

EFFECT OF CO₂ ENRICHMENT AND FOLIAR SPRAY AGROLEAF AND KELPAK ON LRAVES CONTENT OF N, P, K, PROTEIN AND CARBOHYDRATE OF SMOOTH PEACH TRANSPLANTS

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ABSTRACT

An experiment was conducted at the Lath house of Horticulture Department , College of Agriculture , University of Bagdad, during the growing seasons 2010 , 2011, to study the effect of CO₂ enrichment and Foliar spray of Agroleaf and Kelpak on peach transplants (nectarina) leaves contents of nutrients N, P, K, Protein and carbohydrates. 180 one year old transplants were selected planted in polyethylene bags containing 15 kg soil and exposed to four concentrations of CO₂ (atmospheric,600, 900, 1200). Agroleaf and Kelpak were sprayed at (2.5, 5 g.L⁻¹) and (2, 4 ml. L⁻¹) respectively in addition to control. The experiment was designed according to the Nested-factorial experiments. Treatment C₃ gave low contents of N (1.93, 1.86%), P (0.27, 0.28%), K (1.84, 1.78%) and Protein (12.04, 11.60%) in the leaves for two seasons respectively, while the treatment of C₀ increased the contents. Enrichment of CO₂ led to increase the percentage of carbohydrate in the leaves. Treatment T₂ significantly increased the contents of N (2.85, 2.98%), P (0.40, 0.40%), K (2.36, 2.32%), Protein (17.82, 18.65%) and carbohydrates (15.76, 16.08) in the leaves for both seasons.

Key word: carbon dioxide, foliar spray, transplants and smooth peach.

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الحجيمي و الخفاجي

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تأثير الإغناء بـ CO₂ و الرش الورقي بالـ Agroleaf و Kelpak في محتوى الأوراق من العناصر N و P و K

والبروتين والكاربوهيدرات لشتلات الخوخ الأملس

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المستخلص

أجريت هذه الدراسة في الظلة الخشبية التابعة لقسم البستنة – كلية الزراعة – جامعة بغداد خلال موسمي النمو 2010 و 2011 بهدف دراسة تأثير الإغناء بالـ CO₂ والرش بالمحلول المغذي Agroleaf ومستخلص الطحالب البحرية Kelpak في محتوى أوراق الخوخ الأملس (النكتارين) من عناصر N و P و K والبروتين والكاربوهيدرات، تم اختيار 180 شتلة بعمر سنة واحدة مزروعة في أكياس بلاستيكية سعة 15 كغم تربة، تم تعريض الشتلات إلى أربع تراكيز من الـ CO₂ (الجوي، 600، 900، 1200 مايكرومول.مول⁻¹) ورشت الشتلات بالـ Agroleaf بتركيز (2.5، 5 غم.لتر⁻¹) والـ Kelpak بتركيز (2، 4 مل. لتر⁻¹) إضافة إلى معاملة المقارنة. نفذت التجربة وفق التصميم التجريبي Nested. بينت النتائج انخفاض نسبة N (1.93 و 1.86%) و P (0.27 و 0.28%) و K (1.84 و 1.78%) والبروتين (12.04 و 11.60%) في الأوراق عند زيادة تركيز الـ CO₂ في المعاملة C₃ في حين ازدادت نسبة هذه العناصر عند معاملة المقارنة C₀، أما الكاربوهيدرات فقد أزداد تركيزها عند الإغناء بغاز الـ CO₂. وأظهرت معاملات التغذية الورقية تفوق المعاملة T₂ معنوياً ولكلا الموسمين بإعطائها أعلى نسبة لك N (2.85 و 2.98%) و P (0.40 و 0.40%) و K (2.36 و 2.32%) والبروتين (17.82 و 18.65%) والكاربوهيدرات (15.76 و 16.08%) في الأوراق وللموسمين بالتتابع.

الكلمات المفتاحية : ثنائي أكسيد الكربون، الرش الورقي، شتلات الخوخ الأملس.
*بحث مستل من أطروحة دكتوراه للباحث الأول

INTRODUCTION

Smooth peach (*Prunus persica* var. nectarina) belong to the Rosaceae family and are thought to have originated in China, Chinese literature dates cultivation of the peach in China to 1000 B.C. and it was probably carried from China to Persia. Peach, at one time called “Persian apple”, quickly spread from there to Europe. In the 16th century, it was established in Mexico and in the 18th century Spanish missionaries introduced the peach to California, which turned out to be the most important production area after China and Italy, of important stone fruit trees, trees considered that high yield and high nutritional value and multiple uses, Peach fruit is rich in nutrients N, P, K, also rich in ascorbic acid (vitamin C), carotenoids and phenolic compounds that are good sources of antioxidants (10,11,16,29). The reductase CO₂ to carbohydrate through install a carbon process was estimated 95% of the dry matter accumulated in the plant, that means CO₂ concentration is determining factor in photosynthetic activities (19). The foliar nutrition play important role to improving vegetative characteristics through the contribution of nutrients needed for growth to building the main and secondary compounds which had a coherent role in formation plant able to growth and development which is reflected on great root and vegetative systems size and this increase the ability of plants to uptake greatest amount of nutrients through foliar spray, also can improve production by using sea weed extract (Kelpak) as a foliar spray on leaves (13). Kelpak is contains many nutrients and some growth regulator which reflected to improvement vegetative growth and root (27). Chen et al (12) finding that CO₂ enrichment 700 $\mu\text{mol}\cdot\text{mol}^{-1}$ for 60 days had increased carbohydrate percentage in plant to 48%. Also Al-Zuhairi (9) found that treated apple transplant with high CO₂ led to reduce nutrients (N, P, K) in leaves. Al-Shemary (8) obtain on significant increase in nutrients N, P, K in pear leaves, carbohydrate percentage when use Agroleaf. Abd EL-Motty (2) found that spray mango trees of sea weed extract (2%) had increase in nutrients N, P, K in leaves. Ismael and Ghazzi (20) findings that using marine fert on olive seedling had

increase in nutrients N, P, K in leaves, According to above finding this study aimed to study Nectarine transplants (Nectar 6) response at different levels of CO₂ enrichment and interaction with Agroleaf and Kelpak.

MATERIAL AND METHODS

The experiment was carried out during the growing season 2010-2011 at Horticulture Department, lath house, College of Agric., Abu-Graib, 180 transplants (one years old) were selected planted in polyethylene bags containing 15 kg soil, a transplants put in close chambers dimension 470×270×175 cm (length×width×height) a transplants exposed to four concentrations of CO₂ (atmospheric, 600, 900, 1200 $\mu\text{mol}\cdot\text{mol}^{-1}$) for 4 hours and 4 weeks, the CO₂ was measured by portable indoor air quality CO₂ meter. The CO₂ enrichment in first seasons was 1/4/2010 and second seasons 20/3/2011. Agroleaf and Kelpak were sprayed on plants every two weeks for three months. Nested Design arrangement with three replicates was used. A CO₂ treatments was includes C₀ atmospheric, C₁ 600, C₂ 900, C₃ 1200 $\mu\text{mol}\cdot\text{mol}^{-1}$, foliar nutrition includes five treatment: T₀ control, T₁ Agroleaf 2.5 g.l⁻¹, T₂ Agroleaf 5 g.l⁻¹, T₃ Kelpak 2 ml.l⁻¹, T₄ Kelpak 4 ml.l⁻¹. The results was analyzed using Genstat method of analysis and the means were compared using LSD at 5% level of significant. Three plant were randomly choosed of each experiment unit and determination of nitrogen content in leaves by using micro Kjeldahl according to Jackson (21), phosphor content in leaves using ammonium heptamolybdate and measured using spectrophotometer at 880 nm was practice (25), Potassium content in leaves measured using Flame photometer according to Haynes (18), total carbohydrates according to Joslyn (22) and protein content (14, 24).

RESULTS AND DISCUSSION

Nitrogen percentage in leaves %

Results in table 1 revealed that N in leaves was effected by CO₂ enrichment where C₀ had the highest nitrogen 2.17 and 2.10% for two seasons respectively as compared with lowest nitrogen in C₃ 1.93 and 1.86% for two seasons respectively, foliar spray treatments T₂ was significantly superior in leaf content of nitrogen which gaves 2.85 and 2.98%, while T₀ had the lowest nitrogen 1.48 and 1.21% for

two seasons respectively. The interaction between CO₂ enrichment and foliar spray treatments affected nitrogen percentage in leaves, C₂T₂ had the highest nitrogen 2.97% in

first seasons and C₀T₂ treatment gave highest nitrogen 3.07% in second seasons, as compared to lowest nitrogen 1.22 and 1.07% found in C₃T₀ of two seasons respectively.

Table 1. Effect of CO₂ enrichment and foliar spray Agroleaf , Kelpak and interaction in nitrogen percentage in leaves for two seasons 2010-2011

Nitrogen %										
2010						2011				
Treatment	C ₀	C ₁	C ₂	C ₃	Mean	C ₀	C ₁	C ₂	C ₃	Mean
T ₀	1.73	1.51	1.47	1.22	1.48	1.29	1.26	1.21	1.07	1.21
T ₁	2.40	2.25	2.39	2.34	2.35	2.46	2.26	2.34	2.29	2.34
T ₂	2.81	2.78	2.97	2.85	2.85	3.07	2.96	3.03	2.88	2.98
T ₃	1.79	1.60	1.61	1.50	1.63	1.75	1.63	1.43	1.40	1.55
T ₄	2.13	1.89	1.83	1.72	1.89	1.94	1.82	1.73	1.64	1.78
Mean	2.17	2.01	2.06	1.93		2.10	1.99	1.95	1.86	
L.S.D 0.05	C		0.20			C		0.12		
	T		0.12			T		0.13		
	Interaction		0.28			Interaction		0.25		

Phosphor percentage in leaves %

Data in table 2 reveal that C₃ treatment reduced phosphors percentage in leaves 0.27 and 0.28% compared with C₀ which gives highest phosphor percentage at 0.32 and 0.33% for two seasons respectively, foliar spray also effected of phosphors percentage

were T₂ treatment dominated over other treatment in phosphors percentage it was 0.40 for both seasons. Interaction treatment C₀T₂ gave highest phosphors in leaves at 0.42 and 0.46% while C₃T₀ had the lowest phosphors percentage 0.13 and 0.11% for two seasons respectively.

Table 2. Effect of CO₂ enrichment and foliar spray Agroleaf , Kelpak and interaction in phosphor percentage in leaves for two seasons 2010-2011.

Phosphors %										
2010						2011				
Treatment	C ₀	C ₁	C ₂	C ₃	Mean	C ₀	C ₁	C ₂	C ₃	Mean
T ₀	0.19	0.16	0.15	0.13	0.16	0.17	0.14	0.14	0.11	0.14
T ₁	0.37	0.38	0.36	0.33	0.36	0.38	0.34	0.36	0.31	0.35
T ₂	0.42	0.40	0.39	0.38	0.40	0.46	0.35	0.39	0.40	0.40
T ₃	0.29	0.24	0.22	0.22	0.24	0.28	0.28	0.23	0.25	0.26
T ₄	0.35	0.31	0.27	0.26	0.30	0.35	0.32	0.28	0.30	0.31
Mean	0.32	0.30	0.28	0.27		0.33	0.29	0.28	0.28	
L.S.D 0.05	C		0.03			C		0.05		
	T		0.03			T		0.04		
	Interaction		0.06			Interaction		0.08		

Potassium percentage in leaves %

Table 3 shows reduced in leaves content of potassium at C₃ to reach 1.84 and 1.78% while C₀ show significantly superior in potassium percentage 2.16 and 2.08% for two seasons respectively, foliar spray T₂ increased potassium percentage it's gave 2.36 and 2.32% while T₀ gave the lowest percentage 1.70 and 1.56% for two seasons respectively. Interaction is significant where C₀T₂ had the highest potassium percentage at 2.54 and 2.44% for two seasons respectively, C₃T₀ had the lowest potassium percentage 1.59 and 1.46% for two seasons respectively. The lowest potassium percentage at highest CO₂

enrichment may be due to increased consumption by the plant to improvement vegetative growth, also increased CO₂ concentration may be effected on the mechanism of opening and closing of stomata at is helps to reduce the stomata activites and stomata size so reduced nutrients could be taken by plant and utilize it in photosynthesis process so that reduce nutrients content in leaves, similar results found by Al-Zuhiare (9) and AL-Juboory (6) they found that CO₂ enrichment with 1200 μmol.mol⁻¹ was reduce nutrients content in leaves (N, P, K) when used. These result coincided with Anisworth and Rogers (3), Loladze (23), Taub and Wang

(28). Increased N, P, K percentage in leaves could be due to the direct addition of this element by sprayed Agroleaf and Kelpak on the leaves and its effective role of increasing the vegetative growth and photosynthesis

process so that an increase absorption nutrients and increased concentration in plant. These result coincided with Aksoy and Anac (4), Al-Mousawi (5), AL-Rawe et al (7), Al-Shemary (8).

Table 3. Effect of CO₂ enrichment and foliar spray Agroleaf , Kelpak and interaction in potassium percentage in leaves for two seasons 2010-2011

Potassium %										
2010						2011				
Treatment	C ₀	C ₁	C ₂	C ₃	Mean	C ₀	C ₁	C ₂	C ₃	Mean
T ₀	1.86	1.72	1.64	1.59	1.70	1.66	1.58	1.56	1.46	1.56
T ₁	2.27	2.19	2.21	2.02	2.17	2.24	2.14	2.09	2.05	2.13
T ₂	2.54	2.39	2.28	2.22	2.36	2.44	2.34	2.30	2.21	2.32
T ₃	2.01	1.79	1.74	1.63	1.79	1.99	1.72	1.62	1.51	1.71
T ₄	2.12	1.94	2.00	1.77	1.96	2.09	1.99	1.83	1.68	1.90
Mean	2.16	2.01	1.97	1.84		2.08	1.96	1.88	1.78	
L.S.D 0.05	C		0.11			C		0.16		
	T		0.12			T		0.17		
	Interaction		0.23			Interaction		0.33		

Protein percentage in leaves (%)

Percentage of protein in leaves has been significantly affected by CO₂ enrichment (Table 4) the lowest protein percentage was obtained from C₃ 12.04 and 11.60%, while it increase to 13.85 and 13.14 % in C₀ for two seasons respectively, foliar spray treatment T₂ dominated other treatments in protein percentage in leaves (17.82 and 18.65%), while the lowest was in T₀ (9.28 and 7.54%) for two seasons respectively Interaction of CO₂ enrichment and foliar spray treatments is significant, C₂T₂ treatment gives highest protein percentage in leaves (18.54 and 18.92%) while the lowest percentage was 7.60 and 6.69% in C₃T₀ for two seasons respectively. Reduction of protein percentage could be due to reduce of nitrogen in leaves as a result to uptake by the plants, also could be attributed to the effective role of nutrients through for plant growth and development which is reflected on great root and vegetative systems size and this increase the ability of plants to uptake great amounts of nutrients in particular nitrogen which is a constituent of amino acids (15), These results are agreement with Abbas et al (1) and Peacock et al (26) they found that nitrogen fertilizers had increased nitrogen content in leaves so increased protein percentage in leaves.

Carbohydrates percentage in leaves (%)

Results in table 5 shows an increase in carbohydrates percentage in leaves at first

season when CO₂ enrichment (C₂) was used 12.47%, as compared to had the lowest carbohydrate in C₀ treatment 11.75%, but in second season not differ significantly between treatments but C₃ had the highest carbohydrate 12.55%. foliar nutrients also affected this trail where T₂ had the highest carbohydrates percentage 15.76 and 16.08% respectively, while lowest carbohydrates 8.72 and 7.71% found in T₀. Interaction treatments affected on carbohydrates percentage, in first season C₂T₂ produced highest carbohydrate 16.47% and in second season C₃T₂ gives highest carbohydrate percentage 16.20%, while lowest carbohydrates (8.18 and 8.11 %) found in C₀T₀. The effect of CO₂ enrichment on carbohydrate content of leaves may be due to increased CO₂ concentration surrounding plant had increased photosynthetic process and assimilates accumulation. The positive effect of foliar spray (Agroleaf) on carbohydrate percentage of leaves may be due to the effect of fertilizer an increased nutrients on assimilates accumulation through the increased leaf content of chlorophyll and leaf area so increase photosynthetic activities and assimilates accumulation of carbohydrates (17). These result coincided with the findings of Al-Mousawi (5) and Al-Shemary (8) they found that carbohydrate percentage increased when Agroleaf fertilizer used.

Table 4. Effect of CO₂ enrichment and foliar spray Agroleaf , Kelpak and interaction in protein percentage in leaves for two seasons 2010-2011.

protein %										
2010						2011				
Treatment	C ₀	C ₁	C ₂	C ₃	Mean	C ₀	C ₁	C ₂	C ₃	Mean
T ₀	10.83	9.46	9.21	7.60	9.28	8.08	7.85	7.54	6.69	7.54
T ₁	15.00	14.06	14.96	14.60	14.66	15.37	14.15	14.65	14.31	14.62
T ₂	17.56	17.38	18.54	17.81	17.82	19.17	18.50	18.92	18.00	18.65
T ₃	11.21	10.02	10.08	9.40	10.18	10.92	10.21	8.94	8.73	9.70
T ₄	13.31	11.81	11.42	10.77	11.83	12.15	11.40	10.79	10.25	11.15
Mean	13.58	12.55	12.84	12.04		13.14	12.42	12.17	11.60	
L.S.D 0.05	C		0.78			C		0.74		
	T		0.87			T		0.79		
	Interaction		1.74			Interaction		1.54		

Table 5. Effect of CO₂ enrichment and foliar spray Agroleaf , Kelpak and interaction in carbohydrates percentage in leaves for two seasons 2010-2011.

Carbohydrates %										
2010						2011				
Treatment	C ₀	C ₁	C ₂	C ₃	Mean	C ₀	C ₁	C ₂	C ₃	Mean
T ₀	8.18	9.21	8.62	8.86	8.72	8.11	7.11	7.63	7.98	7.71
T ₁	11.86	11.54	11.45	11.54	11.60	12.58	12.73	12.67	12.83	12.70
T ₂	15.43	15.86	16.47	15.27	15.76	16.06	16.16	15.92	16.20	16.08
T ₃	11.07	11.05	12.47	12.08	11.67	11.79	12.19	12.81	12.41	12.30
T ₄	12.20	12.68	13.32	13.16	12.84	13.63	13.22	13.06	13.33	13.31
Mean	11.75	12.07	12.47	12.18		12.44	12.28	12.42	12.55	
L.S.D 0.05	C		0.37			C		N.S		
	T		0.54			T		0.37		
	Interaction		1.01			Interaction		0.73		

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