Effect of humic acid and seaweed extract (ALGA) on growth characteristics and nutrient content of local apricot seedlings 
Prunus armeniaca L.

H M A Al- Temimi 1, A A Ali1 and Z M. Muhsin
1Department of Horticulture and Landscape, College of Agriculture, University of Kerbala, Iraq
E-mail: harith.mhmod@uokerbala.edu.iq

Abstract. The research was carried out at the Plant canopy of the Department of Horticulture and Landscape, College of Agriculture, University of Kerbala during the growing season of 2016. A factorial experiment with two factors designed. In accordance of randomized completely block design R.C.B.D. to study the effect of spraying with three levels of humic acid (0, 5 and 10 cm³.l⁻¹)and three levels of Alga seaweed extract (0, 1 and 1.5 cm³.l⁻¹)on some vegetative, root growth characteristics and leaf content of mineral elements N, P, K for local apricot seedlings. Treatments with three replicates. Each containing 45 seedlings with five seedlings per experimental unit were adopted. The results showed that a significant increase in plant height, stem diameter, number of leaves, leaf area, leaf content of chlorophyll, nitrogen, phosphorus and potassium, dry weight of shoot, root length, and dry weight of root was noticed when treated with humic acid or seaweed extract (ALGA) alone or jointly compared with control treatment. The interaction between treatments measured at a concentration of 10 cm³.l⁻¹ humic acid and 1.5 cm³.l⁻¹ Alga the highest significant increase in the vegetative, root and leaf content of N.P.K for apricot seedlings was observed.

1. Introduction
Apricot (Prunus armeniaca (L.)) belongs to the Rosaceae family. It is one of the most important deciduous fruit trees, which carry heavy and high nutritional value of the fruits. Apricot fruit is an excellent source of carbohydrates, vitamins A, B and C and minerals K, P and Ca [1]. It believed that the native habitat of Apricot is central and western China and Siberia, from them moved to the rest of the world [2]. The global area of apricot cultivation is estimate at 387.20 ha distributed in more than 63 countries producing about 3728083 tons per year, the most productive countries are Turkey, Iran, Italy, France, Pakistan, Spain, Syria, Morocco, China and the United States United States of America [3]. In Iraq, it is still under cultivation. The estimated number of apricot trees are 547,508 trees producing 26276 tons per year and the average production per tree is about 26.2 kg. Salahuddin governorate ranked first in the production rate followed by Baghdad and Anbar[4].
Apricots are propagated in several ways, including seeds (for production of assets and for breeding purposes), which require a period of stratification for a month or more at a temperature of 5°C for the purpose of breaking their dormancy and preparing them for germination. The seeds grown in the spring and then grafting to the desired commercial varieties, in its growth force to reach the appropriate size of the grafting, the assets may be grafting in the autumn of the same year or left to the next year or more of agriculture without grafting depending on soil and environmental conditions [2].

The disparity in seedling growth and the length of the period in which the seedlings reach the stage of grafting or transfer to a permanent place increase the cost of production. This means to improve vegetative and root growth. Accelerate the seedlings' reach to the appropriate size of the grafting and the lowest costs, Organic or plant extracts are rich in nutrients, growth regulators, vitamins and organic acids as well as easy to be absorbed by the plant and are cheap and environmentally sound as they do not cause pollution of water, soil or air[5].

Humic acid comes in the forefront of this fertilizer. It is one of the humic compounds derived from the decomposition of organic matter. It helps to improve the absorption of nutrients from the soil. Improves the ability of the plant to retain water and stimulates the growth and activity of microorganisms. In addition, enters as a complementary source for multiple phenols in the early stages, which increases the biological efficiency of the plant, as the enzymatic system becomes more efficient cell division increases all division root system development, and dry production matter [6].

The use of biomass derivatives on the vegetation contributes to elongation and cell division due to the ability of the biomolecules to enter the cytoskeleton and make the cell membrane more efficient [7]. The treatment of apricot seedlings (Canino) with humic acid resulted in a significant increase, in the length and diameter of the main stem and the content of the leaves of mineral elements (nitrogen, phosphorus and potassium) [8]. The addition of humic acid concentration (10 ml. l⁻¹) to seedlings Pear class Eggplant grafted on apricot led to a significant increase in the height and diameter of seedlings, leaf area, the number of leaves, branches, dry weight of shoots, content of chlorophyll, Nitrogen, phosphorus and potassium in the leaves[9]. Addition of Humic acid to the pomegranate trees resulted in a significant increase in branch length, number of leaves and area of leaves compared to untreated trees[10].

Algae is a seaweed extract that is dried or extracted because it contains a large percentage of growth promoters, amino acids, nutrients and vitamins, which lead to physiological effects when added to plants as they increase resistance to stress and disease conditions and improve growth and production [11]. The spraying of kaki seedlings with the seaweed extract at a concentration of 2 and 4 ml. l⁻¹ resulted a significant increase in seedling height, number of branches, number of leaves, leaf content of chlorophyll, nitrogen, phosphorus and potassium, number and length of roots compared with control[12]. While [13] pointed out the spraying of olive seedlings with seaweed extracts at a concentration of 4 ml.l⁻¹ resulted in a significant increase in vegetative characteristics compared with control.

The aim of the research is to improve the vegetative and root growth of local apricot seedlings by treating them individually or collectively with humic acid and seaweed extract to achieve the best concentration for producing strong homogenous growth seedlings suitable for grafting.

2. Materials and methods
The experiment was conducted in the vegetable canopy of the Department of Horticulture and landscape / college of Agriculture / University of Kerbala in Al- Husseiniya district between latitudes (44-51°) and longitudinal (32-37°) for the period from mid-January to mid-October 2016 to study the effect of foliar spraying with humic acid and seaweed extract on the growth of local apricot seedlings.
Apricot seeds were sown on 15/01/2016 in 1.25 kg polyethylene bags filled with sandy soil shown in table 1 after sterilization with the fungicide Tupson at a concentration of 5% a week before planting.

**Table 1.** shows some physical and chemical properties of soil

| Type of analysis | The analysis' results |
|------------------|-----------------------|
| Sand             | 871 g.Kg⁻¹            |
| Silt             | 41 g.Kg⁻¹             |
| Clay             | 88 g.Kg⁻¹             |
| soil mixture     | sandy loam            |
| pH               | 7.6                   |
| E c.             | 1.23 Desimens.m⁻¹     |
| N                | 25.70 mg. kg⁻¹        |
| P                | 0.48 mg. kg⁻¹         |
| K                | 30.00 mg. kg⁻¹        |

After seed germination and growth, one hundred and thirty five apricot seedlings 10 cm were randomly distributed. Factorial experiment 3 × 3 was carried out within the design of randomized complete block design (RCBD) with three replicates, each containing 45 seedlings with five seedlings per experimental unit. The first factor is spraying with humic acid with three concentrates (0, 8 and 10 cm³.l⁻¹). Table 2 shows the components of humic Acid produced by company Univert LLP Lebanon.

**Table 2.** components of the humic acid

| Component          | Percentage  |
|--------------------|-------------|
| Fulvic acid        | 18%         |
| Organic Matter     | 16,5%       |
| Potassium          | 3%          |
| Iron               | 0.3%        |
| pH                 | 9-10.5      |
| Density            | 1.12 Kg/L   |

Second factor is the spray of seaweed extract (ALGA) with three concentrates (0, 1 and 1.5 cm³.l⁻¹). Table 3 shows the components of ALGA, which produced by Al-Zohour Company for Investment and Agricultural Development. Iraq.

**Table 3 components of ALGA**

| Component | Percentage |
|-----------|------------|
| N         | 4%         |
| P₂O₅      | 4%         |
| K₂O       | 4%         |
| Mg        | 32ppm      |
| Fe        | 30ppm      |
| Mn        | 31ppm      |
| Zn        | 17ppm      |
| Cu        | 12.6ppm    |

The seedlings were spray with organic fertilizer from 15/3/2016 to 15/8/2016 using a 2-liter hand spray. In the early morning, the Humic acid was sprayed with the concentrations under study after
adding (1 cm\(^3\)) of detergent (bright) with each concentration to break the surface tension of the water until the complete wetness of the seedlings, in the evening of the same day the seedlings were sprayed with the seaweed extract in the studied concentrations. The control treatment also sprayed with distilled water only after the irrigation of the seedlings carried out one day before the spraying process to increase the efficiency of the plants in absorbing the sprayed material [5]. The agricultural service operations carried out on a regular basis on all seedlings until seedlings harvest on 15/9/2016. Three seedlings were selected from each treatment and measurements taken for the following characteristics:

2.1. **Plant height (cm)**
Was measured by a measuring tape, from the ground level to the highest point in the plant.

2.2. **Stem diameter (cm)**
Was measured by Vernier, for three seedlings then the mean was taken for each treatment.

2.3. **Number of leaves (leaves.plant\(^{-1}\))**
The number of leaves per plant was calculated and the mean was taken for each plant.

2.4. **Leaf area (cm\(^2\))**
\[
\text{Leaf area} = \frac{\text{Leaf dry weight (g) } \times \text{ average of harvested area (cm}\,^2\text{)}}{\text{Average dry weight of the harvested part (g)}}
\]
Was measured by taking three leaves of different parts of each seedling and weigh and taking the tablets with an area of one cm\(^2\) of the cut leaves. Leaves were placed in an oven at 70\(^\circ\) C, for 48 hours and then area of leaves were calculated according to the following formula [14]:

2.5. **Leaves content of chlorophyll**
The chlorophyll content in the apricot leaves was estimated by a Chlorophyll meter SPAD-502, which was prepare by Minolta, Japan, by reading three leaves per seedling. SPAD UNIT measured the average per treatment according to [15].

2.6. **Shoot dry weight**
The root was separated and washed with water, to remove dust and impurities. The samples placed in paper bags separately and then dried in an oven at 70\(^\circ\) C for 48 hours and weighed by a sensitive balance.

2.7. **Root length (cm)**
The root lengths of each plant were measure by a metric bar and the mean was taken for each treatment.

2.8. **Root dry weight**
The whole root was separated from the vegetative part and washed with water to remove the dust and impurities. The samples placed in paper bags separately and dried in an oven at 70\(^\circ\) C for 48 hours, then weighed by a sensitive balance.

2.9. **Determination of leaves content of elements (N, P, K)**
Samples of leaves were taken from the middle part of each seedling and each replicate, then washed with distilled water to get rid of the dust and suspended impurities. Then placed in perforated paper bags and then dried in an oven at 70\(^\circ\) C for 48 hours until dry weight was confirmed, then, the samples were analyzed in the laboratories of the Agricultural Research Department / Ministry of Agriculture by taking
a sample with a weight of 0.5 g for each replicate. Digested using a 1: 1 mixture of sulfuric and perchlorate acids [16]. Mineral elements were estimated according to-
- Nitrogen by chloride method using Micro - Kjeldahl [17].
- Phosphorus were estimated in a mild digestion using ascorbic acid in the spectrophotometer [18].
- Potassium were measured using a Flame Photometer according to the method in [19].

3. Results and Discussion

It is noted from Tables (4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14) that the spraying of humic acid has a significant effect on plant height, stem diameter, number of leaves, leaf area, leaf content of chlorophyll, nitrogen, phosphorus and potassium percentage, dry weight of vegetative, root length and dry weight of root system. The concentration treatment (10 ml. l⁻¹) was superior with a significant increase of 90.06 cm, 5.54 mm, 34.40, 8.53 cm², 40.52 SPAD, 1.68%, 0.25%, 1.76%, 13.08 g, 43 mg. 78 cm and 6.77 g respectively. Which did not differ significantly with the concentration (8 ml. l⁻¹) in the plant height, number of leaves, leaf area, leaf content of nitrogen, phosphorus and potassium which reached 85.80 cm, 33.20, 8.25 cm², 1.55%, 0.23% and 1.58% respectively. While the control treatment showed a least values in plant height, stem diameter, number of leaves, leaf area, and leaf content of chlorophyll, nitrogen, phosphorus and potassium. The dry weight of shoots, root length and dry weight of the root were 68.84 cm, 3.66 mm, 27.80, 7.44 cm², 30 63.4AD, 1.38%, 0.18, 1.41%, 9.73 g, 34.06 cm and 4.12 g, respectively. This may be due to the humic acid, which contains organic acids and micro nutrient elements. That contribute to the growth of the plant, as well as its content of the potassium component, which plays an important role in increasing the growth of the plant by regulating the opening and closing the Stomata and the entry of the important CO₂. In the photosynthesis, increase chlorophyll, metabolism and accumulation in the tissues of the plant and thus stimulate the cells division and elongation. Which reflected positively in the increase of indicators of vegetative growth [20], or perhaps due to the properties of the humic acid in the activation of enzymes because it contains a guanine group which is receives hydrogen [6].

The addition of humic acid has increases the activity of many enzymes such as oxidase, phosphatase and dehydrogenase and inhibits the action of other enzymes such as peroxidase and IAA oxides [7]. show that humic acid increases the growth of roots and has an effect similar to the effect of auxin in encouraging cells to divide and elongate[21]. Where [22] showed that Fulvic acid found in the structure of the humic has the effect of auxin in the cells, which increases its permeability and promotes the movement of the element ions (N.P.K) and its accumulation in leaf cells, thus increasing the vital functions and improving overall growth.

As show in tables (4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14) that spraying with Alga seaweed extract at 1.5 ml. 1⁻¹ concentration. Recorded the highest rate of plant height, stem diameter, number of leaf area, and leaf content of chlorophyll and root length, dry weight of the root and leaves content of nitrogen 88.24 cm, 5.16 mm, 34.70, 9.12 cm², 39.79 SPAD, 45.28 cm, 6.58 g and 1.64 respectively. Concentration 1 ml. 1⁻¹ gave the highest significant increase, of dry weight of vegetative part and leaf content of phosphorus and potassium (11.96 g, 0.28% and 1.78%). While, least values of plant height, stem diameter, number and area of leaf, leaf content of chlorophyll, dry weight of shoots, root length, dry weight of root total, leaf content of nitrogen, phosphorus and potassium were obtained from control treatment 75.45 cm, 3.90 mm, 28.80, 6 48 cm², 31.34 SPAD 9.48 g, 29.50 cm, 4.00 g, 1.32%, 0.13% and 1.21% respectively.

This may be because the seaweed extract contains macro elements (N, P, K and Mg) and microelements (Fe, Zn, Cu and Mn) to fill the plant's need of mineral. Elements necessary for photosynthesis, respiration and various metabolic processes cell division and elongation. As well as the role of micro elements Fe, Zn, Cu and Mn necessary to build protein and increase the formation of
chlorophyll and the synthesis of the elongation hormone IAA and division of the cells, which in turn lead to an increase in the amount of processed food and its accumulation within the plant [23].

The interaction treatment between humic acid with 10 ml. l\(^{-1}\) and Alga spraying at 1.5 ml. l\(^{-1}\) was the best from other. By given The highest rate of plant height, stem diameter, number of leaves, leaf area, leaf content of chlorophyll, dry weight of shoot, root length, dry weight of the root compared with control treatment, which gave the least of the studied traits. This may be due to the positive joint role of both humic acid and Alga as previously explained.

**Table 4. Effect of humic acid and Alga and their Interaction on Plant height (cm)**

| ALGA ml.l\(^{-1}\) | 0   | 1   | 1.5 | Average |
|---------------------|-----|-----|-----|---------|
| 0                   | 62.36 | 69.67 | 74.50 | 68.84 |
| 8                   | 80.00 | 84.83 | 92.56 | 85.80 |
| 10                  | 84.00 | 88.52 | 97.67 | 90.06 |
| Average             | 75.45 | 81.01 | 88.24 |
| L.S.D 0.05          | humic acid 5.12 | ALGA 5.12 | Interaction 8.88 |

**Table 5. Effect of humic acid and Alga and their Interaction on Stem diameter (mm)**

| ALGA ml.l\(^{-1}\) | 0   | 1   | 1.5 | Average |
|---------------------|-----|-----|-----|---------|
| 0                   | 3.05 | 3.60 | 4.35 | 3.66 |
| 8                   | 3.73 | 4.14 | 4.57 | 4.15 |
| 10                  | 4.92 | 5.12 | 6.57 | 5.54 |
| Average             | 3.90 | 4.29 | 5.16 |
| L.S.D 0.05          | humic acid 0.52 | ALGA 0.52 | Interaction 0.90 |

**Table 6. Effect of humic acid and Alga and their Interaction on Number of leaves**

| ALGA ml.l\(^{-1}\) | 0   | 1   | 1.5 | Average |
|---------------------|-----|-----|-----|---------|
| 0                   | 27.3 | 25.2 | 31.00 | 27.80 |
| 8                   | 29.8 | 33.8 | 36.00 | 33.20 |
| 10                  | 29.2 | 36.8 | 37.10 | 34.40 |
| Average             | 28.80 | 31.90 | 34.70 |
| L.S.D 0.05          | humic acid 5.24 | ALGA 5.24 | Interaction 9.27 |

**Table 7. Effect of humic acid and Alga and their Interaction on leaf area (cm\(^2\))**

| ALGA ml.l\(^{-1}\) | 0   | 1   | 1.5 | Average |
|---------------------|-----|-----|-----|---------|
| 0                   | 5.94 | 7.89 | 8.50 | 7.44 |
| 8                   | 6.95 | 8.83 | 8.97 | 8.25 |
| 10                  | 6.56 | 9.16 | 9.88 | 8.53 |
| Average             | 6.48 | 8.63 | 9.12 |
| L.S.D 0.05          | humic acid 0.75 | ALGA 0.75 | Interaction 1.30 |
Table 8. Effect of humic acid and Alga and their Interaction on Leaves content of chlorophyll (SPAD)

| ALGA ml.l⁻¹ | 0     | 1     | 1.5   | Average |
|------------|--------|--------|-------|---------|
| 0          | 26.81  | 31.47  | 33.62 | 30.63   |
| 8          | 32.70  | 35.90  | 39.38 | 35.99   |
| 10         | 34.50  | 40.70  | 46.37 | 40.52   |
| Average    | 31.34  | 36.02  | 39.79 |         |
| L.S.D 0.05 | humic acid 2.33 | ALGA 2.33 | Interaction 4.05 |         |

Table 9. Effect of humic acid and Alga and their Interaction on Shoot dry weight (gm)

| ALGA ml.l⁻¹ | 0     | 1     | 1.5   | Average |
|------------|--------|--------|-------|---------|
| 0          | 8.20   | 10.27  | 10.73 | 9.73    |
| 8          | 9.91   | 11.70  | 12.92 | 11.51   |
| 10         | 10.35  | 13.93  | 14.97 | 13.08   |
| Average    | 9.48   | 11.96  | 11.87 |         |
| L.S.D 0.05 | humic acid 1.37 | ALGA 1.37 | Interaction 2.38 |         |

Table 10. Effect of humic acid and Alga and their Interaction on Root length (cm)

| ALGA ml.l⁻¹ | 0     | 1     | 1.5   | Average |
|------------|--------|--------|-------|---------|
| 0          | 25.83  | 36.67  | 39.67 | 34.06   |
| 8          | 30.33  | 42.00  | 43.50 | 38.61   |
| 10         | 32.33  | 46.33  | 52.67 | 43.78   |
| Average    | 29.50  | 41.67  | 45.28 |         |
| L.S.D 0.05 | humic acid 2.48 | ALGA 2.48 | Interaction 4.29 |         |

Table 11. Effect of humic acid and Alga and their Interaction on Root dry weight (gm)

| ALGA ml.l⁻¹ | 0     | 1     | 1.5   | Average |
|------------|--------|--------|-------|---------|
| 0          | 3.47   | 4.10   | 4.80  | 4.12    |
| 8          | 3.76   | 5.46   | 6.78  | 5.34    |
| 10         | 4.77   | 7.38   | 8.17  | 6.77    |
| Average    | 4.00   | 5.65   | 6.58  |         |
| L.S.D 0.05 | humic acid 0.54 | ALGA 0.54 | Interaction 0.94 |         |
Table 12. Effect of humic acid and Alga and their Interaction on leaves content of N%

| ALGA ml.l⁻¹ | 0   | 1   | 1.5  | Average |
|-------------|-----|-----|------|---------|
| 0           | 1.32| 1.39| 1.42 | 1.38    |
| 8           | 1.38| 1.57| 1.70 | 1.55    |
| 10          | 1.54| 1.70| 1.81 | 1.68    |
| Average     | 1.41| 1.55| 1.64 |         |
| L.S.D 0.05  | humic acid 0.11 | ALGA 0.11 | Interaction 0.19 |

Table 13. Effect of humic acid and Alga and their Interaction on leaves content of P%

| ALGA ml.l⁻¹ | 0   | 1   | 1.5  | Average |
|-------------|-----|-----|------|---------|
| 0           | 0.13| 0.22| 0.20 | 0.18    |
| 8           | 0.19| 0.28| 0.22 | 0.23    |
| 10          | 0.20| 0.33| 0.22 | 0.25    |
| Average     | 0.17| 0.28| 0.21 |         |
| L.S.D 0.05  | humic acid 0.06 | ALGA 0.06 | Interaction 0.09 |

Table 14. Effect of humic acid and Alga and their Interaction on leaves content of K%

| ALGA ml.l⁻¹ | 0   | 1   | 1.5  | Average |
|-------------|-----|-----|------|---------|
| 0           | 1.21| 1.56| 1.46 | 1.41    |
| 8           | 1.29| 1.79| 1.66 | 1.58    |
| 10          | 1.34| 1.98| 1.78 | 1.70    |
| Average     | 1.28| 1.78| 1.63 |         |
| L.S.D 0.05  | humic acid 0.13 | ALGA 0.13 | Interaction 0.21 |

References

[1] Paunovic S A 1988 Apricot cultivars (Prunus armeniaca L.) In Europe Acta Horticulture 20983 – 114.
[2] Al-Jumaili A A M and Abu Al-Saad M A 1990 Deciduous Fruit Technical Education Authority. Baghdad.
[3] Anonymous 2009 Production yearbook Rom FAO www.Faostat.org.
[4] Annual Statistical Yearbook 2013 Central Organization for Statistics and Information Technology, Ministry of Planning and Development Cooperation Iraq.
[5] Al-Temimi et al 2014 Effect of sprinkling with garlic and strawberry extract in improving some of the characteristics of the root range of Pomegranate seedlings. Journal of Kerbala University 14 (4) 246-250.
[6] Seen T L and Kingman A R 1998 A review of humus and humic acid research series no. 145, S.C. Agricultural experiment station, Clemson, South Carolina.
[7] Faust R H 1998. Humate and humic acid Agriculture users guide. Novaco marketing and management services. Australian Humates.
[8] Kandil E A and Ahmed S M 2010 Improving growth, yield and fruit of "Canion" Apricot under organic agriculture system. *Egypt J. Hort.* **37 (2)** 257-275.

[9] Joody A T 2013 Effect of GA₃ and Method Application of humic Acid on Some Vegetative Characteristics of Plum *Prunus salicina* L. Tikrit University *Journal of Agricultural Sciences* **13 (1)** 198-204.

[10] Khattab M M et al 2012 Effect of humic acid and Amino Acids on Pomegranate Trees under Deficit Irrigation: Growth, Flowering and Fruiting. *J. of Hort. Science & Ornamental Plants* **4 (3)** 253-259.

[11] Abd El-Motty E Z et al 2010 Effect of algae extract and yeast application on growth ,Nutritional status , yield and fruit quality of Keitte mango trees. *Agric Biol. J. N. Amer.* **1 (3)** 421-429.

[12] Kazem A A and Hadi A A 2015 Effect of Spraying Seaweed Extract and humic acid on the growth Pointers Persimmon root stock "Lotus" sapling *Diospyrus kaki* L. *Euphrates Journal of Agriculture Science* **7 (1)** 10-20.

[13] Ismael A. A. and Gray A.K. 2012 Response of Olive transplants to seaweed extract as soil application and foliar application of magnesium. *Iraqi journal of agricultural science.* **43 (2)** 119-131.

[14] Drovnic V 1965 Lucraripactic de ampelographic E. Didacticta spedagogica Bucureseti R. S. Romania

[15] Jemison J and Williams M 2006 Potato Grain study project report, Water Quality office.University of Maine, Cooperation Extension.

[16] Gresser M S and Parson G W 1979 Sulfuric and perchloric acid digestion of plant material for the determination nitrogen, phosphorus, potassium. Calcium and Mg. *Analytical chemical Acta.* **109** 431-436.

[17] Novozamsky R Van Ech J Van Schouvanbury Ch and Wasillinga L 1974 Total nitrogen determination in plant material by mean of indophenol blue method. *Netherlands Journal of Agricultural Sci.* **22** 3-5.

[18] John M K 1970 Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid. *Soil Science,* **109** 214.

[19] Hesse P R 1971 A Textbook of Soil Chemical Analysis . John M London , Britain.England.

[20] Al-Rayes A J 1987 Plant nutrition part One Plant nutrition Baghdad University college Agriculture. Ministry of Higher Education, Iraq.

[21] Ali T J M 2011 Effect of foliar application with humic acid and chemical with ammonium phosphate in the growth of olive seedlings c.v Shami . Master Thesis. Middle Euphrates University.

[22] Fathy M A et al 2010 Effect of Humic acid treatments on Canino apricot growth , yield and fruit quality. *New York science Journal* **3 (12)** 109-115.

[23] Al-Temimi H M A 2010 Effect of IAA concentration and paper feeding on the growth of grafted apple seedlings. Master Thesis. Technical College Musayyib. Middle Euphrates University.