EFFECT OF CULTIVARS, COMPOST, HUMIC ACID AND THEIR INTERACTIONS ON LEAF NUTRITIONAL STATES OF SWEET CHERRY (*PRUNUS AVIUM* L.)

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Abstract:

The present study was carried out on sweet cherry (*Prunus avium* L.), during the growing season of (2012-2013) on private sweet cherry orchard, located in the Bibad village near Amadi town / Duhok governorate- Kurdistan region-Iraq. The field experiment was done in the orchard that contained two sweet cherry cultivars ("Nefertity" and "Berlit"). The application of compost was done in December 25th 2012, at (0, 2, 4 and 6 kg /tree), foliar spray of humic acid done at (0, 100, 200 and 300 ppm) and repeated after two weeks. The results are summarized as follows: Nefertity cultivar significantly dominated over Berlit cultivar in leaf N, P content, whereas Berlit cultivar dominated leaf (N, K, Ca). Compost specially at 4kg/tree has significantly improved leaf P, K,whereas, compost at 6 kg/tree leaf nutrient N. Humic acid specially at 300 ppm has significantly increased the leaf nutrients N, P, while, 200 ppm increased the leaf K, while, 100 ppm increased the leaf N, K. The interactions between cultivars, compost and humic acid has affected significantly most of the studied parameters. The more effective treatment interactions was Nefertity + 6 Kg /tree of compost plus 200 ppm of humic acid which increased significantly P,K, but Nefertity + 6 Kg /tree of compost plus 300ppm of humic acid treatment increased leaf N content.

***Part of M.Sc thesis of the second author**

***Key word*: Cherry , Compost, Humic acid**

INTRODUCTION:

The sweet cherry (*Prunus avium.* L.) belongs to the Rosaceae family, sub-family Prunidaecea (Rodrigues and Antunes, 2008). It is believed to be originated from the regions between the Black and Caspian Sea of Asia Minor. Seed spreading by birds carried it to Europe, where the earliest cultivation of sweet cherry was reported. Further spread to North America via English colonists occurred in the seventeenth century. (Webster and Looney, 1996). Sweet cherry is one of the most popular temperate fruits. According to (FAO, 2010), cherries produced worldwide, and an important horticultural crop - approximately 2.2 million tons of cherries were produced worldwide in 2009 (Anonymous, 2010). Compost is a resource of converting organic waste material, such as food waste, yard waste and manure, into a matter called humus, a nutrient-rich soil amendment.

Humus is an essential element in maintaining healthy soil and plant, making composting a useful tactic for nurturing productive agricultural fields, ornamental plants and grasses (Chiumenti, 2005).The compost has an important role in the agriculture sector because it contains a high amount of elements necessary for plant growth and soil improvement, the use of compost as a fertilizer for plant in Iraq and Kurdistan has a large space and this is backward in the field of agriculture when we compare with the developed countries. Thus, encouraging to use the compost as a first studies in Kurdistan and Iraq in order to encourage our farmer to use the compost as a plant fertilizer. The risks and problems posed by heavy metals in fertilizers and other soil inputs have increasingly drawn the attention of farmers, environmental organizations, consumers, and public policy makers.

This study evaluates a wide spectrum of soil amendments and fertilizers used in organic agriculture, including biosolids, major nutrient fertilizers, industrial wastes, composts, liming materials and micronutrient sources with a focus on inputs used in organic agricultural production in Iraq. Humic substances are no one single chemical recognized as humic acid, since the chemical makeup has never been completely defined. These materials are composed of complicated organic mixtures which are associated together in a random manner, resulting in extraordinarily complex materials. It has been suggested that no two molecules of humus are exactly the same (Mikkelsen, 2005). The cherry fruit is desirable in Kurdistan in relations as far as consumption and also desirable by farmers to cultivate but the production is very little so far. Therfor, this study is as the first one on the nutrition of cherry fruits in order to improve the quality and increase their production.

This investigation aimed to study the response of two cultivars to local environmental condition, and their response to fertilized by organic matter (compost and humic acid). However, it also hopes to confirm the risk of heavy metal concentration in compost to find a fertilization program that can replace the minerals which will be beneficial for organic production of sweet cherry, since there are little or no studies in Kurdistan about the role organic fertilization in yield and quality of sweet cherry according the aims were to evaluate the interaction effect of cultivars, compost, humic acid on leaf nutrient statutes and some heavy metal concentration of two cultivars of sweet cherry.

MATERIALS AND METHODS

This study was carried out in the Bibad village near Amadi town/ Duhok governorate/ Kurdistan region of Iraq. The orchard is situated at latitude: 37.05°N, and longitude 43.29° E and at an altitude of 1202 m above the sea level. The experiment included two cultivar of sweet cherry "Nefertity" and "Berlit". Application of compost at different levels (0, 2, 4 and 6 kg /tree), and foliar spray of humic acid at concentrations (0, 100, 200 and 300 ppm). The compost were carried out is consisting from resides waste of Dohuk city, is produced in Kawsha manufacture of compost fertilizer. The orchard experiment of compost application was done in December 25th 2012, by working hole around the tree under brunch projection and mixed with the soil in order to investigate the effect of soil application of four levels of compost, (0, 2, 4 and 6 kg /tree). The humic acid is a liquid content analysis w/w, organic matter 5%, (K_2 O) 1%, total humic + fulvic acid 15%. The foliar spray of humic acid was done in April 15th 2013, after full bloom at four concentrations (0, 100, 200 and 300 ppm) and replicated the same concentrations after two weeks after the first spray.

Statistical analysis

All the obtained data were tabulated and statistically analyzed with computer using SAS system (SAS, 1996). The experiment followed Randomized Complete Block Design in factorial Experiment; the experiment comprised of 32 treatments with three replicates, each replicate was presented by one tree of each cultivar. The differences between various treatment means were tested with Duncun Multiple Range Test at 5% level, (Al- Rawi and Khalaf-Alla, 2000).

Measurements:
Leaf nutrients states
1- Total nitrogen (N %).
2- Total phosphorus (P%).
3- Total potassium (K %).
4-Total calcium (Ca%).

RESULTS

1- Leaf nitrogen content (%)

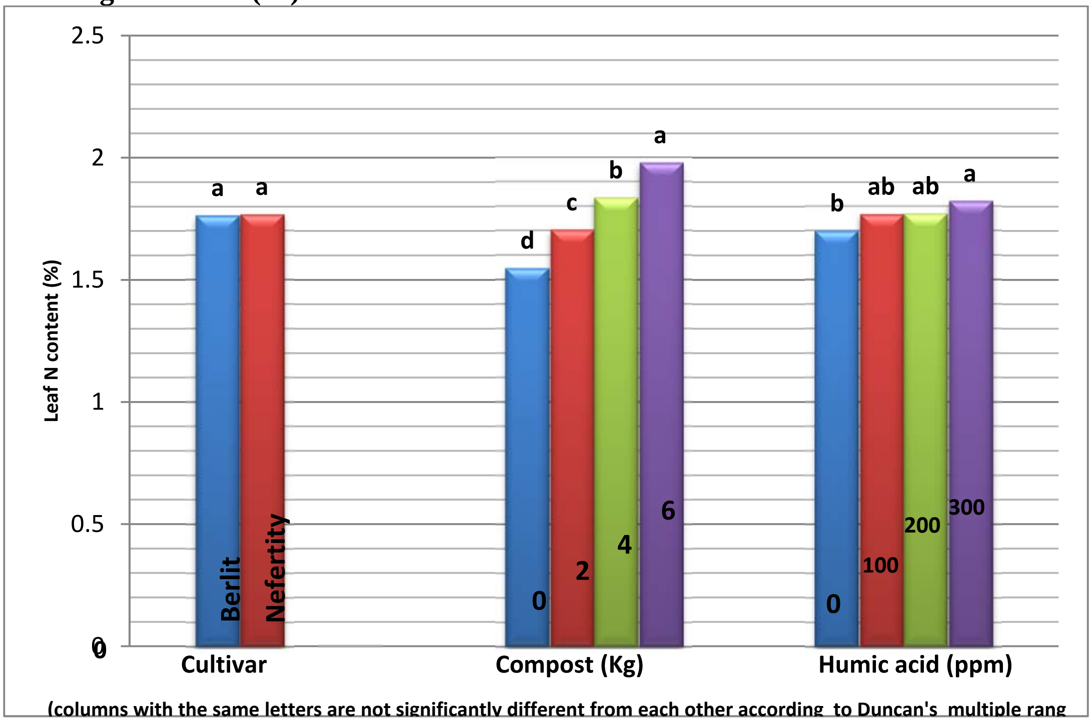

Figure (1) Effect of cultivar, compost and humic acid on leaf N content (%) of sweet cherry.

Table (1): interactions effect of cultivar, compost and humic acid on leaf N content (%) of sweet cherry.

Cultivar	Humic acid (ppm)	Compost (Kg/tree) 0	2	4	6	Cultivar × Humic
Berlit	0	1.13 h	1.37 gh	1.82 a-f	1.92 a-c	1.56 c
	100	1.62 b-g	1.47 fg	2.03 a	1.81 a-f	1.73 b
	200	1.86 a-e	1.51 e-g	1.92 a-c	2.02 a	1.83 ab
	300	1.98 ab	1.93 a-c	1.78 a-f	1.99 a	1.92 a
Nefertity	0	1.54 d-g	1.74 a-f	2.04 a	2.01 a	1.84 ab
	100	1.61 c-g	1.83 a-f	1.88 a-d	1.88 a-d	1.80 ab
	200	1.31 gh	1.86 a-e	1.58 d-g	2.09 a	1.71 bc
	300	1.30 gh	1.90 a-d	1.57 c-g	2.10 a	1.72 bc
		Cultivar × Compost				
Cultivar	Berlit	1.65 de	1.57 ef	1.89 a-c	1.93 ab	
	Nefertity	1.44 f	1.83 bc	1.77 cd	2.02 a	
		Humic acid × Compost				
Humic acid (ppm)	0	1.34 e	1.56 d	1.93 ab	1.97 ab	
	100	1.62 cd	1.65 cd	1.96 ab	1.84 a-c	
	200	1.59 d	1.68 cd	1.75 b-d	2.05 a	
	300	1.64 cd	1.92 ab	1.68 cd	2.05 a	

Means of each factor and their interaction followed by the same letter are not significantly different from each others according to duncans multiple ranges test at 5% level.

Figure (1) clearly shows that there are no significant differences between two cultivar on leaf nitrogen content. Soil application of compost at a level (6 kg/tree) had significantly effect which recorded (1.98 %), and the lowest value was recorded in control (1.55 %). Foliar spray of humic acid at a concentration (300 ppm) were significantly effective, which registered (1.82 %), while the lowest values were recorded in control (1.70 %). The interaction between cultivars and humic acid on leaf N indicate that cultivar Berlit with humic acid at a (300 ppm) was the best treatments when compared with other treatment. The results of interaction between application (6 kg/tree) of compost plus (200 ppm) of humic acid, produced the better treatment (2.059 %), while the lowest concentration was observed in control (1.464 %).

2. Leaf phosphorus content (%):

Figure (2) shows the phosphors concentration in cultivar Nefertity increased significantly compared with cultivar Berlit. Obviously soil application of compost at a (4 kg/tree) was better treatment when compared with other treatments which recorded (0.949%), and the lowest value was recorded in control (0.437%). The same figure illustrates that the humic acid at a concentrations (300 ppm) was suggestively better treatment which registered (0.823 %), but the lowest values were recorded in control (0.468 %).

However, the interaction between Nerfertity plus (6 kg/tree) of compost gave the highest value (1.306 %) when compared with control. The interaction between cultivar Nefertity and (100 ppm) of humic acid gave the highest value compared with other treatment.

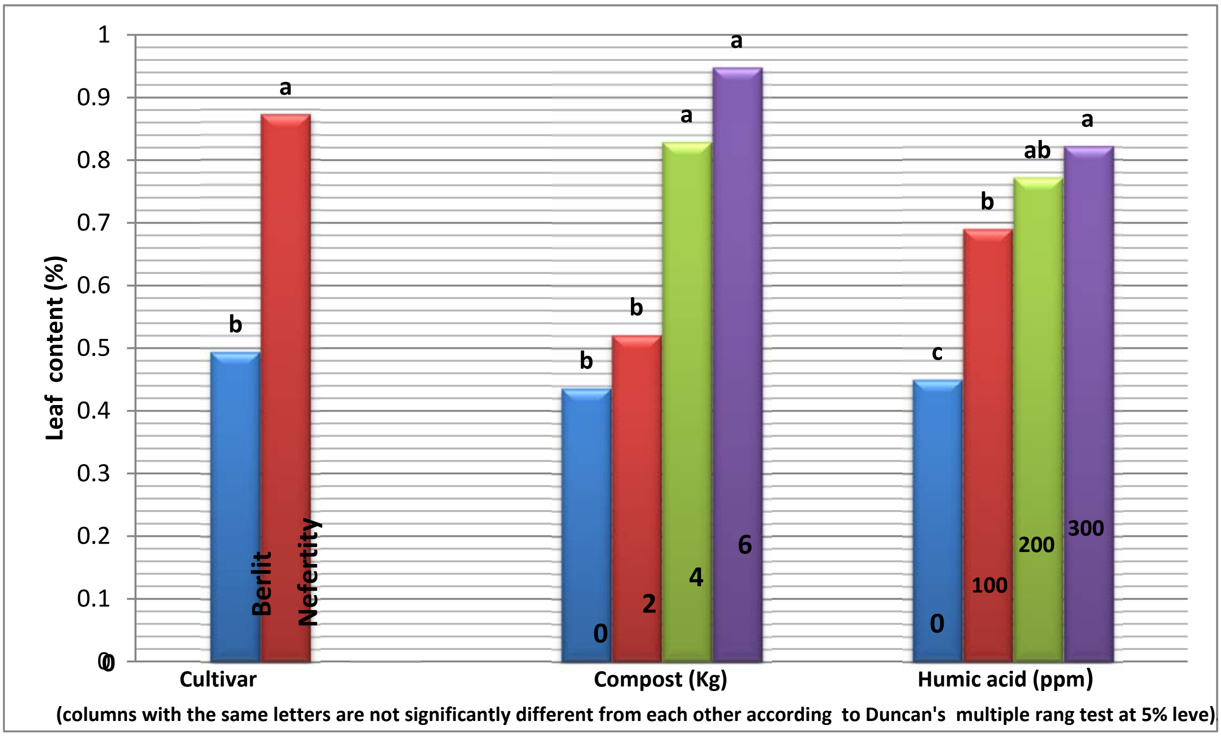

Figure (2) Effect of cultivar, compost and humic acid on leaf P content (%) of sweet cherry.

Manifests the interaction between (4 kg/tree) of compost with (100 ppm) of humic acid, produced the better treatment which registered (0.917) when compared with other treatments.

The same tableillustrates that the interaction effect of cultivar Nefertity + (4 kg/tree) compost + (100 ppm) humic acid provided the best treatment which was (1.26 %) when compared with another treatments.

Table (2) : Interactions effect of cultivar, compost and humic acid on leaf P content (%) of sweet cherry.

Cultivar	Humic acid (ppm)	Compost (Kg/tree)				Cultivar × Humic
		0	2	4	6	
Berlit	0	0.17 e	0.21 c-e	0.27 c-e	0.30 b-e	0.24 d
	100	0.27 c-e	0.33 b-e	0.56 b-e	0.66 bc	0.46 c
	200	0.60 b-d	0.50 b-e	0.61 b-d	0.67 bc	0.59 bc
	300	0.63 bc	0.67 bc	0.68 bc	0.72 b	0.67 b
Nefertity	0	0.22de	0.54 de	0.66 bc	1.20 a	0.65 b
	100	0.40 de	0.68 bc	1.26 a	1.33 a	0.92 a
	200	0.53 b-e	0.61 b-d	1.28 a	1.36 a	0.94 a
	300	0.65 bc	0.60 b-d	1.29 a	1.32 a	0.96 a
Cultivar × Compost						
Cultivar	Berlit	0.42 c	0.43 c	0.53 c	0.59 c	
	Nefertity	0.45 c	0.61 c	1.12 b	1.30 a	
Humic acid × Compost						
Humic acid (ppm)	0	0.19 e	0.37 c-e	0.468 cd	0.75 ab	
	100	0.33 de	0.51 b-d	0.91 a	1.00 a	
	200	0.56 bc	0.561 b-d	0.94 a	1.01 a	
	300	0.64 bc	0.63 bc	0.98 a	1.02 a	

Means of each factor and their interaction followed by the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

The interaction between cultivar Berlit + (100 ppm) was the best treatment when compared with other treatments. The interaction between (6 kg/tree) of compost + (200 ppm) of humic acid produced the best treatment.

3. Leaf potassium content (%):

Figure (3) shows that the leaf potassium in cultivar Berlit had significant effect compared to cultivar Nefertity. Obviously application of compost at a level (4 kg/tree) was the best treatments which noted (1.701 %), when compared with other treatment. The foliar spray of humic acid at a (100 ppm) was a better treatment among the humic concentration which registered (1.746 %), value (1.926 %), when compared with other treatments. In the same table the interaction between cultivar Nefertity + (6 kg/tree) of compost + (200 ppm) of humic acid provided the maximum value (2.011 %), when compared with other treatments. The interaction of cultivars Berlit plus (2 kg/tree) of compost has the best treatment to increase the leaf potassium, (1.608 %) when compared with other treatments.

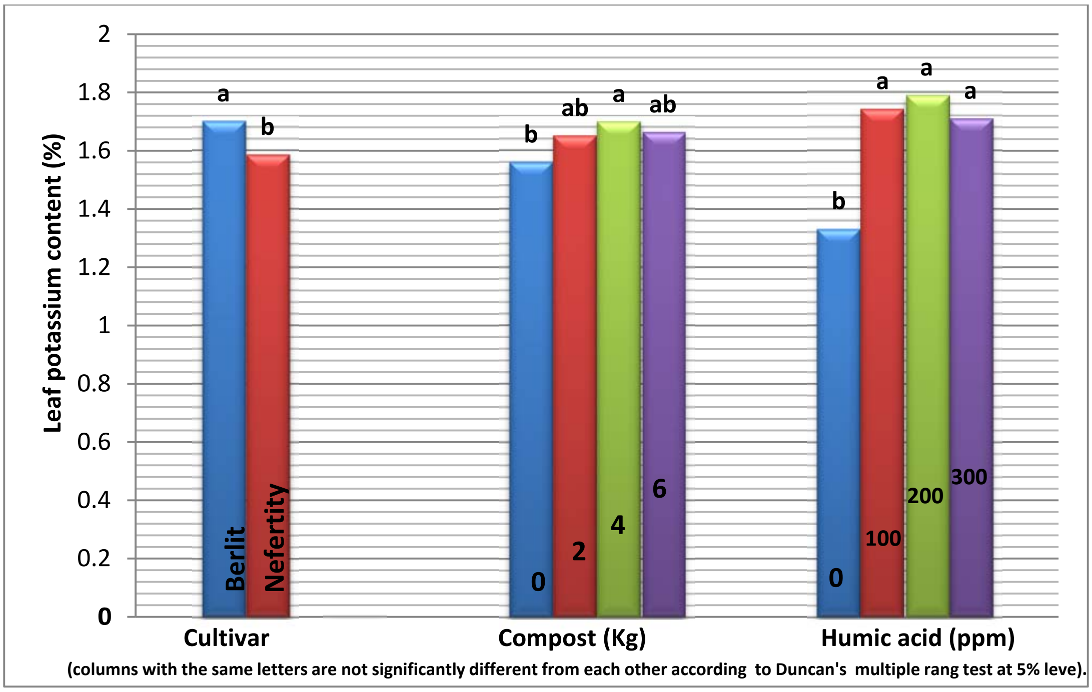

Figure (3): Effect of cultivar, compost and humic acid on leaf K content (%) of sweet cherry.

Table (3): Interactions effect of cultivar, compost and humic acid on leaf K content (%) of sweet cherry.

Cultivar	Humic acid (ppm)	Compost (Kg/tree) 0	2	4	6	Cultivar × Humic
Berlit	0	1.21 jk	1.39 g-j	1.41 f-j	1.48 d-j	1.37 d
	100	1.84 a-c	1.87 a-c	1.93 ab	1.66 b-i	1.82 a
	200	1.77 a-e	1.77 a-e	1.85 a-c	1.84 a-c	1.81 ab
	300	1.689a-h	1.75 a-f	1.84 a-c	1.91 a-c	1.80 ab
Nefertity	0	1.04 k	1.32 i-k	1.42 f-j	1.36 h-i	1.29 d
	100	1.61 b-i	1.64 b-i	1.81 a-d	1.57 c-i	1.66 bc
	200	1.63 b-i	1.74 a-f	1.70 a-g	2.01 a	1.77 ab
	300	1.68 a-h	1.70 a-g	1.63 b-i	1.47 e-j	1.62 c
Cultivar × Compost						
Cultivar	Berlit	1.63 ab	1.70 a	1.76 a	1.72 a	
	Nefertity	1.49 b	1.60 ab	1.64 ab	1.607ab	
Humic acid × Compost						
Humic acid (ppm)	0	1.13 f	1.36 e	1.42 de	1.42 de	
	100	1.73 a-c	1.76 a-c	1.87 ab	1.61 cd	
	200	1.70 a-c	1.76 a-c	1.78 a-c	1.92 a	
	300	1.68 bc	1.73 a-c	1.73 a-c	1.69 a-c	

Means of each factor and their interaction followed by the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

4. Leaf calcium content (%)

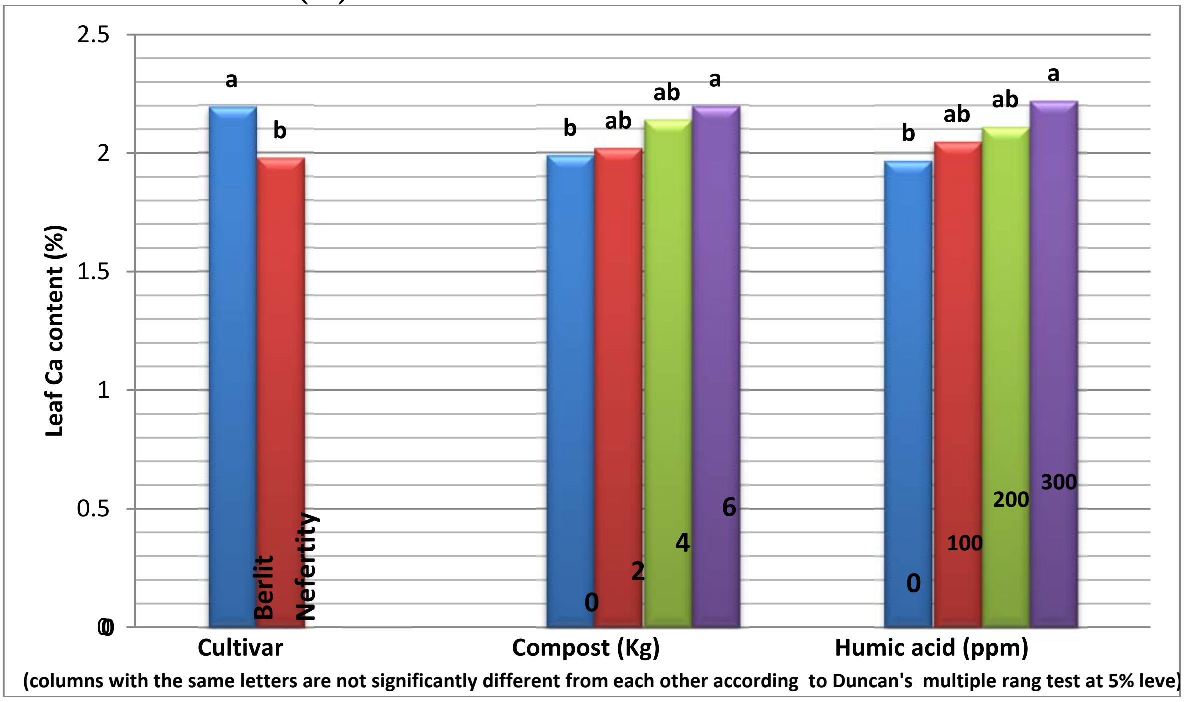

Figure (4) effect of cultivar, compost and humic acid on leaf calcium content (%) of sweet cherry.

Table (4) interactions effect of cultivar, compost and humic acid on leaf Ca content (%) of sweet cherry.

Cultivar	Humic acid (ppm)	Compost (Kg/tree) 0	2	4	6	Cultivar × Humic
Berlit	0	2.05 b-d	2.08 a-d	2.08 a-d	1.88 cd	2.02 b
	100	2.14 a-d	2.08 a-d	2.18 a-d	2.04 b-d	2.11 b
	200	2.20 a-d	2.15 a-d	2.27 a-d	2.13 a-d	2.18 b
	300	2.30 a-c	2.31 a-c	2.54 ab	2.673 a	2.46 a
Nefertity	0	1.66 d	1.74 cd	1.98 b-d	2.27 a-d	1.91 b
	100	1.78 cd	1.85 cd	2.03 b-d	2.27 a-d	1.98 b
	200	1.84 cd	2.06 a-d	2.04 b-d	2.19 a-d	2.03 b
	300	1.92 b-d	1.89 cd	2.00 b-d	2.12 a-d	1.98 b
Cultivar × Compost						
Cultivar	Berlit	2.17 a	2.15 a	2.27 a	2.18 a	
	Nefertity	1.80 b	1.88 b	2.01 ab	2.21 a	
Humic acid × Compost						
Humic acid (ppm)	0	1.86 b	1.91 b	2.03 ab	2.07 ab	
	100	1.96 b	1.96 b	2.10 ab	2.15 ab	
	200	2.02 ab	2.10 ab	2.15 ab	2.16ab	
	300	2.11 ab	2.10 ab	2.27 ab	2.40 a	

Means of each their interaction followed by the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Figure (4) shows leaf Ca content in cultivar Berlit had a significant effect when compared with cultivar Nefertity. The results clearly show the soil application of compost at a level (6 kg/tree) was significantly increased the leaf Ca content, (2.201 %), when compared with other treatments.

Foliar spray of humic acid at (300 ppm) was better treatment which registered (2.224 ppm), when compared with other treatments. Table (4), the interaction between cultivar Berlit plus (2 kg/tree) of compost was the best treatment when compared with other treatments. The results of combining between cultivar Berlit plus humic acid at a (300 %) indicated the highest significant effect when compared with other treatments. Also, the interaction between (6 kg/tree) compost plus plus (300 ppm) humic acid produced the best treatment (2.400 ppm), when compared with control. The interaction between cultivar Berlit + (6 kg/tree) compost + (300 ppm) humic acid which provided the best treatment (2.673 %) when compared with other treatments.

DISCUSSION

1. The effect of cultivar on leaf nutritional state, may be ascribed to the differences in genotype characteristics for root growth, nutrient absorption efficiency and photosynthesis process efficiency (Jorda, *et al,* 1999). Also, the response of different cultivars to the local environmental condition according to the genetic variation between the cultivars (Gaafar and Saker, 2006 ; Khalifa, 2007).
2. The effect of compost may be due to the improvement of soil physical, biological properties and chemical properties resulting more release of nutrient elements available which absorbed by plant root and its effect on the physiological process, in addition to water use efficiency, also adequate nutrient quantities of nitrogen, phosphorus, and potassium, which increase both rate of leaf expansion as well as cell division which subsequently leads to larger individual leaves and higher photosynthesis activities (Abd El-Wahab, 2011). May be attributed to a higher nutritional uptake mainly by greater expansion of root system due to increased supply of photosynthetic productions in the leaves, attributed to presence of plant growth regulators, which are produced by increased activity of microbes such as fungi, bacteria, yeasts, actinomycetes and algae (Arancon *et al.,* 2004).
3.The effect of humic acid may be acting on mechanisms involved in: cell respiration, photosynthesis, protein synthesis, water and nutrient uptake, enzyme activities. (Ali *et. al.,* 2007). The hormone like activities of (HA) is well documented in various papers, in particular auxin-, cytokinin and gibberellins like effects (Pizzeghello *et al.,* 2002). Also, the effect of humic acid may be due to the role of (HA) to increase of cation exchange capacity which affects the retention and availability of nutrients, or due to a hormonal effect, or a combination of both. (Chun hua *et al.,* 1998).

Conclusions:

1. The Nefertity cultivar was superior on the Berlit cultivar in increasing vegetative growth, and most leaf nutrients.
2. Soil application of compost at a level 4 kg/tree was more than other levels and control in increasing most vegetative growth parameters and most leaf nutrients.
3. Foliar spraying of humic acid at concentration 300 ppm had more effects .
4. The interaction of Nefertity cultivar + 4 Kg of compost + 300 ppm of humic acid had more effect on increasing in most studied parameter.

2. Recommendations:

The flowing points of view can be recommended:

1. Testing other cultivars of sweet cherry.
2. Testing the different level and time of application of compost as well testing other organic fertilizer such as animal manure chicken manure and municipal.
3. Testing the effect of spraying with humic acid on the other sweet cherry cultivar.
4. Farmers are recomended to use the compost in their orchards like other organic fertilizer, such as animal manure without any fear of toxic materials, soil pollution and harmful effect of heavy metals.

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کارتێکرنا توخم وکومپوست وترشیێ هیومیك و تێکەلکرنا وان لسەر توخمێت ناڤ بەلگێت هەهەلوك (گێلاس)

پوختە:

ئەڤ ڤەکولینە هاتە ئەنجامدان لسەر دارا هەهەلوکا (گێلاسا) شرین,(*Prunus avium L.*) دوەرزی چاندنێ ٢٠١٢–٢٠١٣ ل ناف بیستانەکێ کەرتیێ تایبەت ل گوندێ بێبادێ نێزیکی دەڤەردایا ئامێدییێ سەرب پارێزگەها دهوکێ ل هەرێما کوردستانا ئیراقێ.بیستانێ ڤەکولین دناف هاتیە ئەنجامدان ژ دوو جورێن هەهەلوکا یێت شرن هاتبونە چاندن (نەفەرتیتی و بێرلایت) ، کارئینانا زبلێ کومپوست ب سێ ئاستا (٠، ٢، ٤ و ٦ کغم بو هەر دارەکێ)، رەشاندنا هیومیك ئەسیدی ب سێ تیراتییا (٠، ١٠٠، ٢٠٠، ٣٠٠ ppm).

کارتێکرنا جوری: ئەنجام هوسا دیاردکەن کو جورێ نەفەرتیتی کارتێکرنەکا بەرچاف هەبو لسەر جورێ بێرلایت تیراتییا توخما N, P, Ca, دناف بەلگادا، هەروسا جورێ بێرلایت کارتێکرنەکا بەرچاف هەبو دزێدەکرنا تیراتییا N ،K، Ca د بەلگا دا. کارتێکرنا زبلێ کومپوست: بکارئینانا زبلێ کومپوستی دناف ئاخێ دا و تایبەت ئاستێ ٤ کیلو بو هەر دارەکێ کارتێکرنەکا بەرجاف هەبو لسەر تێرایی,P, K دناف بەلگادا و ئاستێ ٢ کیلو یی کومپوستی

کارتێکرن د زێدەکرنا Fe ، Cd دناف بەلگادا ، و ئاستێ ٦ کیلو یی کومپوستی کارتێکرن د تیرایێ N،Ca، دناف بەلگا دا. کارتێکرنا رەشاندنا هیومیك ئەسیدی: ئەنجام هوسا دیاردکەن کو رەشاندنا ب هیومیك ئەسیدی ب تیرایێ ٣٠٠ ppm بوویە ئەگەرێ زێدەبوونەکا بەرچاڤ ددرێژکرنا تیراتیبا Ca ,P,N دناف بەلگا.و تیراتیا ٢٠٠ ppm کارتێکرنەکا بەرچاف هەبو ب P K دناف بەلگا. سەبارەت سەرەدەریین تێکەل کرنا جوری،زبلێ کومپوست دگەل رەشاندنا هیومیك ئەسیدی: ئەنجام هوسا دیاردکەن کو تێکەل کرنا جورێ نەفەرتیتی دگەل ئاستێ ٤ کیلوییێت زبلێ کومپوست بو هەر دارەکێ دگەل هیومیك ئەسیدی ب تیراتیا ٣٠٠ ppm کارتێکرنەکا ئێگجار بەرچاف هەبو.

تأثير الصنف و الكومبوست وحامض الهيوميك و تدخلاتها على مستوى المغذيات فى الكرز الحلو (*Prunus avium* L.)

الخلاصة:

اجريت الدراسة على الاشجارالكرز الحلوى (*Prunus avium L.*) خلال الموسم نمو ٢٠١٢- ٢٠١٣ في بيستان أهلية مزروعة باشجار الكرز الحلو، الواقع في قرية بيباد قرب مدينة العمادية / محافضة دهوك / اقليم كردستان / العراق.

استخدم كومبوست باربعة مستويات من سماد (٠، ٢، ٤، ٦ كيلو/ شجرة) وبالهيوميك اسيد،الاول الرش الورقي بالهيوميك اسيد باربعة تراكيز (٠، ١٠٠، ٢٠٠، ٣٠٠ ppm) بدات بعد التزهير الكامل و وكرر نفس التراكيز بعد اسبوعين من الرش الاول .

تاثير الصنف :كان للصنف نفرتيتي تاثير معنوي و تفوق على الصنف بيرلايت في مستوى المغذيات فى الورقة من N, P وكذالك الصنف بيرلايت لها تأثير معنوي في مستوى المغذيات فى الورقة من Ca, K N .

تاثير الكومبوست: اضافة الكومبوست الى تربة في مستوى ٤ كيلو/ شجرة لها تاثير معنوي على مستوى المغذيات فى الورقة من P,وكذالك المستوى المستوى ٦ كيلو/ شجرة كان له تاثير معنوي في زيادة مستوى المغذيات فى الورقة من N, Ca,

تاثيرالهيومك اسيد :الرش الورقي بهيوميك اسيد بتركيز ٣٠٠ ppm له تاثير معنوي في زيادة مستوى المغذيات فى الورقة من N,P,Ca, اما التركيز ٢٠٠ ppm لها تاثير معنوي في مستوى المغذيات فى الورقة من K, و تركيز ١٠٠ ppm لها زيادة فى محتوى المغذيات في الورقةCa, N .

تاثيرالتداخل الثلاثيي بين الصنف، الكومبوست مع الهيومك اسيد: التداخل الثلاثي كان له تاثير فى زيادة معظم الصفات المدروسة، لكن العامل الاكثر فعالية هوالتداخل بين صنف نفرتيتي + ٤ كيلومن الكومبوست + المستوى ٣٠٠ ppm من الهيوميك اسيد حيث كان له تاثيرمعنوي في زيادة مستوى المغذيات فى الورقة .