*Egypt. J. Agric. Res., 79 (2) , 2001*



# EFFECT OF SALINE IRRIGATION WATER ON GROWTH, OIL YIELD AND QUALITY AND ASSOCIATED INSECTS OF SOME OCIMUM SPECIES

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(Manuscript received Oct. 2000)

***Abstract***

The effect of irrigation of some Ocimum species (*O. basilicum, O. kilimandscharicum and O. minimum*) with saline solution of 750, 1500, 2400 and 3600ppm along with control of 315ppm on its growth yield, oil composition, soil and insect attacking was studied. The results indicated that the high salinity levels (2400 and 3600ppm) caused significantly reduction in fresh herb yield of all studied Ocimum species. *O. basilicum* could tolerate the salinity level of 750ppm. Whereas *O. kilimandscharicum* and *O. minimum* could tolerate the increasing salinity up to 1500ppm.

Saline irrigation water had slight effect on the essential oil percentage in the three Ocimum species. Some of the essential oil constituents increased with increasing the salinity levels as methyl eugenol and camphor in the *O. basilicum* and *O. kilimandscharicum,* and linalool in all studied Ocimum species. While eugenol and alpha terpineol decreased with increasing the salinity levels.

Soil analysis after the plant harvest indicated that salt content of the irrigation water had a dominant effect on soil salinity. The SAR and KAR values showed an increase with increasing salinity levels but K/Na decreased. The white fly, aphids, jassid and mealy bugs attacked Ocimum species during the two experimental seasons.

*O. basilicum* and *O. kilimandscharicum* were more susceptible to *B. tabaci* attacking than *O. minimum.* Whereas *O. minimum* was more susceptible to *A. gossypii* attacking than other studied Ocimum species. *B. tabaci* and *A. gossypii* populations increased with increasing salinity levels on all the three of Ocimum species.

## INTRODUCTION

The medicinal and aromatic plants are special and important all over the world. The local interest in extending the area cultivated with medicinal and aromatic plants would give a great profit.

Utilization of the saline water in irrigation is very important to overcome the shortage of water. Medicinal and aromatic plants differ in its degree of salinity tolerance. (Basil) which was chosen for these experiments are very important member of family Lamiaceae.

Ocimum species are aromatic herbs used in traditional medicine and its essential oils are used in industry and perfumery (Kharti, *et al.*, 1995)

Fresh leaves used as antispasmodic, carminative, mild sedative and it may be employed in wide range of simple gastro-intestinal complaints. It is also used in the culinary purposes (Salem, 1995). Basil oil contains too many of the principal compounds such as linalool, cineol, camphor, eugenol, ...etc. It is also used very widely in countless medicinal preparations, flavoring confectionery, food condiment, cosmetic and perfumes (Hassan and Haikal, 1988).

Many researches studied the effect of different levels of salinity on the growth, essential oil percentage and constitute of several medicinal and aromatic plants.

Hussein, *et al.,* 1999 studied the effect of salinity levels on some varieties of *Ocimum basilicum.* He found that the level of salinity (1500ppm) caused an increase in plant height, number of leaves/plant, fresh and dry weight of leaves as well as oil percentage and content in *O. basilicum var. Purpurascens.*

*El-Shafey, et al.,* 1991 recorded that plant height of *O. basilicum* was significantly decreased by increasing saline water irrigation at 2000 and 4000ppm concentrations.

Abou El-Fadl, *et al.,* 1990, found that the level of salinity (3000ppm) caused a reduction in total fresh herb yield of peppermint, however it could tolerate the salinity level of 1500ppm, whereas Spearmint could tolerate up to 3000ppm. As well as, saline irrigation water had slight effect on essential oil percentage in both species.

Hussein and Abd El-Nabi (1996) studied the effect of saline solution irrigation of 2560ppm along with control of 300ppm on damsisea oil. They found that damsisea oil percentage increased by salinity level increasing. Most components of the oil especially cineol were significantly increased.

The yield of medicinal and aromatic plants is affected not only by the saline water irrigation but also by the insects and pests, which regarded as one of the important factors responsible for the reduction of medicinal and aromatic plants yield. Therefore, it was very necessary to make an attempt through these experiments to study the effect of different levels of salinity on the soil, growth of Ocimum species, essential oil percentage and its components. Also it aims to survey the insect and pests that attack Ocimum species and determine the efficacy of irrigation with saline water on these insects.

## MATERIALS AND METHODS

The present experiments were carried out in Sabahia Horticulture Research Station, Alexandria, through two successive seasons of 1998 and 1999. Three species of Ocimum plants were chosen for these experiments. These species were *Ocimum basilicum* (annual plant) (Bailey, 1986), *Ocimum kilimandscharicum* and *Ocimum minimum* (perennial plants). In these experiments the perennial species were cultivated as annual plants, i.e. all the species renew their planting every year.

Seeds of *Ocimum basilicum* and *O. kilimandscharicum* were obtained from Medicinal and Aromatic Plants Research Department, Sabahia, Alexandria. Terminal stems of *Ocimum minimum* were obtained also from the same place. The seeds of *O. basilicum* and *O. kilimandscharicum* were sown in pots 40cm diameter, on February, 27$^{th}$ 1998 and 1999. The media used for seed germination was 2clay: 1sand by volume. After two months from sowing the seedlings were transplanted to 15cm diameter pots and one seedling was planted in each pot. Three weeks later, plants transferred to the final size of glazed pots of 40cm diameter and 10 Kg of the soil capacity, physical and chemical properties of the initial soil are shown in table (1 and 2). The same previous steps were carried out on the terminal stems of *O. minimum*, which has been planted on February 27$^{th}$.

All plants were given an equal dose of N-P-K at documented rates. Five levels of an artificial saline water were used; these levels were tap water as control; 315, 750; 1500; 2400 and 3600ppm. Saline solution was prepared from a mixture of 2:1 Sodium and Calcium both in chloride form respectively. The pots were irrigated with tap water for four weeks before irrigation with the saline water. Irrigation water was applied to raise the soil moisture content up to the field capacity with 15% excess as leaching fraction to avoid salt accumulation in the pots.

The experiments were planned in a complete randomized block design with three replicates, each replicate contained fifteen treatments (i.e. Five salinity levels by three Ocimum species) and three pots were used for each treatment. The normal agriculture practices were done for all pots of the experiment. Plants of all species were harvested when the plants were in full bloom and the lower leaves begin to turn yellow (Guenther,

Table 1. Physical properties of the soil used before planting

| Soil type | Mechanical analysis | | | | Texture |
|---|---|---|---|---|---|
| | S.P.%* | Sand% | Silt% | Clay% | |
| Alluvial | 85 | 33 | 12 | 55 | Clay |

S.P.%* = Saturation Percentage

Table 2. Chemical properties of the soil used before planting

| Soil type | E C $dsm^{-1}$ | PH | S.P.% | Soluble anions (mg/L) | | | | Soluble cations (mg/L) | | | | | SAR* | KAR** | $CaCo_3$% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $CO_3^{--}$ | $HCO_3^-$ | $Cl^-$ | $So_4^{--}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ | K/Na | | | |
| Alluvial | 1.85 | 8.0 | 42 | 0.06 | 1.39 | 7.5 | 9.5 | 9.44 | 5.0 | 3.3 | 1 | 0.21 | 1.51 | 0.24 | 25.7 |

* SAR = Sodium adsorption ratio $Na^+$ /? $\overline{(Ca^{++} + Mg^{++})/2}$

** KAR = Potassium adsorption ratio $K^+$ /? $\overline{(Ca^{++} + Mg^{++})/2}$

1961). The annual species were reached to flowering stage earlier than the perennial species. Therefore the date of the first and second cuts of *O. basilicum, O. kilimandscharicum* and *O. minimum* was (on August 10$^{th}$ and September 29$^{th}$), (on August 22$^{nd}$ and October 16$^{th}$), and (on August 28$^{th}$ and on October 30$^{th}$) respectively.

Two cuts were taken in each season, the following data for every cut were recorded in each treatment: plant height (cm), number of the main branches per plant, fresh and dry weights of herbs per plant (gm), percentage of essential oil and its constituents.

The essential oil was extracted by water distillation according to the method described by Guenther (1961) and British Pharmacopeia (1968). The components of essential oil for *Ocimum spp.* were determined by using the Gas Chromatography – Mass Spectrum Technique.

**Conditions of GC- MS:**

| Information | Conditions |
|---|---|
| • Instrument | M SD 5971 Hewlett Packard |
| • Column | Cupper Capillary Column<br>60m X 0.25mm X 0.5µm film thickens |
| • Stationary Phase | Polyethylene Glycol |
| • Flow rate | 1.5ml.H/min |
| • Column temp. | 30-220Cº |
| • Rate temp. | 5ºC/min |
| • Injection temp. | 250ºC |
| • Detector temp. | 280ºC |
| • Recorder | HP |

The oil constituents percent were estimated from the measured peak area of the chromatogram according to Heftman (1967), Guenther and Joseph (1978).

The obtained results from each cut during both seasons were statistically analyzed according to Snedecor and Cochran (1974).

At the end of the second season, soil samples were taken from the pots, crushed and sieved. Saturation extract analysis was made according to U.S salinity laboratory (1954). Three plants from every treatment of each replicate were examined weekly before each cut to survey insect pests attacking the plants during two seasons, statistical analysis of the insect pests data was made according to Steel and Torrie (1981).

## RESULTS AND DISCUSSION

### I. Effect of saline irrigation water on the soil

The final analyses of soil after the second cut of the second season are presented in table (3). Electrical conductivity (EC) of the soil paste extract was increased with the increase in salinity levels. The correlation coefficient between EC of irrigation water and that of soil was extremely high (0.9). The SAR and KAR values tended to increase with the increasing of salinity levels.

### II. Effect of salinity levels on the vegetative growth

#### 1. Plant height (cm)

Data of means of the plant height of basil as influenced by the different levels of salinity are given in table (4). Data indicate that there were significant differences between the treatments in the plant height within each species by using the different salinity levels. Results showed that the plant height of *O. basilicum* and *O. kilimandscharicum* decreased significantly in most treatments when the plants were irrigated with the high salinity levels (2400 and 3600ppm) as compared with the control treatment (tap water). El-Shafey, *et al.*, (1991) in agreement with that reported these results on *O. basilicum*, El-Keltauwi and Crotean 1987, on spearmint and Meawad Mahmoud (1999a) on Egyptian henbane. Such decrease in plant height might be due to that salinity decreased cell division of plant as reported by Bolus, *et al.*, 1972 on Castor bean. Low salinity level (750ppm) gave a significant increase in the plant height of *Ocimum basilicum* over the control during the whole first season and during the second cut of both the two seasons for *O. kilimandscharicum.* Also there was a significant increase in the plant height of *O. kilimandscharicum* after using the salinity level (1500ppm) in the second cut of the second season.

The results in table (4), showed that the high salinity levels (2400 and 3600ppm) had no significant effect on the height of *O. minimum* plants, while the plant height was generally increased as salinity levels in irrigation water decreased compared with control. Similar results were obtained by Hussein 1999, on *O. basilicum var. Purpurascens* and Abou El-Fadl, *et al.,* 1990 on peppermint.

#### 2. Number of branches per plant

It was observed from table (5) that the effect of different concentrations of salinity on the number of branches of the three species of Ocimum was insignificant dur-

Table 3. Effect of different salinity levels on the chemical properties of soil cultivated with *Ocimum spp.* After the second cut of the second season (1999)

| *Ocimum spp.* | Salinity level ppm | E C $dsm^{-1}$ | PH | Soluble anions (mg/L) | | | | Soluble cations (mg/L) | | | | K/Na | SAR | KAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $CO_3^{--}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{--}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ | | | |
| Basilicum | 315 (control) | 1.98 | 8.27 | 0.08 | 1.58 | 7.50 | 11.42 | 10.83 | 6.67 | 3.30 | 0.85 | 0.260 | 1.12 | 0.29 |
| | 750 | 2.08 | 8.35 | 0.06 | 1.44 | 10.00 | 10.50 | 7.22 | 8.06 | 6.57 | 0.97 | 0.150 | 2.38 | 0.35 |
| | 1500 | 2.29 | 8.30 | 0.09 | 1.78 | 14.17 | 11.20 | 10.00 | 6.44 | 9.97 | 0.83 | 0.083 | 3.48 | 0.28 |
| | 2400 | 3.30 | 8.32 | 0.11 | 1.92 | 15.83 | 12.41 | 10.56 | 6.11 | 13.20 | 0.80 | 0.061 | 4.57 | 0.28 |
| | 3600 | 3.48 | 8.32 | 0.12 | 2.06 | 20.83 | 12.90 | 10.56 | 5.62 | 16.50 | 1.40 | 0.081 | 5.80 | 0.49 |
| kilimandscharicum | 315 (Control) | 1.85 | 8.30 | 0.06 | 1.39 | 7.50 | 9.23 | 9.44 | 5.00 | 3.30 | 0.70 | 0.212 | 1.23 | 0.26 |
| | 750 | 2.42 | 8.34 | 0.08 | 1.61 | 11.67 | 9.59 | 7.78 | 6.11 | 7.33 | 0.77 | 0.105 | 2.78 | 0.29 |
| | 1500 | 2.97 | 8.32 | 0.11 | 1.89 | 13.33 | 14.29 | 8.89 | 8.33 | 11.37 | 0.88 | 0.070 | 3.88 | 0.27 |
| | 2400 | 3.37 | 8.36 | 0.12 | 2.00 | 16.67 | 14.10 | 10.28 | 7.50 | 14.30 | 0.77 | 0.054 | 4.79 | 0.26 |
| | 3600 | 3.78 | 8.33 | 0.13 | 2.14 | 19.17 | 12.73 | 10.00 | 6.50 | 17.07 | 0.83 | 0.049 | 5.94 | 0.29 |
| Minimum | 315 (Control) | 1.93 | 8.26 | 0.06 | 1.44 | 9.17 | 9.88 | 7.22 | 9.44 | 4.03 | 0.87 | 0.216 | 1.39 | 0.30 |
| | 750 | 2.12 | 8.34 | 0.07 | 1.50 | 8.33 | 10.40 | 7.78 | 7.22 | 6.97 | 0.73 | 0.105 | 2.55 | 0.26 |
| | 1500 | 2.53 | 8.37 | 0.08 | 1.61 | 10.83 | 10.90 | 8.61 | 5.28 | 9.17 | 0.73 | 0.080 | 3.48 | 0.27 |
| | 2400 | 3.37 | 8.29 | 0.11 | 1.89 | 16.67 | 13.18 | 10.00 | 6.94 | 13.57 | 0.87 | 0.064 | 4.66 | 0.29 |
| | 3600 | 3.62 | 8.33 | 0.13 | 2.17 | 18.33 | 12.34 | 10.00 | 8.12 | 14.67 | 0.83 | 0.057 | 4.87 | 0.28 |

Table 4. Effect of different salinity levels on the plant height (Cm) of *Ocimum spp.* during 1998 and 1999 seasons

| *Ocimum spp.* | Salinity level ppm | 1998 | | 1999 | |
|---|---|---|---|---|---|
| | | $1^{st}$ cut | $2^{nd}$ cut | $1^{st}$ cut | $2^{nd}$ cut |
| **Basilicum** | 315 (control) | 61.77 D | 55.43 CD | 59.00ABC | 56.67 BC |
| | 750 | 69.93ABC | 64.97AB | 57.10 BCD | 55.23 C |
| | 1500 | 60.33 D | 53.00 CD | 59.20ABC | 56.00 BC |
| | 2400 | 51.67 EF | 48.87 CDEF | 50.23 EFG | 46.70 E |
| | 3600 | 49.77 F | 43.33 EFG | 45.27 GH | 40.78 G |
| **kilimandscharicum** | 315 (Control) | 74.57A | 57.13 BC | 60.10AB | 51.77 D |
| | 750 | 71.43AB | 69.50A | 61.67AB | 57.33 B |
| | 1500 | 73.43A | 51.33 CDE | 63.33A | 60.23A |
| | 2400 | 65.33 BCD | 57.23 BC | 52.20 DEF | 46.00 E |
| | 3600 | 63.13 CD | 56.33 BCD | 53.00 DEF | 43.10 F |
| **Minimum** | 315 (Control) | 49.57 F | 36.23 G | 44.37 H | 35.77 H |
| | 750 | 52.57 EF | 47.23 DEFG | 54.13 CDE | 42.90 F |
| | 1500 | 53.97 DE | 52.57 CDE | 52.97 DEF | 40.47 G |
| | 2400 | 51.20 F | 40.20 FG | 46.23 GH | 37.00 H |
| | 3600 | 46.80 F | 40.47 FG | 48.10 FGH | 34.93 H |
| **L.S.D at 0.05** | | 7.688 | 9.527 | 5.333 | 2.096 |

Table 5. Effect of different salinity levels on the number of the main branches per plant of *Ocimum spp.* during 1998 and 1999 seasons

| *Ocimum spp.* | Salinity level ppm | 1998 | | 1999 | |
|---|---|---|---|---|---|
| | | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Basilicum** | 315 (control) | 6.33 | 6.71 EFG | 4.55 | 5.33 |
| | 750 | 6.13 | 8.23 CDE | 5.87 | 6.60 |
| | 1500 | 5.99 | 9.75 ABC | 5.17 | 7.89 |
| | 2400 | 5.11 | 5.70 GH | 4.33 | 5.89 |
| | 3600 | 4.30 | 4.43 H | 3.33 | 4.10 |
| **kilimandscharicum** | 315 (Control) | 6.77 | 8.23 CDE | 6.13 | 7.87 |
| | 750 | 7.43 | 10.89A | 7.20 | 9.11 |
| | 1500 | 7.10 | 11.12A | 6.80 | 10.43 |
| | 2400 | 5.89 | 6.47 FG | 4.67 | 8.19 |
| | 3600 | 4.55 | 6.00 GH | 4.89 | 6.47 |
| **Minimum** | 315 (Control) | 5.99 | 6.13 G | 5.00 | 6.10 |
| | 750 | 6.55 | 10.23AB | 5.55 | 7.33 |
| | 1500 | 6.43 | 9.17 BCD | 6.10 | 8.43 |
| | 2400 | 5.00 | 7.99 DEF | 5.12 | 5.70 |
| | 3600 | 4.13 | 5.80 GH | 3.99 | 4.71 |
| **L.S.D at 0.05** | | **n.s** | **1.593** | **n.s** | **n.s** |

ing the first cut of the first season and, the whole second season. It is also shown in table (5) that the number of branches of *O. basilicum* was significantly reduced as a result of the application of high salinity level (3600ppm), while the growth was stimulated under the salinity level (1500ppm) as branching. It was significantly increased compared with the control.

High salinity levels (2400 and 3600ppm) significantly decreased the number of branches of *O. kilimandscharicum*. These results might be related to the fact that salinity directly has been affected on the vegetative buds under the soil surface that inhibited its growth and meristems activity (Abou El-Fadl, *et al.*, 1987) on lemongrass. Kandeel and Elwan in line with those state these results, 1991 on marjoram, and Ramadan, 1996 on guar.

There is a significant increase in the number of branches of *O. kilimandscharicum* and *O. minimum* after using the salinity levels (750 and 1500ppm). Also the level of salinity 2400ppm caused a significant increase in the number of branches of *O. minimum*. These results varied than those reported by Kotb and El-Gamal, 1997 on *Lupinus termis* (Forsk). While these results were in harmony with those reported by Hussein, 1999 on *O. basilicum var. Purpurascens*.

### 3. Fresh herb weight (gm)

It is clear from data listed in table (6) that there were a significant reduction in the fresh herb yield per plant for all species during the two experimental seasons when plants were irrigated with the saline water of 2400 and 3600ppm compared with the control. In the first season the level of salinity (3600ppm) caused a reduction in fresh herb weight of *O. basilicum* by about 38% compared to about 20% and 23.8% in the weight of *O. kilimandscharicum* and *O. minimum* respectively. Similar results were obtained by Hussein, 1999 on sweet basil plant and Faid, 1997 on *Nigella sativa*. The decrease in fresh weight of plants might be due to that salinity increased osmotic pressure which caused a drop in plant water content as found by Sanchezonde and Azura, 1979 on tomato plant. High salinity levels could cause a depression in photosynthetic activities resulting in low $CO_2$ fixation. The absorption of minerals could be related leading to low plant metabolism.

Data in table (6) also show that the fresh herb yield of *O. basilicum* increased significantly by about 8.2% compared to the control plant resulted from the application of the salinity level of 750ppm. The levels of salinity 750 and 1500ppm caused - in general - significant increase in the fresh herb weight of *O. kilimandscharicum* during

Table 6. Effect of different salinity levels on the fresh herb weight of *Ocimum spp.* during 1998 and 1999 seasons

| *Ocimum spp.* | Salinity level ppm | 1998 | | 1999 | |
|---|---|---|---|---|---|
| | | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Basilicum** | 315 (control) | 82.80 B | 65.87 B | 72.23 BC | 53.23 E |
| | 750 | 88.53A | 72. 30A | 68.90 CD | 51.17 EF |
| | 1500 | 74.90 CD | 53.33 E | 71.13 BC | 50.90 EF |
| | 2400 | 62.30 FG | 47.80 F | 63.43 DEF | 45.78 G |
| | 3600 | 61.10 FG | 45.90 F | 58.87 FG | 44.43 GH |
| **kilimandscharicum** | 315 (Control) | 76.00 CD | 66.53 B | 71.2 BC | 62.20 C |
| | 750 | 71.83 DE | 72.13A | 75.53AB | 65.77 B |
| | 1500 | 76.10 C | 70.89A | 79.71A | 69.13A |
| | 2400 | 63.90 F | 61.07 D | 60.23 FG | 56.27 D |
| | 3600 | 59.13 G | 54.67 E | 56.87 G | 52.10 E |
| **Minimum** | 315 (Control) | 65.23 F | 54.00 E | 63.92 DEF | 42.54 H |
| | 750 | 69.87 E | 62.27 CD | 67.00 CDE | 49.17 F |
| | 1500 | 70.23 E | 64.43 BC | 61.0 DEFG | 48.92 F |
| | 2400 | 54.60 H | 41.13 G | 58.33 FG | 34.63 I |
| | 3600 | 51.20 H | 39.67 G | 47.10 H | 31.11 J |
| **L.S.D at 0.05** | | 4.168 | 2.73 | 6.496 | 2.798 |

the second cut of the first season and the whole second season. The recorded increase was 11.6% in the second season after using the concentration of salinity (1500ppm) compared to the control plants. A similar trend was also observed in the fresh herb weight of *O. minimum*.

The heaviest plants were obtained in the first season after using the level of salinity of 1500ppm. The increase in the *O. minimum* fresh weight had reached about 12.9% compared to the control. These results are in accordance with the findings of Abou El-Fadl, *et al.,* 1990 on spearmint.

From the previous results, it could be concluded that *O. kilimandscharicum* and *O. minimum* could tolerate high salinity levels up to 1500ppm, while; the levels of salinity above 750ppm affected *O. basilicum.* Such results might be due to the genetic variations among the used of Ocimum species which led to tolerance variation to soil salinity conditions between these species.

## 4. The herb dry weight (gm)

The obtained data in table (7) revealed a significant decrease in the plant dry weight of *O. basilicum* in the two experimental seasons as a result of using the levels of salinity (1500, 2400 and 3600ppm). The difference between the level of salinity (750ppm) and control was not significant. These results are in agreement with the findings of Kandeel and Elwan (1991) on marjoram.

The high level salinity (3600ppm) caused a significant reduction in the herb dry weight of *O. kilimandscharicum* in the first season only, while, the two levels salinity of 750 and 1500ppm caused a significant increase in the second season compared with the plants irrigated only with tap water (control). There was a significant decrease in the plant dry weight of *O. minimum* in the second cut of the first season when the high level of salinity (3600ppm) was added. The decrease in the dry weight of plants due to salinity treatments might be attributed to that salinity reduced the synthesis of organic matter in the plant as mentioned by Kabanov , *et al.,* 1973 on pea. The salinity level of 750 and 1500ppm caused a significant increase in *O. minimum* plants in the two-second cuts of the first and second seasons. The differences between the control and the different levels of salinity were insignificant during the first cut of the first season.

Table 7. Effect of different salinity levels on dry weight of *Ocimum spp.* during 1998 and 1999 seasons

| *Ocimum spp.* | Salinity level ppm | 1998 | | 1999 | |
|---|---|---|---|---|---|
| | | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Basilicum** | 315 (control) | 25.68A | 20.20 CDE | 20.90 CDE | 19.70 BC |
| | 750 | 27.50A | 21.27 C | 19.53 EF | 17.67 CD |
| | 1500 | 22.13 B | 16.17 FG | 20.13 DEF | 17.43 D |
| | 2400 | 19.10 C | 14.78 G | 18.97 F | 10.55 E |
| | 3600 | 17.45 CD | 14.27 G | 14.43 G | 11.93 EF |
| **kilimandscharicum** | 315 (Control) | 27.87A | 24.13 B | 23.33 B | 20.23 B |
| | 750 | 26.16A | 26.77A | 27.87A | 24.10A |
| | 1500 | 26.71A | 23.90 B | 29.20A | 25.61A |
| | 2400 | 25.60A | 24.87AB | 22.23 BC | 19.77 BC |
| | 3600 | 22.20 B | 20.87 CD | 21.70 BCD | 19.68 BC |
| **Minimum** | 315 (Control) | 18.84 CD | 14.47 G | 20.10 DEF | 12.87 E |
| | 750 | 19.61 C | 18.23 EF | 20.17 DEF | 17.13 D |
| | 1500 | 19.52 C | 19.13 DE | 18.89 F | 16.55 D |
| | 2400 | 17.67 CD | 11.70 H | 19.00 F | 11.43 EF |
| | 3600 | 16.43 D | 12.10 H | 13.97 G | 10.20 F |
| **L.S.D at 0.05** | | **2.274** | **2.111** | **1.762** | **2.122** |

## I. Effect of saline water irrigation on the essential percentage and its composition

### 1. The essential oil percentage

The data obtained in table (8) indicate clearly that plants of *Ocimum spp.* irrigated with different concentrations of saline water produced herbs contain almost similar percentage of essential oil in the first cut of the two experimental seasons. The highest salinity level of 3600ppm caused a significant reduction in the essential oil percentage of *O. basilicum*, only in the second cut of the first season. Similar results were obtained on sweet basil by Hussein, 1999 and El-Shafey, *et al.*, 1991. The decrease in oil production might be due to the decrease in plant anabolism (Penka, 1978 on official plants).

The essential oil percentage of *O. kilimandscharicum* increased significantly as salinity level in irrigation water increased up to 2400ppm in the second cut of the first season compared to the control. In the second cut of the second season there was a significant increase in the essential oil percentage of *O. kilimandscharicum* after using the salinity levels of 750, 1500 and 2400ppm compared to the control. These results are in harmony with that obtained by Hussein and Abd El-Nabi (1996) on damsisea oil. Morales, *et al.*, 1993, suggested that on increase in oil content in some of the salt stressed plants might be attributed to decline the primary metabolites due to the effect of salinity. Salinity levels had no effect on the essential oil percentage of *O. minimum* in both the two seasons.

### 2. Essential oil constituents

Data of means percentage of principle compounds of Ocimum species oil as influenced by the different levels of salinity are given in table (9). Data show that some of the oil constituents are present in the three species of Ocimum such as linalool, alpha terpineol, methyl eugenol and eugenol. While others, such as alpha pinene, beta pinene and ocimene were only detected in *O. minimum* and in *O. basilicum*. D-limonene was not detected in *O. minimum* and in *O. kilimandscharicum* with high salinity levels (2400 and 3600ppm). Cineol disappeared in *O. kilimandscharicum*. Camphor was detected in both *O. basilicum* and *O. kilimandscharicum,* while; alpha terpineol was not only detected in *O. minimum* when plant was irrigated with tap water and saline water contains 750ppm.

Data in table (8) illustrated also that the increasing of salinity levels as compared with control treatment had significantly increased most components. These results

Table 8. Effect of different salinity levels on the essential oil percentage of *Ocimum spp.* during 1998 and 1999 seasons

| *Ocimum spp.* | Salinity level ppm | 1998 | | 1999 | |
|---|---|---|---|---|---|
| | | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Basilicum** | 315 (control) | 1.17 | 1.12 CD | 1.03 | 0.89 DEF |
| | 750 | 1.14 | 1.24 C | 1.30 | 1.02 D |
| | 1500 | 1.10 | 0.89 DE | 1.45 | 0.93 DE |
| | 2400 | 0.98 | 0.97 DE | 0.89 | 0.75 EF |
| | 3600 | 0.87 | 0.81 EF | 0.78 | 0.69 FG |
| **kilimandscharicum** | 315 (Control) | 2.13 | 1.83 B | 1.97 | 1.43 C |
| | 750 | 2.00 | 1.88 B | 2.28 | 2.13A |
| | 1500 | 2.10 | 2.03AB | 2.33 | 2.27A |
| | 2400 | 2.23 | 2.14A | 2.16 | 1.89 B |
| | 3600 | 1.95 | 1.87 B | 2.00 | 1.55 C |
| **Minimum** | 315 (Control) | 0.47 | 0.45 GH | 51.00 | 0.39 H |
| | 750 | 0.55 | 0.57 GH | 57.00 | 0.52 GH |
| | 1500 | 0.59 | 0.61 FG | 0.60 | 0.49 GH |
| | 2400 | 0.63 | 0.37 H | 0.68 | 0.41 H |
| | 3600 | 0.41 | 0.33 H | 0.43 | 0.37 H |
| **L.S.D at 0.05** | | n.s | 0.2303 | n.s | 0.2048 |

Table 9. Effect of different salinity levels on the essential oil constituents of *Ocimum spp.* during 1998 and 1999 seasons

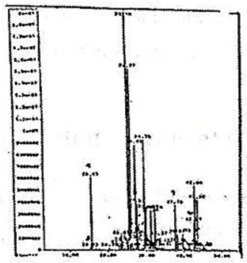
| *Ocimum spp.* | Salinity level ppm | Alpha pinene | Beta pinene | d-imonen-e | 1,8 Cineol | Ocime-ne | Linalool | Camp-hor | Alpha terpineol | Methyl eugenol | eugenol |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Basilicum** | 315 (control) | 0.09 C | 0.11 D | 0.72 D | 9.12 C | 0.10 C | 30.57A | 0.54 E | 2.81 BCD | 1.34 DE | 2.33A |
| | 750 | 0.58 B | 0.72A | 1.79A | 13.95AB | 0.23A | 30.68A | 0.66 E | 2.48 CDE | 1.71 CD | 0.44 H |
| | 1500 | 0.57 B | 0.48 C | 1.23 C | 13.29 B | 0.22A | 30.45A | 0.71 E | 2.20 CDE | 1.67 CD | 0.57 FG |
| | 2400 | 0.83A | 0.62 B | 1.37 B | 13.96AB | 0.12 B | 31.17A | 0.69 E | 2.91 BCD | 1.74 CD | 1.22 C |
| | 3600 | 0.0 | 0.0 | 0.14 E | 4.94 E | 0.0 | 31.84A | 0.90 E | 2.10 DE | 2.29 C | 1.75 B |
| **Kilimand-Scharicum** | 315 (control) | 0.0 | 0.0 | 0.06 F | 0.0 | 0.0 | 7.16 E | 21.65 D | 2.98 BC | 1.27 DEF | 1.21 C |
| | 750 | 0.0 | 0.0 | 0.07 F | 0.0 | 0.0 | 10.44 D | 21.78 D | 1.89 E | 3.55A | 1.16 C |
| | 1500 | 0.0 | 0.0 | 0.09 F | 0.0 | 0.0 | 17.08 C | 38.79A | 1.86 E | 1.63 CD | 0.65 F |
| | 2400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.78 C | 27.69 C | 1.97 E | 2.78 B | 0.97 D |
| | 3600 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.97 C | 30.93 B | 2.65 BCDE | 1.76 CD | 0.82 E |
| **Minimum** | 315 (Control) | 0.0 | 0.0 | 0.0 | 2.77 F | 0.0 | 7.11 E | 0.0 | 0.0 | 1.26 DEF | 0.89 DE |
| | 750 | 0.0 | 0.0 | 0.0 | 3.17 F | 0.0 | 9.133 DE | 0.0 | 0.0 | 2.13 C | 0.64 F |
| | 1500 | 0.0 | 0.0 | 0.0 | 1.55 G | 0.0 | 16.78 C | 0.0 | 2.13 CDE | 0.97 EF | 0.45 GH |
| | 2400 | 0.0 | 0.0 | 0.0 | 14.23A | 0.0 | 23.66 B | 0.0 | 3.51 B | 0. 82 F | 0.20 I |
| | 3600 | 0.0 | 0.0 | 0.0 | 7.0 D | 0.0 | 24.54 B | 0.0 | 4.97A | 0.77 F | 0.30 I |
| **L.S.D at 0.05** | | 0.2447 | 0.02447 | 0.03316 | 0.7056 | 0.0173 | 2.683 | 1.333 | 0.8642 | 0.5696 | 0.1296 |

may lead to an accumulation of organic acids in response tap water stress caused by differential water potentials between the plant and the. soil solution (Hussein and Abd El-Nabi, 1996). These results also are in accordance with the findings of Boselah (1995), who reported that linalool and cineol in coriander oil increased with increasing the salinity levels.

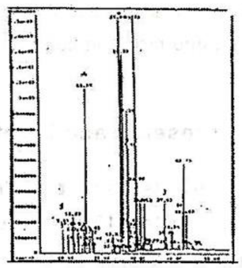
## VI. Population densities of insects and its effects with salinity

The population densities of insects associated with Ocimum species during 1997 and 1998 seasons were recorded in table (10). It is shown that each of Ocimum species (*O. basilicum*, *O. kilimandscharicum* and *O, minimum*) were attacked by the white fly (*Bemisia Tabaci*), Aphids (*Aphis gossypii*), Jassid (*Empoasca spp.*) and mealy bugs (*Icerya aegyptiaca*) during two seasons. There were significant correlation between insects and intervals, where the population *of B.tabaci* and *Empoasca spp.* increased during September and October. And *A.gossypii* population increased during July and August. This result is in agreement with that of Abd El-Nabi, *et al.*, 1996. As shown in the previous table, there were significant correlation between *B.tabaci* population and Ocimum species where *O. kilimandscharicumand* and *O. basilicum* were more susceptible to insect attacking than *O. minimum. B.tabaci* population in all Ocimum spices increased with saline water increasing. Data show that *O. minimum* was more susceptible to *A.gossypii* attacking than the other species where *A.gossypii* population increasing occurred with saline water increasing. Correlation between *Empoasca spp.* and Ocimum species was not significant. There were small populations of *I. aegyptiaca* on the studied Ocimum species.

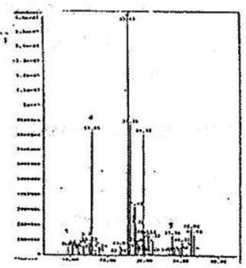
Effect of salinity levels on Ocimum oil constituents.



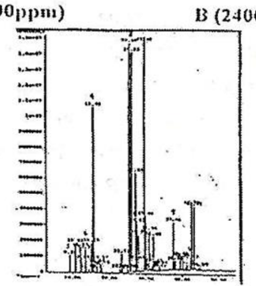
A (3600ppm)



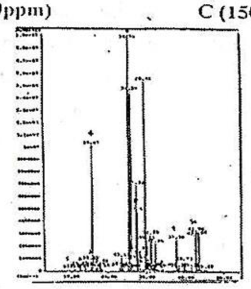
B (2400ppm)



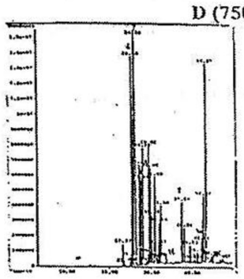
C (1500ppm)



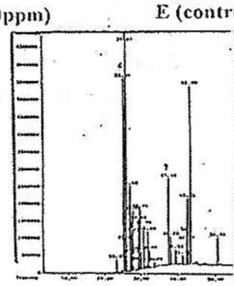
D (750ppm)



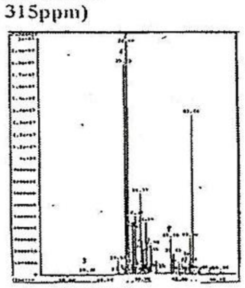
E (control, 315ppm)



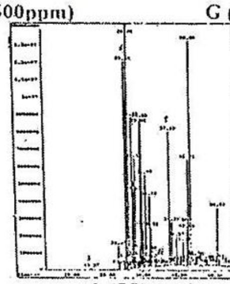
F (3600ppm)



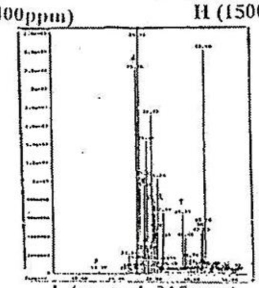
G (2400ppm)



H (1500ppm)

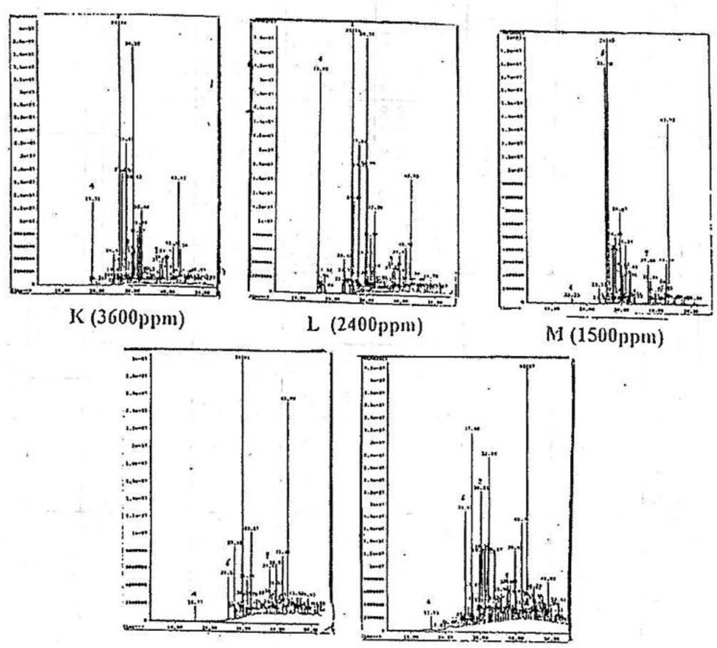


I (750ppm)



J (control, 315ppm)

1. Alpha pinene
2. Beta pinene
3. d-limonene
4. 1, 8 cineol
5. Ocimum
6. Linalool
7. Camphor
8. Alpha terpineol
9. Methyl eugenol
10. Eugenol




N (750ppm) O (control, 315ppm)

Fig. 1. Chromatogram of Ocimum oil constituents affected by different salinity levels (O. basilicum; A, B, C, D and E); (O. kilimandscharicum; F, G, H, I and J) and (O. minimum; K, L, M, N and O).

Table 10. Mean counts of injurious insects infesting *Ocimum* species during the growing seasons of 1998 and 1999

| Treatment | 1998 | | | | | | | | | | | | Treatment | 1999 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *O. Basilicum* | | | | *O. Minimum* | | | | *O. kilimandscharicum* | | | | | *O. Basilicum* | | | | *O. Minimum* | | | | *O. kilimandscharicum* | | | |
| | *B.t* | *A.g* | Jassid | M.B. | *B.t* | *A.g* | Jassid | M.B. | *B.t* | *A.g* | Jassid | M.B. | | *B.t* | *A.g* | Jassid | M.B. | *B.t* | *A.g* | Jassid | M.B. | *B.t* | *A.g* | Jassid | M.B. |
| 20/73600 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15/8 | 0.00 | 5.00 | 0.33 | 0.67 | 0.33 | 43.30 | 0.00 | 0.00 | 0.67 | 0.00 | 0.33 | 0.33 |
| 2400 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 40.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.33 | 0.33 |
| 1500 | 0.67 | 0.00 | 0.33 | 0.00 | 0.00 | 23.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 30.00 | 0.33 | 0.00 | 0.67 | 0.00 | 0.33 | 0.67 |
| 750ppm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 80.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.67 | 0.00 | 0.00 | 0.00 | 0.33 | 10.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.33 |
| T.W. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 62.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 1.00 | 0.00 | 0.00 | 0.00 | 1.33 | 0.00 | 0.00 | 1.00 | 2.50 | 0.00 | 0.00 | 0.00 |
| 27/73600 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 16.67 | 0.33 | 0.00 | 3.00 | 0.00 | 0.00 | 0.67 | 23/8 | 0.00 | 5.00 | 0.33 | 0.67 | 0.67 | 56.67 | 0.00 | 0.00 | 1.33 | 0.00 | 0.33 | 0.33 |
| 2400 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.67 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 21.70 | 0.67 | 0.33 | 0.67 | 0.00 | 1.00 | 0.33 |
| 1500 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.33 | 0.00 | | 0.33 | 0.00 | 0.00 | 0.00 | 0.33 | 35.00 | 0.67 | 0.00 | 1.00 | 0.33 | 0.67 | 0.67 |
| 750ppm | 0.67 | 0.00 | 0.00 | 0.00 | 0.33 | 7.33 | 0.00 | 0.00 | 2.00 | 0.00 | 0.00 | 0.00 | | 0.67 | 0.00 | 0.00 | 0.00 | 0.67 | 13.33 | 0.00 | 0.00 | 0.67 | 0.00 | 0.00 | 0.33 |
| T.W. | 0.67 | 33.33 | 0.33 | 0.00 | 0.00 | 15.00 | 0.00 | 0.33 | 1.67 | 0.00 | 0.00 | 0.00 | | 1.00 | 0.00 | 0.00 | 0.00 | 2.00 | 1.33 | 0.33 | 0.67 | 4.00 | 0.00 | 0.00 | 0.00 |
| 7/83600 | 0.00 | 0.00 | 0.00 | 0.00 | 1.33 | 0.00 | 0.00 | 0.00 | 5.33 | 0.00 | 0.00 | 0.00 | 31/8 | 0.00 | 0.00 | 0.67 | 0.33 | 0.00 | 20.67 | 24.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 |
| 2400 | 0.00 | 0.00 | 0.00 | 0.00 | 0.67 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.00 | 0.33 | 0.00 | 0.00 | 0.00 | 0.33 | 1.00 |
| 1500 | 0.00 | 0.00 | 0.00 | 0.00 | 0.67 | 6.67 | 0.00 | 0.00 | 0.67 | 0.33 | 0.00 | 0.00 | | 0.00 | 3.33 | 1.33 | 0.33 | 0.00 | 2.67 | 1.67 | 0.00 | 0.00 | 0.00 | 0.33 | 0.33 |
| 750ppm | 1.00 | 26.67 | 0.00 | 0.00 | 0.00 | 3.33 | 0.00 | 0.00 | 1.33 | 0.00 | 0.00 | 0.00 | | 0.30 | 0.33 | 3.50 | 0.00 | 0.00 | 1.67 | 2.50 | 0.00 | 0.00 | 0.00 | 0.67 | 0.67 |
| T.W. | 1.67 | 0.00 | 0.00 | 0.00 | 0.00 | 16.67 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | | 0.33 | 18.33 | 1.33 | 0.00 | 0.00 | 1.67 | 0.00 | 0.33 | 0.00 | 0.00 | 0.67 | 0.00 |
| 22/93600 | 13.00 | 0.00 | 0.00 | 0.33 | 7.67 | 0.00 | 0.00 | 1.00 | 14.67 | 0.00 | 0.00 | 0.67 | 11/10 | 11.00 | 9.00 | 0.00 | 0.00 | 6.67 | 11.70 | 1.33 | 0.00 | 28.00 | 0.00 | 3.00 | 0.00 |
| 2400 | 12.33 | 0.00 | 0.00 | 0.00 | 7.67 | 0.00 | 0.00 | 0.00 | 6.33 | 0.00 | 0.00 | 0.33 | | 9.30 | 0.00 | 0.00 | 0.00 | 13.33 | 3.00 | 0.33 | 0.00 | 15.33 | 0.67 | 0.00 | 0.00 |
| 1500 | 8.00 | 0.00 | 0.00 | 0.00 | 3.67 | 0.00 | 0.67 | 0.00 | 7.00 | 0.00 | 0.00 | 0.67 | | 12.00 | 5.00 | 0.00 | 0.00 | 6.67 | 0.00 | 0.33 | 0.00 | 11.67 | 0.00 | 1.67 | 0.00 |
| 750ppm | 11.67 | 0.00 | 0.33 | 0.67 | 5.67 | 4.67 | 0.33 | 0.67 | 11.00 | 0.00 | 0.00 | 1.00 | | 18.67 | 0.00 | 0.00 | 0.00 | 4.67 | 3.33 | 0.00 | 0.33 | 17.00 | 0.00 | 0.00 | 0.00 |
| T.W. | 11.00 | 0.00 | 0.00 | 0.00 | 8.67 | 2.30 | 0.00 | 3.00 | 11.00 | 0.00 | 0.33 | 0.33 | | 13.67 | 0.00 | 0.67 | 0.00 | 8.67 | 4.00 | 0.00 | 0.33 | 0.30 | 0.26 | 0.00 | 0.00 |
| 28/93600 | 1.67 | 0.00 | 0.00 | 0.00 | 2.50 | 0.00 | 0.30 | 0.00 | 4.00 | 0.00 | 0.67 | 0.67 | 18/10 | 2.50 | 8.33 | 0.00 | 0.00 | 1.33 | 11.67 | 0.00 | 0.00 | 3.00 | 0.00 | 0.67 | 0.00 |
| 2400 | 5.67 | 0.00 | 0.33 | 0.00 | 2.00 | 0.00 | 1.33 | 0.00 | 3.00 | 0.00 | 0.67 | 0.67 | | 0.67 | 1.33 | 0.33 | 0.00 | 1.67 | 1.00 | 1.00 | 1.00 | 3.67 | 0.00 | 0.00 | 0.00 |
| 1500 | 2.00 | 0.00 | 1.66 | 0.00 | 3.67 | 0.00 | 2.67 | 0.33 | 2.50 | 0.00 | 0.00 | 0.67 | | 2.00 | 6.33 | 0.67 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 4.67 | 0.00 | 0.67 | 0.00 |
| 750ppm | 3.00 | 0.00 | 1.00 | 0.00 | 2.00 | 0.00 | 1.33 | 0.33 | 2.00 | 0.00 | 1.30 | 0.67 | | 0.67 | 4.00 | 1.30 | 0.00 | 2.00 | 13.33 | 0.33 | 0.00 | 4.33 | 0.00 | 1.00 | 0.33 |
| T.W. | 3.00 | 0.00 | 0.00 | 0.33 | 3.67 | 1.67 | 0.00 | 0.67 | 3.33 | 0.00 | 0.00 | 1.33 | | 5.00 | 3.33 | 1.00 | 0.33 | 3.00 | 8.00 | 0.00 | 0.00 | 8.33 | 0.00 | 0.67 | 0.00 |
| 13/103600 | 50.00 | 0.00 | 0.00 | 0.00 | 25.00 | 0.00 | 0.00 | 0.00 | 36.00 | 0.00 | 0.00 | 1.00 | 26/10 | 0.67 | 1.67 | 2.00 | 0.00 | 0.33 | 7.67 | 0.33 | 0.00 | 2.50 | 0.00 | 1.00 | 0.67 |
| 2400 | 7.00 | 0.00 | 1.00 | 0.00 | 9.00 | 0.00 | 0.00 | 0.00 | 13.00 | 0.00 | 0.00 | 1.00 | | 0.67 | 1.00 | 1.67 | 0.00 | 0.67 | 3.00 | 1.67 | 0.00 | 0.00 | 0.00 | 2.00 | 0.00 |
| 1500 | 6.00 | 0.00 | 1.00 | 2.00 | 6.00 | 0.00 | 0.00 | 0.00 | 8.00 | 0.00 | 2.00 | 0.00 | | 0.67 | 1.67 | 0.67 | 0.33 | 1.67 | 0.67 | 0.00 | 0.00 | 2.50 | 0.00 | 1.33 | 0.00 |
| 750ppm | 12.00 | 0.00 | 2.00 | 0.00 | 9.00 | 0.00 | 4.00 | 0.00 | 12.00 | 0.00 | 4.00 | 2.00 | | 0.67 | 1.67 | 0.67 | 0.00 | 0.00 | 5.00 | 0.67 | 0.00 | 0.00 | 0.00 | 2.00 | 0.33 |
| T.W. | 2.00 | 0.00 | 2.00 | 0.00 | 2.00 | 0.00 | 2.00 | 0.00 | 4.00 | 0.00 | 0.00 | 1.00 | | 0.33 | 0.67 | 0.67 | 0.00 | 2.00 | 8.33 | 0.33 | 0.00 | 2.50 | 0.00 | 0.00 | 0.33 |

| L.S.D. | *B.Tabaci* | *A.gossypii* | Jassid | M.B. | *B.Tabaci* | *A.gossypii* | Jassid | M.B. |
|---|---|---|---|---|---|---|---|---|
| Between Intervals | 1.7063*** | 0.6813*** | 0.3050*** | 0.1395*** | 1.9637*** | 2.589*** | 0.5220** | 0.1729* |
| Between Varities | 1.4339* | (N.S.) | (N.S.) | 0.1959* | 0.7260*** | 2.6017*** | (N.S.) | (N.S.) |
| Between Treatment | 1.1328*** | 0.4172* | 0.2077*** | (N.S.) | 1.3049* | 3.9312** | (N.S.) | (N.S.) |

where *,**,*** Significant at 0.05, 0.01, 0.001, respectively    N.S. = Not Significant

B.T. = *Bemesia tabaci*    A.g = *Aphis gossypii*

J = *Empoasca* spp    M.B = mealbuy (*I. Aegyptiaca*)

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# تأثير الري بالمياه المالحة على النمو و محصول الزيت و جودته و الإصابة الحشرية لبعض أصناف الريحان OCIMUM SPECIES

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أجرى هذا البحث بغرض دراسة تأثير مستويات مختلفة من الملوحة المكونة من كلوريدات الصوديوم و الكالسيوم بنسبة ٢:١ بالوزن على التربة و إنتاجية العشب و كمية و نوعية الزيت الطيار و أيضا الإصابات الحشرية لثلاثة أنواع من الريحان هي: الريحان الأبيض أو الحلو و الريحان الكافوري و أخيرا الريحان صغير الأوراق. و مستويات الملوحة المستخدمة كانت (٧٥٠، ١٥٠٠، ٢٤٠٠ و ٣٦٠٠ جزء في المليون) مقارنة بـ ٣١٥ جزء في المليون (ماء الصنبور).

**و قد أوضحت النتائج ما يلي:**

استخدام مستويات الملوحة العالية (٢٤٠٠ و ٣٦٠٠ جزء في المليون) سببت نقصا معنويا في إنتاجية العشب للأنواع الثلاثة من الريحان. الريحان الأبيض تحمل الري بالمياه المالحة بتركيز ٧٥٠ جزء في المليون دون نقص معنوي بينما الريحان الكافوري و الريحان صغير الأوراق تحملا الملوحة حتى ١٥٠٠ جزء في المليون.

أثرت مستويات الملوحة المختلفة تأثيرا طفيفا على النسبة المئوية للزيت الطيار في كل أنواع الريحان المدروسة. يوضح التحليل الكروماتوجرافى للزيت الطيار أن بعض مكونات الزيت ارتفعت مع زيادة الملوحة مثل الميثيل ايجانول و الكمفور في الريحان الأبيض الحلو و الريحان الكافوري و اللينالول في أنواع الريحان الثلاثة، بينما انخفضت بعض المكونات بزيادة مستويات الملوحة مثل الايجانول و ألفا تربينيول.

أظهرت نتائج تحليل التربة بعد الحصاد أن المحتوى الملحي لمياه الري كان له التأثير السائد على ملوحة الأرض و أظهرت قيم SAR (نسبة الصوديوم المد مص) و KAR (نسبة البوتاسيوم المد مص) زيادة مع زيادة مستويات الملوحة. بينما K/Na نقصت بزيادة الملوحة.

اتضح من الحصر أن أنواع الريحان المدروسة تصاب بحشرات الذبابة البيضاء ز المن و الجاسيد (النطاطات) و البق الدقيقي، و كان الريحان الأبيض و الريحان الكافوري اكثر حساسية للإصابة بحشرة الذبابة البيضاء، بينما كان الريحان صغير الأوراق اكثر عرضي للإصابة بحشرة المن عن باقي الأنواع، كما لوحظ أن ارتفاع مستوى الملوحة سبب زيادة في أعداد حشرات الذبابة البيضاء و المن على كل أنواع الريحان موضع الدراسة.