

**EFFECT OF ORGANIC MANURE WITH BIOFERTILIZERS ON GROWTH,
FLOWERING AND CHEMICAL COMPONENTS OF
Echinacea purpurea (L.) MOENCH PLANT**

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By

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ABSTRACT

The performance of organic manure with biofertilizers was compared with chemical fertilizer in two successive seasons of 2005/2006 and 2006/2007 at the experimental area of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, Egypt to investigate the possibility of organic manure with biofertilizer utilization instead of chemical fertilizers. The obtained results indicated that vegetative, flowering and rooting growth parameters, NPK and chicoric acid content were augmented on the application of organic manure with biofertilizers especially when chicken manure + *Azospirillum lipoferum* + *Bacillus megatherium* treatment was used as compared to NPK as chemical fertilizer treatment.

Key words: *Echinacea purpurea*, biofertilizers, organic fertilizers.

1. INTRODUCTION

Echinacea purpurea (L.) Moench is a perennial medicinal herb, known as the purple coneflower, belonging to the Asteraceae family. It has gained an economic importance as a medicinal and ornamental plant. *Echinacea* extracts have been used by Native Americans as pain killer, snakebite treatment, and cold remedy for centuries. It has been used for its antibiotic and immunostimulatory properties (Kindscher, 1989). Using organic fertilization to increase yield and quality is more acceptable than chemical fertilizer, especially in medicinal and aromatic plants. (Abou El-Fadl *et al.*, 1990). Also *Echinacea* extracts showed antioxidative, antibacterial, antiviral, antifungal properties and are used for treating common cold, respiratory and urinary diseases (Barrett, 2003).

Numerous studies using organic and biofertilizers have been undertaken to improve growth, yield and active components in anise (Safwat *et al.*, 2001), cumin (Safwat and Badran, 2002), fennel (Badran and Safwat, 2004 and Azzaz *et al.*, 2009), *Rosmarinus officinalis* (Abd El Aziz *et al.*, 2007) and *Borago officinalis* and *Echium vulgare* (Hendawy and El Gengaihi, 2010).

Hendawy (1995), investigated the effect of chemical fertilizers on *Echinacea purpurea* plant while (Rashad, 1999), studied the effect of

different organic fertilizers on the same plant on growth, yield and active components. But the use of organic manure with biofertilizers has not been extensively used in *Echinacea purpurea* cultivation. Therefore, the objective of this study was to evaluate the effect of organic manures with biofertilizers in comparison with chemical fertilizers on growth, flowering and chemical components of *Echinacea purpurea* plant.

2. MATERIALS AND METHODS

Two successive field experiments were established during seasons of 2005/2006 and 2006/2007, at the Experimental Area of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, Egypt, to study the influence of organic manure with biofertilizers in comparison with chemical fertilizers on growth, NPK, and chicoric acid content of *Echinacea purpurea* (L.) Moench plant.

2.1. Seed source

A seed lot was obtained from the United States of America.

2.2. Cultivation

Seeds of *Echinacea purpurea* were sown inside the greenhouse in clay soil on the first of November. The seedlings were transplanted to the field on the first of April 2006 and 2007 in both seasons, respectively.

The area of the experimental plot was 4 m² consisted of 3 rows, the planting distance was 30 cm apart and each plot contained 18 plants.

2.3. The soil used

The physical and chemical characteristics of the soil used are presented in Table (1), and chemical analyses of the organic manures are shown in Table (2).

Biofertilizers were kindly obtained from The Department of Microbiology, National Research Center.

Treatments were as follows:

- 1- Control (NPK recommended doses).
- 2- FYM + *Azospirillum lipoferum*.
- 3- FYM+ *Bacillus megatherium*.
- 4- FYM+ *Azospirillum lipoferum* + *Bacillus*

Table (1): Some physical and chemical characteristics of the soil of the experimental field during the two seasons of 2005/2006 and 2006/2007

| Texture | pH | E.c.(ds/m) | CaCO ₃ % | Available nutrients (ppm) | | | Water soluble ions (meq/l) | | | | |
|-----------|-----|------------|---------------------|---------------------------|----|------|----------------------------|-----|------------------|----|-----------------|
| | | | | Total N | P | K | Ca | Mg | HCO ₃ | CL | SO ₄ |
| Sand Loam | 8.2 | 2.3 | 2.9 | 473 | 35 | 31.4 | 12 | 7.9 | 4.1 | 10 | 21.3 |

Table (2): Some physical and chemical properties of the organic manure during the two seasons of 2005/2006 and 2006/2007:

| Organic manure type | pH | Ec m.mohs | Organic matter (%) | C/N ratio | N (%) | P (%) | K (%) |
|---------------------|------|-----------|--------------------|-----------|-------|-------|-------|
| FYM | 7.30 | 5.0 | 33.2 | 18.4 | 1.90 | 0.54 | 0.7 |
| CH.M | 7.41 | 3.8 | 28.0 | --- | 2.46 | 0.77 | 1.4 |
| Compost | 7.49 | 4.4 | 35.0 | 18.95 | 2.00 | 0.66 | 1.0 |

FYM: Farm Yard Manure. CH.M: Chicken Manure Compost: Nile Compost.

2.4. Fertilization

Three resources of fertilization were used.

2.4.1. Chemical fertilizers as a control treatment

The recommended doses on *Echinacea purpurea* plant were added as follows:

150 kg ammonium sulphate (20.5%N) + 100 kg calcium superphosphate (15.5%P₂O₅) + 100 kg potassium sulphate (48%K₂O) per feddan, in three doses, the first one, month after transplanting, the second, two weeks later and the third dose, two weeks after the second one (Hendawy, 1995).

2.4.2. Organic fertilizers

The amounts of organic fertilizers were calculated according to their content of nitrogen which must be equal to that found in the amount of ammonium sulphate recommended as chemical fertilizer as follows:

1.62 ton Farm Yard Manure (FYM), 1.16 ton chicken manure (CH M) and 1.52 ton compost per feddan were added during soil preparation.

2.4.3. Biofertilizers

Bacillus megatherium (B), *Azospirillum lipoferum* (A), and a mixture of them, (2.5 L of the used strain + 22.5L Tap water) / Feddan were added to the soil surface beside plants after a month from transplantation.

megatherium.

5- CH.M+ *Azospirillum lipoferum*.

6- CH.M+ *Bacillus megatherium*.

7- CH.M+ *Azospirillum lipoferum* + *Bacillus megatherium*.

8- Compost + *Azospirillum lipoferum*.

9- Compost + *Bacillus megatherium*.

10-Compost + *Azospirillum lipoferum* + *Bacillus megatherium*

2.5. Experimental design

The experimental treatments were a randomized complete block design with three replicates. The statistical analysis was carried out using the method of (Snedecor and Cochran, 1982). Means were compared by Duncan's multiple range test at 5% level of probability in the seasons of experiment.

2.6. Data recorded

The following data were recorded at the maturity stage, when 70% of the flowers bloomed and seeds started to be mature:

2.6.1. Vegetative growth characters

- 1- Plant height (cm).
- 2- Number of branches/plant.
- 3- Number of flowers / plant
- 4- Number of suckers/plant.
- 5- Root length (cm).
- 6- Aerial parts fresh and dry weights (g)/plant
- 7- Flowers fresh and dry weight g/plant.
- 8- Roots fresh and dry weight g/plant.

2.6.2. NPK content % of dry matter of herb, flower heads and roots according to the described methods of Cottenie *et al.*, 1982).

2.6.3. Chicoric acid content (% of dry matter) as a caffeic acid derivative according to (Bauer and Wagner, 1988).

3. RESULTS AND DISCUSSION

3.1. Vegetative, flowering and rooting growth

The data presented in Tables (3) and (4) show that, all organic manures with biofertilizers treatments significantly increased the vegetative, flowering and rooting growth parameters, and fresh and dry weights of *Echinacea purpurea* plant, compared with the chemical fertilizer treatment in the two seasons respectively.

Treating *Echinacea purpurea* plant with organic manure + a mixture of biofertilizers gave the highest vegetative, flowering and rooting growth parameters, and the highest fresh and dry weights per plant, followed by treatments fertilized with organic manure + one strain of biofertilizer. While the lowest vegetative, flowering and rooting growth parameters were occurred the chemical fertilizer treatment.

The highest values were 61.8 and 59.3 cm for plant height, 15.7 and 15.7 number of branches, 49.7 and 52.3 number of flowers, 7.67 and 7.00 number of suckers, 24.6 and 24.4 cm root length, , obtained from CH.M+ *Azospirillum lipoferum* + *Bacillus megatherium* in the two seasons respectively. The same results of organic

Table (3): Effect of organic manure with biofertilizer on vegetative, flowering and rooting growth of *Echinacea purpurea* plants in the first season 2005/2006.

| Treatments | Plant height cm | No. of branches /plant | No. of flowers /plant | No. of suckers /plant | Aerial parts g/plant | | Flowers weight g/plant | | Root length | Roots weight g/plant | |
|-------------|-----------------|------------------------|-----------------------|-----------------------|----------------------|---------|------------------------|---------|-------------|----------------------|---------|
| | | | | | Fresh wt. | Dry wt. | Fresh wt. | Dry wt. | | Fresh wt. | Dry wt. |
| NPK | 42.2e | 11.7c | 37.7e | 5.0c | 104.9a | 30.4c | 150.3e | 40.8f | 18.0f | 32.4e | 10.5d |
| FYM+A | 43.6e | 12.3c | 43.0c | 5.67c | 125a | 38.5abc | 165.6d | 42.2ef | 19.5de | 46.2c | 14.6bc |
| FYM+B | 44.5de | 12.3c | 42.7c | 5.33c | 116.5a | 33.3bc | 158.3de | 42.3ef | 18.7ef | 40.9d | 12.7cd |
| FYM+A+B | 47.4d | 14.3b | 48.3a | 7.0ab | 126.5a | 38.3abc | 203.6b | 55.4bc | 23.6b | 53.7ab | 16.6ab |
| CHM+A | 53.0c | 12.3c | 41.0d | 5.67c | 155a | 39.1abc | 211.0b | 54.2c | 22.0c | 52.4ab | 16.1ab |
| CHM+B | 52.0c | 12.0c | 42.7c | 5.00c | 148.8a | 40.7ab | 200.0bc | 50.3d | 19.8d | 52.0ab | 16.0ab |
| CHM+A+B | 61.8a | 15.7a | 49.7a | 7.67a | 174.5a | 45.9a | 234.0a | 58.9a | 24.6a | 56.9a | 17.3a |
| Compost +A | 52.9c | 12.7c | 45.7b | 5.67c | 135a | 38.5abc | 191.3c | 52.1cd | 19.3de | 49.5bc | 15.9ab |
| Compost+B | 45.4de | 12.0c | 38.3e | 6.67b | 122.7a | 40.5ab | 164.3d | 44.6e | 18.9ef | 39.6d | 12.4cd |
| Compost+A+B | 58.1b | 15.3ab | 49.3a | 6.67b | 157.7a | 44.7ab | 224.0a | 57.7ab | 24.5a | 54.2ab | 17.1a |

Mean values followed by the same letter within the treatments are not significantly different at 5% according to Duncan's multiple range tests. NPK:Recommended dose FYM:Farm Yard Manure CHM: Chicken Manure A: Azospirillum lipoferum B: Bacillus megatherium Compost: Nile Compost

Table (4): Effect of organic manure with biofertilizer and biofertilizer on vegetative, flowering and rooting growth of *Echinacea purpurea* plants in the second season 2006/2007.

| Treatments | Plant height cm | No. of branches /plant | No. of flowers /plant | No. of suckers /plant | Aerial parts g/plant | | Flowers weight g/plant | | Root length cm | Roots weight g/plant | |
|-------------|-----------------|------------------------|-----------------------|-----------------------|----------------------|---------|------------------------|---------|----------------|----------------------|---------|
| | | | | | Fresh wt. | Dry wt. | Fresh wt. | Dry wt. | | Fresh wt. | Dry wt. |
| NPK | 41.17e | 11.00d | 37.7e | 4.67cd | 110.4f | 26.7d | 144.7h | 36.6f | 17.4d | 29.4f | 7.82e |
| FYM+A | 43.0De | 11.33c | 40.3d | 5.00bcd | 120.7e | 28.6d | 162.6f | 40.2e | 18.4cd | 43.2cd | 9.69d |
| FYM+B | 43.5De | 11.00c | 37.00e | 4.33d | 123.5e | 37.4b | 155.3g | 39.1ef | 18.4cd | 37.9de | 12.9bc |
| FYM+A+B | 47.3cd | 11.33c | 48.7b | 6.00abc | 133.3d | 36.8b | 201.6d | 52.3bc | 22.3b | 49.4ab | 13.7ab |
| CHM+A | 52.5b | 11.7c | 45.0c | 5.00bcd | 151.7b | 36.4b | 207.3c | 51.2c | 21.00b | 49.4ab | 13.6ab |
| CHM+B | 51.3bc | 13.7b | 42.0d | 4.33d | 144.4c | 35.4bc | 198.8d | 46.9d | 19.2c | 49.0abc | 13.1abc |
| CHM+A+B | 59.3a | 15.7a | 52.3a | 7.00a | 169.2a | 43.6a | 230.0a | 55.9a | 24.4a | 53.9a | 15.0a |
| Compost+A | 52.0b | 11.7c | 42.3d | 5.00bcd | 126.3e | 34.3bc | 186.2e | 50.8c | 18.7cd | 46.5bc | 11.6c |
| Compost+B | 44.7de | 12.00c | 42.0d | 6.00abc | 120.7e | 31.0cd | 161.4f | 41.6e | 18.3cd | 36.6e | 9.4de |
| Compost+A+B | 57.7a | 15.33a | 49.0b | 6.33ab | 153.3b | 42.2a | 222.2b | 54.7ab | 24.00a | 51.2ab | 14.8ab |

Mean values followed by the same letter within the treatments are not significantly different at 5% according to Duncan's multiple range tests. NPK:Recommended dose FYM:Farm Yard Manure CHM: Chicken Manure A: Azospirillum lipoferum B: Bacillus megatherium Compost: Nile Compost

fertilization treatment have been reported by El-Gengaihi and Abdallah (1982), El-Sayed (1985) and Li, (1996).

3.2. N, P and K content

The obtained data in Tables (5) and (6) indicate that organic manure + a mixture of biofertilizers treatment led to a significant increment in N, P and K % content compared with the other treatments under the same organic manure in the two seasons.

strain of biofertilizer. While the lowest values of N P and K% content were obtained by treating plants with chemical fertilizer alone.

The highest values of nitrogen were 2.19 and 2.19% in herb, 2.52 and 2.48% in flower heads and 2.89 and 2.91% in roots. Also the highest values of phosphorous in herb were 0.39 and 0.35%, in flower heads 0.42 and 0.39% and 0.62 and 0.59% in roots and the highest values of potassium were 3.32 and 3.31% in herb, 3.52 and

Table (5): Effects of organic manure with biofertilizer on N, P and K content % in different plant organs at the first season 2005/2006.

| Treatments | Herb | | | Flower Heads | | | Roots | | |
|--------------------|-------|---------|--------|--------------|----------|--------|--------|---------|---------|
| | %N | % P | %K | %N | % P | %K | %N | % P | %K |
| NPK | 1.66f | 0.31c | 2.25h | 1.84f | 0.32d | 3.16d | 2.73cd | 0.50cde | 1.42e |
| FYM+A | 1.67f | 0.33bc | 2.53f | 1.88f | 0.34bcd | 3.18d | 2.74c | 0.47de | 1.44de |
| FYM+B | 1.81e | 0.29c | 2.33g | 2.06d | 0.33cd | 3.41b | 2.66e | 0.44e | 1.46cde |
| FYM+A+B | 2.03c | 0.35abc | 2.96cd | 2.14c | 0.37abcd | 3.37bc | 2.76bc | 0.53bc | 1.47cde |
| CHM+A | 1.94d | 0.34abc | 3.00c | 2.23b | 0.39abc | 3.36bc | 2.76bc | 0.55bc | 1.51bc |
| CHM+B | 1.93d | 0.30c | 2.91d | 2.07d | 0.34bcd | 3.21d | 2.66e | 0.52bcd | 1.49bcd |
| CHM+A+B | 2.19a | 0.39a | 3.32a | 2.52a | 0.42a | 3.52a | 2.89a | 0.62a | 1.65a |
| Compost+A | 1.83e | 0.33bc | 2.75e | 2.04d | 0.34bcd | 3.36bc | 2.74c | 0.51bcd | 1.46cde |
| Compost+B | 1.79e | 0.30c | 2.27gh | 1.98e | 0.37abcd | 3.34c | 2.68de | 0.53bc | 1.47cde |
| Compost+A+B | 2.11b | 0.37ab | 3.25b | 2.24b | 0.40ab | 3.49a | 2.81b | 0.57ab | 1.54b |

Mean values followed by the same letter within the treatments are not significantly different at 5% according to Duncan's multiple range tests. **NPK**:Recommended dose **FYM**:Farm Yard Manure **CHM**: Chicken Manure **A**: *Azospirillum lipoferum* **B**: *Bacillus megatherium* **Compost**: Nile Compost

Table (6): Effects of organic manure with biofertilizer on N, P and K content %in different plant organs at the second season 2006/2007.

| Treatments | Herb | | | flower Heads | | | Roots | | |
|--------------------|-------|---------|--------|--------------|--------|--------|--------|---------|---------|
| | %N | % P | %K | %N | % P | %K | %N | % P | %K |
| NPK | 1.63f | 0.27d | 2.14h | 1.82g | 0.31b | 3.14f | 2.62f | 0.44d | 1.43d |
| FYM+A | 1.65f | 0.28cd | 2.49f | 2.06cd | 0.31b | 3.16ef | 2.69de | 0.51bc | 1.45cd |
| FYM+B | 1.80e | 0.31bcd | 2.28g | 1.91f | 0.34b | 3.39c | 2.65ef | 0.45cd | 1.4cd |
| FYM+A+B | 2.01c | 0.34ab | 2.96cd | 2.11c | 0.35b | 3.36cd | 2.70de | 0.52b | 1.48bcd |
| CHM+A | 1.89d | 0.33abc | 2.10c | 2.22b | 0.35b | 3.35cd | 2.76bc | 0.52b | 1.50bc |
| CHM+B | 1.87d | 0.28cd | 2.90d | 2.06cd | 0.33b | 3.21e | 2.65ef | 0.51bc | 1.49bcd |
| CHM+A+B | 2.19a | 0.35a | 3.31a | 2.48a | 0.39a | 3.61a | 2.91a | 0.59a | 1.69a |
| Compost+A | 1.80e | 0.32bcd | 2.74e | 2.01de | 0.33b | 3.34cd | 2.72cd | 0.51bc | 1.47cd |
| Compost+B | 1.76e | 0.30bcd | 2.24g | 1.96e | 0.32b | 3.30d | 2.69de | 0.49bcd | 1.46cd |
| Compost+A+B | 2.09b | 0.35ab | 3.24b | 2.21b | 0.37ab | 3.48b | 2.81b | 0.53b | 1.52b |

Mean values followed by the same letter within the treatments are not significantly different at 5% according to Duncan's multiple range test. **NPK**:Recommended dose **FYM**:Farm Yard Manure **CHM**: Chicken Manure **A**: *Azospirillum lipoferum* **B**: *Bacillus megatherium* **Compost**: Nile Compost

Treating *Echinacea purpurea* plants with organic manure + a mixture of biofertilizers gave the highest values of N, P, and K% content per plant followed by organic manure treatment + one

3.61% in flower heads, 1.65 and 1.69% in roots (% of dry matter in the two seasons, respectively).

3.3. Chicoric acid content (as a caffiec acid derivative) % of dry matters

The data recorded in Table (7) show that all treatments fertilized by organic manure + a mixture of biofertilizers gave a significant increment of chicoric acid as compared with the same organic manure with one strain of biofertilizer in most cases in the two seasons.

Badran (2002) on cumin, Sha'alan (2005) on *Nigella sativa*, Abd El Aziz *et al.*, (2007) on *Rosmarinus officinalis*, Azzaz *et al.* (2009) on fennel, and Hendawy and El Gengaihi (2010) on *Borago officinalis* and *Echium vulgare*.

4. REFERENCES

Table (7): Effect of organic manure with biofertilizer on chicoric acid content (%) at the two seasons 2005/2006 and 2006/2007.

| Treatments | Herb | | Flower Heads | | Roots | |
|-------------|--------------|---------------|--------------|---------------|--------------|---------------|
| | First season | Second season | First season | Second season | First season | Second season |
| NPK | 1.13d | 1.09d | 1.863e | 1.86g | 1.00Fg | 1.00f |
| FYM+A | 1.15d | 1.11d | 1.92de | 1.92ef | 1.07de | 1.04ef |
| FYM+B | 1.14d | 1.11d | 1.92de | 1.91fg | 0.96g | 1.00f |
| FYM+A+B | 1.21bc | 1.19bc | 1.99c | 1.96de | 1.13bc | 1.13cd |
| CHM+A | 1.25b | 1.24b | 2.016ab | 2.04abc | 1.17b | 1.22b |
| CHM+B | 1.21bc | 1.20bc | 1.973bc | 2.01bcd | 1.11cd | 1.1bc |
| CHM+A+B | 1.33a | 1.30a | 2.06a | 2.08a | 1.30a | 1.29a |
| Compost+A | 1.21bc | 1.20bc | 2.06bc | 2.00d | 1.08cde | 1.09de |
| Compost+B | 1.18cd | 1.18c | 2.016cd | 1.98cd | 1.03ef | 1.05ef |
| Compost+A+B | 1.24b | 1.21bc | 2.103ab | 2.06ab | 1.18b | 1.21b |

Mean values followed by the same letter within the treatments are not significantly different at 5% according to Duncan's multiple range test. **NPK**:Recommended dose **FYM**:Farm Yard Manure **CHM**: Chicken Manure **A**: *Azospirillum lipoferum* **B**: *Bacillus megatherium* **Compost**: Nile Compost

The highest values of chicoric acid occurred by fertilizing plants with organic manure + a mixture of biofertilizers, but the lowest values of chicoric acid per plant occurred with chemical fertilizer treatment.

Organic fertilization had a positive effect on chicoric acid content of the plants fertilized by chicken manure with a mixture of the used strains. Results obtained were significant in the two seasons; Chicoric content was 1.33 and 1.30 in herb, 2.06 and 2.08 in flower heads, 1.30 and 1.29 % of dry matter in roots in the two seasons, respectively.

These results may be due to the great benefits of organic manure with biofertilizers on amending the plants with their requirements of nutrients.

Organic manure supply plants with continuous nutrients which improve some physical properties of the soil and increase water retention than that for chemical fertilizers (Abd Elmoez *et al.*, 1995); Filesbach *et al.*, 2000). In addition, biofertilizers increase the availability of nutrients and provide plants with promoting substances such as indole acetic acid and gibberellins (Fayez *et al.*, 1985).

The same effect of using organic manure + biofertilizers on other medicinal and aromatic plants was emphasized by Osman (2000) on coriander, Kandil, (2002) on fennel, Safwat and

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تأثير التسميد العضوى مع التسميد الحيوى على النمو والتزهير والمكونات الكيمياءية فى نبات *الاشنسيا بوربوريا*

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ملخص

أجريت هذه الدراسة خلال موسمى 2006 /2005 ، 2006 / 2006 فى مشتل قسم بساتين الزينة – كلية الزراعة- جامعة القاهرة ، مصر .
كان الهدف من هذه الدراسة هو معرفة مدى امكانية استبدال الاسمدة الكيمياءية بالاسمدة العضوية مع الاسمدة الحيوية فى تسميد نبات *الاشنسيا بوربوريا* تم دراسة تأثير هذه الاسمدة على النمو الخضرى والزهرى ونمو الجذور ومحتوى النبات من العناصر الاساسية (النيتروجين-الفوسفور- البوتاسيوم%) وكذلك محتوى النبات من حامض الشيكوريك .
وقد أشارت النتائج الي أن النباتات التى تم معاملتها بالسماد العضوى + خليط من الاسمدة الحيوية المستخدمة أدت الى الحصول على أعلى القيم بالنسبة للنمو الخضرى والزهرى ونمو الجذور والمحتوى من العناصر الاساسية (N,P,K) وكذلك أعلى محتوى من حامض الشيكوريك % ، خاصة المعاملة بسماد الدواجن + خليط من الاسمدة الحيوية المستخدمة ، أما معاملة النباتات بالاسمدة الكيمياءية فقط. فتد أدى الى الحصول على أقل القيم بالنسبة للنمو الخضرى والزهرى ونمو الجذور ومحتوى النبات من العناصر (N,P ,K) وكذلك حامض الشيكوريك.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (61) العدد الرابع (أكتوبر 2010):415-421.