

The Effect of Two Organic Fertilizers Addition on Vegetative Growth and Yield of Strawberry (*Fragaria ananassa* Duch) Plant Variety (Ruby Gem).

Mustafa A.M. Hameed* and Mahmoud F. Lattif

Department of Horticulture and gardening landscape/ University of Tikrit, Iraq

ABSTRACT

Key words:

manure fertilizers , Humic acid , Strawberry.

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This study project was conducted at the unheated greenhouse of the department of horticulture and gardening landscape/College of Agriculture/ University of Tikrit during the growing season of 2016-2017, to study the effect of addition of two organic fertilizers on the vegetative growth and yield of strawberry (*Fragaria ananassa* Duch) plant variety (Ruby Gem). The study included addition of Humic acid at two levels; no addition H1 and 4 ml.liter⁻¹ addition, H2. The second factor was poultry and sheep manure addition at three levels 0.00, 3, 6 tones. Donim⁻¹ as change followed: O₁ – no addition, O₂ – Poultry manure 3.0 tones. Donim⁻¹, O₃ – Poultry manure 6.0 tones. Donim⁻¹, O₄ – sheep manure 3.0 tones. Donim⁻¹, O₅ – sheep manure 6.0 tones. Donim⁻¹.

The experiment was designed using Randomized complete block design (RCBD), with three replicates. Each replicate included 12 experimental units with 10 plants in each unit. Duncan multiple range test at 5% probability was applied to compared the results. The results showed that the addition of Humic acid significantly increased the number of leaves, their chlorophyll contents, average of fruit weight size, TSS percentage, and sugar percentage in the fruit juice. The addition of poultry and sheep manures showed a domination of O₃ (6.0 tones. Donim⁻¹ poultry manure) and significantly affected all the properties. The combination of Humic acid and poultry manure (6.0 tones. Donim⁻¹) got a significant effect on all the properties of vegetative growth and yield.

تأثير اضافة نوعين من السماد العضوي في النمو الخضري والحاصل لنبات الشليك *Fragaria ananassa* Duch

صنف Ruby gem

مصطفى عبدالرحمن مصطفى حميد ومحمود فاضل لطيف

قسم البستنة وهندسة الحدائق/ كلية الزراعة/ جامعة تكريت/ العراق

الخلاصة

أجريت هذه الدراسة في البيت البلاستيكي غير المدفأ التابع الى قسم البستنة وهندسة الحدائق- كلية الزراعة جامعة- تكريت خلال الموسم (2016 – 2017) بهدف دراسة تأثير إضافة نوعين من السماد العضوي في النمو الخضري والحاصل لنبات الشليك (*Fragaria ananassa* Duch) صنف Ruby gem. تضمنت الدراسة عاملين العامل الاول: الهيومك أسد (Humic acid) بمستويين المستوى الاول عدم إضافة الهيومك ورمز له بالرمز H₁ والمستوى الثاني إضافة الهيومك (4 مل. لتر⁻¹) ورمز له بالرمز H₂ والعامل الثاني: الاسمدة العضوية (الدواجن والاغنام) بخمسة مستويات للسمادين وهي:

O₁ بدون إضافة (المقارنة)

O₂ سماد الدواجن 3 طن .دونم⁻¹

O₃ سماد الدواجن 6 طن .دونم⁻¹

O₄ سماد الاغنام 3 طن .دونم⁻¹

O₅ سماد الاغنام 6 طن .دونم⁻¹

الكلمات المفتاحية :

اسمدة حيوانية ، حامض الهيومك ، الشليك .

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* Corresponding authorE-mail: master_mustafa1992@yahoo.com

نفذت التجربة بتصميم القطاعات العشوائية الكاملة (RCBD) بثلاث مكررات وكل مكرر يحتوي على (10) وحدة تجريبية وبواقع (10) شتلات لكل وحدة تجريبية ووزعت المعاملات عشوائياً وقورنت بين المتوسطات وفق اختبار دنكن المتعدد الحدود عند مستوى احتمال 5% وقد بينت النتائج ان إضافة حامض الهيومك أدت الى زيادة معنوية في معدل عدد المدادات ومحتوى الاوراق من الكلوروفيل ومعدل وزن وحجم الثمرة وكذلك نسبة الTSS ونسبة السكريات الكلية في عصير الثمار، وأدت إضافة الاسمدة العضوية (سماد الدواجن والاغنام) الى تفوق المعاملة O_3 (6 طن .دونم⁻¹ سماد دواجن) معنوياً في جميع الصفات المدروسة. وكان لمعاملة التداخل الثنائي بين حامض الهيومك وسماد الدواجن H_2O_3 تأثير معنوي في جميع الصفات المذكورة سابقاً.

INTRODUCTION

Strawberry is a perennial herbal plant and it is considered with small fruits Horticultural crop. It spreads all over the world. Its name *Fragaria ananassa* was derived from Latin word Frangens, the English name is strawberry, French name is Fraise, and Italian name is fragola in which the Egyptian name was derived from. In Syria, they call it Earth mulberry or Fraise. In Turkey, they call it Chilliak and from that, people from Iraq call the plant Chilliak, (Al-Saidi , 2000). More literatures point out that it is originated in North America the cultivation is spread out between latitudes 28-60 North of Equator, (Hancock, 1999). Now strawberry is widely planted in 63 countries of the world. The total world production for 2012 was 4516810 tones the cultivated area with strawberry was 241109 Hectares, the US comes First in production of strawberry (1366850 tones), which was over a quarter of the world production, then Mexico, Turkey, Spain, and Egypt which produced 242279 tons on 2014, (FAO, 2014). Arancon et al., (2004) reported in their study on the effect of some fertilizers on growth and yield. The organic fertilizers caused an increase of 37% in the growth level, leaf area and increased flowering by 40%. The number of runners increased 36% , 35% increase of the yield quantity and fruit weight. The addition of organic fertilizer participated in increase of leaf area.plant⁻¹ compared to the plants with no fertilization. The organic fertilizers contain nitrogen element that increases directly the volume of vegetative growth. Mahadeen (2009), found poultry manure at 40 tones .Hectare⁻¹ added to the strawberry planted in the greenhouse increased yield, vegetative growth, and leaf contents of nutrients. Al-Ethaway and Al-Ali, (2015), reported that poultry manure treatment at 40 tones. Hectare⁻¹ got the highest fruit weight 23.537 gm. in their study on manure and chemical fertilizers role to improve the growth and the yield. The addition of 50 tones.Hectare⁻¹, significantly gave the highest number of leaves 79.327. Duhoky et al., (2014), found that the addition of sheep manure at 15, 30, and 45 kg. tree⁻¹, to the Pomegranates plants variety Royal, increased significantly leaf area especially at 45 kg. tree⁻¹. Al-Sinbol (2012), declared that the treatment of the varieties of strawberry Fern and Ruby gam with Humic acid concentration 4ml. liter⁻¹, it was significantly affected number of flowers, leaf area, and fruit weight. Farahi et al.,(2013) found an increase in the number of strawberry plant flowers with using of 3 ml. liter⁻¹ of Humic acid. In a study was done by Al-Karawi and Al-Rawi, (2016), on the effect of spraying by organic extract and Humic acid combination, they noticed a significant increase in the number of flowers and node percentage.

MATERIALS AND METHODS

This experiment was conducted at the unheated greenhouse of the department of horticulture and garden landscape field/ College of Agriculture/ University of Tikrit, on the growing season of 2016-2017. The greenhouse soil was analysis at the department of soil and water resources. Table (1) gives the soil analysis chemical and physical properties of the greenhouse soil before planting in Tikrit university.

Table (1) The chemical and physical properties of the greenhouse soil.

Soil characters	Sand	Silt	Clay	Soil texture	pH	EC	Organic matter	NO ₃	NH ₄	K	P
Analysis results	36	27	37	Sand-clay-silt	7.29	3.65	1.12 gm.kg	11.3 ml.kg ⁻¹	13.9 ml.kg ⁻¹	3.13 ml.kg ⁻¹	14.6 ml.kg ⁻¹

The experiment designed based on Randomized complete block design (RCBD) with three replicates and 12 experimental units and 10 plants for each experimental unit. The treatments were distributed randomly. The experiment included two factors:

First factor: Humic acid at two levels; H₁ no Humic acid addition and H₂ Humic acid concentration 4 ml. liter⁻¹.

Second factor: Organic fertilizers (manures of sheep and poultry) at three levels of each: 0 , 3, 6 tone. Donim⁻¹, they assigned O and included:

O₁: no addition (control)

O₂: Poultry manure at 3.00 tone. Donim⁻¹

O₃: Poultry manure at 6.00 tone. Denim⁻¹

O₄: Sheep manure at 3.00 tone. Donim⁻¹

O₅: Sheep manure at 6.00 tone. Donim⁻¹

Studied plant characteristics:

1. Average number of runners (runners. Plant⁻¹):

The number of runners was counted on five plants on June 1, 2017.

2. Leaves contents of chlorophyll (SPAD):

The chlorophyll content was measured using Chlorophyll meter SPAD-502 based on three readings for each plant and calculate the average.

3. Fruit weight average (gm.):

The total fruit weight was calculated for marked five plants and then divided the results on the fruit number of the experimental unit to find the average:

$$\text{Average fruit weight} = \frac{\text{Experimental unit total weight of fruits}}{\text{Total number of fruits at experimental units}}$$

4. Average fruit size (cm³):

The average fruit size was calculated using the displacement method in a measured cylinder size one liter and the water was the fluid.

5. Total soluble solid matter percent (TSS%):

The total soluble solids percent was measured using Hand refractor meter. Ten homogenized and mature fruits were cut into slices for each experimental unit. The slices were blended in electric blender for 2-3 minutes, and then the juice was filtered using cotton rag. The reading was recorded from the device to represent the (TSS) in the fruit juice.

6. Total sugar percent %:

The total sugar percent was determined from the filtered juice using Joslyn method (1970). It was done by taking 1 ml of the filtered juice by pipette and the volume completed to 200 ml and mixed. 1 ml of filtered juice in a glass conical flask, 1 ml of phenol (concentration 5%) was added and then 5 ml of concentrated sulfuric acid 98% with continuous hand shaking of the mixture until light color appeared. The mixture was left to cool down, and then the light absorption was measured using the light spectrogram type EMCLAB at wavelength of 490 Nm. The standard solutions of glucose were prepared to make standard curve and locate the readings. Total sugar concentration calculated as a percent in the juice based on the following equation:

$$\text{Total sugar percent \%} = \frac{\text{Concentration from standard curve X dilution}}{\text{Analysis of juice volume X 10000}}$$

RESULTS AND DISCUSSION

1. Runner's average number. Plant⁻¹:

The results from Table (2) point out that the Humic acid addition treatment (H₂) significantly increased the runners average number, as it gave average of 1.60 runners.plant⁻¹, compared to non-added Humic acid treatment (H₁) which got only 1.28 runners.plant⁻¹. The addition of manures (poultry and sheep), treatment O₃ significantly increased the average of runners up to 2.26 runners.plant⁻¹ compared to the non-added treatment (control O₁) which it got 0.80 runners.plant⁻¹. The combination treatment of Humic acid and manures showed that H₂O₃ (Humic acid and 6.0 tones. Donim⁻¹ of poultry manure), gave the highest average of runners number (2.50 runners.plant⁻¹), while the control treatment gave only 0.70 runners.plant⁻¹.

Table (2) The addition of Humic acid and manures on the average runners number (runner.plant⁻¹) in strawberry plant.

treatment		Organic fertilizer(Poultry and Sheep)ton.d ⁻¹					Average Humic
		control	O ₂	O ₃	O ₄	O ₅	
Humic	H ₁	0.70 e	1.10 de	2.00 ab	1.13 De	1.46 Bcd	1.28 B
	H ₂	0.90 de	1.26 cde	2.50 a	1.46 Bcd	1.86 Bc	1.60 A
Average organic fertilizer		0.80 d	1.81 cd	2.26 a	1.30 Bc	1.66 b	

*Numbers with same letter means no significant on Duncan test at probability of 5%.

2. Chlorophyll contents of the leaves (%):

the results of Humic acid addition (treatment H₂) which gave the highest significant value (49.592 SPAD), compared to the non-addition treatment (H₁) which got 45.456 SPAD. While the manures addition was significantly effective, on leaves chlorophyll contents, as the treatments O₂ and O₃ got the highest chlorophyll contents in the leaves as 50.73 and 52.123 SPAD respectively compared to the control (no added manure) which got 42.577 SPAD. The combination of Humic acid and manure results showed a significant domination of H₂O₃ and H₂O₂ as the reached 53.353 and 53.733 SPAD respectively and it was clear when comparison with control treatment (no added manure), H₁O₁ as it reached only 41.427 SPAD, Table (3).

Table (3): Effect of Humic acid and manures addition on the leaves chlorophyll contents (SPAD) in strawberry plant .

treatment		Organic fertilizer(Poultry and Sheep)ton.d ⁻¹					Average Humic
		Control	O ₂	O ₃	O ₄	O ₅	
Humic	H ₁	41.427 C	48.107 bc	50.513 ab	43.007 De	44.227 cde	45.456 b
	H ₂	43.727 Cde	53.353 a	53.733 a	47.240 Bcd	49.907 ab	49.592 a
		42.577 C	50.730 a	52.123 a	45.123 Bc	47.067 b	

*Numbers with same letter means no significant on Duncan test at probability of 5%.

3. The fruit average weight (gm.):

From Table (4), the addition of Humic acid to the soil was effective as the fruit average weight increased significantly from 19.346 gm. with no addition, to 21.592 gm. The addition of manures also gave a significant increase, as the treatment O₃ gave the highest fruit weight average (24.013 gm.), compared to the control treatment O₁, in which it gave 15.908 gm. The combination of Humic acid and manures was effectively increased the fruit average weight from 15.2233 gm. with the control treatment to 25.906 with H₂O₃.

Table (4): The effect of Humic acid and manures addition on the fruit average weight (gm) in strawberry plant.

treatment		Organic fertilizer(Poultry and Sheep)ton.d ⁻¹					Average Humic
		Control	O ₂	O ₃	O ₄	O ₅	
Humic	H ₁	15.223 F	18.650 E	22.120 bc	19.680 de	21.060 cd	19.346 b
	H ₂	16.593 F	19.636 de	25.906 A	22.673 bc	23.150 b	21.592 a
		15.903 D	19.143 C	24.013 A	21.176 b	22.105 b	

*Numbers with same letter means no significant on Duncan test at probability of 5% .

4. Fruit average size (cm³):

The results of fruit average size are appeared in Table (5).). From the table, the addition of Humic acid (H₂), significantly increased the size of the fruit to 20.258 cm³ compared to 17.988 cm³ of non-added acid. The treatments of manure addition also clearly increased the size of the fruit as treatment O₃ (6.0 tons of poultry manure), to 22.018 cm³ compared to the control treatment in which it gave only 15.865 cm³. The combination of Humic acid and manures was significantly increased the fruit size to 23.150 cm³ for treatment H₂O₃ and to 21. 413 cm³ for treatment H₂O₅ and both compared to the control treatment, which it gave only 15.007 cm³.

Table (5): the effect of addition of Humic acid and manures on the fruit size (cm³) in strawberry plant.

Treatment		Organic fertilizer(Poultry and Sheep)ton.d ⁻¹					Average Humic
		Control	O ₂	O ₃	O ₄	O ₅	
Humic	H ₁	15.007 E	17.063 cde	21.013 Ab	17.500 cd	19.357 bc	17.988 b
	H ₂	16.707 De	19.357 Bc	23.150 A	20.663 b	21.413 ab	20.258 a
		15.865 D	18.210 C	22.081 A	19.081 bc	20.385 b	

*Numbers with same letter means no significant on Duncan test at probability of 5%

5. Total soluble solid materials percent %:

Table (6), gives the results of Humic acid and manures addition. From the table, it is clear that the addition of Humic acid increased the total soluble materials from 8.273% for the control to 7.120%. The addition of manures also increased the percentage as the treatment of O₃ gave 8.716% compared to the control treatment as it gave only 6.212%. The combination of Humic acid and the manures achieved significant increase of 9.466% for H₂O₃ from 6.533% for H₁O₁ (control treatment).

Table (6): Humic acid and manures addition effect on the total soluble solid materials percent in strawberry plant.

Treatment		Organic fertilizer(Poultry and Sheep)ton.d ⁻¹					Average Humic
		Control	O ₂	O ₃	O ₄	O ₅	
Humic	H ₁	5.900 g	7.233 ef	7.966 cd	6.933 ef	7.566 de	7.120 b
	H ₂	6.533 fg	8.400 bc	9.466 A	8.000 cd	8.966 ab	8.273 a
		6.212 d	7.816 bc	8.716 a	7.466 c	8.266 ab	

*Numbers with same letter means no significant on Duncan test at probability of 5%.

6. Total sugar percent %:

The result of total sugar percent in Table (7) showed that there is a positive effect on sugar percent. The addition of Humic acid as treatment H₂ resulted in increase of the total sugars percent from 6.240% of the control treatment (no addition), to 7.426%. While the addition of manures was clearly, affected the increase of total sugars percent and related to the increase in the level of manures addition. The treatment of O₃ got the highest total sugars percent as of 7.866% compared to non-addition treatment O₁ which gave the lowest percent of 5.500%. The combination of Humic acid and the manures addition, showed a significant increase of the total sugar percent as for H₂O₃, the percent was 8.733%, followed by treatment H₂O₅ which got 8.00%, then the control treatment as it gave the lowest result of the total sugar percent of 5.133%.

Table (7): The effect of Humic acid and manures addition effect on total Sugar percent (%)in strawberry plant .

treatment		Organic fertilizer(Poultry and Sheep)ton.d ⁻¹					Average Humic
		Control	O ₂	O ₃	O ₄	O ₅	
Humic	H ₁	5.133 f	6.500 de	7.000 cd	6.066 e	6.500 de	6.240 b
	H ₂	5.866 ef	7.533 bc	8.733 a	7.000 cd	8.000 ab	7.426 A
		5.500 d	7.016 bc	7.866 a	6.533 c	7.250 b	

*Numbers with same letter means no significant on Duncan test at probability of 5%.

The results of the experiment could be discussed and interpreted as the Humic acid could improve the soil characteristics including physical, chemical, fertility, and biotic, in addition to increase the availability of nutrients as nitrogen and increases the absorption by plant roots. These improvement of soil features would increase the vegetative growth Humic acid contains some potassium which also plays an important role in increase the plant growth through opening and closing of stomata and allowing CO₂ to enter the leaves which is the major factor of photosynthesis (Mengel and Kerkby, 1987). This improving can be seen in Table (3) on leaves chlorophyll contents and other vegetative characteristics studied in this experiment. There are more plant regulators Auxins, gibberellins, cytoquinins in which they activate the division of cells and extension. The chlorophyll increased in the leaves as appeared in Tables 4, for fruit weight, Table 5, for fruit size, and Table 6 for improving of yield quality as total soluble materials percent. These findings are agreed with Kivijarvi et al. (2002), Jensen, (2004), Al-Sinbol, (2012).

The addition of poultry and sheep manures, as they considered a rich resource for macronutrients and micronutrients, in addition to that the organic matter improves the soil texture and chemical features. The organic manures helps in breaking down of organic matters in soil and release of carboxylic acids as Humic and folvic acids, (Nur et al. 2006, Oagile and Mufwanzala,

2010). The manures also play a role in decreasing of soil pH, (Joann et al., 2000) in which it increases the availability of nitrogen, potassium, and phosphorus. Nitrogen formed about 70% of the chlorophyll in the leaves, (Wample et al., 1991). Nitrogen is the major element in the structure of amino acid Tryptophan, the precursor in synthesis of Auxins that, lead to cell division and cell elongation and formation of new tissues and increase of the vegetative growth, (Taiz and Zeiger, 2006). As the manures improve the vegetative growth and chlorophyll contents of leaves, it can be seen in Table 3, as the increased of photosynthesis increased the contents of formed carbohydrates, transfer them to the fruits resulting in increasing of fruit weight and size, and improve fruit quality features.

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