EFFECT OF FOLIAR APPLICATION OF GIBBERELLIC ACID AND SEAWEED EXTRACT SPRAY ON GROWTH AND LEAF MINERAL CONTENT ON PEACH TREES

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ABSTRACT

This study was conducted at the peach orchard, Horticultural Department, College of Agriculture – University of Baghdad during 2013 / 2014 growing seasons to investigate the influence of gibberellic acid spray and seaweed extract spray on 3 year's old trees of "Peento" peach cultivar. This study included two factors; gibberellic acid spray (GA) and seaweed extract spray (Sea Force) (SF). The first factor three levels were used, 0, (GA_0), 50 (GA_{50}) and 100 (GA_{100}) mg.L^{-1} and three levels of seaweed extract, 0 (SF_0), 2 (SF_2) and 4 (SF_4) ml.L^{-1}. Each treatment replicated three times with a factorial experiment using RCBD. The number of trees used was 27 trees. The experimental results showed that gibberellic acid at 100 mg.L^{-1} and seaweed extract at 4 ml.L^{-1} ($GA_{100}SF_4$) significantly gave the highest total leaves area of 2316 and 3115 cm^2, the highest leaf chlorophyll content of 36.33 and 37.18 mg.g^{-1}, leaf carbohydrates content 12.14 and 12.65 %, the highest leaf nitrogen content of 1.82 and 1.94 %, and the highest leaf zinc content of 22.39 and 25.21 ppm for both seasons, respectively. The lowest value of these parameters was found in the control (GA_0SF_0) treatment. It could be concluded of this experiment that the gibberellic acid at level GA_{100} and seaweed extract at level SF_4 improved vegetative characteristics and leaf mineral content in peach trees cv. Peento and we recommended conducting these treatments annually and study the effect of gibberellic acid and seaweed extract on other concentrations on other fruit trees.

Key words: Plant growth regulators, Algae, Peento cultivar, Vegetative growth, Fruit trees.

تأثير رش حامض الجبرليك و مستخلص الطحالب في النمو و المحتوى المعدني لأوراق اشجار الخوخ

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المستخلص

أجريت هذه التجربة في بستان الخوخ التابع لقسم البستنة / كلية الزراعة / جامعة بغداد للموسمين 2013 و 2014 لمعرفة تأثير رش حامض الجبرليك و مستخلص الطحالب البحرية في صنف الخوخ Peento بعمر ثلاث سنوات. استخدم عاملا رش حامض الجبرليك (GA) ومستخلص الطحالب البحرية Sea Force (SF) . العامل الأول بثلاثة مستويات هي صفر (GA_0) و50 (GA_{50}) و 100 (GA_{100}) ملغم.لتر$^{-1}$ وثلاثة مستويات من مستخلص الطحالب البحرية هي صفر (SF_0) و2 (SF_2) و4 (SF_4) مل.لتر$^{-1}$. صممت المعاملات بتجربة عامليه بتصميم القطاعات الكاملة المعشاة بثلاثة مكررات بواقع شجرة واحدة لكل وحدة تجريبية وبذلك يكون عدد الأشجار الداخلة في التجربة 27 شجرة . أظهرت النتائج أن معاملة التداخل $GA_{100}SF_4$ قد تفوقت على باقي المعاملات في المساحة الورقية الكلية حيث أعطت 2316 و 3115 سم^2 وأعلى محتوى للأوراق من الكلوروفيل بلغ 36,33 و 37,18 ملغم.غم$^{-1}$ واعلى محتوى للأوراق من الكاربوهيدرات بلغ 12,14 و 12,65% وأعلى محتوى للأوراق من النتروجين بلغ 1,82 و 1,94% و اعلى محتوى للأوراق من الزنك بلغ 22,39 و 25,21 جزء بالمليون لموسمي الدراسة ، بالتتابع . كانت اقل القيم لهذه القياسات في معاملة المقارنة GA_0SF_0. نستنتج من هذا البحث أن معاملات رش حامض الجبرليك عند المستوى GA_{100} و رش مستخلص الطحالب عند المستوى SF_4 أدت إلى تحسين الصفات الخضرية و محتوى الأوراق من العناصر في أشجار الخوخ صنف Peento . نوصي بأجراء هذه المعاملات سنوياً على أشجار الخوخ ودراسة تأثير حامض الجبرليك و مستخلص الطحالب بتراكيز أخرى و على اشجار فاكهة اخرى.

الكلمات المفتاحية: منظمات النمو النباتية، الطحالب، الصنف Peento، النمو الخضري، اشجار الفاكهة.

INTRODUCTION

Peaches (*Prunus persica* L.) are native to family Rosaceae. They were early cultivated in China since approximately 4000 years ago from it speeded world wide. The acreage of peach in the world reached about 1499872 hectare, with production of 21083151 tons (22).The main producing countries are China then Italy, United States of America, Greece, Spain (22).The estimated number of peach fruit trees in Iraq, including nearly 152273 tree produces up to 2451 tons, and the average production per tree about 16.1 kg (16). It is well known that peach fruit contains carbohydrates, organic acids, pigments, phenolic compounds, volatile compounds, antioxidants and trace amounts of proteins and lipids. It is a rich source of potassium, iron, fiber, vitamin A, vitamin C and other vitamins (19, 24). Gibberellins it is the second group of plant hormones that were discovered after auxins, are tetracyclic diterpenoid acids, biologically effective in stimulating cell division or elongation or both, they also have a role in the phenomenon of genetic dwarfism of plants and their influence in the process of formation of flowers and parthenocarpic fruits and the removal of seed dormancy and buds(9). (39) Mentioned that the foliar spray with 50 mg $GA_3.L^{-1}$ caused significant increase in leaves P concentration, leaves number, trees leaf area, leaves carbohydrates concentration and main stem diameter, mean while the foliar spray with 100 mg.$GA_3.L^{-1}$ caused significant increase in leaves N concentration and trees height compared with the control treatment in his study on peach trees Al-Abbassy (3) fount that foliar spray with Gibberellic acid at 100mg.L^{-1} caused significant increase in height and diameter of the main stem, total chlorophyll in leaves and nitrogen and phosphorus percentage in apricot leaves. Hassan et al. (25) Recorded that, highest content of leaves N, K, Fe and Zn it was in the plum trees treated with gibberellic acid (GA_3) as foliar spray. Soest (41) Found that the spray apple trees with gibberellic acid at 20ppm gave the highest leaf N, P, K and chlorophyll content. Algae extract or seaweed extract as a new bio fertilizer containing N, P, K, Ca, Mg, and S as well as Zn, Fe, Mn, Cu, Mo, and Co, some growth regulators, polyamines and vitamins applied to improve nutritional status, vegetative growth, yield and fruit quality in different orchard as well as vineyards (2, 42).(27) mentioned that the treatment of K18 and Khodeiri olive transplant with Marine fert (12% natural organic matter extracted from seaweed (*Ascophyllum nodosum*) showed higher concentration of leaf N, P and K . Al-Hadethi et al. (5) reported that seaweed extract increased the vegetative growth characteristics and leaf chlorophyll content of apricot trees. Bradshaw et al. (14) Found the spray algae extract Stimplex and Seacrop16 extracted from seaweed *Ascophyllum nodosum* have affected significantly in most recipes vegetative growth studied in apple trees Al-Hadethi (4) found that spraying seaweed extract (Marine fert) each at 2.5 and 5 ml.L^{-1} enhanced leaf area, leaf chlorophyll content, leaf mineral content (N, K, Ca, Fe) and leaf carbohydrates content and of apricot trees. The target of this study was to evaluate "Peento" peach cultivar parameters under using GA_3 and seaweed extract.

MATERIALS AND METHODS

This study was conducted in the peach orchard, Horticultural Department, College of Agriculture – University of Baghdad during 2013 / 2014growing seasons to investigate the influence of gibberellins spray (GA_3) and seaweed extract spray (Sea Force) on 3 year's old trees of "Peento" peach cultivar. Trees were cultivated at 3 X 3 m apart under basin irrigation system. Trees were healthy, similar in vigor and subjected to the same horticultural practices adapted in the region. This study included the following treatment: three levels of spraying of GA_3, 0 (GA_0), 50mg.L^{-1} (GA_{50}) and 100mg.L^{-1} (GA_{100}) and three levels of spraying of Sea Force, 0 (SF_0), 2ml.L^{-1} (SF_2) and 4ml.L^{-1} (SF_4) and their interaction. Treatments were replicated three times at factorial experiment in a completely randomized block design. The number of transplant used was 27 transplants. The following parameters were determined in the two successive seasons:

1.Leaves area (cm^2): By taken ten leaves from the middle position of the shoot randomly and measuring leaf area (cm^2). By Digimizer program Windows 7 operating system, then

mean of leaf area × number of leaves to calculate the total leaves area.

2.Increase in stem diameter (mm): Stem diameter were measured by (Vernier) at the beginning and end of the experiment, according to the difference between them and that such an increase in stem diameter and both seasons.

3. Average of branches length (cm): Taking four branches of each experimental unit at the beginning of the month of October and measured annual shoots formed during the season in each unit empirical metric tape measure and mined the average branches length.

4. Leaf chlorophyll contents ($mg.g^{-1}$ fresh weight): Representative fresh leaf sample at middle part of shoots were taken in the first week of June and used for analysis of chlorophyll were calorimetrically according to (31).

5.Leaf dry weight (%): Various leaves were taken from the sapling was weighing then drained degree 3. While proven weight and calculated the percentage of dry matter by dividing weight after drying on weight before drying× 100.

6. Leaf carbohydrates content (%): was determined according to Dubois *et al*. (20).

7. Leaf mineral content: Leaf samples were collected for chemical analysis at the 1st week of June of both seasons. Each sample consisted of 20 leaves / tree. Leaves were washed several times with tap water, rinsed with distilled water, and then dried at 70 c^0 until a constant weight, ground and digested according Chapman et.al. (17). Nitrogen was estimated by semi-micro kieldahl method of (37). Phosphorus was determined by the method outlined by Jackson (29). Potassium was determined using atomic absorption spectrophotometer "Perkin Elmer 1100B" after samples digested according to Chapman et.al. (17). Iron, Manganese and Zinc were determined as ppm using atomic absorption according to Carter (15). The obtained results were subjected to analysis of variance according to (21) using L.S.D 0.05 for comparing differences between various treatment means.

RESULTS AND DISCUSSIONS

Effects of Seaweed extract and GA_3 spray on leaves area, Increase in stem diameter Average of branches length:

Data concerning the effect of treatments on leaves area, increase in stem diameter average of branches length during the two experimental seasons are listed in Table (1). The data cleared that, GA_3 spray at $100mg.L^{-1}$ significantly increased leaves area of 2168 and 2897 cm^2, increase in stem diameter of 8.63 and 18.68 mm and the highest average of branches length of 26.26 and 28.19 cm for both seasons, respectively. Table (1) also shows that the sprayed seaweed extract at levels $4ml.L^{-1}$ significantly superiority of the control treatment and gave the highest leaves area of 1979 and 2740 cm^2, increase in stem diameter of 8.22 and 15.50 mm and the highest average of branches length of 24.54 and 26.00 cm for both seasons, respectively. The interaction between seaweed extract and GA_3 significantly affected in all studied parameters. This is probably due to the increased outputs of the process of photosynthesis and which carbohydrates when spraying this level of gibberellic acid (Table 2) which are used in various processes of growth, and this is in line with the sentiments Mostafa et al.(34) that the foliar spraying of gibberellic acid has the ability to stimulate plant growth and development, working to increase the speed of the process of photosynthesis. The gibberellic acid may lead to increased side buds open in many plant species, which produce branches and leaves, as well as that Gibberellic acid retards aging and fallen leaves, leading to increase the number of remaining leaves on the trees until the end of the season (9). Generally, these results are in harmony with those reported by Al-Jubury (8) on pistachio transplant, (13, 39) when they worked on peach trees. Also, (10, 25) decided the same results on plum trees and (12) on olive trees. As for the increase vegetative growth resulting from the impact of spraying seaweed extract was due to the content extracted from the major micro nutrients and plant hormones, particularly cytokinins which have an active role in stimulating growth and increase plant height and side branches (43). The similar substances auxins increase in treatment plants

seaweed extract (30). The positive effect of seaweed extract have been due to the content of the basic growth, such as nitrogen, phosphorus, potassium, vitamins, amino acids and organic, which have a wide range in their impact on the vital activity of the plant nutrients (36) thereby increasing absorbed by the plant, which is reflected in a positive increase vegetative growth of the trees. These results are in agreement with those obtained by, Al- Hchami (7) on peach trees, (4,5) on apricot trees, they found that the leaves area and increase in stem diameter and average of branches length positively correlated with seaweed extract spray in those trees.

Table 1. Effects of GA_3 and Seaweed extract spray on leaves area, Increase in stem diameter and average of branches length of Peento peach trees during 2013 and 2014 seasons.

r	2013				2014			
GA_3	Sea Force (SF)				Sea Force (SF)			
	0	2	4	mean	0	2	4	mean
Leaves area (cm^2)								
0	1626	1683	1714	1674	1986	2119	2321	2142
50	1725	1878	1908	1837	2408	2566	2783	2586
100	2033	2154	2316	2168	2652	2924	3115	2897
mean	1795	1905	1979		2349	2536	2740	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	163	163	282		319	319	553	
Increase in stem diameter (mm)								
0	4.77	6.64	7.32	6.24	5.51	8.98	10.11	8.20
50	5.76	7.23	7.89	6.96	10.35	11.65	13.15	11.72
100	7.80	8.65	9.45	8.63	14.56	18.22	23.25	18.68
mean	6.11	7.51	8.22		10.14	12.95	15.50	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	1.17	1.17	2.03		4.21	4.21	7.29	
Average of branches length (cm)								
0	16.22	19.19	19.97	18.46	17.88	19.59	21.45	19.64
50	18.54	20.29	23.78	20.87	19.12	21.76	25.16	22.01
100	23.76	25.15	29.86	26.26	24.82	28.36	31.40	28.19
mean	19.51	21.54	24.54		20.61	23.24	26.00	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	3.22	3.22	5.58		3.98	3.98	6.89	

Effects of Seaweed extract and GA_3 spray on Leaf chlorophyll content, Leaf dry weight and Leaf carbohydrates content: Seen from the results shown in the table (2) the spray gibberellic acid and seaweed extract and interaction between them are affected significantly. In the case of spray gibberellic acid is noted that the level 100mg.L^{-1} it has given the highest results in leaf chlorophyll content of 34.58 and 36.09 mg.g^{-1}, leaf dry weight of 32.40 and 33.04 %, leaf carbohydrates content of 11.18 and 12.19 % for both seasons respectively. Either when sprayed seaweed extracts findings in table (2) that spray at levels 4ml.L^{-1} significantly superiority of the control treatment and gave the leaf chlorophyll content of 33.97 and 34.89 mg.g^{-1}, leaf carbohydrates content of 11.13 and 11.72 % for both seasons, respectively. The reason may be due to the role of gibberellic acid which increased the nitrogen concentration in leaves (table 3) and which contribute to the building of chlorophyll in addition to some other nutrients which may contribute indirectly in the construction of chlorophyll, as well as the spray Gibberellic acid leads to delaying the aging of leaves as a result of a delay in the lack of protein and RNA and chlorophyll a result of the slow demolition of these compounds and increase composition (9). The reason increase the leaf carbohydrates content may be due to the role of gibberellic acid increase in leaves content of total chlorophyll (Table 2) as a result of the delay in the demolition and increase built and leaf area of transplants (Table 1) and that may work to increase the speed of the process of photosynthesis, compounds and resulting materials (18). This is consistent with the sentiments (33) on apple trees, (13) on peach trees, (10 and 25) decided the same results on plum trees. The reason the increasing in some vegetative traits may be due to contain seaweed extract nutrients which lead to

increased activities metabolic plant including potassium is essential in activating enzymes amino acids and protein synthesis as well as help to chlorophyll important manufacturing in photosynthesis and the formation of sugars, proteins and compounds the process of element ATP energy, all of which affect the growth and increase the size of the plant, which ultimately leads to an increase in prescriptions vegetative growth (32). This is consistent with the sentiments (26) on olive trees, (5) on apricot trees.

Effects of Seaweed extract and GA_3 spray on leaf N, P, K content:

Data concerning the effect of treatments on nitrogen, phosphor and potassium during the two experimental seasons are listed in Table (3). The data cleared that, GA_3 spray at 100mg.L^{-1} significantly increased and gave the highest leaf nitrogen content of 1.59 and 1.66 %, the highest leaf potassium content of 1.60 and 1.69 % for both seasons, respectively. Table (3) also shows that sprayed seaweed extract at levels 4ml.L^{-1} significantly superiority of the control treatment and gave the highest leaf nitrogen content of 1.54 and 1.66 %, leaf phosphor content of 0.31 and 0.40 % and the highest leaf potassium content of 1.57 and 1.72 % for both seasons, respectively. The interaction between seaweed extract and GA_3 significantly affected all studied parameters.

Table 2 . Effects of GA_3 and Seaweed extract spray on Leaf chlorophyll content, Leaf dry weight and Leaf carbohydrates content of Peento peach trees during 2013 and 2014 seasons.

season	2013				2014			
GA_3	Sea Force (SF)				Sea Force (SF)			
	0	2	4	mean	0	2	4	mean
Leaf chlorophyll contents (mg.g^{-1} fresh weight)								
0	31.15	31.78	32.17	31.70	30.21	32.51	32.78	31.84
50	31.91	32.65	33.41	32.66	33.16	34.29	34.71	34.05
100	33.19	34.22	36.33	34.58	34.87	36.22	37.18	36.09
mean	32.08	32.88	33.97		32.75	34.34	34.89	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	1.14	1.14	1.97		1.32	1.32	2.29	
Leaf dry weight (%)								
0	29.78	29.79	30.15	29.91	30.31	30.44	30.47	30.41
50	31.22	31.26	31.11	31.20	32.66	32.81	32.90	32.79
100	32.27	32.40	32.53	32.40	32.93	33.07	33.11	33.04
mean	31.09	31.15	31.26		31.97	32.11	32.16	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	1.02	N.S	1.77		0.83	N.S	1.44	
Leaf carbohydrates content (%)								
0	8.62	9.77	9.91	9.43	9.44	9.69	10.56	9.90
50	9.81	10.55	11.35	10.57	10.18	10.42	11.96	10.85
100	10.24	11.15	12.14	11.18	12.14	11.87	12.65	12.19
mean	9.56	10.49	11.13		10.59	10.66	11.72	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	0.97	0.97	1.68		0.83	0.83	1.44	

Effects of Seaweed extract and GA_3 spray on leaf Fe, Mn, Zn content:

Seen from the results shown in the table (4) the interaction between gibberellic acid and seaweed extract are affected significantly. In the case of spray gibberellic acid it had no significant affect on the leaf Fe, Mn and Zn content. Either when sprayed seaweed extracts findings in table (4) that spray at levels 4ml.L^{-1} significantly superiority of the control treatment and gave leaf Fe content of 186.4 and 201.7 ppm, leaf Mn content of 2.087 and 2.325 ppm and leaf Zn content of 22.03 and 24.50 ppm for both seasons, respectively. The reason for this may be due to increase the growth and spread of root in the soil, as a result of the role of gibberellic acid in the division and cell elongation (23), which may lead to increased absorption of some nutrients from the soil, including nitrogen potassium concentrations in leaves. Generally, these results are in harmony with those reported by (1) on fig trees, (35) on pear trees, (3, 6) when they worked on apricot trees. Also, (11, 41) decided the same results on apple trees. As for the effect of the algae extract turned out tables above that there is a significant effect and that this increase is due to contain the fertilizer nutrients especially the N, P and K as well as micronutrients which absorbs directly when sprayed on the leaves and thus an increase in the plant (40). These results are in agreement

with those obtained by, (38) on apple trees, Ismail et al. (28) on orange trees, (6) on peach trees, (4) on apricot trees; they found that the leaves mineral content positively correlated with seaweed extract spray in those trees.

Table 3. Effects of GA_3 and Seaweed extract spray on Leaf N, P and K content of Peento peach trees during 2013 and 2014 seasons.

season	2013				2014			
GA_3	Sea Force (SF)				Sea Force (SF)			
	0	2	4	mean	0	2	4	mean
				N (%)				
0	1.05	1.11	1.30	1.15	1.08	1.22	1.41	1.24
50	1.18	1.21	1.49	1.29	1.20	1.45	1.62	1.42
100	1.38	1.57	1.82	1.59	1.34	1.69	1.94	1.66
mean	1.20	1.30	1.54		1.21	1.45	1.66	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	0.17	0.17	0.30		0.21	0.21	0.36	
				P (%)				
0	0.19	0.22	0.23	0.21	0.21	0.29	0.37	0.29
50	0.20	0.26	0.30	0.25	0.22	0.33	0.39	0.31
100	0.23	0.31	0.39	0.31	0.25	0.35	0.44	0.35
mean	0.21	0.26	0.31		0.23	0.32	0.40	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	0.07	0.07	0.12		N.S	0.09	0.16	
				K (%)				
0	1.29	1.33	1.40	1.34	1.35	1.47	1.53	1.45
50	1.32	1.41	1.55	1.43	1.38	1.56	1.74	1.56
100	1.44	1.60	1.75	1.60	1.46	1.72	1.88	1.69
mean	1.35	1.45	1.57		1.40	1.58	1.72	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	0.13	0.13	0.23		0.16	0.16	0.28	

Table 4. Effects of GA_3 and Seaweed extract spray on Leaf Fe, Mn and Zn content of Peento peach trees during 2013 and 2014 seasons

season	2013				2014			
GA_3	Sea Force (SF)				Sea Force (SF)			
	0	2	4	mean	0	2	4	mean
				Fe (ppm)				
0	134.2	165.9	176.0	158.7	154.3	178.7	192.2	175.1
50	139.1	167.2	185.3	163.9	163.9	181.6	199.1	181.5
100	148.9	179.6	197.9	175.5	175.3	188.4	213.8	192.5
mean	140.7	170.9	186.4		164.5	182.9	201.7	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	N.S	19.22	33.29		N.S	20.21	35.00	
				Mn (ppm)				
0	1.734	1.896	1.976	1.869	1.813	2.154	2.277	2.081
50	1.755	1.919	2.117	1.930	1.822	2.213	2.310	2.115
100	1.785	1.967	2.169	1.974	1.834	2.229	2.387	2.150
mean	1.758	1.927	2.087		1.823	2.199	2.325	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	N.S	0.142	0.246		N.S	0.155	0.268	
				Zn (ppm)				
0	16.56	19.36	21.67	19.20	17.35	21.25	23.94	20.85
50	16.77	19.42	22.04	19.41	17.51	21.54	24.34	21.13
100	16.83	19.55	22.39	19.59	18.11	21.87	25.21	21.73
mean	16.72	19.44	22.03		17.66	21.55	24.50	
L.S.D5%	GA_3	SF	Inter		GA_3	SF	Inter	
	N.S	1.43	2.48		N.S	1.75	3.03	

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