values of initial fruit set % compared with other treatment in every temperature level.

The data concerning the effect of application different rates of (MLE) and (SWE) concentrations in different temperature level on final fruit set % showed that, the effects of temperature level, spray extracts and interaction were Significant. For temperature data revealed that the best results were in (T2), (T1) and (T3) respectively in both season. Furthermore, data clarified that spraying the trees with MLE20 treatments increased final fruit set % significantly as compared with control treatment and other foliar application treatments in both growing seasons in each temperature level. Generally, control treatment gave the lowest values of final fruit set %, while foliar of MLE20 gave the highest values of final fruit set % compared with all treatment in different temperature level in both season.

The results of fruit set (initial and final) are agreed with Featonby-Smith and Van Staden (1987). Same results are reported by Arthur et al. (2003) they reported that application of seaweed extract-based preparations triggers earlier flowering, better fruit set and development of fruits of numerous crop plants. In same line this result came with that reported by Nasir et al. (2016). The data concerning the effect of different rates of (MLE) and (SWE) in different temperature level on fruit drop % of "Anna" apple trees during 2015 and 2016 seasons revealed that, high Significant effect of temperature level and foliar application of different MLE and SWE extracts concentrations on fruit drop %. Data showed that (T3) cause highest value of fruit drop % for every foliar extract treatment but the lowest values were in (T2) in both season. Also data cleared positive effect for application of different MLE and SWE on decrease fruit drop % in every temperature level in both season. Generally, the MLE10 gave less values of fruit drop % while control treatments gave a higher value of fruit drop in each temperature level in both seasons in partnership with SWE1ml /L in low level in first season only. The same results were reported by Nasir et al. (2016).

3. Effect of spraying different concentrations of moringa leaf extract (MLE) and seaweed extract (SWE) on yield:

Concerning the effects of different concentrations of spraying the rates of (MLE) and (SWE) on yield of "Anna" apple trees during 2015 and 2016 seasons the data is shown in Table (4). 3.1Yield weight/feddan (Ton): The data in Table (4) represented the effect of spraying of different concentrations of Moringa leaf extract and Seaweed extract in different level of temperature on yield weight/feddan (ton) of “Anna” apple trees during the both seasons. The data indicated that all concentrations increased significantly yield weight/feddan (ton) as compared with control in both season in each temperature level. The best results that achieved of yield as a result of spraying various treatments was found in (T2) and lowest values was in (T3) in both season in general. Furthermore, data

revealed that the Yield of each spraying extract treatments in (T1) was higher than it in (T3) for the same treatment. In general, data cleared that the control treatment gave the lowest value of yield weight/feddan (ton) while MLE10 gave the highest value of yield weight/feddan (ton) in each temperature level in both seasons.

These results are supported by Iqbal (2014) who reported that moringa leaf extract is rich with numerous growth hormones, particularly zeatin that has been reported to increase the crops yield in the range of 10-45 % and it also contains micronutrients in sufficient quantities and suitable proportions that increase the yield and yield components. Also same results found on “Le-Conte" pear by Abd El-Hamied and El-Amary (2015).

Table (4). Effect of foliar application with different moringa leaf and seaweed extracts on initial fruit set %, final fruit set %, fruit drop %in different temperature level of "Anna" apple trees during 2015 and 2016 seasons.

	Factor	Spray treatments								L.S.D 0.05
	Heat	tr1	tr2	tr3	tr4	tr5	tr6	tr7	Average	
Initial fruit set % 2015	T1	45.95	51.68	52.45	52.07	51.13	50.87	49.15	50.47	Heat =0.347
	T2	52.58	53.50	54.60	53.76	53.86	52.87	52.83	53.43	Treatment=0.792
	T3	48.24	50.96	52.01	51.09	50.98	50.56	49.15	50.43	Averages =1.192
	Average	48.92	52.05	53.02	52.31	51.99	51.42	50.39		
Initial fruit set % 2016	T1	48.26	51.66	52.79	52.22	51.76	51.27	49.78	51.11	Heat =0.535
	T2	50.03	53.07	56.40	54.71	53.25	51.76	51.56	52.97	Treatment = 0.92
	T3	45.62	49.57	52.39	50.91	49.76	48.60	47.80	49.24	Averages =0.892
	Average	47.97	51.44	53.86	52.61	51.59	50.54	49.71		
Final fruit set% 2015	T1	12.41	15.69	18.73	17.80	16.62	16.16	14.44	15.98	Heat= 0.135
	T2	14.11	17.62	19.69	18.56	18.50	18.11	17.48	17.72	Treatment=0.176
	T3	12.72	14.64	16.02	14.59	14.75	13.16	13.81	14.24	Averages =0.391
	Average	13.08	15.98	18.15	16.98	16.62	15.81	15.24		
Final fruit set% 2016	T1	14.68	17.54	19.22	18.37	18.54	18.28	17.33	17.71	Heat =0.161
	T2	16.67	21.56	22.23	21.03	18.17	17.98	16.19	19.12	Treatment=0.173
	T3	12.78	14.21	15.63	14.33	14.19	13.31	12.76	13.89	Averages =0.364
	Average	14.71	17.77	19.03	17.91	16.97	16.52	15.43		
Fruit drop% 2015	T1	69.43	64.35	63.82	61.50	65.26	68.38	69.15	65.98	Heat = 0.545
	T2	67.07	62.53	63.64	58.66	64.15	64.23	66.51	63.83	Treatment=1.298
	T3	82.98	80.67	79.64	76.70	78.83	80.71	81.47	80.14	Averages =2.405
	Average	73.161	67.895	69.03	66.902	69.41	71.106	72.378		
Fruit drop% 2016	T1	81.30	78.98	73.65	73.18	73.33	74.76	76.43	75.95	Heat = 0.748
	T2	77.21	75.76	75.20	75.01	75.64	77.97	79.05	76.55	Treatment=0.681
	T3	83.89	82.33	82.25	81.40	81.91	82.06	82.73	82.37	Averages =1.375
	Average	80.80	79.02	77.03	76.53	76.96	78.26	79.41		
Yield weight (Ton/fed) 2015	T1	7.70	9.91	10.91	10.93	10.85	9.95	9.7	9.99	Heat = 0.255
	T2	7.96	10.68	12.24	12.41	11.71	10.92	10.24	10.88	Treatment=0.156
	T3	5.57	5.78	6.86	7.25	7.04	6.09	5.79	6.34	Averages =0.218
	Average	7.08	8.79	10.00	10.19	9.87	8.99	8.58		
Yield weight (Ton/fed) 2016	T1	7.26	9.64	10.34	10.77	10.53	9.62	9.56	9.67	Heat = 0.132
	T2	7.43	10.38	11.48	11.53	11.35	10.72	10.04	10.42	Treatment=0.192
	T3	5.83	6.19	7.26	7.28	7.20	6.58	6.17	6.64	Averages =0.281
	Average	6.84	8.74	9.69	9.86	9.69	8.97	8.59		

T1: Low level of heat, T2: Medium level of heat, T3: High level of heat
tr1 (Control), tr2 (MLE 30), tr3 (MLE 20), tr4 (MLE 10), tr5 (SWE3), tr6 (SWE 2), tr7 (SWE1)

CONCLUSIONS

Results of this study revealed that all studied traits were significantly affected by temperature level except in leaf area. Also all applied treatments led to significant effect too. The interaction between temperature and foliar treatments was significant except in shoot thickness and leaf area. Generally, the level (T2) had best results for all applied treatments. MLE10 treatment caused the best results of vegetative growth parameters (except in shoot thickness where SWE3 gave the highest value), fruit drop% and the yield. MLE20 treatment gave the highest values of initial fruit set%, final fruit set %. Based on these results the study recommends the application of MLE 20 at full bloom and MLE10 at month after full bloom and at two month after full bloom.

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الملخص العربى

تأثير الرش بمستخلصات المورينجا وأعشاب البحر لتقليل الاجهاد الحراري وتحسين المحصول في اشجار التفاح الانا

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أجريت هذه الدراسة لتقييم فعالية رش مستخلصات اوراق المورينجا واعشاب البحر كمحسن نمو طبيعي على التخفيف من اثار الإجهاد الحراري وتحسين النمو و محصول أشجار التفاح صنف "آنا" فى الظروف العادية و تحت ظروف الإجهاد الحرارى خلال موسمى الدراسة (٢٠١٥ و ٢٠١٦) على التوالي. وشملت الدراسة ثلاثة مستويات من عامل الحرارة هى منخفض(طبيعي) ومتوسط ومرتفع وتحت كل مستوى لدرجات الحرارة طبقت سبع معاملات هى على النحو التالي: معاملة الكنترول ، ومستخلص المورنجا في تخفيف (١٠ ، ٢٠ ، ٣٠ مرة) ومستخلص الأعشاب البحرية بتركيز (١ و ٢ و ٣ مللى/ لتر). تم تطبيق كافة المعاملات ثلاث مرات يفصل بينهما شهر ابتداء من الإزهار الكامل (٨٠٪ من الإزهار).

اظهرت النتائج أن جميع المعاملات المطبقة أدت إلى تأثير كبير على جميع الصفات المدروسة ونفس الشيء بالنسبة لمستوى درجة الحرارة والتفاعل بين العاملين إلا في حالة سمك الافرخ حيث كان التفاعل غير معنوى، وكذا في حالة مساحة الورقة حيث كان تاثير الحرارة وتفاعلها مع المعاملات غير معنوى ايضا. وأشارت النتائج الى وجود تاثير ايجابى على النمو الخضري والمحصول. عموما، كانت أفضل النتائج لجميع المعاملات المطبقة فى مستوى درجات الحرارة المتوسط (T2) . تسببت معاملة MLE10 على أفضل النتائج لصفات النمو الخضري (باستثناء سمك الافرخ حيث أعطت معاملة SWE3 أعلى قيمة)، ونسبة تساقط الفاكهة والمحصول. أعطت معاملة MLE20 أعلى قيمة لنسبة العقد الابتدائى و نسبة العقد النهائى. وبناء على هذه النتائج اوصت الدراسة بالرش الورقى ب MLE 20 في الإزهار الكامل و ب MLE10 بعد شهر من الإزهار الكامل و شهرين بعد الإزهار الكامل للحصول على أفضل النتائج.