Influence of Organic Fertilization, Liquorice, and Bread Yeast Extracts Spray in Some Growth and Yield Properties of Cucumbers Under Unheated Plastic House Conditions

A F Mutlak*, M M Muslat

Department of Horticulture, College of Agriculture, University Of Anbar, Iraq

*Corresponding author’s e-mail: afe19g5004@uoonbar.edu.iq

Abstract. A field study was carried out in unheated plastic house A field study was carried out in the unheated greenhouses of the Department of Horticulture and Landscaping at the College of Agriculture, University of Anbar, at longitude 43.31 and latitude 33.42, to evaluate the effect of adding levels of organic manure (poultry manure) to the soil (weight to weight) and foliar application by spraying liquorice and bread yeast extract on cucumber growth and yield. The study included adding poultry manure to the soil at three levels, 2, 3 and 5%, with spraying two concentrations of liquorice, 2.5 and 5 g liter$^{-1}$, with or without bread yeast extract 1:10, in addition to control treatment (without addition), and the mineral fertilization treatment according to the fertilizer recommendation. The experiment was carried out according to a Randomized Complete Block Design (R.C.B.D) with three replications, and the treatments means were compared using Least Significant Difference Test (L.S.D) at the probability level of 0.05. The results showed that: organic fertilization of poultry manure 2% + liquorice extract 5 g. L$^{-1}$ recorded a highest leaf area 1435.9 dcm$^2$, and highest plant height (190.0 cm). While the use of poultry manure 3% + liquorice extract 5 g. Liter$^{-1}$ gave the highest relative content of chlorophyll in leaves (84.47 Spad), whereas the control treatment gave the highest percentage of dry matter in the plant (12.54%). The treatment of poultry manure 2% + liquorice extract 2.5 g. Liter$^{-1}$ gave the highest number of fruits (14.5 fruits plant$^{-1}$), the highest yield per plant (1.228 kg plant$^{-1}$), the highest total yield of 1.228 tons Plastic house$^{-1}$, and the lowest nitrates concentration in fruits (9.541 mg kg$^{-1}$). whereas the treatment of poultry manure 2% + liquorice extract 2.5 g. 1 liter- + bread yeast extract 10:1. gave the highest fruit weight of 88.76 g. The treatment of poultry manure 5% + liquorice extract 2.5 g. Liter$^{-1}$ achieved the highest nitrogen concentration of 1.758%, and the highest potassium concentration of 6.200% in the fruits. While the treatment of poultry manure 5% + liquorice extract 2.5 g. Liter$^{-1}$ + bread yeast extract 10:1 gave the highest phosphorous percentage of 0.850% in fruits.

1. Introduction

Cucumber (Cucumis sativus L.) is one of the crops of the Cucurbitaceae family. It is an important summer vegetable crop in Iraq and the world. It is grown in Iraq in open fields in spring and autumn seasons, and in the protected environment under tunnels and in greenhouses and plastic houses [1]. The area planted with this crop in Iraq for the year 2018 reached 13784 hectares, with a production rate of 138,353 tons.
Cucumber is cultivated for its fruits that are consumed fresh or cooked and in pickling as well, and its fruits have medicinal uses, including, the freshness of skin, relieving nervous disorders, purifying the body from toxins and relieving headaches in humans, and it is also useful in balancing blood pressure [3]. Fertilization in general and organic fertilization in particular is considered one of the most important means of increasing crop productivity and supplying the soil with the major elements necessary for the plant [4]. In addition to its ability to provide micro-nutrients [5]. And the production of a crop free of chemical pollutants [6]. Chemical fertilization has dangerous negative effects on human health, especially the effects of nitrate residues resulting from the excessive addition of nitrogen fertilizers [7]. Despite the efficient use of animal organic fertilizers, which are rich in important macro-elements (nitrogen, phosphorous and potassium), especially poultry manure [8]. However, the available quantities of them are few when compared to what is required to be provided for the cultivated areas.

On the other hand, a number of researchers pointed to the positive effect of using a number of natural organic extracts rich in nutrients that provide the plant's requirements during the critical and sensitive stage of plant growth. It also treats the deficiency of elements, especially the micro nutrients [9]. The liquorice plant (Glycyrrhiza glabra) is rich in many nutrients such as potassium, calcium salts, volatile oils, and lignin [10], which contains (glycyrrhjeail and liquoric acid) with similar efficiency to steroid hormones, which are plant hormones that raise the growth rate through their formation of proteins [11].

Biofertilizers are also one of the sources that have received great attention in recent years, including bread yeast and its extracts, which contain many important nutrients for the plant such as (iron, calcium, potassium, magnesium, nitrogen, phosphorous, sulfur, zinc, sodium and silicon). It produces growth regulators such as gibberelins and auxins [12]. Therefore, this study aimed to evaluate the response of cucumber plant growth and its yield to fertilization with different levels of poultry manure with spraying of liquorice and bread yeast extracts Under plastic houses the unheated.

found [13] that fertilization with poultry manure averaged 8 tons. hectares-1 gave the highest plant height, the largest leaf area and the highest yield of cucumber plants. [14] found when using poultry manure at a level of 10 tons’ hectare-1 and spraying with organic fertilizer Humic-Feed at three concentrations (0, 0.5, 1 ml liter-1) on cucumber plant gave the highest rate of plant height, leaf area, number of fruits, fruit weight, yield per plant and total yield. [15] found in their study on cucumber plants that they used poultry manure at rates of 1, 2, and 4%, and lawn mowing waste at 0.5% and 2% of poultry manure + 0.5% of lawn mowing waste and the control treatment. The treatment of 4% poultry residues was superior in the rate of plant height and leaf area, while the treatment of 2% poultry residues + 0.5% lawn mowing waste was superior in the chlorophyll content of leaves, number of fruits and plant yield. [16] found in their study on cucumber plants in which they used poultry manure (10-ton ha-1) and horse manure 20-ton ha-1 and plant manufactured organic fertilizer 30 kg ha-1 and dry yeast fertilizer 10 g l-1 with the control treatment (400 kg ha-1 NPK). Poultry manure treatment (10 tons’ ha-1) outperformed by giving the highest plant height, leaf area, chlorophyll percentage, number of fruits and plant yield, and the lowest nitrate content in fruits for both seasons of the study. [17] also found in a study on the cucumber plant, which included spraying liquorice extract with concentrations (0, 2.5 and 5 g L-1), the concentration of 5 gm L-1 outperform by giving it the highest plant height in the first season and a concentration of 2.5 g L-1 liter in the second season and the largest leaf area and the highest plant yield, while the control treatment gave the lowest values for the two seasons, respectively. In another study on the cucumber plant, the treatments included a spray of yeast extract 2 gm. Liter -1 (once and twice) and two isolates of yeast Candida 2 g Liter -1 (once and twice) and control treatment, the yeast spray once was superior by giving it the largest leaf area and the highest number of fruits [18]. [19] also found that spraying cucumber plant with yeast extract at concentrations (5, 10, 15 and 20 g L-1), the treatment of yeast extract at a concentration of 20 g. L-1, outperform by giving the highest plant height, the largest number of fruits, the highest yield of the plant, and highest total yield for the two seasons respectively.
2. Materials and Methods
The study was implemented according to the Randomized Complete Block Design (RCBD) [20]. In one of the unheated greenhouses of the Department of Horticulture and Landscaping at the College of Agriculture, University of Anbar, at longitude 43.31 and latitude 33.42 during the fall season of the 2020 growing season on the local hybrid cucumber plant (2036) registered with the National Committee for Registration Accreditation and Protection of Agricultural Varieties, it is an early hybrid, with medium-sized dark green fruits with an acceptable taste. The plastic house was divided into six lines, the distance between them is 90 cm. A trench was made for each experimental unit, with a length of 5.20 m, a width of 0.3 m, and a depth of 0.3 m, separated by a distance of 1 m, leaving a distance of 1.5 m from both door sides unexploited. The trenches were filled after lining them with a layer of perforated polyethylene with river mixture soil. Its specifications are shown in Table (1) after mixing it with the specified percentages (weight to weight) of organic manure (poultry manure), Taken from local fattening fields, and which was fermented for three months and was moistened for four days until it got wet and made a pile 1.5 m high and 1 m wide, it was turned every two weeks (5 turns), with wetting the surface layer on a daily basis [21] and a sample was taken for analysis (Table 2). which included 14 treatments as combinations to add three percentages of poultry manure with spraying some organic and biological extracts, as follows:

T0: Soil without fertilization.
T1: Chemical recommended fertilization (92 kg N + 200 kg P₂O₅ + 150 kg K₂O) [22].
T2: poultry manure 5% + spraying liquorice 2.5 g L⁻¹.
T3: poultry manure 5% + spraying liquorice 5 g. L⁻¹.
T4: poultry manure 5% + spraying liquorice 2.5 g. L⁻¹+ spraying Bread Yeast Extract 1:10.
T5: poultry manure 5% + spraying liquorice 5 g. L⁻¹+ spraying Bread Yeast Extract 1:10.
T6 poultry manure 3% + spraying liquorice 2.5 g. L⁻¹.
T7 poultry manure 3% + spraying liquorice 5 g. L⁻¹.
T8 poultry manure 3% + spraying liquorice 2.5 g. L⁻¹+ spraying Bread Yeast Extract 1:10.
T9 poultry manure 3% + spraying liquorice 5 g. L⁻¹+ spraying Bread Yeast Extract 1:10.
T10 poultry manure 2% + spraying liquorice 2.5 g. L⁻¹.
T11 poultry manure 2% + spraying liquorice 5 g. L⁻¹.
T12 poultry manure 2% + spraying liquorice 2.5 g. L⁻¹+ spraying Bread Yeast Extract 1:10.
T13 poultry manure 2% + spraying liquorice 5 g. L⁻¹+ spraying Bread Yeast Extract 1:10.

Table 1. Physical and chemical properties of the soil used

| physical and chemical properties of the soil | Unit |
|--------------------------------------------|------|
| Sand                                       | 600  gm . kg⁻¹ |
| Silt                                       | 396  gm . kg⁻¹ |
| Clay                                       | 4    gm . kg⁻¹ |
| EC                                         | 4.32 dc . m⁻¹ |
| O. M                                       | 0.552 % |
| pH                                         | 7.58 |
| Total N                                    | 0.061 % |
| Available nutrients                        |       |
| P                                          | 7.596 mg . kg⁻¹ |
| K                                          | 69.30 mg . kg⁻¹ |
| Soil texture                               | Sandy clay |


Table 2. Physical properties of the organic fertilizer before and after decomposition

| Poultry manure | Nutrients | C/N | EC ds/m⁻¹ | pH |
|----------------|-----------|-----|-----------|----|
|                | N %       | P mg.kg⁻¹ | K mg.kg⁻¹ |    |
| Before fermentation | 1.400 | 0.8615 | 1.755 | 18.642 | 18.90 | 7.02 |
| After fermentation  | 0.817 | 0.6504 | 0.948 | 12.086 | 10.83 | 7.62 |

The seeds were sown on 7/10/2020 directly, with a distance of 40 cm between one plant and another, ie 12 plants for each experimental unit. The extracts were sprayed with a 20-liter knapsack sprayer, the first spray was 30 days after the emergence of seedlings, and the process was repeated every two weeks (4once).

The following characteristics were measured:

1. **Characteristics of vegetative growth**
   1.1. **leaf area dm²**
   Thirty discs of known area were taken from ten plants from each experimental unit after the second spraying process and dried in an electric oven at a temperature of 65 °C until the weight was stable, and the leaf area was calculated according to the equation [23].
   \[
   \text{Leaf area} = \frac{\text{Disc area} \times \text{leaf DW}}{\text{Disc DW}}
   \]
   Leaf area of the plant = Leaf area x number of leaves per plant

2.1.2. **Plant height cm**
   The height of the plant was measured from the soil surface to the top of the plant at the end of the season for the average of three plants using a tape measure.

2.1.3. **Relative chlorophyll content (SPAD)**
   The relative chlorophyll content of leaves was calculated with a 502 Spad (Chlorophyll meter) device supplied by the Japanese Minolta Co., Ltd. The first two readings were taken after the first spraying and the second one after a month and the average was extracted.

2.1.4. **Plant dry matter percentage**
   At the end of the season, three plants were taken from each experimental unit, their fruits were removed and weighed before drying, then dried at a temperature of 70 degrees Celsius until the weight was stable [24], then weighed and calculated according to the following equation:
   \[
   \text{Plant dry matter percentage} = \frac{\text{plant weight after drying}}{\text{plant weight before drying}} \times 100
   \]

2.2. **Yield characters**
   2.2.1. **Fruit number (fruit plant⁻¹)**
   The number of fruits in the experimental unit was calculated from the beginning of harvest until the end of the growing season and divided by the number of plants in the experimental unit.
   \[
   \text{Fruit number} = \frac{\text{Total fruit number in experimental unit}}{\text{number of plant in experimental unit}}
   \]

2.2.2. **Fruit weight gm**
   Measured according to the following equation: Fruit weight = \[
   \frac{\text{Average yield per plant}}{\text{Fruit number per plant}}
   \]
2.2.3. Average yield per plant kg plant⁻¹
Measured according to the following equation: 
Plant yield = \( \frac{\text{yield per experimental unit}}{\text{Fruit number per experimental unit}} \)

For the total of early yield and in each harvest (10 harvests).

2.2.4. The total yield tons, plastic house⁻¹
Measured according to the following equation:

The total yield \( = \text{yield per plant (kg)} \times \text{number of plants in plastic house} \)

(1000) plants were considered for the number of plants in the plastic house, which has an area of 500 square meters.

2.3. Chemical characteristics
2.3.1. Estimation of Nitrogen in fruits %
Three fruits were taken from the sixth harvest and nitrogen was estimated by Micro Kjeldahl device as mentioned in [25].

2.3.2. Estimation of phosphorus in fruits %
Three fruits were taken from the sixth harvest and phosphorous was estimated using a UV-VIS Spectrophotometer at a wavelength of 662 nm [26].

2.3.3. Estimation of potassium in fruits %
Three fruits were taken from the sixth harvest and potassium was estimated using a Photometer Flame spectrometer [27].

2.3.4. Estimation of nitrate concentration in fruits mg. kg⁻¹
Three fruits were taken from the sixth harvest. It was estimated using a spectrophotometer at a wavelength of 410 nanometers, and according to what was mentioned in [28].

The data were collected and analyzed statistically and the differences between treatment means were tested according to the least significant difference L.S.D at the probability level of 0.05 using the Excel program.

3. Results and Discussion
3.1. Effect of organic fertilization and spraying with liquorice and bread yeast extracts on vegetative growth characteristics

The leaf area is one of the most important indicators of the strength of the vegetative system that shows the activity of metabolic processes and the accumulation of carbohydrates formed in the plant. The results of the statistical analysis in Table (3) show that treatment T11 (poultry manure 2% + liquorice extract 5 g. L⁻¹) recorded the highest leaf area average of 1435.9 dm² Plant⁻¹, and the highest plant height (190.0 cm). It significantly outperformed the chemical fertilization treatment T1, which gave values of 865.1 and 140.6 cm for the two traits, respectively. The T7 treatment (poultry manure 3% + liquorice extract 5 g. L⁻¹) recorded the highest relative content of chlorophyll in leaves that (84.47 spad) with a significant difference from the chemical fertilization treatment (63.47 spad). While the control treatment was superior with highest percentage of dry matter in the plant, (12.54%), and the chemical fertilization treatment ranked second with a rate of 12.08%. The differences were of statistical value with most organic fertilization treatments and spraying of extracts under study.

Table 3. Effect of poultry manure, liquorice extract and bread yeast vegetative growth characteristics

| Treatment | Leaf area (dm²) | Plant height cm | Chlorophyll Spad | Dry weight % |
|-----------|----------------|-----------------|-----------------|-------------|
| T0        | 97.4           | 40.1            | 32.61           | 12.54       |
### Table 4. Effect of poultry manure, liquorice extract and bread yeast on yield and its components

| Treatment | Fruit number Plant⁻¹ | Fruit weight Gm | Plant yield Kg plant⁻¹ | Total yield ton house⁻¹ |
|-----------|-----------------------|-----------------|------------------------|------------------------|
| T0        | 0.6                   | -*              | 0.062                  | 0.062                  |
| T1        | 9.9                   | 79.38           | 0.804                  | 0.804                  |
| T2        | 12.4                  | 75.46           | 0.956                  | 0.956                  |
| T3        | 11.6                  | 80.46           | 0.955                  | 0.955                  |
| T4        | 13.0                  | 79.96           | 1.057                  | 1.057                  |
| T5        | 9.0                   | 73.47           | 0.685                  | 0.685                  |
| T6        | 9.4                   | 78.35           | 0.726                  | 0.726                  |
| T7        | 13.6                  | 84.43           | 1.170                  | 1.170                  |
| T8        | 12.3                  | 83.19           | 1.022                  | 1.022                  |
| T9        | 11.7                  | 83.33           | 0.968                  | 0.968                  |

3.2. **Effect of organic fertilization and spraying with liquorice extracts and bread yeast on yield and its components**

The results of the statistical analysis in Table (4) showed that T10 treatment (poultry manure 2% + liquorice extract 2.5 g. L⁻¹) was superior with the highest average number of fruits that reached 14.5 fruits plant⁻¹, while the chemical fertilization treatment recorded an average of 9.9 fruits Plant⁻¹, and the control treatment gave the lowest number of 0.6 fruits plant⁻¹. While the T12 treatment (poultry manure 2% + liquorice extract 2.5 g. L⁻¹ + bread yeast extract 1:10) gave the highest average fruit weight of 88.76 g with statistically different from T6, T2 and T5 treatment, which recorded the lowest average fruit weight of 78.35 and 75.46 and 73.47 g respectively.
On the other hand, T10 treatment (poultry manure 2% + liquorice extract 2.5 g. L$^{-1}$) was superior by giving the highest yield per plant of 1.228 kg. plant$^{-1}$ and the highest total yield of 1.228 tons Plastic house$^{-1}$, it was statistically different from the chemical fertilization treatment (0.804 kg. Plant$^{-1}$) and a total yield of 0.804 tons Plastic house$^{-1}$.

On the other hand, the results presented in Table (5) show the superiority of T2 treatment (poultry manure 5% + liquorice extract 2.5 g. L$^{-1}$) with highest nitrogen concentration in fruits (1.758%), which is significantly different from chemical fertilization treatment (1.104%). The same treatment also recorded the highest potassium concentration in the fruits (6.200%), while the chemical fertilization treatment gave a concentration of 5.263%. While the T4 treatment (poultry manure 5% + liquorice extract 2.5 g. L$^{-1}$ + bread yeast extract 10:1) was superior with highest phosphorous concentration in the fruits with 0.850% while the chemical fertilization treatment gave 0.637%. The treatment of T10 (poultry manure 2% + liquorice extract 2.5 g. L$^{-1}$) showed the lowest concentration of nitrate in fruit (9.541 mg kg$^{-1}$), while chemical fertilization treatment gave the highest concentration of 34,220 mg. kg$^{-1}$.

Table 5. Effect of poultry manure, liquorice extracts and bread yeast chemical characteristics

| Treatment | N – Fruit % | P – Fruit % | K – Fruit % | Nitrate – Fruit mg kg$^{-1}$ |
|-----------|-------------|-------------|-------------|-----------------------------|
| T0        | *           | -           | -           | -                           |
| T1        | 1.104       | 0.637       | 5.263       | 34.220                      |
| T2        | 1.758       | 0.847       | 6.200       | 27.542                      |
| T3        | 1.353       | 0.840       | 4.119       | 13.896                      |
| T4        | 1.447       | 0.850       | 3.796       | 11.574                      |
| T5        | 1.478       | 0.707       | 5.296       | 22.607                      |
| T6        | 1.478       | 0.734       | 5.227       | 16.945                      |
| T7        | 1.680       | 0.774       | 3.422       | 17.380                      |
| T8        | 0.996       | 0.648       | 2.898       | 24.388                      |
| T9        | 1.268       | 0.631       | 3.111       | 16.219                      |
| T10       | 1.221       | 0.606       | 3.879       | 9.541                       |
| T11       | 1.307       | 0.578       | 3.061       | 14.187                      |
| T12       | 1.447       | 0.577       | 3.770       | 22.171                      |
| T13       | 1.455       | 0.669       | 3.266       | 17.090                      |
| L.S.D     | 0.249       | 0.262       | 1.366       | 7.633                       |
The increase in the vegetative growth rate and the nutrient content of cucumber leaves as a result of the poultry manure treatments shown by the statistical analysis in Table (3) and (4) may be due to the effect of the fertilizer added to the soil and its content of nutrients and the role of organic fertilizers in improving the Physical, chemical and biological characteristics of soils that increase their porosity and aeration, as well as raising the ambient temperature for the growth of the root system and maintaining soil moisture, which helps the roots to increase the absorption of water and nutrients, which positively affects the vegetative growth [29]. This helps to increase nutrients supply that enter into biological and physiological reactions and in the processes of carbon metabolism, as well as in the elongation and division of cells, which affect the height of the plant and increase the number of leaves and leaf area [30][31]. In this study cucumber plants responded to the additions of poultry manure and this was reflected in the measurements of the vegetative growth characteristics shown in Table (3).

Nitrogen is one of the most important and essential elements, as it enters the composition of many important organic compounds in the vital processes in the plant, and in cell division and elongation as a result of stimulating the plant to make proteins and produce auxins, as well as the increase in the manufacture of chlorophyll. [32]. Therefore, the addition of organic fertilizer rich in its content of nutrients led to an increase in vegetative growth and its components compared to chemical fertilizers [33]. These results are consistent with what was reached [16].

The increase that was achieved in the quantity and quality of yield in the treatments in which poultry manure was used (Tables 4 and 5), was due to the improvement of the soil’s physical, chemical and biological properties and an increase in its ability to retain water, and the increase in the concentration of the main nutrients especially nitrogen, phosphorous and potassium, which was demonstrated by the chemical analysis of manure sample (Tables 2). The decomposition of the organic matter may result in most of the nutrients needed by the plant in proportions that depend on the source and nature of the organic matter [34]. The increase in yield resulting from the use of organic fertilizer may be due to its effect on the chemical, biological and physical properties of the soil. In addition to providing the plant with nutrients to a later stage of plant growth, which gave an increase in vegetative growth and photosynthesis products, which was reflected in the increase in yield. These findings are in agreement with [13] and [35]. On the other hand, the low nitrate rate in fruits with organic fertilization (Table 3) may be due to the fact that the rate of nitrate consumption by microorganisms is more than ammonium, and the inhibition rates by microorganisms of nitrate are large compared to the total nitrification [36]. The high nitrate content in chemical fertilization treatment may be due to the fact that the part of the nitrogen fertilizer that dissolves produces ammonium ion (NH$_4^+$) in large quantities, which is oxidized to (NO$_3^-$) and (NO$_2^-$) by the action of microorganisms in the soil and then absorbed by the plant, it accumulates in its tissues in greater quantities than what happens in the case of organic fertilizers, which gradually supply ammonium. These results are in agreement with [37]and [16].

The results presented in Tables (4 and 5) may be due to the effect of spraying with liquorice extract, as it plays a role similar to gibberellin by increasing elongation and division in cells, because of its effect on enzymes that transform complex compounds into simple compounds that the plant can benefit from in building protein materials necessary for growth [38]. It may be due to the effect of spraying with bread yeast extract rich in nutrients such as nitrogen, amino acids, calcium 0.1, potassium 30, phosphate 38, magnesium 2, iron 0.05, zinc 0.05 (mg. grams$^{-1}$) and others, and enzymes that can convert monosaccharides into alcohol and carbon dioxide necessary for the photosynthesis process in higher plants [12]. This is consistent with the findings [19].

Based on the reported results, we recommend using the lowest percentage of organic fertilizer to reduce the production cost per unit area.
References

[1] Matlob, AN, Muhammad ES, Abdul AKS 1989, Vegetable production. The second part. Revised second edition. Ministry of Higher Education and Scientific Research. University of Al Mosul. The Republic of Iraq.

[2] The Ministry of Planning. Central Statistics Organization 2018, Report on the production of secondary crops and vegetables according to the Iraqi governorates for the 2018 season.

[3] Al-Shammari, AMA, and Saud OGY 2013, Effect of spraying by some organic nutrients and growing up manner on the characteristics and components of growth and harvest of three hybrids cucumber under protected cultivation conditions. *Diyala Journal of Agricultural Sciences* 5(2), 283-294.

[4] Al-killardar, QQ, Bresam TH, and Nasser SA 2010, Economitrics to achieved of find out the capability of using Sewage fertiles instead of chemical, also to use drain water instead of river& impact of these change on production of corn crop yield in Babilon 2008. *Anbar Journal of Agricultural Sciences* 8 (4), 213-232.

[5] Abu Nukat, F, Al-Shater MS, and Al-Balkhi A 2010, The effect of organic fertilizers on the availability of some micro-nutrients in the soil and on spinach productivity. *Damascus University Journal of Agricultural Sciences* 26 (2), 15-26.

[6] Al-Sahaf, FH, Al-Mharib MZ, and Al-Saadi FM 2011, Response of cucumber hybrids to chemical and organic fertilizers. *Iraqi Journal of Agricultural Sciences* 42(4), 52-62.

[7] Khallouf, A, Alkhedr A, Khazaal A, Kridi N, and Wehbe S 2019, Effect of biofertilizers on some of fertility soil properties and some qualitative and production traits of potato. *Syrian Journal of Agricultural Research* 6(1), 276-287.

[8] Al-a`amry, NJ, and Matlob AN 2012, Effect of organic fertilizers growth and production of tomato under heated greenhouse conditions. *Al-Furat Journal of Agricultural Sciences* 4(3), 28-38.

[9] Atallah, HS, Salim HM, and Hussein WA 2019, Effect of foliar fertilization by two types of fertilizers on the growth and yield of cucumber cultivar (Omega Variety) under protected environment conditions. *Babylon University Journal - Pure and Applied Sciences* 27(4), 178-183.

[10] Ati, AS, Al-Sahaf FH, and Khalaf SM 2008, Effect of Glycyrrhiza glabra on Soil-Water Properties, Aggregates Stability, and Growth, Yield *Allium sativum* L. [https://www.researchgate.net/publication/328049363](https://www.researchgate.net/publication/328049363)

[11] Al-Wailhi, FK, 2015, Effect of treatment with cold periods and spraying with licorice extract on the growth and nuts Strawberry *Fragaria x ananassa* Duch, cultivar Festival. *Iraqi Journal of Biotechnology* 14(2), 427-433.

[12] Hussain, WA, and Khalaf LQ 2008, Some parameters of growth and productivity of potato crop after spraying with different concentrations of bread yeast carrier. *Al-Nahrain University Journal* 11(1), 33-37.

[13] Ikeh, AO, Udob EI, Udauk GI, Udounang PI, and Etokeren UE 2012, Response of cucumber (*cucumis sativus* L.) different rates of goat and poultry manure on an ultisol. *Journal of Agriculture and Social Research* 12(2), 132-139.

[14] Al-Tohafi, SAA, Hamza MM, and Habib HA 2013, Effect of the type of animal manure and spraying with organic fertilizer (Humi-Feed) on growth and yield of Cucumber var. Sahra. *Kufa Journal of Agricultural Sciences* 5(1), 179-197.

[15] Muslat, MM, and Geetan AA 2013, Influence of poultry manure and land grass cutting wastes on growth and yield of cucumber (*Cucumis sativus*). *Al Furat Journal of Agricultural Sciences* 5(2), 66-74.

[16] Kalefa, HG, and Jubair NI 2013, Effect of adding organic fertilizers and dry yeast on some characteristics of vegetative growth and yield of two hybrids of cucumber. *Cucumis sativus* L under protected cultivation conditions. *Anbar Journal of Agricultural Sciences* 11(2), 16-29.
[17] Hussain, WA, and Al-Rakabi FH 2006, Response to cucumber plant (Cucumis sativus L.) to foliar sprays of garlic and licorice root extracts, and urea on vegetative characters and plant yield. *Iraqi Journal of Agricultural Sciences* 37(4), 33-38.

[18] Muslat, MM 2013, Response of cucumber under organic farming to the spray with saccharomyces cerevisiae or some candida isolates extract. *Iraqi Journal of Agricultural Sciences* 44(4), 528-539.

[19] Nassef. DM; El-Aref HM 2016, Response of cucumber to yeast and royal jelly foliar applications. *Assiut J. Agric. Sci.* 47 (6-2); 633-648.

[20] Al-Mohammmedi, Sh. M. and F. M. AlMohammadi. 2012. Statistics and Experiments Design. *Dar Osama for Publishing and Distribution*. Amman - Jordan.

[21] Muslat, MM, and Mosleh OH 2012, Fundamentals of Organic Agriculture. College of Agriculture, University of Anbar. Ministry of Higher Education and Scientific Research. Sima Press. Iraq. p 258

[22] Hassan, AAM 2004, Production of secondary and non-traditional vegetables. The vegetable crop series: production technology and advanced agricultural practices. part One. first edition. *Arab House for Publishing and Distribution*. p. 304

[23] Watson, DJ, and Waston MA 1953, Comparative Physiological Studies on the growth of field crops. III. Effect of infection with beet yellow. *Annals of Applied Biology* 40(1), 1-37.

[24] Al-Sahhaf, FH 1989, Applied Plant Nutrition. Ministry of Higher Education and Scientific Research. *Bait Al-Hikma*. Baghdad University - Iraq.

[25] Jackson, ML 1958, Soil Chemical analysis. Prentice Hall, Inc. Englewood Cliff, N.J.USA. P. 225-276.

[26] Olsen, SR, and Sommers LE 1982, Phosphorus in A. L Page, (Ed). Methods of soil analysis. Part 2. Chemical and Microbiological properties 2nd edition, Amer. Soc. Of Agron. Inc. Soil Sci. Soc. Amer Inc. Madison. Wis. U.S.A.

[27] Bhargava, BS, and Chadha KL. 1988, Leaf nutrient guide for fruit and plantation crops. *Fertilizer New* 33(7), 21-29.

[28] Al-Tamimi, RAK 2016, Chemical analysis of soil, water and plants - foundations and applications. *Shams Al-Andalus for Printing and Publishing*, University of Anbar-Iraq

[29] Agbede, TM, Ojeniyi SO, and Adeyemo AJ 2008, Effect of poultry manure on soil physical and chemical properties, growth and grain yield of sorghum in southern Nigeria. *American-Eurasian Journal of Sustainable Agriculture* 2, 72-77.

[30] Abu Dahi, YM, and Al-Younis MA 1988, Plant Nutrition Handbook. Baghdad University. Ministry of Higher Education and Scientific Research. Iraq p. 411.

[31] Nur, D, Selcuk G, and Yuksel T 2006, Effect of organic manure application and solarization of soil microbial biomass and enzyme activities under greenhouse conditions. *Biological Agriculture & Horticulture* 23, 305-320.

[32] Taiz, L, and Zeiger E 2006, Plant Physiology. 4th ed. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts.

[33] Al-Bayati, HJM, and Kamel TJ 2016, The role of soil mulching and organic fertilizer in improving the vegetative growth and yield of cucumber plants. *Cucumis sativus* L growing under an unheated greenhouse. *Karbala Scientific Journal* 14(1), 12-21.

[34] Al-Sahaf, FH, and Atee AS 2007, Potato production by organic farming - 3. Effect of organic fertilization and mulch on plant growth, yield and tubers qualitative characteristics. *Iraqi Journal of Agricultural Sciences* 38(4), 65-82.

[35] Mahmood, JT, and Salman NA 2019, Effect of organic manure source and the level of mineral fertilizer on concentrations of N, P and K in leaves and total yield potato (*Solanum tuberosum* L.). *Rafidain Agriculture Journal* 47(3), 432-440.
[36] Burger, M, and Jackson LE 2003, Microbial immobilization of ammonium and nitrate in relation to ammonification and nitrification rates in organic and conventional cropping systems. *Soil Biology and Biochemistry* **35**, 29–36.

[37] Al-Sahaf, FH, Ati AS, and Mosleh OH 2009, Use of Manure and Whey qualities and their impact on quality, amino acids and nitrates of the potato. *Anbar Journal of Agricultural Sciences* 7(4),172-188.

[38] Matar, HM, Mahmoud SA, and Ramadan AF 2012, Effect of the treatment by gibberellic acid and liquorice extract on growth and yield to potatoes. *Diyala Journal of Agricultural Sciences* **4** (1), 220–234.