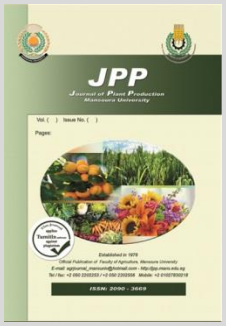
**Journal of Plant Production**

**Journal homepage: www.jpp.mans.edu.eg**
**Available online at: www. jpp.journals.ekb.eg**

# Impacts of Using some Fertilization Treatments in Presence of Salicylic Acid Foliar Spray on Growth and Productivity of *Coriandrum sativum* L. Plant

**Ghatas, Y. A. A.***

Hort. Dept., Fac. of Agric., Benha Univ., Egypt.




## ABSTRACT

The present study was conducted during ( 2017-2018 and 2018-2019) seasons, at the Hort. Dept., Fac., of . Agric., Benha Univ., Egypt to study the effect of chemical fertilizers (NPK) as a full dose and biofertilization (Bio.) consisting of a mixture of (Nitrobein + Phosphorein) in the presence of Salicylic acid ( SA) foliar spray at 150 ppm in a single or combinations inbetween them on vegetative growth ,grain yield ,chemical constituents parameters and oil productivity of coriander plants comparison with control plants in both seasons. The results indicated that different treatments of NPK mineral fertilizer, biofertilization and salicylic acid treatments, either alone or mixed among them, resulted in a significant increase in the growth ,chemical constituents parameters and oil productivity in both seasons. The use of 100% NPK achieved the highest results in the characteristics of growth, yield and chemical composition, followed by the use of the treatment of 75%NPK +Bio.+SA, where it achieved a significant maximize in this concern,whereas the treatment of 75% NPK + Bio. ranked the third in this context as compared with untreated plants in both seasons. Also, the combined treatment of 75% NPK + Bio. + SA gave the highest values of oil productivity. Consequently, in order to achieve the highest values of growth and chemical constituents ,it is preferable to treate coriander with NPK at 100% or 75%NPK + Bio. + SA. Also, it is possible to treat coriander plant with 75% dose NPK +Bio. + SA to improve oil productivity.

***Keywords:*** *Coriandrum sativum*∗NPK∗ Biofertilizer∗Salicylic acid∗volatile oil ∗chemical compositions

## INTRODUCTION

Medicinal and aromatic plants content spice group, it is very important and widely used in many countries to raise the value of food and improve the taste and flavor. The spices are of great importance, as they are widely accepted by consumers in different foods because they are natural compounds that improve the taste and flavor of food compared with the industrial additives that harm human health. Also,they enter the manufacture of cosmetics and perfumes in addition to their uses in the pharmaceutical industries (Christine and Milner, 2008 and Snigdha and Monika, 2013 ).

*Coriandrum sativum* L., (coriander) is spread over a wide range in Egypt, Morocco, India, Russia, Central Europe and Bangladesh. The plant is cultivated worldwide,since, it is important for medicinal purposes and to obtain seeds that are used as spices or in order to obtain the volatile oil ( Bhuiyan *et al*., 2009 and Khan *et al*.,2014). The linalool compound is the main compound in the essential oil, which accounts more than 67.4% of the chemical composition of the aroma oil. In addition, many compounds such as geraniol ,linalyl acetate, α-pinene, β-pinene, β- myrcene, and α-terpinene and others are the antifungal. In addition to its medical properties and the oil of the coriander is considered to be anti-fungal and bacterial, antioxidant and has a distinctive aromatic aroma, beside its medicinal properties (Weiss ,2002 ; Matasyoh *et al*., 2009 ; Asgarpanah and Kazemivash ,2012 and Władysław and Nowak,2015) .

These days it is preferable to reduce the use of chemical fertilizers, especially in the field of medicinal and aromatic plants because of the high cost, the environment pollution and the danger to human health. Therefore, the trend is to use bio or organic fertilizer. Bio-fertilization is safe for the environment than chemical fertilization and has a significant role in reducing the use of chemical fertilizers, thus reducing the pollution of the environment, Bio fertilizers are microbial inoculants consisting of micro-organism living cells like bacteria, algae and fungi alone or in combination which may help in increasing crop production. Bio-fertilization directly induce positive effects on plant growth through the production of phytohormones such as cytokinins , gibberellins and IAA, which act as growth regulators and its affect through the fixation of nitrogen and biological control and increase the metabolites, which is reflected in enhancing the vegetative growth and improvement of the meristematic tissue activity accompanied by plant growth enhancement (Glick, 2003 and Ahmed and Kibret, 2014). The effect of biofertilization on vegetative growth, yield and oil content has been demonstrated in many studies (Amran 2013 on *Pelargonium graveolens*; Farhood *et al* ., 2016 on Coriender ;Abdollahi *et al*., 2016 on coriander and El-Tarawy *et al*., 2017 on caraway).Salicylic acid (SA) is a phytohormones regulates the physiological and biochemical processes and improves the growth and productivity of the plant under different conditions and is enriched in the process of photosynthesis and chlorophyll content.In this respect ,The effect of SA on enhancing

* **Corresponding author.**
**E-mail address: yasser.abdelaty@fagr.bu.edu.eg**
**DOI: 10.21608/jpp.2020.79105**

growth,fresh and dry weigths ,grain yield,No.of umbles ,seed yield and volatile oil % was studied by Badran *et al* ., (2011 and 2013) and Rekaby, (2013) on coriander plants.

The objective of this study is to evaluate the effect of NPK chemical fertilization, bio-fertilization and salicylic acid and their interaction on some vegetative growth, yield traits, chemical components and production of the volatile oil for coriander plant.

## MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of the Faculty of Agri., Benha Univ., Egypt during 2017/2018 and 2018/2019 seasons to study the influence of some fertilization forms and salicylic acid on growth,grain yield,chemical constituents and oil productivity of coriander plants. Seeds of Coriander plants were obtained from the Experimental Farm ,Faculty of Agric., Benha Univ., Seeds were sown in clay loam soils on 15th November in two seasons in plots, the area of each plots was ( $1m^2$),.Each plot contained four plants and two rows (50 cm inbetween) every row contains two hills (50 cm apart) with two plants.Soil analyses (physical and chemical properties) of experimental soil were reported in (Table ,a) soil analyses were conducted according to the method described by Page *et al*., (1982) .

**Table a. Physical and chemical analyses of the experimental soil.**

| Properties | Value |
|---|---|
| Physical properties | |
| Coarse sand% | 3.41 |
| Fine sand% | 15.11 |
| Silt % | 27.19 |
| Clay % | 54.29 |
| Textural class | Clay loam |
| Chemical properties | |
| pH | 7.30 |
| EC dS/m | 0.62 |
| Organic matter % | 1.86 |
| Ca Co3 % | 0.49 |
| Total nitrogen % | 0.33 |
| Total phosphorus % | 0.13 |
| Total potassium % | 0.25 |

**Treatments**

**Mineral fertilizer**

The plants were fertilized with full chemical fertilizer as recommended dose somewhere NH4 NO3(33.5%N) was added at 90 Kg N/ fed.,calcim superphosphate (15.5 $P_2O_5$) was added at 60 Kg $P_2O_5$ and potassium sulphate (48.5 $K_2$**O**) at 60 Kg $K_2$**O** fed.The N and K fertilizer was rate divided into three equal doses at 30 , 45 , and 60 days after sowing in both seasons.However, P – fertilizer dose was added during preparing the soil .

**Biofertilization**

Coriander seeds were inoculated with a mixture of nitrobein + phosphorein contained bacteria namely, Azotobacter chroococcum and Bacillus megatherium phosphorus dissolving bacteria which supplied by ARC,Giza,Egypt .The inoculation, with a mixture of nitrobein and phsphorein ( 1 ml contain $10^8$ viable cell) for 30 min. was by coating coriander seeds using a sticking substrance Arabic gum at 16% just before seed sowing.The inoculated seeds were air dried at room temperature for one hour .While,another two application were applied 1000 g / fed.,as an aqueous solution for maximizing the power ability of bacteria i-e the first one was applied after 45 day from planting .Whereas,the second was done after 90 day from planting date.

**Salicylic acid ( SA)**

Salicylic acid soulution was done as foliar sprays at 150 ppm four times a year at 20 days intervals,the first one was done after two months from planting date in both seasons.

**Experimental layout:**

Consequently, This experiment was set up in (CRBD) A complete randomized block design as 10 treatments for each treatment replicated three times and each replicate contained 3 plots ,each plot contained 4 plants.The treatments were conducted as follows :

**1- Control ( untreated)**
**2- Biofertilization( Bio.)**
**3- NPK 100 %**
**4- Salicylic acid ( SA)**
**5- NPK 75% + Bio.+ SA**
**6- NPK 75% +Bio.**
**7- NPK75% +SA**
**8- NPK 50% + Bio. +SA**
**9- NPK 50% +Bio.**
**10-NPK 50% +SA**

At the starting of flowering stage, vegetative measurements were conducted and recorded ( plant height (cm.), number of branches / plant ,stem diameter (cm.),fresh and dry weights / plant (g) , number of leaves / plant ),while total chlorophylls (a&b) and carotenoides were determined in the fresh leaves of coriander plants after one month from the last treatment according to A.O.A.C. (1980). N,P and K, percentage and total carbohydrates were determined in the dry leaves at the flowering stage, according to Horneck and Miller (1998), Sandell (1950), Horneck and Hanson (1998) and Herbert *et al*. (1971), respectively. At harvesting time the following measurements were done and recorded; No. of umbels per plant , fruit yield per plant (g.), weight of 100 seeds (g) and seed oil percentage. The essential oil of each tested treatment was extracted by hydro-distillation according to Guenther (1961). Gas liquid chromatography analysis of essential oil (GLC) was carried out at the Medicinal and Aromatic Plant Laboratory, Dokki, Egypt.

**Statistical analysis.**

The obtained data was subjected to statistical analysis according to Snedecor and Cochran, (1989),

## RESULTS AND DISCUSSION

**I- Vegetative growth**

Data presented in Tables,1 and 2 indicate that the studied vegetative growth characteristics i.e. plant height, No. of branches/plant,stem diameter,fresh and dry weights/plant, and No. of leaves/plant were significantly responded to all treatments under the experimental(NPK, biofertilizer and salicylic acid ) compared to the untreated plants (control) in both seasons. The full dose of NPK gave the highest values of these vegetative growth parameters in both seasons. Whereas, 75% NPK combined with biofertilzer and salicylic acid occupied the 2nd position in

this concern, while 75%NPK and Bio. took the third descending order in the two seasons. Conversely, the untreated plant provided with "control" gave the lowest values of this parameters in the two seasons. The positive effects of these treatments (NPK,biofertilization ,SA and their interactions) may be due to the important physiological role of N which inducing the plant constituents through the action of different enzymes activity and protein synthesis (Milica *et al*., 2015)) that was reflected on an increase in growth parameters and chemical constituents of black seed plants.Moreover, the NPK fertilizers provide plants with macro-elements necessary for growth and yield. Nitrogen promotes vegetative growth, phosphorus is a main constituent of energy compounds, nucleic acids, phospholipids and co-enzymes and potassium increases plant resistance to diseases and prevents excessive water loss (Ezz El-Din and Hendawy, 2010). Abdollahi *et al.,* (2016 ).They demonstrated that using N chemical fertilizer enhancement plant height,stem diameter,number of branches/plant and fresh and dry weight for coriander plant.On the other side,,The role of bio-fertilizers may be due to their conents of symbiotic or non-symbiotic nitrogen-fixing bacteria in augmenting vegetative growth characters, yield and yield components, essential oil productivity and/or chemical composition (including chlorophyll a, b and carotenoids and/or N, P and K leaf percent and content on Marigold plant (Wondimkun and Belete,2017). The obtained results are confirmed by Mohammad *et al*., (2012) on *Pimpinella anisum*; Abdel-Latif, (2002) on *Caruim carvi* ;Mohamed *et al*.,(2015) on *Ocimum basilicum* cv Genovese ; Ghatas and Abdallah(2016) on *Echinaceae pupurea* plant and Gendy *et al*., (2013) on guar plant .They reported that bio-fertilizer can promote plant growth directly through fixation of nitrogen, facilitation of mineral uptake, solubilization of phosphorus, production of siderophores that solubilize and sequester iron, production of phytohormones, or reduction in soil ethylene levels. Moreover Ahmed, (2017) stated that application of bio-fertilization and NPK fertilizers induced an vegetative growth parameters of *Apium graveolensL* and *Anethum graveolens L* ,. Diminution of chlorophyll content is usual plant response to stress conditions and since SA plays role in stress induced signalling application of SA can result in reduction of chlorophylls (Farooq *et al*., 2009). In most cases,(SA) encouraged plant growth,fruit yield and oil content on fennel plants (Ali *et al*.,2017) .

Physiological and biological processes in plants are strongly regulated hence SA plays significant role in this regulation. As such SA can be used to improve plant growth under un favourable environmental conditions, but the efficiency of exogenous SA can vary dependent upon the species, developmental stage, application method and SA concentration . Karalija and Parić. (2017), stated that foliar application of salicylic acid induced long-term changes in plant growth and metabolism.Also, they recorded increase in leaf area, secondary metabolites and peroxidase activity. The obtained results are in agreement with the findings of Khodary (2004) and Boroumand *et al*., (2011) who reported that application of SA maximized the fresh and dry weight of shoot and roots under stress conditions and photosynthesis rate, stomatal conductivity and transpiration could be affected by SA application of maize and *Brassica napus*,respectively.

**Table 1. Effect of some fertilization treatments and salicylic acid on plant. height (cm) , number of branches/ plant and stem diameter (cm.) of Coriander plant during (2017- 2018 and 2018- 2019) seasons**

| Treatments | plant height (cm) | | No. of branches / plant | | Stem diameter (cm.) | |
|---|---|---|---|---|---|---|
| season | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Control | 57.86 | 58.44 | 7.07 | 7.27 | 0.32 | 0.34 |
| Biofertilization (Bio) | 68.54 | 69.14 | 7.59 | 7.49 | 0.38 | 0.40 |
| N P K 100% | 101.30 | 105.40 | 14.44 | 15.38 | 0.74 | 0.76 |
| Salyclic acid (SA)at 150 ppm | 65.12 | 65.61 | 7.44 | 8.10 | 0.36 | 0.38 |
| N P K75%+Bio.+SA at 150ppm | 96.00 | 96.55 | 12.75 | 13.00 | 0.65 | 0.68 |
| N P K75%+ Bio. | 92.03 | 92.66 | 11.07 | 11.16 | 0.59 | 0.62 |
| N P K75%+ SA at 150 ppm | 89.34 | 89.34 | 10.92 | 10.90 | 0.51 | 0.52 |
| N P K50%+Bio.+SA at 150ppm | 82.22 | 83.12 | 10.08 | 10.28 | 0.54 | 0.55 |
| N P K50%+ Bio. | 74.19 | 74.49 | 8.51 | 9.35 | 0.44 | 0.46 |
| N P K50%+ SA at 150 ppm | 72.15 | 72.18 | 8.37 | 9.08 | 0.43 | 0.44 |
| LSD at 0.05% | 3.24 | 3.61 | 1.30 | 1.18 | 0.053 | 0.054 |

**Table 2. Effect of some fertilization treatments and salicylic acid on fresh , dry weight / plant(g) and number of leaves/ plant of Coriander plant during (2017- 2018 and 2018- 2019) seasons.**

| Treatments | Fresh weight / plant (g) | | Dry weight / plant (g) | | No. of leaves/ plant | |
|---|---|---|---|---|---|---|
| season | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Control | 70.77 | 70.99 | 8.70 | 10.08 | 37.26 | 37.24 |
| Biofertilization (Bio) | 80.67 | 80.99 | 9.92 | 10.37 | 39.25 | 39.43 |
| N P K 100% | 142.40 | 144.10 | 17.52 | 18.55 | 55.70 | 56.89 |
| Salyclic acid (SA)at 150 ppm | 80.11 | 80.66 | 9.85 | 10.32 | 38.15 | 38.26 |
| N P K75%+ Bio.+ SA at 150 ppm | 128.80 | 136.80 | 15.84 | 17.44 | 50.16 | 50.22 |
| N P K75%+ Bio. | 120.10 | 130.10 | 14.24 | 16.33 | 47.07 | 48.89 |
| N P K75%+ SA at 150 ppm | 115.40 | 120.20 | 14.18 | 15.39 | 44.23 | 44.01 |
| N P K50%+Bio. + SA at 150 ppm | 101.10 | 106.40 | 12.44 | 13.62 | 43.23 | 43.90 |
| N P K50%+ Bio. | 90.64 | 97.32 | 11.19 | 12.46 | 41.78 | 42.17 |
| N P K50%+ SA at 150 ppm | 90.11 | 95.11 | 11.39 | 12.17 | 40.12 | 41.34 |
| LSD at 0.05% | 5.31 | 4.36 | 1.58 | 0.95 | 1.63 | 0.89 |

**II- Yield**

In both seasons, No. of umbles /plant, fruit yield /plant and weight of 100 seeds (g) of *Coriandrum sativum* L.were listed in Table (3),showed that the highest values of these parameters were obtained by using full dose of NPK treatment in the both seasons. Besides, the combined treatments of NPK dose at 75%+Bio.+SA ranked the second value in this concern in the first and second seasons. Meanwhile the combination of 75%NPK+biofertilizer occupied the third order in the two seasons, Control treatment showed the lowest results in both seasons..In this study it seams that using NPK fertilization with biofertilization in presence of SA achieved the maximum yield traits i.e.No.of umbles/plant,fruiet yield per plant and weight of 100 seeds of coriander plant when compared with control treatment, The obtained results are in harmony with the findings of Abdollahi *et al*., (2016) ; Farhood *et al*.,

(2016); Rahimi *et al*., (2009) on *Coriandrum sativum*; Ahmed ,(2017) on *Apium graveolensL* and *Anethum graveolens L.* and Mohammad *et al*., (2012) on *Pimpinella anisum*. NPK fertilizers supply plants with macro-elements essential for growth and yield. Nitrogen promotes vegetative growth which is reflected on the increase of plant yield. Phosphorus is a main ingredient of energy compounds, nucleic acids, phospholipids and co-enzymes and potassium increases plant resistance to diseases and prevents excessive and leading to higher of plant yield and number of seads per plant( Rahimi *et al*., (2009) on coriander plants .In the same time, Ahmed,(2017) ) on *Apium graveolensL* and *Anethum graveolens L.*. stated that bio fertilizers may be credited to maximizing maentration in plant tissues.

**Table 3. Effect of some fertilization treatments and salicylic acid on No. of umbles /plant, Seed yield / plant (g) and Weight of 100 seeds (g) of Coriander plant during (2017- 2018 and 2018- 2019) seasons.**

| Treatments | No . of umbles/plant | | Fruit yield / Feddan (kg) | | Weight of 100 seeds (g) | |
|---|---|---|---|---|---|---|
| season | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Control | 25.41 | 26.37 | 403.60 | 404.70 | 1.14 | 1.17 |
| Biofertilization (Bio) | 37.00 | 37.66 | 470.40 | 472.30 | 1.20 | 1.21 |
| N P K 100% | 50.00 | 50.91 | 885.60 | 905.99 | 1.49 | 1.49 |
| Salyclic acid (SA)at 150 ppm | 36.53 | 37.12 | 417.00 | 418.20 | 1.19 | 1.20 |
| N P K75%+ Bio.+ SA at 150 ppm | 44.15 | 44.60 | 876.10 | 882.40 | 1.38 | 1.39 |
| N P K75%+ Bio. | 42.11 | 43.12 | 870.40 | 873.70 | 1.29 | 1.30 |
| N P K75%+ SA at 150 ppm | 41.44 | 43.55 | 741.70 | 808.20 | 1.27 | 1.30 |
| N P K50%+Bio. + SA at 150 ppm | 39.22 | 40.05 | 540.10 | 608.40 | 1.23 | 1.23 |
| N P K50%+ Bio. | 38.80 | 39.90 | 485.50 | 485.80 | 1.29 | 1.28 |
| N P K50%+ SA at 150 ppm | 37.54 | 39.32 | 485.10 | 485.30 | 1.22 | 1.24 |
| LSD at 0.05% | 1.85 | 1.46 | 4.19 | 7.56 | 0.05 | 0.08 |

As well, the phosphate solubilizing bacteria (phosphorein) and nitrogen fixing cerealine may enhancement synthesis of endogenous phytohormones i.e. IAA, GAs and CKs which play an important role in formation of a big active root system which allow more nutrients, uptake from the soil and finally accelerated . Farhood *et al* .,(2016) demonstrated that using SA enhanced grain yield of *Coriandrum sativum* and improved field performance of this plant ,hence salicylic acid is considered a phyto-hormone that regulates physiological and biological processes in plants and can be used to improve plant growth and productivity under different environmental conditions. (Badran *et al*., (2011 and 2013) and Rekaby(2013) on coriander and Eshak (2013) on caraway,who mentioned that salicylic acid enhancing No.of umbles,seed yield , volatile oile and plant growth.

**III-Leaf N% ,P% ,K% ,total carbohydrates,chlorophylls (a&b) and carotenoids content**

Tables 4 and 5 demonstrate that N%, P%, K%, total carbohydrates , chlorophylls(a&b) and caroteinoidsin leaves of *Corianderum sativum L.* plants were more exaggerated by using all treatments compared to control in the both seasons. However, using complete dose of NPK was the most effective fertilizer for increasing N%, P%, K%,total carbohydrate , chlorophylls (a&b) and carotenoids, followed by the combination of 75 % NPK dose provided with Bio.and SA which occupied the second position in this concern in two seasons. whereas, the treatment of 75 % NPK dose combined with biofertilizer gave the third highest value in this respect in the two seasons.

**Table 4. Effect of some fertilization treatments and salicylic acid on N, P, K% of Coriander plant during (2017- 2018 and 2018- 2019) seasons.**

| Treatments | N% | | P% | | K% | |
|---|---|---|---|---|---|---|
| season | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Control | 2.14 | 2.17 | 0.276 | 0.283 | 1.82 | 1.86 |
| Biofertilization (Bio) | 2.75 | 2.76 | 0.283 | 0.307 | 2.25 | 2.26 |
| N P K 100% | 3.62 | 3.70 | 0.385 | 0.397 | 2.73 | 2.76 |
| Salyclic acid (SA)at 150 ppm | 2.74 | 2.74 | 0.295 | 0.297 | 2.18 | 2.22 |
| N P K75%+ Bio.+ SA at 150 ppm | 3.50 | 3.52 | 0.373 | 0.375 | 2.61 | 2.65 |
| N P K75%+ Bio. | 3.33 | 3.40 | 0.366 | 0.377 | 2.53 | 2.55 |
| N P K75%+ SA at 150 ppm | 3.15 | 3.16 | 0.355 | 0.336 | 2.51 | 2.52 |
| N P K50%+Bio. + SA at 150 ppm | 2.90 | 2.95 | 0.338 | 0.337 | 2.48 | 2.50 |
| N P K50%+ Bio. | 2.80 | 2.82 | 0.308 | 0.323 | 2.38 | 2.44 |
| N P K50%+ SA at 150 ppm | 2.77 | 2.78 | 0.292 | 0.314 | 2.30 | 2.35 |
| LSD at 0.05% | 0.07 | 0.08 | 0.006 | 0.008 | 0.07 | 0.09 |

**Table 5. Effect of some fertilization treatments and salicylic acid on total carbohydrate (%) , chlorophylls ( a & b) mg/g. f.w.) and carotenoids ( mg/g . f.w.) of Coriander plant during (2017- 2018 and 2018- 2019) seasons.**

| Treatments | Total carbohydrates (%) | | Chlorophylls ( a & b) (mg/g. f.w.) | | Carotenoids ( mg/g . f.w.) | |
|---|---|---|---|---|---|---|
| season | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Control | 9.05 | 9.17 | 1.270 | 1.270 | 0.310 | 0.353 |
| Biofertilization (Bio) | 10.90 | 11.48 | 1.280 | 1.282 | 0.367 | 0.394 |
| N P K 100% | 17.44 | 17.77 | 1.495 | 1.498 | 0.629 | 0.682 |
| Salyclic acid (SA)at 150 ppm | 10.60 | 11.00 | 1.285 | 1.318 | 0.361 | 0.368 |
| N P K75%+ Bio.+ SA at 150 ppm | 15.22 | 15.32 | 1.405 | 1.411 | 0.589 | 0.619 |
| N P K75%+ Bio. | 13.34 | 13.02 | 1.324 | 1.325 | 0.529 | 0.585 |
| N P K75%+ SA at 150 ppm | 13.66 | 12.80 | 1.320 | 1.319 | 0.479 | 0.523 |
| N P K50%+Bio. + SA at 150 ppm | 12.21 | 12.55 | 1.300 | 1.310 | 0.403 | 0.456 |
| N P K50%+ Bio. | 11.21 | 12.01 | 1.290 | 1.295 | 0.383 | 0.424 |
| N P K50%+ SA at 150 ppm | 11.00 | 11.66 | 1.285 | 1.288 | 0.375 | 0.403 |
| LSD at 0.05% | 1.72 | 1.43 | 0.054 | 0.054 | 0.04 | 0.03 |

In contrast,the lowest value wase regarded in the two seasons in case of untreated plants treatment . In this concern, Ahmed, (2017) stated that using NPK combined with biofertilizers maximized carotenoids in leaves of Celery and Dill.Mohamed and Ghatas (2016) on *Viola odorata* mentioned that full NPK dose enhanced N ,P and K ,total carbohydrates and total chlorophylls.Also, Mohamed *et al*.,(2015) demonstrated that bio- fertilizers application maximized N,P,K, chlorophyll a& b and carotenoids and total cabohydrate content of *Ocimum basilicum cv Genovese* leaves compared with control plants.

**Essential oil percentage**

Table.6, indicates that essential oil percentage of coriander was more positively affected by using the combined treatment between 75%NPK+Bio.+SA which gave the highest positive values of plant volatile oile ( 0.79%&0.85%) in the first and second season respectively ,followed by full dose of NPK which gave the second value of essential oil percentage (0.70%&0.74 %) in 1st and 2nd seasons respectively.

**Table 6. Effect of some fertilization treatments and salicylic acid on esential oil . (% ) of Coriander plant during (2017- 2018 and 2018- 2019) seasons.**

| Treatments | Esential oil (%) | |
|---|---|---|
| season | 1st | 2nd |
| Control | 0.38 | 0.36 |
| Biofertilization (Bio) | 0.46 | 0.48 |
| N P K 100% | 0.70 | 0.74 |
| Salyclic acid (SA)at 150 ppm | 0.42 | 0.46 |
| N P K75%+ Bio.+ SA at 150 ppm | 0.79 | 0.85 |
| N P K75%+ Bio. | 0.62 | 0.63 |
| N P K75%+ SA at 150 ppm | 0.49 | 0.49 |
| N P K50%+Bio. + SA at 150 ppm | 0.52 | 0.53 |
| N P K50%+ Bio. | 0.51 | 0.54 |
| N P K50%+ SA at 150 ppm | 0.49 | 0.52 |
| LSD at 0.05% | 0.05 | 0.10 |

On the other hand ,75%NPK+Bio. gave the third value (0.62%& 0.63%) in first and second seasons respectively, but the lowest value of essential oil percentage (0.38% & 0.36%) was produced by control plant in the both seasons.These results are in close with Abd El-kader and Ghaly (2003) on coriander ,Mohamed *et al* (2015) on *Ocimum basilicum* and ,Abdollahi *et al*.,(2016) on coriander.In addition , Mohamed and Ghatas (2016) revealed that the application of biofertilizer + 75 % NPK or full dose of NPK gave the maximum of oil yield productivity on *Viola odorata*. In the same context, Ahmed, (2017) demonstrated that application of biofertilization combined with NPK chemical fertilizer encouraged The highest productivity of the oil percentage on Celery and Dill in both seasons.

**Essential oil composition**

Table (7) and Figs. (1 - 4) demonstrate the effect of the assigned treatments of control, 75%NPK +bio+ SA, 100% of NPK and NPK75%+Bio on the composition of essential oil distilled from *Coriandrum sativum*.seven compounds were recognized in the essential oil constituents of coriander , i.e. a-Pinene, β-Myrcene, β- Pinene , β-Cymene , Linalool,Geraniol,Linalyl acetate.The major component was Linalool ,that ranged from (77.50 to 80.90%) followed by Linalyl acetate (3.60 to 5.60%), β-Pinene (3.80 to 4.80%), a-Pinene (3.00 to 3.48%).In addition , unknown component with values (1.42 to 8.79%). Therefore, NPK75% + Bio.+SA gave the maximum value of linalool (80.90%) followed by NPK100 % (79.92%),and NPK 75% +Bio. (78.64%).Furthermore,the lowest value of linalool (77.50) was scored by control.Also,NPK75% +Bio.+SA gave the maximum values (5.60%) , (4.80%) of linalyl acetate and β- Pinene respectively.Comparable result was stated by Szemplinski and Nowak (2015) who reported that the major component of *Coriandrum sativum* was linalool compound which made up 67.4% of chemical composition of oil.

**Table 7. Effect of some fertilization treatments and salicylic acid on essential oil constituents of Coriander plant during (2017- 2018 and 2018- 2019) seasons.**

| Peak No. | Component name | Area% | | | |
|---|---|---|---|---|---|
| | | Control | NPK75% + Bio.+SA | Full dose of NPK | NPK75% +Bio. |
| 1 | a-Pinene | 3.00 | 3.48 | 3.47 | 3.34 |
| 2 | Myrcene | 0.60 | 0.70 | - | - |
| 3 | β-Pinene | 3.80 | 4.80 | 3.90 | 4.59 |
| 4 | β -Cymene | 3.11 | 1.60 | - | 1.97 |
| 5 | Linalool | 77.50 | 80.90 | 79.92 | 78.64 |
| 6 | Geraniol | 0.80 | 1.50 | - | 0.94 |
| 7 | Linalyl acetate | 3.60 | 5.60 | 3.99 | 3.63 |
| * | Unknown | 7.55 | 1.42 | 8.79 | 6.89 |
| Total | | 100.00 | 100.00 | 100.00 | 100.00 |

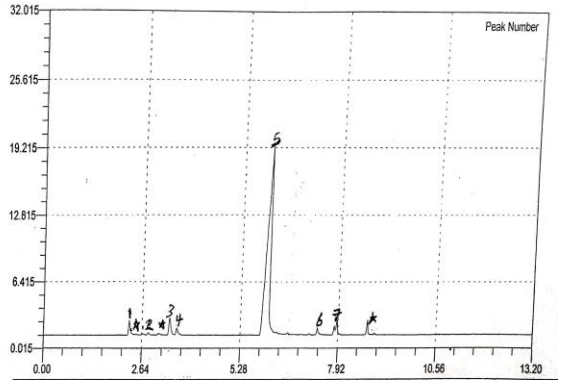



**Fig.1. Effect of control treatment on essential oil composition.**

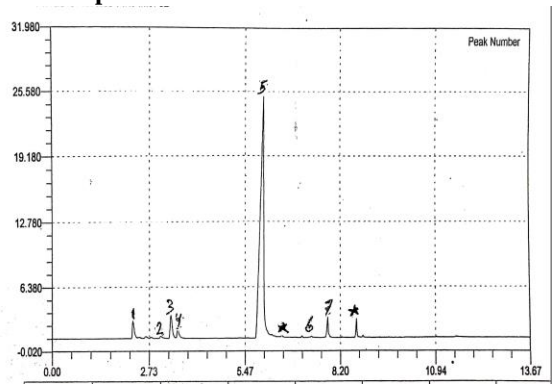



**Fig. 2. Effect of NPK75% +Bio.+SA treatment on essential oil composition**

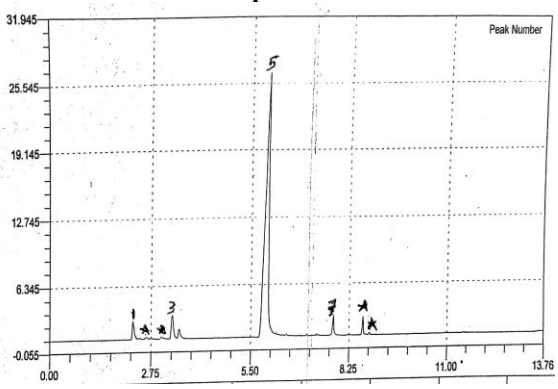



**Fig. 3. Effect of NPK100 percentage treatment on essential oil composition.**

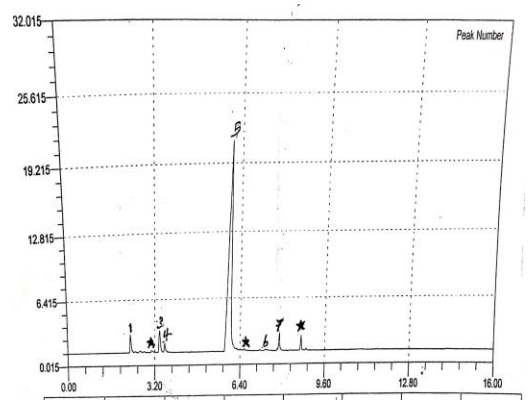



**Fig. 4. Effect of NPK75% +Bio. treatment on essential oil composition.**

Consequently.It is preferable to use NPK 100% to maximize growth , yield and chemical constituents .However,NPK75%+Bio.+SA achieved the greatest values of oil productivity on *Coriandrum sativum* plants. Therefore, the present study strongly admit the use of such treatments to provide good and high exportation characteristics due to its safety role on human health.

## REFERENCES

A.O.A.C. 1980. Official Methods of Analysis,12 Th Ed. Association of official analysis chemists :Washington , D.C., U.S.A

Abd El-kader, H.H. and N.G. Ghaly .2003.Effects of cutting the herb and the use of nitrobein and phosphorein associated with mineral fertilizers on growth, fruit and oil yields and chemical composition of the essential oil of coriander plants (*Coriandrumsativum*, L.). J. Agric. Sci. Mansoura Univ., 28(3):2161-2171.

Abdel-Latif, T. A.. 2002. Effect of organic manure and biofertilizer on caraway plants (*Carum carvi*, L.) j. Agric. Sci. Mansoura Univ., 27 (5): 3459-3468

Abdollahi ,F.; A. Salehi;R. Shahabiand A. Rahimi,2016. Effect of different nitrogen sources on vegetative traits,grain yield and essential oil yield of *Coriandrum sativum*, Cercetări Agronomice în Moldova Vol. XLIX , No. 1 (165) / 2016: 51:65.

Ahmed,Z.A (2017). Effect of NPK and Bio Fertilization on Growth and Oil Yield of Celery (Apium graveolensL.) and Dill (Anethum graveolens L.) Plants. J. Plant Production, Mansoura Univ., Vol. 8 (2): 247 – 251.

Ahmed, M. and M. Kibret.2014.Mechanisms and applications of plant growth promoting rhizobacteria: Current perspective. J. King saud Univ. Sci., 26 :1-20.

Ali, A.F.; E.A. Hassan; E.H. Hamad and W.M.H. Abo-Quta.2017. Effect of Compost, Ascorbic Acid and Salicylic Acid Treatments on Growth, Yield and Oil Production of Fennel Plant .Assiut J. Agric. Sci., (48) No. (1-1) 2017 (139-154).

Amran, K.A.A. (2013): Physiological studies on *Pelargonium graveolens* L plant. Ph.D. Thesis, Fac. of Agric., Moshtohor, Benha. Univ.

Asgarpanah, J. and N. Kazemivash (2012). Phytochemistry, farmacology and medicinal properties of *Coriandrum sativum* L. Afr. J. Pharm. Pharmacol., 6(31), 2340–2345.

Badran, F.S.; F.A. Attia; and A.M. Ayat (2011) . Response of *Coriandrum sativum*, L.) plants, grown in new reclaimed land to NPK fertilization and antioxidant treatment. Inter. Conf. on total Quality Management of herb & medicinal Plants and their products, Egypt, Inter. Center of Agric, Egypt, Dec. 6-8, 2011.

Badran, F.S.; F.A. Attia and A.M.Ayat (2013). Effect of macro/micro fertilization treatment as well as, Salicylic and ascorbic acid on growth, fruit yield and essential oil of coriander. Plants grown in sandy soil. The first Assiut Inter. Conf. of Horticulture. 24-27th Feb., 2013.

Bhuiyan, M.N.I; J. Begum and M. Sultana. (2009). Chemical composition of leaf and seed essential oil of *Coriandrum sativum* L. from Bangladesh. *Bangladesh J. Pharmacol*., 4: 150 – 153

Boroumand,J.; S. Lariyazdi and H. Ranjbar, (2011). Effect of salicylic acid on some plant growth parameters under lead stress in Brassica napus var. Okapi. Iran. J. Plant. Physiol., 1(3), 177-185

Christine ,M .K.and J .A. Milner(2008). The Role of herbs and spices in cancer prevention. *J .Nutr Biochem*, 19(6): 347 – 361.

El-Tarawy, M. A.; M. A. Hegazi 1 and E.Mahmoud (2017). Effect of Bio, Organic and Chemical Fertilization on Growth, Productivity and Oil Consituents of Caraway (Carum carvi, L.). J. Plant Production, Mansoura Univ., Vol. 8 (10): 993 - 997,

Eshak, W.S. (2013). Physiological studies on caraway plants. M.Sc. Thesis, Fac. of Agric., Minia Univ.

Ezz EL-Din, A.A. and S.F Hendawy. (2010). Comparative efficiency of organic and ertilizers on herb production and essential oil of Lovage plants Grown in Egypt AmericanEurasian I Agric. & Environ. Sci., 8 (I): 60-66.

Farhood, Y.; S.Z. Salmasi; J. S. Kolvanagh; K. G. Golezani and S. Dastborhan (2016 Changes in growth, chlorophyll content and grain yield of Coriander (Coriandrum sativum L.) in response to water stress, chemical and biological fertilizers and salicylic acid. International Journal of Advanced Biological and Biomedical Research (2016) 4(3) 229-237.

Farooq, M.;A.Wahid and D.J., Lee (2009). Exogenously applied polyamines increase drought tolerance of rice by improving leaf water status, photosynthesis and membrane properties. Acta. Physiol. Planta., 31(5), 937-945.

Gendy, A.S.H., H.A.H. Said-Al Ahl; A. A. Mahmoud and Hanaa F.Y. Mohamed (2013): Effect of nitrogen sourses, bio-fertilizers and their interaction on the growth, seed yield and chemical composition of guar plants. Life Science Journal, 10(3): 389-402.

Ghatas,Y.A.A. and W.H.Abdallah (2016). Effect of Some Fertilization and Micro-Nutrients Treatments on Growth and Chemical Constituents of Echinacea purpurea plant. J.Plant Production, Mansoura Univ., Vol. 7 (7): 709 – 719.

Glick, B.R. (2003): Plant growth promoting bacteria. In: Glick, B.R. and J.J. Pasternak (eds.), Molecular Biology - Principles and Applications of Recombinant DNA, pp: 436–54. ASM Press, Washington DC, USA.

Guenther, E. (1961). " The Essential Oil ". 4th ed., vol. III.D. Van. Nostrand company, Inc., New York.

Herbert, DP. ; J. Phipps and, R.E. Strange (1971).Determination of total carbohydrates, Methods in Microbiology, 5 (8): 290-344.

Horneck, D.A. and, D. Hanson (1998). Determination of potassium and sodium by flame Emission spectrophotometry. In hand book of reference methods for plant analysis, e.d Kolra, Y. P.(e.ds). 153-155.

Horneck, D.A. and R.O. Miller(1998). Determination of total nitrogen in plant hand book of reference methods for plant analysis, (e.d) Kolra, Y. (eds) P73.

Karalija,E.and A. Parić,(2017). Effects of salicylic acid foliar application on growth and antioxidant potential of basil (Ocimum basilicum L.), BIOLOGICA NYSSANA, 8 (2) December 2017: 145- 150.

Khan, I.U.; W. Dubey and V. Gupta, (2014). Taxonomical aspects of Coriander (*Coriandrum sativum* L.). *International* . Journal of Current Research, 6 (11): 9926 – 9930

Khodary, S.E.A.,( 2004). Effect of salicylic acid on the growth, photosynthesis and carbohydrate. metabolism in salt-stressed maize plants. Int. J. Agr. Biol., 6(1), 5-8

Matasyoh, J.C.; Z.C.Maiyo; R.M.Ngure, and R.Chepkorir (2009). Chemical composition and antimicrobial. activity of the essential oil of Coriandrum sativum. Food Chem., 113, 526–529.

Milica G. A.; Ž. K. Dolijanović and S.I. Oljača (2015). Effect of organic and mineral fertilizers on essential oil content in caraway, anise and coriander fruits, Acta Sci. Pol., Hortorum Cultus 14(1), 95-103 University of Belgrade ISSN 1644-0692.

Mohamed, S.M., E.M.Abou El-Ghait, Y.A.A.Ghatas, El Shayieb, N.M. and A.A. Shahin, (2015). Effect of some fertilizers on improving growth and oil productivity of basil (*Ocimum basilicum*, L.) cv. Genovese plant. Egypt. J. Appl. Sci., 30(6):384-399.

Mohammad, T.; H. Reza and F. Rejale (2012). Effect of the application of vermicompost and phosphate solubilizing bacterium on the morphological trait and seed yield of anise Pimpinella anisum, L.) J. Medi. Plant Res., 6(2):215- 219.

Mohamed, Y. F.Y.and Y.A.A. Ghatas, (2016) Effect of mineral, biofertilizer (EM) and Zeolite on growth, flowering yield and composition of volatile oil of *Viola odorata* L plants. Journal of Horticultural Science & Ornamental Plants 8 (3): 140-148, 2016

Page, A. L., R.Miller, and H.Keeney, (1982). Methods of Soil Analysis. Part 2, 2nd Ed., Am Soc. Agronomy, Inc. Mad. Wisconsin, USA.

Rahimi A.B.; K. Mashayekhi; S. Amini and E. Soltani, (2009)- Effect of mineral vs. biofertilizer on the growth, yield and essential oil content of coriander (Coriandrum sativum L.). Med. Arom. Plant Sci. Biotechnol., 3: 21-23

Rekaby, A.M. (2013): Improving the productivity of coriander plants by the us of some unconventional treatments. Ph.D. thesis, of Agric. Minia Univ.

Sandell, E.B (1950). Colorimetric Determination of Traces of Metals. 2nd Ed. Interscience. Pub. Inc. New. York.

Snedecor, G.W. and W.G. Cochran, (1989). Statistical methods. 8th Ed., Iowa State Univ., Press, Iowa ,U.S.A.

Snigdha ,C. and T. Monika (2013). *Coriandrum sativum* Apromising functional and medicinal food. Int., J.,Phytomed Related Industr, 5 : 59 – 65 .

Szempliński, W. and J. Nowak(2015). Nitrogen fertikization versus the yield and *quality* of coriander (Coriandrum sativum L.). Acta Sci. Pol. Hortorum Cultus14(3) 2015, 37-50,

Weiss, E.A. (2002). Coriander. Spice Crops, CABI Publishing, 243–261. Zawiślak, G. (2011). The chemical composition of essential oil from the fruit of coriander (Coriandrum sativum L.). Annales UMCS, sec. DDD, Pharmacia, 24, 2/21, 169– 175.

Władysław, S. and J. Nowak (2015) Nitrogen fertilization versus the yield and quality of coriander fruit. Acta Sci. Pol. Hortorum Cultus, 14(3) 2015, 37-50.

Wondinkun, D. and K.Belete (2017) . Review on the Effect of Organic fertilizers, Biofertilizers and Inorganic Fertilizers NPK) on Growth and Flower Yield of Marigold (Targets' erecta L.), Acad. Res. J. Agri. Sci. Res. Vol. 5(3), pp. 192-204.

## تداعيات استخدام بعض معاملات التسميد في وجود الرش الورقي بحمض السلسيلك علي نمو وانتاجية نبات الكسبرة

**ياسر عبد الفتاح عبد العاطي غطاس**

**قسم البساتين – كليه الزراعة بمشتهر- جامعه بنها – مصر.**

أجريت هذه الدراسة خلال موسمين متتاليين (٢٠١٧-٢٠١٨ و ٢٠١٨-٢٠١٩) في قسم البساتين . كليه الزراعه.جامعه بنها .مصر لدراسة تأثير الأسمدة الكيماوية المكونة من (النتروجين والفوسفور والبوتاسيوم )كجرعة كاملة والتسميد الحيوي المكون من خليط من (النتروبين + الفوسفورين) مع الرش الورقي بحامض السلسيلك عند تركيز ١٥٠ جزء في المليون في صوره مفرده أو التداخل بينهم على النمو الخضري ،المحصول،المكونات الكيميائية وانتاجية الزيت الطيار لنبات الكسبرة في كلا الموسمين. أوضحت النتائج أن المعاملات المختلفة للأسمدة المعدنية ، ومعامله التسميد الحيوي والرش بحامض السلسيلك ، سواء بمفردها أو مختلطة فيما بينها ، أدت إلى زيادة كبيرة في النمو الخضري والمحصول والمكونات الكيميائية ونسبة الزيت ومكوناته الكيميائيه في كلا الموسمين. حقق استخدام الجرعة الكاملة من التسميد الكيماوي أعلى النتائج في صفات النمو الخضري والمحصول والمكونات الكيميائيه ويليها استخدام المعامله المكونة من ثلاث ارباع الجرعه من التسميد الكيماوي مع التسميد الحيوي مدعوما بالرش بحمض السلسيلك ، حيث حققت زياده معنوية كبيره في النمو الخضري ، والمحصول والمحتوي الكيماوي وحققت المعامله المكونه من استخدام ثلاث ارباع الجرعة من التسميد المعدني + التسميد الحيوي المرتبة الثالثة في النتائج التي تم الحصول عليها عند المقارنه بنباتات الكنترول الغير معاملة في كلا الموسمين. من ناحية أخرى ، فإن المعامله المكونة من ثلاث ارباع الجرعه من التسميد المعدني +التسميد الحيوي+ حمض السلسيلك عند تركيز ١٥٠ جزء في المليون اعطت أعلى نسبة من الزيت الطيار ومكوناته الكيميائية. وبناء علي ذلك و من أجل تحقيق افضل قيم للنمو الخضري والمحصول والمكونات الكيميائية لنبات الكسبرة فانه يفضل معاملة نبات الكزبرة بجرعة كاملة من التسميد المعدني أو المعامله المكونة من ثلاثة أرباع جرعة من التسميد المعدني + التسميد الحيوي المكون من (النتروبين +الفوسفورين ) + حامض السلسيلك رشا علي الاوراق بتركيز ١٥٠ جزء في المليون.من ناحيه اخري ، فانه يفضل معامله نبات الكسبرة بالمعامله المكونه من ثلاث ارباع جرعه من التسميد الكيماوي+التسميد الحيوي+حامض السلسيلك رشا علي الاوراق بتركيز ١٥٠ جزء في المليون للحصول على أعلى إنتاجية من الزيت الطيار ومكوناته.