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# EFFECT OF SOME BIO-FERTILIZERS ON GROWTH AND PRODUCTIVTY OF CUCUMBER PLANTS GROWTH UNDER PLASTIC HOUSE CONDITIONS

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## ABSTRACT

Two field experiments were conducted at Sakha Protected Cultivation Site, Kafr El-Sheikh Governorate during 2003 and 2004 seasons to study the effect of some bio-fertilizers application on growth, productivity and quality of cucumber fruits. The used bio-fertilizers were Microbeine, Nitrobeine and Phosphorine by the rate of 1 kg/plastic house/880 $m^2$) from each one, compared to normal recommended fertilizer as a control.

The obtained results showed that bio-fertilizers significantly improved the vegetative traits of cucumber plants namely (stem length, number of branches and number of leaves total). The highest values of vegetative trait and yield were obtained from application of phosphorine. Application addition of Phosphorine significantly increased number of fruits and yield compared with the plants which received Microbeine and Nitrobeine. The lowest trait yield and the lowest number of fruits were achieved with normal recommended fertilizer application. Best results for i.e., fruit quality characters (fruit length, fruit diameter) and dry matter, content were obtained with cucumber plants which received Phosphorine.

## INTRODUCTION

Cucumber is one of the most important vegetables which showed great success in the protected agriculture. The increase in crop production through plastic culture is mainly an export oriented process meeting the demand of the increasing Egyptian population consequently, increases the consumption. The crop production and quality which can be improved through using healthy and high quality seedlings in addition to application of bio-fertilizer to the soil.

Microbeine is nitrogenous bio-fertilizer, containing nitrogen-fixing bacteria like Rhizobium. Microbeine also improves the vegetative growth of plants compared with no-bio-fertilizer *(Abdalla et al., 2001* and *El-Shazly and Darwish 2001)*. A bio-fertilizer is a commercial compound containing active phosphate-dissolving bacteria, has the ability to converse the insoluble tricalcium phosphate to the soluble mono-calcium phosphate, supplying the plant with its needs during different growth stages. The present study was initiated to elucidate the beneficial effect of using the bio-fertilizers on growth, yield and fruit quality of cucumber plants under plastic-house conditions *(Radwan, 1997)*.

*Ragab, (1998)* Stated that bio-fertilizers drew the attention as a partial good alternative to N fertilizer, application. In addition, bio-fertilizers have many merits *i.e.*, supply part of plant N requirement by 25% increasing the availability of nutrients, reduce the environmental pollution, control the vegetative growth, and improve the yield potential of cucumber transplants.

Bio-fertilizers have a significant effect may be due to the effect of using different strain groups such as nitrogen fixers, nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted material and increased levels of extractable N, P, K, Fe, Zn and Mn *(El-Karamany et al., 2000)*. Bio-fertilizer application improves plant growth, fruit yield and chemical composition, as compared with the untreated plants (*Abdalla et al., 2001* on pepper plants and *Abd El-Mouty et al., (2001)* on potato plants). Application of NPK with bio-fertilizer resulted in the best growth and total yield of garlic plants *(Ali et al., 2001)*.

The aim of the work was to study the effect of some bio-fertilizer application on vegetative growth, fruits productivity and quality of cucumber plants under plastic houses conditions.

## MATERIALS AND METHODS

The present investigation was carried out at Sakha Protected Cultivation Site, Kafr El-Sheikh Governorate during two spring seasons of 2003 and 2004 to study the influence of some bio-fertilizers (Microbeine, Nitrobeine and Phosphorine) on cucumber growth and productivity under plastic house conditions (double plastic-house, its area 880 $m^2$).

Soil analysis was carried out according to the standard methods that outlined by *Black (1983)* and *Weaterman (1990)* and the data are listed in Table (1).

**Table 1: Analysis of soil of the experimental plots.**

| Soil Properties | 2003 season | 2004 season |
|---|---|---|
| **Mechanical analysis:** | | |
| Sand, % | 32.4 | 33.4 |
| Silt, % | 29.8 | 28.2 |
| Clay, % | 37.8 | 38.4 |
| Texture | Clay | Clay |
| **Chemical analysis:** | | |
| $CaCo_3$, % | 1.7 | 2 |
| Organic matter | 3.11 | 2.86 |
| Total nitrogen, % | 0.156 | 0.143 |
| Soil concentration, ppm | 2125 | 2285 |
| Ec, mmhos/cm | 3.32 | 3.57 |
| pH, | 7.60 | 7.9 |
| Soluble N, (mg/100 g) | 34 | 32 |
| Soluble P, (mg/100 g) | 1.4 | 1.3 |
| Soluble K, (mg/100 g) | 17 | 16 |

The experimental design was a completely randomized block design with four replicates. The treatments were as follows:

1. Control (no bio-fertilizer).
2. Soil addition of Microbeine at 1 kg/plastic house.
3. Soil addition of Nitrobeine at 1 kg/plastic house.
4. Soil addition of Phosphorine at 1 kg/plastic house.

**Nitrobeine:** a set of non-symbiotic N- Fixing bacteria (*Azospirillium sp. Azotobacter sp.*)

**Phosphorine:** a set of P-dissolving bacteria (*Bacillus megatheruim var, phosphaticum*).

**Microbeine:** group of N- fixers and phosphate dissolvers.

In both seasons, seeds of cv. Delta Star $F_1$ were sown on the 15th of January in seedling trays. Seedling were transplanted on 13th of February in both experimental seasons. Dauble rows have been planted on each ridge with a distance of 50 cm between rows and 50 cm between plants within the row. The plastic house was divided into ten raised ridges for cultivation, each of them was 100 cm wide, 20 cm height and 50 cm apart. The treatments were arranged in complete randomized plots in four replicates, managements and fertigation techniques were carried out as recommended at the Sakha Site, Ministry of Agriculture, Egypt.

Vegetative trait of the cucumber plants were recorded after 80 days from transplanting using five plants from each plot.. The number of leaves and branches per plant, stem length ( from the ground surface to the top of the plant), per plant as well as total chlorophyll was determined. Chlorophyll fractions in leaves were estimated in the fifth leaf from the growing tip of 10 plants by a spectrophotometer by using N, N- dimethyl formamide according to the methods of *Moran and Porath (1980) and Moran (1982).*

Fruits were harvested successively at regular intervals of two days over 10 weeks period. weight and number of fruits per plot were calculated. The sum of all pickings was expressed as total fruit yield ($kg/m^2$). A random sample of 5 fruits was taken from each plot to measure fruit length and diameter, dry matter and total soluble solids (TSS). Data were statistically analyzed according to procedures of *Snedecor and Cochran (1980).*

## RESULTS AND DISCUSSION

**Effect of bio-fertilizers on vegetative growth:**

Data in Table (2) indicated that the bio-fertilizers significantly affected cucumber growth; *i.e.:* stem length, number of branches and leaves, plant. The highest value of cucumber growth characters was recorded with the treatment which received Phosphorine bio-fertilizer compared with the other bio-fertilizers during 2003 and 2004 seasons. On the other hand, the lowest value was obtained from the control plants. The significant effect of bio-fertilizers may be due to the effect of different strain groups and nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted material and increased levels of extractable minerals *(El-Kramany et al., 2000).* However, application of bio-fertilizer encouraged plant growth characters of many crops, as recorded by *Mansour, (1998); El-Kramany et al., (2000); Rizk and Shafeek (2000) and Adam, (2002)* on vicia faba, *Abdalla et al., (2001). Adam et al., (2001)* on pepper, *Abdel-Mouty et al., (2001)* on potato.

The promoting effect of bio-fertilizer is due to the active bacteria, Phosphorine which is capable of transforming the tri-calcium phosphate to mono-calcium phosphate *(Ashour, 1998). Sherif et al. (1997)* added that phosphate-dissolving bacteria presses the ability to bring insoluble phosphate

in soluble forms secreting organic acids such as formic, acetic and lactic acids. Such acids lower the pH and bring about the dissolution of bonds of phosphate and render them available for growing plants. It could be also concluded that application of the bio-p fertilizer named Phosphorine increased plant growth and dry matter due to enhancement of phosphorus solubilization *( El-Sheekh, 1997)* the effect of bio-fertilizer may be due to the effect of nutrients mobilizing microorganisms which help in availability of metals and increased levels of extractable minerals *(El-Kramany et al., 2000)*.

**Table (2): Effect of the different bio-fertilizers on the vegetative trail characters of cucumber plants during 2003 and 2004 seasons**

| Treatments | Stem length, cm | | No. of branches/plant | | No. of leaves/plant | |
|---|---|---|---|---|---|---|
| | 2003 | 2004 | 2003 | 2004 | 2003 | 2004 |
| Control | 300.25 | 240.67 | 3.28 | 2.38 | 50.75 | 36.32 |
| Microbeine | 325.17 | 260.33 | 7.36 | 5.69 | 64.75 | 46.00 |
| Nitrobeine | 340.92 | 276.33 | 6.76 | 5.16 | 62.28 | 44.60 |
| Phosphoreine | 354.72 | 285.00 | 9.19 | 6.97 | 67.83 | 47.22 |
| L.S.D 0.05 | 11.74 | 10.72 | 1.26 | 1.23 | 3.07 | 2.82 |

The data also showed that the obtained mean values of cucumber growth characters, throughout the 2003 agricultural season were higher than those which were recorded during the following agriculture season 2004 for all the different bio-fertilizers as demonstrated in Table (2). This trend may be attributed to shot the soil was rich with the nutrients macro-and microorganisms which increased levels of extractable minerals as well as decreasing the pH and Ec in the first season (2003) compared to the second season (2004).

Generally, the cucumber plants which were received 1 kg of Phosphorine/plastic house gave the maximum mean values of vegetative traits followed by Microbeine and Nitrobeine while, the control treatment gave the lowest values of all studied traits..

Finally, the various effect of bio-fertilizers on growth, nutritional status of the plants and productivity could be due to :

Encourage the uptake of various elements,

Activate the photosynthesis process and both cell division and cell enlargement, reducing pests and diseases. All of these merits greatly affect the yield and advance fruit ripening *(Mansour, 1998)*

**Effect of bio-fertilizer on cucumber yield:**

The presented data in Table (3) show that the impact of different bio-fertilizers on fruit yield during the two successive planting seasons of 2003 and 2004. Each of fruit yield and number of fruits was positively affected with the application of Microbeine, Nitrobeine and Phosphorine throughout the two seasons of 2003 and 2004. Significant differences were observed on fruit yield and number of fruits between the plants which received bio-fertilizer and the control.

Table (3): Effect of the different bio-fertilizers on the fruits yield and number of fruits in 2003 and 2004 seasons

| Treatments | Fruit yield (kg/plant) | | Fruit yield (kg/m$^2$) | | No. of fruits/plant | | No. of fruits/m$^2$ | |
|---|---|---|---|---|---|---|---|---|
| | 2003 | 2004 | 2003 | 2004 | 2003 | 2004 | 2003 | 2004 |
| Control | 2.523 | 1.280 | 6.310 | 3.203 | 29.51 | 14.97 | 71.43 | 37.423 |
| Microbeine | 4.423 | 3.293 | 10.09 | 8.230 | 40.123 | 30.180 | 100.303 | 75.447 |
| Nitrobeine | 3.930 | 2.550 | 9.830 | 6.370 | 38.893 | 29.973 | 99.727 | 70.933 |
| Phosphoreine | 4.987 | 3.647 | 11.71 | 8.810 | 42.940 | 33.730 | 105.147 | 96.820 |
| L.S.D 0.05 | 0.417 | 0.320 | 1.31 | 1.096 | 6.16 | 3.17 | 12.26 | 8.91 |

It is evident from the data listed in Table 3 that the maximum values of cucumber yield (11.71 kg/m$^2$) and number of fruits (105.15 fruits/m$^2$) were accomplished with application of Phosphorine bio-fertilizer as compared with the Microbeine and Nitrobeine bio-fertilizers during 2003 season. The lowest value of trait yield (6.0 kg/m$^2$) was achieved with the treatment control throughout 2004 season. This effect of Phosphorine on the yield of cucumber was shown in two experimental seasons. The positive effect of bio-fertilizer on the cucumber yield is an expected result for its effect on improving plant growth *( El-Kalla et al., 1999* and *Abdel-Mouty et al., 2001)*. The response of cucumber plants for bio-fertilizers application was higher during 2003 season as compared to 2004 season. This trend might be attributed to the increase of soluble nitrogen, phosphor and potassium in the tested soil during 2003 season compared with the following season 2004 as shown in Table (1).

**Effect of bio-fertizers on fruits quality:**

Results presented in Table 4 indicate that cucumber fruit quality such as fruit length and diameter, dry matter and total soluble solids which were affected by the bio-fertilizers. Data illustrated that all treatments significantly increased the quality of cucumber fruits compared with the control.

The largest values of fruit length (19.3 cm), fruit diameter (4.37 cm), dry matter (4.9 %) and TSS% (4.93%) were produced in plants which received 1 kg/plastic house Phosphorine bio-fertilizer followed by the plants which received 1 kg/plastic house from Microbeine and Nitrobeine bio-fertilizers, respectively, during 2003 season. However, the lowest values of fruit quality: 15.2 cm fruit length, 3.06 cm fruit diameter, 3.62% dry matter and 3.0% TSS% were obtained with the control treatment during 2004 season..

Table (4): Effect of different bio-fertilizers on the cucumber quality during 2003 and 2004 seasons

| Treatments | Fruit length (cm) | | Fruit diameter (cm) | | Dry matter (%) | | TSS% | |
|---|---|---|---|---|---|---|---|---|
| | 2003 | 2004 | 2003 | 2004 | 2003 | 2004 | 2003 | 2004 |
| Control | 16.267 | 15.177 | 3.533 | 3.063 | 4.200 | 3.620 | 4.167 | 3.00 |
| Microbeine | 18.733 | 16.693 | 4.000 | 3.413 | 4.733 | 4.320 | 4.633 | 3.300 |
| Nitrobeine | 18.000 | 16.050 | 3.633 | 3.290 | 4.300 | 4.077 | 4.200 | 3.167 |
| Phosphoreine | 19.267 | 17.877 | 4.367 | 3.420 | 4.900 | 4.580 | 4.933 | 3.633 |
| L.S.D 0.05 | 1.068 | 0.908 | 0.264 | 0.377 | 0.447 | 0.326 | 0.485 | 0.235 |

**Effect of bio-fertilizers on the total chlorophyll:**

Data in Table (5) demonstrated the effect of bio-fertilizers on the total chlorophyll during the two successive seasons of 2003 and 2004. Data in Table 5 show that chlorophyll content of the leaves was not affected by the bio-fertilizer in both seasons. Phosphorine treatment tended to have the highest total chlorophyll content. However, the highest values of total chlorophyll were recorded with the cucumber plants which received Phosphorine bio-fertilizer followed by the Microbeine then Nitrobeine bio-fertilizers. But, the control treatment, which received no bio-fertilizer, gave the lowest values of total chlorophyll during botn seasons of 2003 and 2004 seasons. This trend may be due to increased absorption of the macro- and micro-nutrients which consequently, increases the photosynthesis.

**Table (5): Effect of different bio-fertilizers on chlorophyll content of number plants during 2003 and 2004 seasons**

| Treatments | Chl. (a) $\mu/cm^2$ | | Chl. (b) $\mu/cm^2$ | | Total Chl. $\mu/cm^2$ | |
|---|---|---|---|---|---|---|
| | 2003 | 2004 | 2003 | 2004 | 2003 | 2004 |
| Control | 44.897 | 40.513 | 11.020 | 9.537 | 60.293 | 48.097 |
| Microbeine | 50.833 | 52.180 | 13.260 | 11.223 | 65.187 | 54.057 |
| Nitrobeine | 48.213 | 43.187 | 12.157 | 10.120 | 60.370 | 50.307 |
| Phosphoreine | 52.747 | 52.203 | 14.120 | 12.137 | 65.867 | 55.830 |
| L.S.D 0.05 | 4.374 | 8.991 | 1.870 | 1.783 | 8.878 | 17.58 |

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# تأثير بعض الأسمدة الحيوية على نمو وإنتاجية الخيار تحت ظروف الصوب البلاستيكية

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أقيمت تجربتان حقليتان فى الصوب الزراعية – بموقع الزراعة المحمية بسخا – محافظة كفر الشيخ خلال الموسمين الزراعيين ٢٠٠٣ ، ٢٠٠٤م وذلك لدراسة تأثير ثلاثة أنواع من الأسمدة الحيوية وهى الميكروبين والنتروبين والفوسفورين بمعدل ١ كجم لكل صوبة (٨٨٠م$^{٢}$) مقارنة بالتسميد المعدنى على النمو الخضرى والإنتاجية والجودة لثمار الخيار وقد صممت التجربة بنظام القطاعات الكاملة العشوائية فى ثلاث مكررات. وكانت معاملات التجربة:-

أ. كنترول (تسميد كيماوى يوصى به فى ماء الرى)
ب. ميكروبين + تسميد كيماوى موصى به فى ماء الرى بالتنقيط.
ج. نتروبين + تسميد كيماوى موصى به فى ماء الرى بالتنقيط.
د. فوسفورين + تسميد كيماوى موصى به فى ماء الرى بالتنقيط.

**وتضمنت أهم نتائج هذه الدراسة الآتي:**

- كانت جميع الأسمدة الحيوية المستخدمة فعالة جدا فى تحسين صفات النمو الخضرى للنبات معبرا عنها بطول النبات، مساحة الورقة، عدد الأفرع، عدد الأوراق، الوزن الغض والجاف الكلى للنبات ولأجزائه المختلفة مقارنة بالسماد العضوى البلدى وكان التحسن فى هذه الصفات فى نباتات الخيار التى عوملت بالفوسفورين والميكروبين والنتروبين والسماد البلدى مرتبة ترتيبا تنازليا.
- أدت إضافة الفوسفورين كمخصب حيوى إلى زيادة معنوية فى كل من إنتاجية المحصول وعدد الثمار مقارنة بالنباتات التى عوملت بكل من الميكروبين والنتروبين وكانت أقل القيم لكل من الإنتاجية وعدد الثمار للنباتات التى عوملت بالسماد العضوى البلدى. أيضا زاد محصول الخيار ليصل إلى ٤,٦٥، ٤,٩٩ كجم/نبات وعدد الثمار ليصل إلى ٤٣ ، ٣٤ ثمرة تقريبا فى الموسم الأول والثانى على الترتيب.
- وقد أمكن الحصول على أفضل النتائج بخصوص المحتوى الكلى من الكلوروفيل (٦٥,٨٧%) وخصائص الجودة للثمار والمتمثلة فى طول الثمرة (١٧,٨٨سم) ، قطر الثمرة (٤,٢٧سم)، المادة الجافة (٤,٨%) ، المادة الجافة الذائبة (٤,٩٣%) فى نباتات الخيار المسمدة حيويا بالسماد الفوسفورين بمعدل. وكانت النتائج فى الموسم الزراعي الأول أعلى منها فى الموسم الزراعي الثانى.