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# EFFECT OF BIO AND CHEMICAL FERTILIZATION ON GROWTH AND YIELD OF ANISE PLANTS.

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## ABSTRACT

*The present experiment was conducted during 2004/2005 and 2005/2006 seasons in the Farm of Ornamental, Department, Fac. Of Agric. Cairo University, Giza, to study the effect of some bio and chemical fertilizer on growth and yield of anise plants.*

*The plants were grown in plastic pots (30 cm-diameter) using Mycorrhiza and Phosphorene individually or in combinations with or without chemical fertilizers. Superphosphate was added before sowing, while ammonium sulphate and potassium sulphate were dressed three times at 21 days intervals in both seasons. The chemical fertilizers were added with the bio fertilizer at 3 rates: NPK (1) at (9, 6 and 3 g/ pot), NPK(2) at (15, 12 and 6 g/ pot) and NPK(3) at (30, 24 and 12 g/ pot).*

*Data were recorded on growth, fruit yield, oil percentage, and oil yield and oil composition.*

*The following results were recorded:*

1- *In general, anise plants were significantly responded to bio fertilizer with or without chemical fertilizer.*
2- *Phosphorene increased the vegetative growth expressed as (plant height, number of branches, fresh and dry weight). Also, the vegetative growth was gradually increased with increasing the rate of NPK fertilizers.*
3- *Mycorrhiza increased the vegetative growth, and increased gradually with increasing the rate of NPK fertilizers.*
4- *Phosphorene plus Mycorrhiza with the third level of NPK gave the great stimulation of vegetative growth such as (plant height, number of branches, fresh and dry weight).*
5- *Bio fertilizers (Phosphorene and Mycorrhiza) each alone or together, with or without NPK produced the highest fruit yield.*
6- *The two bio fertilizers with NPK (3) gave the highest fruit yield, oil percentage, oil yield, with the highest anethole content.*

**Key words:** Bio, chemical fertilization, growth, yield, anise plants.

## INTRODUCTION

Medicinal and aromatic plants have a universe importance in the trade of pharmaceutical products in the last few years. The ancient Egyptians were pioneers in this type of herbal medicine; which is called folk medicine and still be used till now.

Among these plants, the plants belong to the Fam. *Apiaceae* such as; fenel, caraway, cumin, coriander, dill, parsley and anise which are of great importance in the kitchen spice, as well as medicinal purposes.

Anise (*Pimpinella anisum*, L.*)* is one of these umbelliferous plants, which cultivated for fruits production .The fruits contain an essential oil in specific structures (vita) and having a special favor due to anethole as the main component.

Medicinally, the oil is occasionally employed to stimulate peristalsis in cases of colic disorders (Guenther, 1961). In this concern, the use of bio fertilizers with or without chemical fertilizers was experimented by El Sawey *et al.* (1998) who obtained that a remarkably increase in growth of *Ammi visnaga* plants after inoculation with Azotobacter, Azosperilla , rock phosphate and NPK in sandy soil. The same results were obtained by; Chezhiyan *et al* (2003) found that the highest plant height, number of leaves per plant, fresh weight and dry weight per plant of *Phyllanthus amarus* plant were produced by treatments with Azospirillum+ phosphate solubilizing bacteria. Also, Shalan *et al*. (2001), on roselle plants, found that treatments by nitrobein and potassin caused highly significant increase in number of fruits per plant. Annamalai et al (2004) on *Phyllanthus amarus* found that, the highest number of branches/ plant was obtained with Azospirillum and phosphor bacteria treatment. Jai-Prakash and Kasera (2003) on *Salvadora persica* recorded the highest plant growth after the application of vesicular arbuscular Mycorrhiza (VAM).

In the same way, Migahed *et al.* (2004) on *Apium graveolens* and Shalan (2005) on *Borage officinalis*. They found that, growth characters in term of plant height, branching fresh and dry weights were stimulated by bio fertilizers.

Khalid *et al.* (2007) on rue, they found that the growth was improved with the bio fertilization.

Amin (1997) on coriander, caraway and fennel found that, bio fertilizers plus NPK gave the highest number of umbels and seed yield/ plant. Also Maheshwari *et al*. (1995) recorded that, the highest essential oil yield of palmarosa plants was recorded with treatment by bio and chemical fertilization.

The experiment had been conducted aiming to study the effect of chemical and bio fertilization on the growth, fruits yield and essential oil content under sandy soil condition.

## MATERIALS AND METHODS

A pot experiment was conducted at the Experimental farm of Ornamental, Departement, Fac. Of Agric. Cairo University, Giza during the two successive seasons 2004/2005 and 2005/2006.

This work was designed to investigate the effect of bio-fertilizer (Phosphorene and Mycorrhiza) and chemical fertilizer (NPK) alone or in combinations on the vegetative growth, fruit yield and essential oil production of anise plant (*Pimpinella anisum* L.) grown in a sandy soil. Seeds were sown in plastic pots (30 cm-diameter) filled up with a sandy soil on November 2th 2004 and October 30th 2005.

***Fertilization treatments:***

**Bio-fertilization:**

Phosphorene was mixed with seeds before sowing and Mycorrhiza was inoculated after seed sowing at one rate 2 ml/ plant (each ml contain 200 spots).

***Chemical fertilization:***

Superphosphate was added before sowing while ammonium sulphate and potassium sulphate were added 3 times at 21 days intervals in both seasons.

***Treatments:***

**The following treatments were used:**

| **Treatments** | |
|---|---|
| **Control (Without fertilizers).** | |
| **Phosphorene +** | ----- |
| | NPK (1) |
| | NPK (2) |
| | NPK (3) |
| **Mycorrhiza +** | ----- |
| | NPK (1) |
| | NPK (2) |
| | NPK (3) |
| **Pho. + Myc.** | ----- |
| | NPK (1) |
| | NPK (2) |
| | NPK (3) |

NPK (1) =9, 6 and 3 g/ pot, (2) =15, 12 and 6 g/ pot. (3) 30, 24 and 12 g/ pot.
Pho. = Phosphorene Myc. = Mycorrhiza

Each treatment was replicated 3 times and each replicate consisted of 15 pots (1 plant/ pot).

Data were recorded on growth characters at harvest date i.e. plant height, number of branches, fresh and dry weight gm/plant, fruit yield, oil percent, oil yield and oil composition.

The essential oil of anise fruits was determined according to British pharmacopeia (1963).

Oil composition was analyzed for some samples only (control, Phosphorene, Phosphorene plus NPK (3), Mycorrhiza, Mycorrhiza plus NPK(3), Phosphorene plus Mycorrhiza, Phosphorene plus Mycorrhiza plus NPK(3) using Ds Chrom 6200 Gas chromatograph with Colum Bpx_5, % phenyl polysillphenylene_ siloxane 30m x 0.25 mm ID x0.25 µ m film.

GLC analysis conditions were as follow:

Flow rate: N2 at 1ml/ min, H2 at 30 ml/ min and 330ml/min from air.

Colum temp: increase with a rate of 1$^{o}$C/ min from $^{o}$70 to 80 $^{o}$C, rate of 5 $^{o}$C/ min from $^{o}$80 to 120 $^{o}$ C/ min from 120 to 190 $^{o}$C. Inj. Tem: 300 $^{o}$C Det. Tem: 250 $^{o}$C.

The experiment was designed in complete randomized blocks, and the recorded data were statistically analyzed according to Snedecor and Cochran (1968), using new L. S. D. at 5%.

## RESULTS AND DISCUSSION

### Effect of chemical and Bio fertilization on:

***I- Vegetative growth:***

Data on vegetative growth revealed that, all the treatments of chemical and bio fertilizers alone or in combinations significantly increased all the vegetative growth characters of anise plant in the two seasons (Table 1).

**1-Plant height:**

***Effect of Phosphorene:***

Generally, It is obvious that, Phosphorene alone or plus NPK at all rates significantly increased the plant height compared to the control in both seasons. The plant height increases gradually with increasing the rate of NPK fertilizers. The tallest plants were produced by treating the plants with Phosphorene and NPK at the rate of 30:24:12 g/ pot.

***Effect of Mycorrhiza:***

As for Mycorrhiza, it is found that, in sandy soil, Mycorrhiza alone or with NPK fertilizer has a significant effect on plant height in both seasons. Increasing NPK rate with Mycorrhiza resulted in a gradual increase in plant height.

***Effect of the combinations:***

It was also noticed that, the interaction treatment Phosphorene and Mycorrhiza plus NPK (3) was found to be the most effective treatment in this respect. Plants of this treatment were the tallest ones and attained 49.00 and 54.50 cm in front of 25.67 and 27.50 for the control plants in the first and second season, respectively.

**2- Number of branches/plant:**

***Effect of Phosphorene***

The results presented in Table 1 showed that, in both seasons, Phosphorene alone or plus NPK fertilizers promoted the branching of anise plants, compared to the control. The number of branches increases gradually with increasing the rate of NPK fertilizer. Treating the plants with Phosphorene plus NPK at the rate of (30: 24: 12 g/ plant) resulted in the greatest number of branches/ plant 9.33 and 10.00 branches/plant in comparison with control plants (5.67 and 6.00 branches/ plant ) in the two seasons, respectively.

***Effect of Mycorrhiza:***

Treatment of Mycorrhiza alone or plus NPK promoted the branching of the plants in both seasons. Treated the plants with Mycorrhiza plus NPK (2) at the rate of (15: 12; 6 g/ plant) gave the greatest number of branches/ plant in the two seasons 10.00 and 10.67 branches/ plant, respectively in comparison with control plants (5.67 and 6.00 branches/ plant ) in the two seasons, respectively.

***Effect of the combinations:***

As for combination treatments Phosphorene with Mycorrhiza plus NPK fertilizer, it was noticed that, anise growth showed a promotion effect due to the combination treatments, values were significantly higher than those of the control values in the two seasons. However, the highest response was obtained in case of phosphorene with Mycorrhiza plus the highest level of NPK. Plants of these treatments produced the highest values of branches/plant 11.33 and 11.67 branches/plant compared with controls (5.67 and 6.00 branches/ plant) in the two seasons, respectively.

**3- Plant fresh weight:**

***Effect of Phosphorene:***

Phosphorene and NPK treatments had highly significant effects on the fresh weight of anise plants. The fresh weight increased gradually with increasing the rate of NPK fertilizer in the tow seasons. The greatest plant fresh weight resulted from treating the plants with Phosphorene plus the third level of NPK the values were 37.33 and 39.67 g, respectively in the two seasons Table 1.

***Effect of Mycorrhiza:***

The greatest fresh weight (40.50 g) results from using Mycorrhiza plus NPK at the second level (15: 12:6 g) in the first season. While, in the second one, the greatest fresh weight (42.39 g) obtained by using Mycorrhiza plus NPK at the third level (30: 24:12 g/ plant)

***Effect of the combinations:***

The treatment of the two bio fertilization with the highest rate of NPK (30: 24: 12 g/ plant) gave the highest values 46.50 and 47.83 g/ plant in comparison with controls (19.77 and 21.83, respectively) in both seasons.

**4- Plant dry weight:**

***Effect of Phosphorene:***

Raising the rate of NPK fertilizers lead to a gradual increase in plant dry weight in the two seasons. The heaviest dry weight (7.30 and 8.07 g) results from using Phosphorene plus NPK (3) at the rate of (30: 24: 12 g/ plant) Table 1.

***Effect of Mycorrhiza*:**

Mycorrhiza alone or plus NPK fertilizer also has a significant effect on plant dry weight. The heaviest dry weights 10.99 and 11.93 g are observed as a result of supplying the plants with Mycorrhiza plus NPK (3) fertilizer at the rate of (30: 24: 12 g/ plant), respectively in the two seasons.

***Effect of the combinations:***

The heaviest dry weights 12.54 and 12.95 g, respectively are detected in the plants treated with the two bio fertilizers plus NPK at the rate of (30:24:12 g/ plant) in the two seasons.

These findings hold true in both seasons and were found to be in harmony with those of El Sawey *et al.* (1998) who found that a remarked increase in growth of *Ammi visnaga* plants after inoculation with Azotobacter, Azosperilla, rock phosphate and NPK in sandy soil.

In the same way, Migahed *et al.* (2004) on *Apium graveolens*, Shalan (2005) on *Borage officinalis*. They found that, growth characters in term of plant height, branching fresh and dry weights were stimulated by bio fertilizers.

**Fruit yield:**

It is evident that all the treatments have a positive effect on the fruit yield in both seasons. The differences between the treatments and the control are highly significant Table 2.

***Effect of Phosphorene:***

From data in Table 2, it can be noticed that treating the plants with Phosphorene alone in the sandy soil significantly increased the number of umbels/ plant, fruit yield/plant and fruit yield/ fad. over the control in both seasons. Application of NPK with Phosphorene increased the fruit yields more than Phosphorene alone. Increasing the rate of NPK gradually increased the fruit yield in the two seasons. Treating the plants with Phosphorene plus NPK at the rate of 30: 24: 12 g/ plant resulted in the greatest number of umbels/plant, fruit yield/plant and fruit yield/fed. In the first season values were 23.33 umbel/ plant, 3.86 g/ plant and 231.40 kg/ fad., while the second one value were 26.67 umbel/ plant, 6.65g/ plant and 399.00kg/ fad., for these characters, respectively.

***Effect of Mycorrhiza:***

Concerning the effect of Mycorrhiza alone or with chemical fertilizer, data reveal that, all the treatments significantly increased the (number of umbels/plant, fruit yield/plant and fruit yield/fed.) compared with control in both seasons. Treating the plants with Mycorrhiza in addition to NPK fertilizer increased the fruit yields of anise plants over Mycorrhiza alone. The occurred increase was found to be gradually with raising the chemical fertilizer rate. The greatest umbels/plant, fruit yield/plant and fruit yield/fed. were recorded in the plants received Mycorrhiza plus the third level of NPK fertilizer at the rate of (30:24:12 g/ plant).The values were 28.33 umbel/ plant, 7.78 g/ plant and 467.00 kg/ fad., respectively in the first season and 33.33 umbel/ plant, 10.95 g/ plant and 657.00 kg/ fad., respectively in the second one

***Effect of the combinations:***

Combined treatments of Phosphorene and Mycorrhiza alone or plus chemical fertilizer also significantly increased the number of umbels/plant, fruit yield/plant and fruit yield/fed. in the two seasons. Treating the plants with the two bio fertilization alone significantly, increased the fruit yield in the two seasons compared to the untreated plants. This beneficial effect was found to be so, gradually increased with increasing NPK level. In the first season the greatest number of umbels/plant, fruit yield/plant and fruit yield/ fad. were 34.00, 11.03 g/ plant and 662.00 kg/ fad., respectively while in the second one 38.33, 12.46 g/ plant and 747.40 kg/ fad. and were recorded in the plants supplied with the two bio fertilizers plus NPK(3) at the rate of (30: 24: 12 g/ plant).

Regarding the effect of bio and chemical fertilization on the yield of the tested plants. The present findings were in agreement with the findings

of Amin (1997) on coriander, caraway and fennel and Maheshwari *et al.* (1995) on palmarosa.

**Oil production:**

Data in Table 3 showed that the oil percentage, oil yield/plant and oil yield/fed. of anise plants were positively affected by Phosphorene, Mycorrhiza individually or in combination with or without NPK fertilizer.

***Effect of Phosphorene:***

Phosphorene alone or with NPK fertilizer raised the oil percentage, oil yield/plant and oil yield/ fad. compared to the control in the two seasons. The highest records in this respect were 1.59%, 0.06 ml/ plant and 3.60 L/ fad, respectively and were resulted from using Phosphorene plus the third level of NPK fertilizer in the first season. Also, in the second season the highest oil yield/plant and oil yield /fad. were 0.9 ml/ plant and 5.40 L/ fad., respectively which produced from using Phosphorene plus the third level of NPK. While, the highest oil percentage 1.58% was obtained from the plants treated with Phosphorene plus the second level of NPK.

***Effect of Mycorrhiza:***

The same trend previously showed in Phosphorene was also observed with Mycorrhiza alone or plus NPK fertilizer, in raising the oil production of anise plants. It is more effective in this concern than Phosphorene. The highest oil percentage, oil yield/plant oil yield/fed. were 1.99%, 0.15 ml/ plant and 9.00 L/ fad., respectively in the first season, and 2.05%, 0.23 ml/ plant and 13.80 L/ fad., respectively in the second one were obtained with the treatment by Mycorrhiza plus the third level of NPK.

***Effect of the combinations:***

The two bio fertilizers (Phosphorene and Mycorrhiza) alone or with the chemical fertilizer was more effective in increasing the oil percentage, oil yield/ plant and oil yield/ fad. than each of them alone. The highest oil percentage (2.05%), oil yield/plant (0.22 ml/ plant) and oil yield/ fad. (13.20 L/ fad.) were obtained from the two bio fertilizer with the second level of NPK (15:12:6 g/ pot) in the first season. In the second one the highest (oil yield/plant and oil yield/ fad.) (0.25 ml/ plant and 15 L/ fad.) were produced with the two bio fertilizers plus the third level of NPK, while the highest oil percentage 2.09% was obtained from the two bio fertilization plus the second level of NPK. These results were similar to that obtained by Kothari and Singh (1996) on *Cymbopogon winterianus* Jowitt.

**Chemical composition of oil:**

Table 4 and Figures (1 -7) showed that, GLC analysis for anise oil revealed that anethole was the main component of anise oil its percentage

**Table 4: Essential oil components percentage as affected by bio and chemical fertilizers in the second season (2005/2006) in anise plant.**

| Treatments | | Anise aldhyde | Anethole | Metheyle chavicole | Eugenole | Unidentified |
|---|---|---|---|---|---|---|
| **Control** | | **1.91** | **88.08** | **5.35** | **-** | **4.66** |
| **Phosphorene** | **------** | **1.40** | **88.99** | **5.77** | **1.53** | **2.31** |
| **+** | **NPK(3)** | **0.95** | **89.05** | **4.99** | **1.82** | **3.19** |
| **Mycorrhiza +** | **------** | **1.13** | **90.16** | **4.14** | **1.54** | **3.03** |
| | **NPK(3)** | **1.24** | **90.24** | **4.24** | **2.09** | **2.19** |
| **Pho+ Myco +** | **------** | **1.03** | **90.39** | **4.34** | **1.62** | **2.62** |
| | **NPK(3)** | **1.24** | **90.48** | **4.72** | **1.86** | **1.70** |

**NPK (1) =9, 6 and 3 g/ pot,**
**(2) =15, 12 and 6 g/ pot.**
**(3) 30, 24 and 12 g/ pot.**

**Pho. = Phosphorene**
**Myc. = Mycorrhiza**

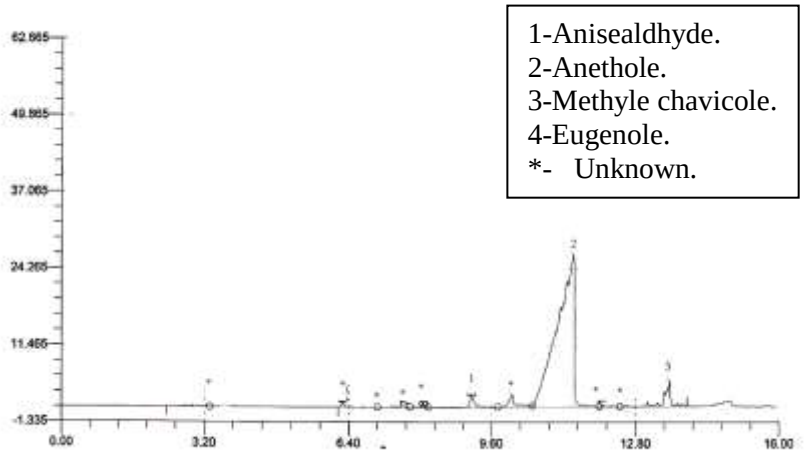


**Figure 1. GLC chromatogram of anise oil (Control).**

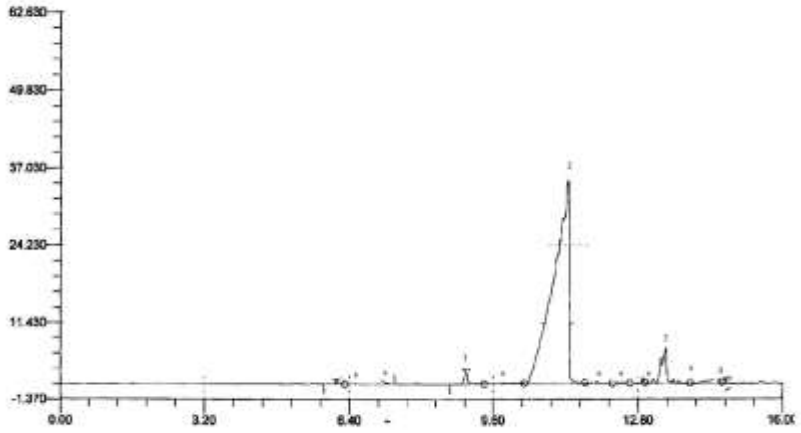


**Figure 2. GLC chromatogram of anise oil (Phosphorene).**

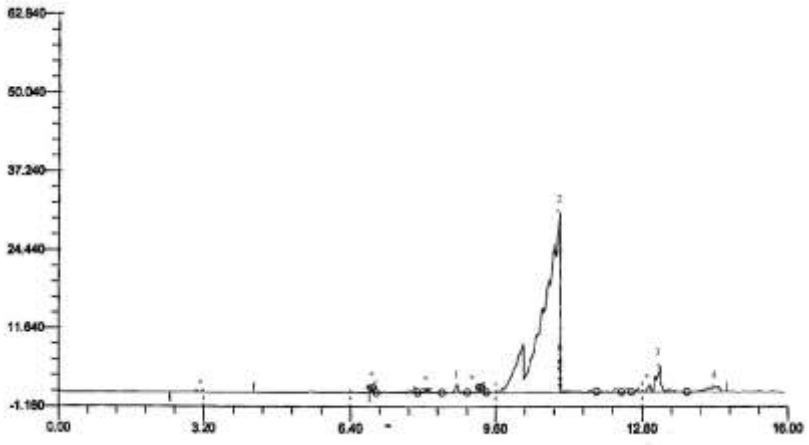


**Figure 3. GLC chromatogram of anise oil (Phosphorene +NPK (3).**

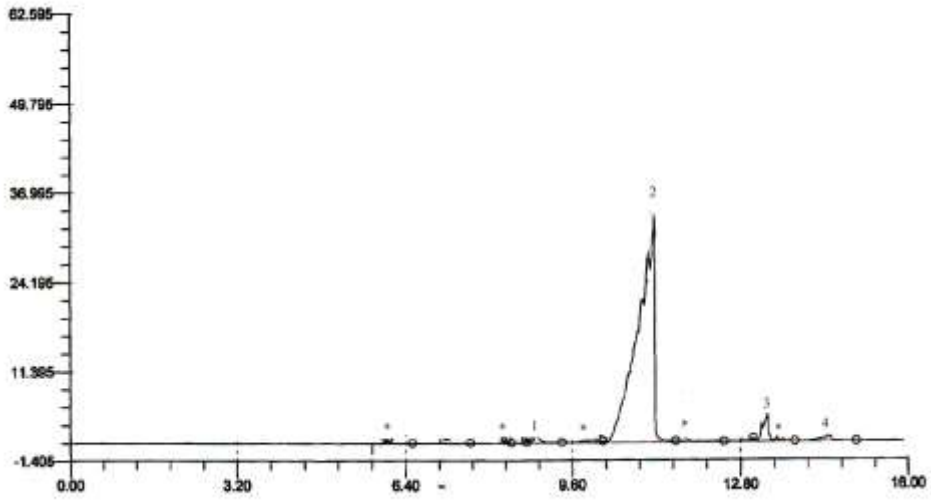


**Figure 4. GLC chromatogram of anise oil (Mycorrhiza).**

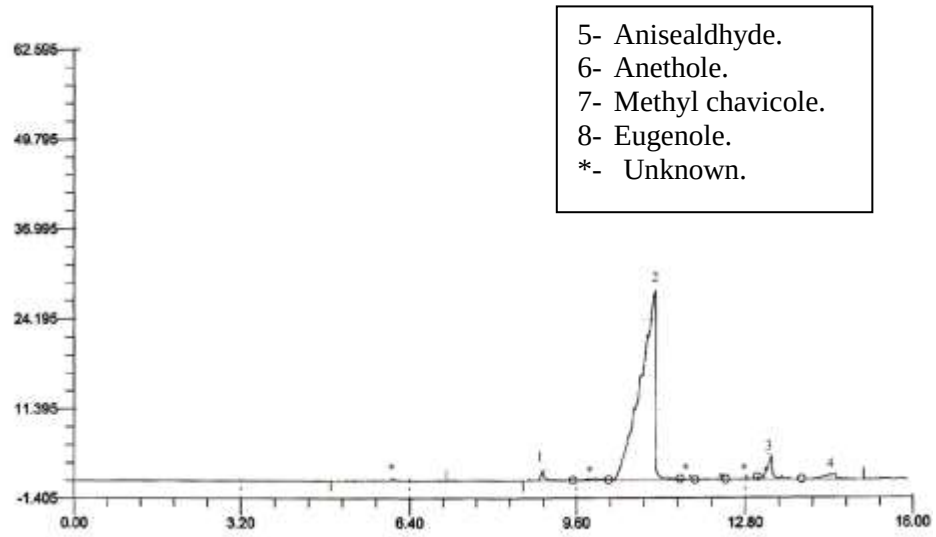


**Figure 5. GLC chromatogram of anise oil (Mycorrhiza +NPK 3).**

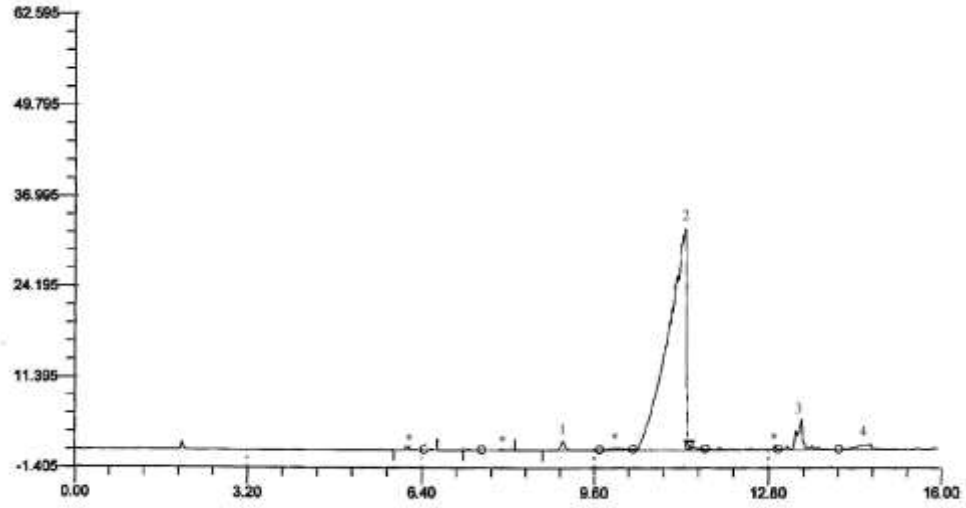


**Figure 6. GLC chromatogram of anise oil (Phosphorene+ Mycorrhiza).**

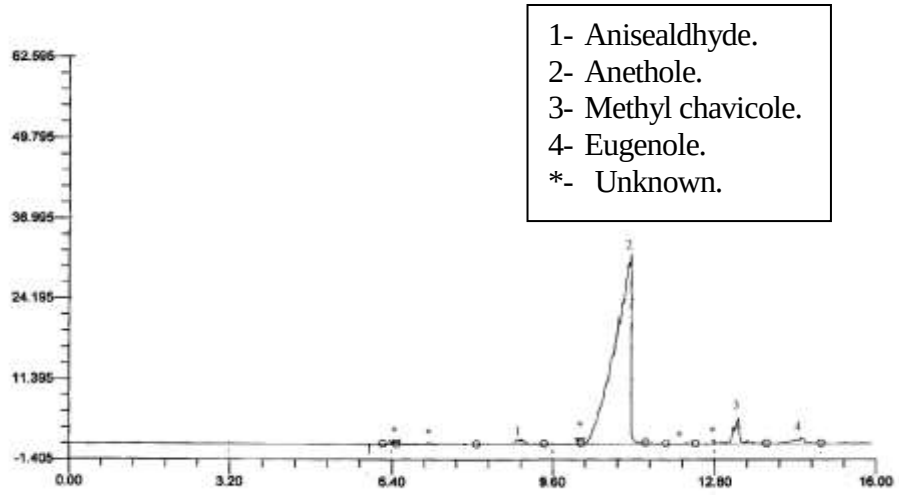


**Figure 7. GLC chromatogram of anise oil (Phosphorene + Mycorrhiza + NPK 3).**

ranged from (88.08 to 90.48%). These results agreed those of Trease and Evans (1978) reported that, the main component of anise oil is anethole, and ranged between 80 to 90%.

***Effect of Phosphorene:***

From Table 4, it could be noticed that anise plants inoculated with Phosphorene produced an essential oil with a relatively high percentage of

anethole (88.99%) in comparison with oil produced from untreated plans (88.08%) in case of the Phosphorene plus NPK(3) treatment, anethole content was 89.05%.

***Effect of Mycorrhiza:***

Also, Mycorrhiza alone increased anethole than control or Phosphorene alone or plus NPK (3), the highest value in this respect (90.24%) was obtained when using Mycorrhiza plus NPK (3).

***Effect of the combinations:***

Plants treated with (Phosphorene+ Mycorrhiza + NPK (3) gave the highest value of anethole content (90.48 %) in comparison with the rest of the treatments and control.

**Recommendation:**

On the light of the present results, it could be recommended anise farmers to apply Phosphorene plus Mycorrhiza and NPK at the highest rate to obtain the highest fruits and essential oil yield as well as the highest oil quality of anise plants cultivated under sandy soil condition.

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# تأثير التسميد الكيماوي والحيوي على نمو ومحصول نباتات الينسون

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أجرى هذا البحث في موسمي ٢٠٠٥/٢٠٠٤ و ٢٠٠٦/٢٠٠٥ في كلية الزراعة- جامعة القاهرة وذلك لدراسة تأثير التسميد الحيوي والكيماوي على نباتات الينسون

تم زراعة النباتات في أصص بلاستيكية بقطر ٣٠سم واستخدمت نوعين من السماد الحيوي (الميكروهيزا والفوسفورين) منفردة أو مع بعضها واستخدمت الأسمدة الحيوية مع السماد الكيماوي أو بدونه.

استخدم السماد الكيماوي بثلاثة معدلات هي: (٩-٦ -٣ جم/أصيص) و (١٥-١٢-٦ جم/أصيص) و (٣٠- ٢٤- ١٢ جم/أصيص) من( ن- فو٢أ٥- بو٢أ).

تمت مقارنة النتائج المتحصل عليها بالمعاملة الغير مسمدة وتم أخذ البيانات على النمو الخضري ومحصول الثمار ونسبة الزيت ومحصول الزيت خلال الموسمين.

وكانت أهم النتائج المتحصل عليها كما يلي:

١- بصفة عامة استجابت نباتات الينسون معنويا بصفة عامة للتسميد الحيوي مع أو بدون التسميد الكيماوي.

٢-الفوسفورين أدى إلى زيادة النمو الخضري وكانت الزيادة أكثر معنوية كلما زاد معدل السماد الكيماوي المضاف.

٣- أدى التلقيح بالميكروهيزا إلى زيادة النمو الخضري وكانت الزيادة تدريجية كلما زاد معدل السماد الكيماوي.

٤- أدت المعاملة بالميكروهيزا والفوسفورين إلى زيادة أكبر للنمو الخضري عن استخدام كلا منهما على حدة وكانت الزيادة أكثر معنوية عندما أضيف لها المستوى الثالث من التسميد الكيماوي.

٥- التسميد الحيوى بالميكروهيزا و الفوسفورين كلا على حدة أو معا مع إضافة السماد الكيماوي أو بدونه أدى إلى زيادة المحصول الثمرى.

٦- المعاملة بالميكروهيزا والفوسفورين معا بالإضافة إلى المستوى الثالث من التسميد الكيماوي أدى إلى زيادة نسبة ومحصول الزيت.

٧- المعاملة بالميكروهيزا والفوسفورين معا مع المستوى الثالث من التسميد الكيماوي أدى إلى زيادة نسبة الأنيثول في الزيت الطيار لنبات الينسون.