# EFFECT OF ORGANIC AND BIO-FERTILIZERS ON VETIVER PLANT *VETIVERIA ZIZANIOIDES,* L. NASH

**HAMMAM, KH. ABD-EL-MONEM[1]and E.A. HASSAN[2]**

1. *Medicinal and Aromatic Plants Researches Department, Horticulture Research Institute, ARC, Giza, Egypt*
2. *Central Lab. of Organic Agri., ARC, Giza, Egypt*

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***Abstract***

The response of (*Vetiveria zizanioides,* L. Nash) to organic fertilizer *i.e*. compost, chicken manure and feldspar (12 % $K_2O$) + rock phosphate (20 % $P_2O_5$) with microorganism (*Bacillus megatherium var. phosphaticum* and *B. circulanse*) in comparison with recommended chemical NPK were studied. In both tested seasons, the fertilization with compost (2 ton/fed.) + Chicken manure (2 ton/fed.) + 100kg feldspar + 100 kg rock phosphate mixed inoculation with *Bacillus megatherium var. phosphaticum and B. circulanse* were resulted the highest values of plant height, root length, number of tillers, fresh and dry weights of roots and shoots as well as oil % and oil yield.

**Key words,** *Vetiveria zizanioides,* compost, chicken manure, *Bacillus megatherium var. phosphaticum and B. circulanse.*

## INTRODUCTION

Vetiveria zizanioides L. Nash is popularly known as Khas Khas, Khas or Khus grass in India. (Family Poaceae), perennial, reached, 1.5 – 3 m.high. Leaf-blades narrow, up to 90 cm. long and 7 mm. wide. Vetiver has been known to India since ancient times. It has been considered as a high class perfume and copper plate inscriptions list the perfume as one of the articles used by royalty. The roots are woven along with bamboo splits and made into flat mattresses for use as under-beds to give a cooling effect. The roots have found increased use in electric room-coolers. Local application of leaf paste for rheumatism, lumbago and sprain gives good relief. Vetiver roots are the most useful part of the plant. The dried, chopped roots can be steam distilled and the oil known as vetiver oil. This oil calms the mind and reduces the tension. Chemical components of vetiver roots are very important because they posses fungicidal, herbicidal and insecticidal properties. (Ibrahim *et al.* 2004 and Henderson *et al.* 2005b).

The essential oil of vetiver (*Vetiveria zizanioides,* L. Nash) is one of the most important raw materials in perfumery both as a fixative and in its own right as a fragrance ingredient. It has extensive applications in toiletries and cosmetic industries and vetiver roots are also important in traditional medicine as a carminative, stimulant

and diaphoretic. Vetiver oil possesses sedative property and has been traditionally used in aromatherapy for relieving stress, anxiety, nervous tension and insomnia for a long time Fischer-Rizzi, (1990).

The essential oil obtained by steam distillation from the roots of *Vetiveria zizanioides*, L. Nash was investigated for its chemical constituents by GC and GC/MS. The major volatile components belong to the sesquiterpene group are khusimol, α-vetivone, and b-vetivone. The sedative effect of vetiver oil upon inhalation in rats was studied by observing the number of crossing and rearing motilities, (Sirinan Thubthimthed *et al*. 2003).

Pascal *et al.* (2006) reported that, oil was obtained from roots of *Vetiveria nigritana* (Benth.) Stapf collected in Mali and analyzed by GC and GC/MS. Fifty-four constituents (79.7% of the whole oil) were identified. Prezizanoic acid (15.0%), preziza-7(15)-en-12-ol (9.5%), cedren-8-en-15-ol (6.2%), preziza-7(15)-en-3α-ol (6.0%) and zizanoic acid (5.9%) were the major components *of Vetiveria nigritana* essential oil.

Pascal *et al*. (2007) showed that, essential oil from roots (2% w/w) of *Vetiveria nigritana* (Benth.) Stapf (Poaceae) from Mali was analyzed by GC–MS. there were two norsesquiterpene hydrocarbons, and two sesquiterpene acids of components.

Regarding the effect of organic and biofertilization, Lakshmanaperumalsamy *et al.* (2007), showed that the maximum root and shoot length, fresh and dry weights, number of culms, number of leaves and total chlorophylls when the vetiver ( *Vetiveria zizanioides*, L. Nash) plants grown using soil, cow dung, vermicompost and coir pith at ratios of 1:1:1:1, respectively. Aderinola *et al*. (2009) noticed that, the number and height of tillers as well as number and length of leaves were increased with age of the grass and highest values obtained with application of 100 kg/ha organic fertilizer on *Vetiveria nigritana.* Priyadarshani *et al.* (2013) on (*Vetiveria zizanioides* L. Nash) plants indicated that, compost : inorganic fertilizer (3:1) mixture showed significant high shoot and root dry weights, number of leaves and tillers at 9 months after planting. Compost: inorganic fertilizer (3:1) mixture also showed significantly higher amounts of β– Vetivenene, Khusimol, and Iso-valencinol contents compared to other treatments.

Abdelaziz *et al*. (2007) on rosemary plant indicated that, the plant received compost + microorganism had higher levels of NPK, oil %, oil yield and carbohydrates contents compared to compost or NPK (control). Gharib *et al*. (2008) on sweet Marjoram showed that, the highest values of NPK contents obtained from plants treated with 30% aqueous extracts of compost with bio-fertilizer treatments (*Azosspirillum brasiliense* + *Azotobacter chroococcum* + *acillusB. polymyxa* + *B. circulans*) recording

(1.84, 0.35 & 2.02%.) compared with (1.29, 0.16&1.00%)for control plants, respectively. Ahmad *et al.* (2011) on marjoram plants, showed that, sources of organic fertilizers (farmyard manure and poultry manure at a rate of 75 $m^3$/ha) reflected significant effect on volatile oil yield/ plant, oil yield per hectare in herb and NPK (%) contents. Moradi *et al* (2011) reported that, essential oil yield and percentage of anethole and fenchone contents in essential oil were significantly higher in all organic and biological treatments on sweet fennel (*Foeniculum vulgare* var. dulce). El-Kallaf ( 2012) pointed that, the beneficial effects of organic manure levels at 24 $m^3$ fed. and bio fertilization as alternative nutrition systems on the growth characteristics, total N, P and carbohydrate content, and essential oil yields of spearmint. Mehrab *et al*. (2012) indicated that, the application of bio fertilizers (phosphate-solubilizing bacteria, nitroxin and frowzy manure) caused the highest biomass and essence production of Thyme (*Thymus vulgaris*) plants. Ismail *et al.* (2013) cleared that, cattle manure at (20 $m^3$ /fed.) and biofertilization treatments as interaction had a significant effect on growth of *Silybum marianum in* terms of plant height, number of branches, number of roots and root length and dry matter accumulation in plant organs significantly increased with the application of biofertilizer in combination with organic fertilizer. Also, both biofertilizers and organic fertilizer significantly affected the dry weight of herbs and roots as compared with the control treatments (NPK). Gajbhiye *et al.* (2013) revealed that, application of 10 t FYM / ha significantly improved growth parameters viz, plant height, number of tillers / clumps and number of leaves / clump at all the days intervals and yield contributing characters viz, herbage yield and dry matter yield of lemongrass (*Cymbopogon flexuosus*)**.** Whereas, quality parameters viz, oil content and oil yield of lemongrass was increased with 5 t FYM / ha. Therefore, the aim of this study was to investigate the effect of compost, chicken manure mixed with feldspar (12 % $K_2O$), rock phosphate (20 % $P_2O_5$) and microorganism on the vegetative growth, oil production and chemical oil composition of vetiver plant *Vetiveria nigritana* (Benth.) Stapf.

## MATERIALS AND METHODES

This study was carried out at the Farm of Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, El-Kanater El- Khairiya, during the two successive seasons of 2012 and 2013. The investigation chemical analyses were determined at the Laboratory of Medicinal and Aromatic Plants Research Department, Horticulture Research Institute and Central Lab. of Organic Agric., A.R.C.

Vetiver offsets (20 cm long) were planted on 15th March, 2012 and 20th march, 2013. The plants were grown at spacing of 45x60cm, there were 27 plants / plot, (4.0x2.0 m) with three replicates. The experiment was designed using the complete randomized blocks design.

**The experimental treatments were as follows:**

1- Control treatment was fertilized with the recommended rate of chemical fertilizers, i.e. 450 kg. Ammonium sulphate (20.5%N) /fed., 350 kg. Calcium super phosphate (15.5%$P_2O_5$) /fed. and 75 kg. Potassium sulphate (48% $K_2O$) /fed. Calcium super sulphate was added before planting, while Ammonium sulphate and Potassium sulphate were added in two equal doses after 45 and 60 days from planting.
2- Compost at 5 ton / fed.
3- Compost at 5 ton / fed. + 125kg feldspar + 125kg rock phosphate.
4- Compost at 5 ton / fed. + 125kg feldspar + 125kg rock phosphate + microorganism (*Bacillus megatherium var. phosphaticum* and *B. circulanse* at 600 g/ fed. for each).
5- Chicken manure at 2 ton / fed.
6- Chicken manure at 2 ton / fed. + 50kg.feldspar + 50kg rock phosphate.
7- Chicken manure at 2 ton /fed. + 50kg.feldspar + 50kg rock phosphate + microorganism (*Bacillus megatherium var. phosphaticum* and *B. circulanse* at 600 g/ fed. for each).
8- Compost at 2 ton/fed. + chicken manure at 2 ton /fed.
9- Compost at 2 ton/fed. + Chicken manure 2 ton /fed + 100kg feldspar + 100 kg rock phosphate.
10- Compost at 2 ton/fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism (*Bacillus megatherium var. phosphaticum* and *B. circulanse* at 600 g/ fed. for each).

- All the microorganisms and biofertilizer used in this study were obtained from Central Laboratory of Organic Agriculture, ARC. And used as carrier inocula.
- Feldspar, rock phosphate and microorganism were applied one time before planting.
- Different samples of soil at 30 cm depth were taken randomly for physical and chemical analyses were done at Water and Soil Lab. (A.R.C.) as shown in Table (1).
- Physical and chemical analysis of compost and chicken manure are shown in Table (2):

Table 1. Physical and chemical analysis of the experimental soil:

| 1-Physical properties of the experimental soil. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentages | | | | | | | | | | | | | | Texture | |
| Sand | | | Silt | | | Clay | | | Gravel | | | | | Clay | |
| 29.60 | | | 9.30 | | | 59.03 | | | 2.07 | | | | | | |
| 2-Chemical properties of the experimental soil. | | | | | | | | | | | | | | | |
| Total (ppm) | | | N % | O.M % | $CaCO_3$ % | pH | E.C(dS/m) | $Ca^{++}$(meq/L) | $Mg^{++}$ (meq/L) | $Na^{+}$ (meq/L) | $k^{+}$(meq/L) | $Co_3$(meq/L) | $HCO_3$(meq/L) | $CL^{-}$ (meq/L) | $SO4^{-}$(meq/L) |
| N | P | K | | | | | | | | | | | | | |
| 2.1 | 28.6 | 6.5 | 0.21 | 1.8 | 2.9 | 7.3 | 3.2 | 17.2 | 5.6 | 10.4 | 1.6 | - | 6.4 | 12.3 | 16.1 |

Table 2. physical chemical analysis of compost and chicken manure

| Characters | Chicken manure | Compost |
|---|---|---|
| pH(1:10) | 8.15 | 7.32 |
| E.C. dS $m^{-1}$ | 1.85 | 1.91 |
| O.M % | 46.35 | 59.50 |
| O.C % | 26.88 | 34.60 |
| Total N % | 1.73 | 1.95 |
| Bulk density (g /cm ) | 0.39 | 0.55 |
| Available (P %) | 0.139 | 0.30 |
| Available K % | 1.220 | 1.68 |

After 7 months from planting in the first and second seasons, shoots of 5 plants were clipped at 5 cm. above ground and roots were excavated as completely as possible from each experimental unit and were washed by water and recorded the following data:

Five plants were taken randomly from each experimental unite and the growth data were recorded plant height (cm), number of tillers, root length (cm), fresh and dry weight of roots (g.) and shoots. The oil percentage was determined in the fresh roots using the method described by the British Pharmacopoeia (1963), and the

essential oil per plant was calculated in proportion to the fresh weight (oil yield/plant = fresh weight of roots x oil percentage).

Oil samples taken from the second season (2013) were analyzed using GC/MS, Shimadzu-QP5000 GC 17A series, column DB5-ms 30m × 0.250mm × 0.1 µm film thickness to determine their main constituents as described by EL Tobgy (1999).

The analysis conditions were as follows: GC/MS Oven temp.: 50°C, injector temp.:200°C, interface temp.: 230°C, temperature programming: 50°C for 5 minutes, rate: 3o/min to 200°C for 2 minute, injection type: split less, carrier gas: helium 99.999%, carrier flow rate: 1.7 ml/min, detector gain: 1.50 kV, mass range: 40: 350 M/Z, run time: 57 min.

Chlorophyll (A, B& total) and carotenoides in tissues of fresh leaves (mg. /g. fresh weight) were determined according to Saric *et al*. (1967).

Samples of dry shoots were digested for elements determination using the method of Piper (1947). Nitrogen % was determined by the modified microkejldahl method as described by Jackson *et al*. (2001). Phosphorus % was determined according to Olsen and Sommers (1982) method. Potassium % was determined using flame photometericlly as described by Dewis and Freitas (1970).

The collected data were subjected to the statistical analysis and means were compared using the L.S.D. at 5% as described by Gomez and Gomez (1984). This statistical analysis was done by using the computer program MSTATEC software version (4).

## RESULTS AND DISCUSSION

**1- Plant height and number of tillers:**

In Table (3). It was clearly indicated that, organic and biofertilizers had a significant effect on plant height and number of tillers.

Plant height increased from 160.29 when vetiver plants treated with (chicken manure at 2 ton / fed.) to 216.11 (cm.) when plants treated with (compost at 2 ton /fed. + chicken manure at 2 ton /fed.+ 100kg feldspar + 100 kg rock phosphate + microorganism) in the first season, while from 161.29 to 217.04 (cm.) in the second season. Data show also, that plants treated with (compost at 5 ton / fed+125kg feldspar+125kg rock phosphate + microorganism), (compost at 2 ton /fed.+ chicken manure at 2 ton /fed.), (compost at 2 ton/fed.+ chicken manure 2 ton /fed + 100kg feldspar + 100 kg rock phosphate.) and (compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism) significantly

increased number of tillers/ plant compared with control which gave 25.35 / plant and 26.07 / plant in the first and second seasons, respectively. Plants treated with (compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism) gave the highest values of plant height and number of tillers/ plant in the two seasons which gave (216.11(cm) and 217.04(cm)) and (36.78/ plant and 37.45/ plant) in the two seasons, respectively. Similar results were obtained by Gajbhiye *et al.* (2013) on lemongrass.

**2- Root length, fresh and dry weights of roots/plant and per Fedden:**

Data presented in Table (4) and Figure (1) also, show that, vetiver plants treated with (compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism) gave the tallest roots (41.78 cm. 42.54 cm.) in the two seasons respectively, and the plants treated with (compost at 5 ton/ fed. + 125kg feldspar + 125kg rock phosphate + microorganism), (compost at 2 ton /fed. + chicken manure at 2 ton /fed.), (compost at 2 ton/fed. + chicken manure 2 ton /fed + 100kg feldspar + 100 kg rock phosphate.) and (10) were significantly in both seasons. On the other hand, the fresh weight of root was ranged between 210.18 g/ plant to 245.47 (g/ plant) and between 211.35 g/ plant to 246.40 (g/ plant) in the first and second season, while dry weight of root was ranged between 43.72 g/ plant to 49.29 (g/ plant) and between 43.71 g/plant to 49.32 (g/ plant) Table (4). The fresh weight of roots per Fedden was increase from 3257.79kg/ fed. to 3804.87 (kg/ fed.) and from 3275.92kg/fed. to 3819.25 (kg/fed.) in the first and second seasons, respectively and the best treatment was (compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism) which gave the highest values (3804.87kg / fed. and 3819.25 kg/fed.) in the two seasons respectively. Some investigators pointed similar results such as Aderinola *et al*. (2009) on *Vetiveria nigritana* and Ismail *et al.* (2013) on *Silybum marianum*.

**3- Fresh and dry weight of shoots (g / plant)**:

Regarding the effect of fertilizers on fresh and dry weights of shoot of *vetiveria zizanioides* plants, the data in Table (5) show that most treatments increased the recorded values significantly compared to the control. Plants treated with (compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism) gave the highest values (4178.66 (g) and 4181.33 (g / plant) and (627.66 (g / plant) and 632.66 (g / plant) fresh and dry weights in the two seasons, respectively. Similar increases were obtained by Priyadarshani *et al.* (2013) on (*Vetiveria zizanioides* L.) plants.

**4- Oil percentage, Oil yield per plant and per Feddan:**

Data in Table (6) and Figure (2) indicated that oil percentage was higher when fertilizer with 5 ton compost compared with chemical fertilizer. The best fertilizer treatment was (compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism), it gave the highest oil percentage (2.60 % and 2.61%) in the first and second seasons, respectively. Oil yield per plant was increasing with significant values in both seasons. It increased from 4.26 to 6.38 (ml. / plant) and from 4.28 to 6.43 (ml. / plant) in the first and second seasons, respectively. Also, oil yield per Feddan was increased from 66.03 to 98.89 (L. /fed.) and from 66.34 to 99.66 (L. / fed.) in the first and second seasons, respectively Table (6) and figure (2). The results indicated that the best fertilizer treatment which gave the highest value of oil yield per Feddan was (compost 2 ton/fed. + chicken manure (2 ton/fed.) + 100kg feldspar + 100 kg rock phosphate + microorganism) (98.89 L. and 99.66 L. in the two seasons), respectively. In accordance with results, it was found that compost + microorganism resulted in the highest of oil % and oil yield of rosemary plants, Abdelaziz *et al*. (2007).

**5- Leaf pigments:** Chemical analysis of the fresh leaves in the two seasons (Table 7) revealed that, the treatments had generally favorable effect on the synthesis and accumulation of chlorophyll A, B and carotenoides in the leaves of vetiver plants. The values increased from 0.39, 0.33 and 0.0.24 mg / g fresh matter to 0.71, 0.57and 0.46 mg / g fresh matter in the first season, while from 0.40, 0.34 and 0.23 mg / g fresh matter to 0.71, 0.58 and 0.0.48 mg / g fresh matter in second season respectively. These results are in agreement with those obtained by (Lakshmanaperumalsamy *et al*. 2007) on *Vetiveria zizanioides.*

**6- Nitrogen, phosphorus and potassium contents**:

Data in Table (7) clearly reveal that organic and biofertilizers had effect on the percentages of nitrogen, phosphorus and potassium. Percentage of nitrogen increased from 1.11 to 1.53 % and from 1.09 to 1.54 % in first and second seasons, respectively. Also, percentages of phosphorus and potassium were increased from 0.27 to 0.45 % and from 0.25 to 0.46 % in the first season and from 1.11 to 1.75 % and from 1.33 to 1.98 % in the second season, respectively. Similar results were obtained by Gharib *et al*. (2008) on sweet marjoram plant ,Abdelaziz *et al*. (2007) on rosemary plant and El-Kallaf ( 2012) on spearmint.

**7- The effect of chemical and organic fertilizer on chemical analysis constituents of oil:**

The effect of chemical and organic fertilizer on chemical analysis constituents of vetiver *(vetiveria zizanioides* L. Nash) plants are shown in Table (8) and Figures

(3, 4, 5 and 6).Ten constituents were separated and identified by GC/MS analysis in a fresh root essential oil: preziza-7(15)-en-3α-ol, prezizaan- l5- al, khusian-2- ol (helifolan- ol), cedren-8-en-15-ol, . ziza-5-en-12- ol, ziza-6(13)-en-12-o l(khusirnol), preziza-7(15)-en-12-ol, . zizanoic acid, . prezizanoic acid and . prezizanoic acid. The main compound in oil vetiver . prezizanoic acid, the second one is preziza-7(15)-en-12-ol. The highest percentage of prezizanoic acid was recorded with 10 and 7 (38.73 and ٣٥.٣٨, % respectively). In preziza-7(15)-en-12-ol percentage the highest percentage ١٦.١٥ and ١١.٦٨ % were recorded with 10 and 7. In general, previous data show that, the treatment 10 gave the highest results compared with other treatments. Similar results were reported by Moradi *et al*. (2011) on sweet fennel.

In general, these results indicated that, when fertilized with compost (5 ton/fed.) all characters studied were increased compared with chemical fertilizer. This increasing may be related to the rate of organic matter, the balance of NPK and microelements in compost.

The best fertilizer treatment which gave the highest value of all characters studied was (compost 2 ton/fed. + chicken manure (2 ton/fed.) + 100kg feldspar + 100 kg rock phosphate + microorganism). It may be related to the added biofertilizer which increased the availablility of macro and micro-nutrients and also, for their growth regulators.

## CONCLUSION

We can recommended that the best fertilizer treatment for *Vetiveria zizanioides* L. Nash (Khus grass) under the same conditions of this investigation is Compost (2 ton/fed.) + Chicken manure (2 ton/fed.) + 100kg feldspar + 100 kg phosphate rock + microorganism (*Bacillus megatherium var. phosphaticum and B. circulanse*).

Table 3. Effect of organic and bio fertilizers on Plant height (cm.) and No. of tillers of vetiver plants *Vetiveria zizanioides* L. Nash in 2012 and 2013.

| Treatments | First season 2012 | | Second season 2013 | |
|---|---|---|---|---|
| | Plant height (cm.) | No. of tillers | Plant height (cm.) | No. of tillers |
| Control | 175.23 | 25.35 | 176.29 | 26.07 |
| Compost at 5 ton / fed. | 180.21 | 26.29 | 180.53 | 26.92 |
| Compost at 5 ton / fed. + 125kg f. + 125kg r. pho. | 187.33 | 27.25 | 186.96 | 27.99 |
| Compost at 5 ton/fed+125kg f. + 125kg r. ph+ micro. | 190.35 | 30.20 | 190.45 | 31.70 |
| Chicken m. at 2 ton/fed. | 160.29 | 20.10 | 161.29 | 21.70 |
| Chicken m. at 2 ton / fed. + 50kg.f. + 50kg r. ph. | 165.17 | 22.25 | 166.35 | 23.29 |
| Chicken m. at 2ton/fed. +50kg.f. + 50kg r. ph.+micro. | 170.17 | 24.58 | 171.22 | 25.71 |
| Compost at 2 ton/fed. + chicken m. at 2 ton/fed. | 193.77 | 30.83 | 193.37 | 33.45 |
| Compost at 2 ton/fed.+ Chicken m.2 ton/fed+ 100kg f. + 100 kg r. ph. | 200.11 | 33.13 | 202.22 | 34.15 |
| Compost at 2 ton /fed+ Chicken m. at 2 ton /fed +100kg f.+100 kg r. ph+ micro | 216.11 | 36.78 | 217.04 | 37.45 |
| LSD: at 0.05 | 4.91 | 4.04 | 2.35 | 1.32 |

m.=manure r. ph= rock phosphate

f=feldspar micro. =microorganism

Table 4. Effect of organic and bio fertilizers on Root length (cm), fresh and dry weight per plant (g) and per Fadden (kg) of vetiver plants *Vetiveria zizanioides* L. Nash in 2012 and 2013.

| Treatments | First season 2012 | | | | Second season 2013 | | | |
|---|---|---|---|---|---|---|---|---|
| | Root length | Fresh w. of roots/p. | Dry w. of roots | Fresh w. of roots /fed | Root length | Fresh w. of roots/p. | Dry w. of roots | Fresh w. of roots /fed |
| Control | 31.13 | 218.40 | 44.64 | 3385.22 | 32.36 | 219.23 | 44.92 | 3398.12 |
| Compost at 5 ton / fed. | 32.52 | 220.20 | 45.41 | 3413.23 | 33.02 | 221.34 | 45.73 | 3430.87 |
| Compost at 5 ton / fed. + 125kg f. + 125kg r. pho. | 33.32 | 224.87 | 45.50 | 3485.57 | 33.35 | 225.38 | 45.92 | 3493.49 |
| Compost at 5 ton/fed+125kg f. + 125kg r. ph+ micro. | 34.48 | 226.43 | 45.61 | 3509.77 | 34.88 | 226.23 | 45.82 | 3506.67 |
| Chicken m. at 2 ton/fed. | 28.10 | 210.18 | 43.72 | 3257.79 | 28.83 | 211.35 | 43.71 | 3275.92 |
| Chicken m. at 2 ton / fed. + 50kg.f. + 50kg r. ph. | 30.43 | 214.14 | 44.23 | 3319.17 | 31.30 | 215.19 | 44.34 | 3335.45 |
| Chicken m. at 2ton/fed. +50kg.f. + 50kg r. ph.+micro. | 30.43 | 215.33 | 44.33 | 3337.67 | 31.24 | 216.16 | 44.76 | 3350.58 |
| Compost at 2 ton/fed. + chicken m. at 2 ton/fed. | 36.21 | 231.33 | 46.41 | 3585.67 | 37.26 | 232.55 | 47.31 | 3604.58 |
| Compost at 2 ton/fed.+ Chicken m.2 ton/fed+ 100kg f. + 100 kg r. ph. | 38.14 | 240.84 | 47.34 | 3733.02 | 38.30 | 240.55 | 48.26 | 3728.63 |
| Compost at 2 ton /fed+ Chicken m. at 2 ton /fed +100kg f.+100 kg r. ph+ micro | 41.78 | 245.47 | 49.29 | 3804.87 | 42.54 | 246.40 | 49.32 | 3819.25 |
| LSD: at 0.05 | 2.48 | 3.21 | 0.93 | 49.74 | 2.05 | 2.95 | 1.35 | 45.69 |

m.=manure

f=feldspar

r. ph= rock phosphate

micro. =microorganism

Table 5. Effect of organic and bio fertilizers on fresh and dry weights of shoots per (g) of vetiver plants *Vetiveria zizanioides* L. Nash in 2012 and 2013.

| Treatments | First season 2012 | | Second season 2013 | |
|---|---|---|---|---|
| | Fresh w. of shoots | Dry w. of shoots | Fresh w. of shoots | Dry w. of shoots |
| Control | 3604.66 | 535.33 | 3606.33 | 538.00 |
| Compost at 5 ton / fed. | 3705.00 | 546.00 | 3705.33 | 548.00 |
| Compost at 5 ton / fed. + 125kg f. + 125kg r. pho. | 3801.00 | 549.66 | 3816.66 | 551.66 |
| Compost at 5 ton/fed+125kg f. + 125kg r. ph+ micro. | 3822.33 | 555.00 | 3827.00 | 556.66 |
| Chicken m. at 2 ton/fed. | 3406.00 | 482.00 | 3408.66 | 483.33 |
| Chicken m. at 2 ton / fed. + 50kg.f. + 50kg r. ph. | 3507.33 | 510.00 | 3511.33 | 512.00 |
| Chicken m. at 2ton/fed. +50kg.f. + 50kg r. ph.+micro. | 3538.66 | 520.66 | 3541.00 | 523.00 |
| Compost at 2 ton/fed. + chicken m. at 2 ton/fed. | 4004.00 | 591.00 | 4012.00 | 591.66 |
| Compost at 2 ton/fed.+ Chicken m.2 ton/fed+ 100kg f. + 100 kg r. ph. | 4105.66 | 613.00 | 4115.66 | 617.33 |
| Compost at 2 ton /fed+ Chicken m. at 2 ton /fed +100kg f.+100 kg r. ph+ micro | 4178.66 | 627.66 | 4181.33 | 632.66 |
| LSD: at 0.05 | 12.72 | 4.75 | 7.34 | 2.14 |

m.=manure

r. ph= rock phosphate

f=feldspar

micro. =microorganism

Table 6. Effect of organic and bio fertilizers on Oil %, Oil yield/ plant (ml) and oil yield/fed (L) of vetiver plants *Vetiveria zizanioides* L. Nash in 2012 and 2013.

| Treatments | First season 2012 | | | Second season 2013 | | |
|---|---|---|---|---|---|---|
| | Oil % | Oil yield/ plant(ml) | Oil yield/fed(L) | Oil % | Oil yield/ plant(ml) | Oil yield/fed(L) |
| Control | 2.25 | 4.91 | 76.17 | 2.26 | 4.95 | 76.72 |
| Compost at 5 ton / fed. | 2.30 | 5.06 | 78.43 | 2.30 | 5.11 | 79.20 |
| Compost at 5 ton / fed. + 125kg f. + 125kg r. pho. | 2.38 | 5.35 | 82.93 | 2.39 | 5.39 | 83.54 |
| Compost at 5 ton/fed+125kg f. + 125kg r. ph+ micro. | 2.40 | 5.43 | 84.17 | 2.41 | 5.45 | 84.47 |
| Chicken m. at 2 ton/fed. | 2.02 | 4.26 | 66.03 | 2.02 | 4.28 | 66.34 |
| Chicken m. at 2 ton / fed. + 50kg.f. + 50kg r. ph. | 2.19 | 4.69 | 72.69 | 2.21 | 4.76 | 73.78 |
| Chicken m. at 2ton/fed. +50kg.f. + 50kg r. ph.+micro. | 2.20 | 4.74 | 73.47 | 2.22 | 4.80 | 74.40 |
| Compost at 2 ton/fed. + chicken m. at 2 ton/fed. | 2.47 | 5.71 | 88.50 | 2.48 | 5.77 | 89.43 |
| Compost at 2 ton/fed.+ Chicken m.2 ton/fed+ 100kg f. + 100 kg r. ph. | 2.50 | 6.01 | 93.15 | 2.51 | 6.05 | 93.77 |
| Compost at 2 ton /fed+ Chicken m. at 2 ton /fed +100kg f.+100 kg r. ph+ micro | 2.60 | 6.38 | 98.89 | 2.61 | 6.43 | 99.66 |
| LSD: at 0.05 | 0.53 | 0.23 | 8.29 | 0.05 | 0.08 | 1.21 |

m.=manure r. ph= rock phosphate

f=feldspar micro. =microorganism

Table 7. Effect of organic and bio fertilizers on nitrogen, phosphours, potassium as well as chlorophyll A, B and carotenoides of vetiver plants *Vetiveria zizanioides* L. Nash during 2012 and 2013.

| **Treatments** | First season 2012 | | | | | | Second season 2013 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N% | P % | K % | Chlo(A) | Chlo(B) | Carot. | N % | P % | K % | Chlo.(A) | Chlo.(B) | Carot. |
| Control | 1.26 | 0.33 | 1.31 | 0.39 | 0.33 | 0.24 | 1.32 | 0.29 | 1.41 | 0.40 | 0.34 | 0.23 |
| Compost at 5 ton / fed. | 1.30 | 0.35 | 1.41 | 0.40 | 0.36 | 0.25 | 1.28 | 0.35 | 1.51 | 0.41 | 0.36 | 0.24 |
| Compost at 5 ton / fed. + 125kg f. + 125kg r. pho. | 1.35 | 0.37 | 1.50 | 0.41 | 0.37 | 0.26 | 1.31 | 0.36 | 1.55 | 0.42 | 0.37 | 0.25 |
| Compost at 5 ton/fed+125kg f. + 125kg r. ph+ micro. | 1.40 | 0.40 | 1.57 | 0.44 | 0.39 | 0.26 | 1.42 | 0.43 | 1.63 | 0.44 | 0.38 | 0.26 |
| Chicken m. at 2 ton/fed. | 1.11 | 0.27 | 1.11 | 0.49 | 0.40 | 0.26 | 1.09 | 0.25 | 1.33 | 0.47 | 0.39 | 0.28 |
| Chicken m. at 2 ton / fed. + 50kg.f. + 50kg r. ph. | 1.17 | 0.28 | 1.20 | 0.50 | 0.41 | 0.29 | 1.21 | 0.29 | 1.41 | 0.48 | 0.40 | 0.31 |
| Chicken m. at 2ton/fed. +50kg.f. + 50kg r. ph.+micro. | 1.21 | 0.30 | 1.21 | 0.50 | 0.44 | 0.31 | 1.23 | 0.31 | 1.42 | 0.49 | 0.42 | 0.34 |
| Compost at 2 ton/fed. + chicken m. at 2 ton/fed. | 1.44 | 0.41 | 1.65 | 0.59 | 0.52 | 0.34 | 1.39 | 0.39 | 1.77 | 0.62 | 0.49 | 0.34 |
| Compost at 2 ton/fed.+ Chicken m.2 ton/fed+ 100kg f. + 100 kg r. ph. | 1.49 | 0.43 | 1.70 | 0.61 | 0.53 | 0.37 | 1.47 | 0.44 | 1.80 | 0.63 | 0.51 | 0.37 |
| Compost at 2 ton /fed+ Chicken m. at 2 ton /fed +100kg f.+100 kg r. ph+micro | 1.53 | 0.45 | 1.75 | 0.71 | 0.57 | 0.46 | 1.54 | 0.46 | 1.98 | 0.71 | 0.58 | 0.48 |
| LSD at 0.05 | 0.05 | 0.04 | 0.64 | 0.05 | 0.03 | 0.03 | 0.05 | 0.03 | 0.52 | 0.05 | 0.03 | 0.04 |

m.=manure micro=microorganism r. ph= rock phosphate f=feldspar

Table 8. The effect of chemical and organic fertilizer on chemical analysis constituents of vetiver plants *Vetiveria zizanioides* L. Nash in 2013.

| Compound % | Treatments | | | |
|---|---|---|---|---|
| | 1 (Chemical fertilizer) | 2 (Compost 5ton/fed.) | 7 (Chickenmanure2ton /fed. +50kg.feldspars+50kg.phosphate rook + microorganisms) | 10 (Compost 2 ton/ fedd. + Chicken manure 2ton/fed.+ 50kg. feldspar +50kg.phosphate rook + microorganisms) |
| 1. preziza-7(15)-en-3α-ol | ٦.٠٠ | ٦.٠٢ | ٨.٥١ | ٩.١٥ |
| 2. prezizaan- l5- al | ٢.٢٠ | ٢.٢١ | ٢.٢١ | ٢.٢٣ |
| 3. khusian-2- ol (helifolan- ol) | ١.٩٤ | ١.٩١ | ١.٩٤ | ١.٩٥ |
| 4. cedren-8-en-15-ol | ٦.٢٠ | ٦.٢٠ | ٦.٢٠ | ٦.٢٠ |
| 5. ziza-5-en-12- ol | ٢.٤٨ | ٢.٤٨ | ٢.٤٨ | ٢.٤٨ |
| 6.ziza-6(13)-en-12-ol (khusirnol) | ١.٧٣ | ١.٧٣ | ١.٧٣ | ١.٧٣ |
| 7. preziza-7(15)-en-12-ol | ٩.٨٣ | ١٠.٨٣ | ١١.٦٨ | ١٦.١٥ |
| 8. zizanoic acid | ٤.٠١ | ٤.٦٥ | ٥.٦٠ | ٦.١٥ |
| 9. prezizanoic acid | ٣١.٥٤ | ٣١.٥٤ | ٣٥.٢٨ | ٣٨.٧٣ |
| 10-. prezizanoic acid | ٢.٦٩ | ٢.٧٤ | ٤.٣٠ | ٤.٣٩ |

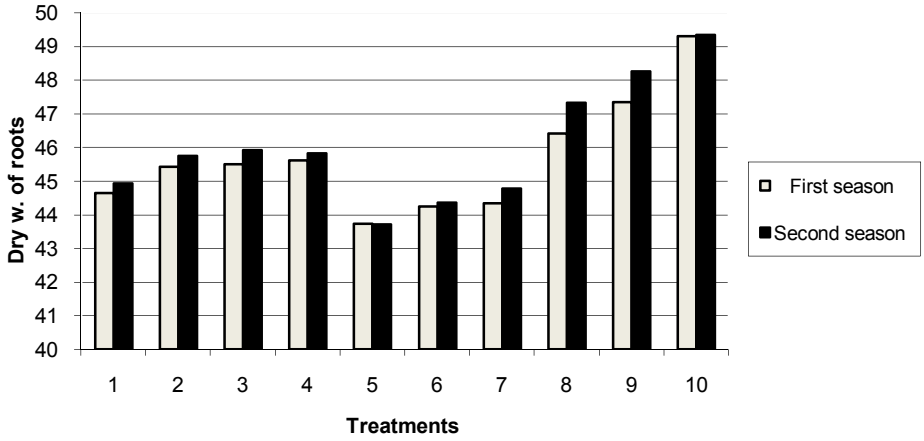


Fig.(1): Effect of fertilizers and bio fertilizers on dry w. of roots (kg) of vetiver plants (*vetiveria zizanioides* L Nash)

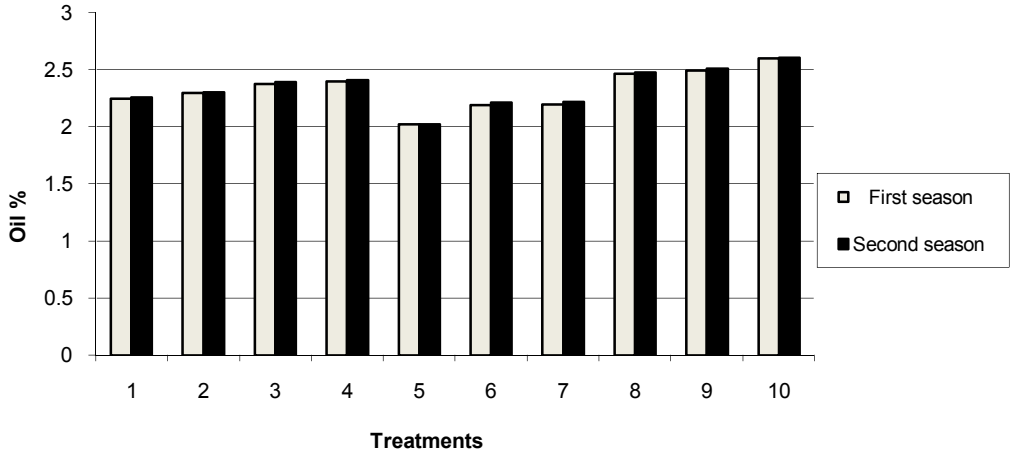


Fig.(2): Effect of fertilizers and bio fertilizers on oil % of vetiver plants (*vetiveria zizanioides* L Nash)

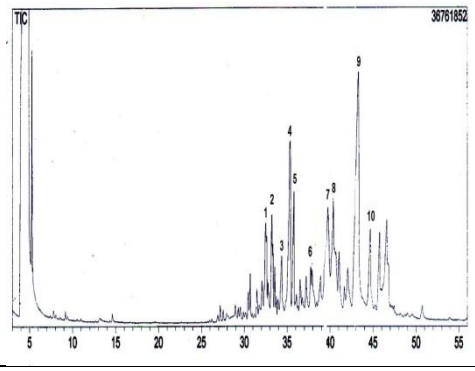


*Fig. (3).Chromatogram of essential oil of Vetiver plants distilled from control plants in 2013.*

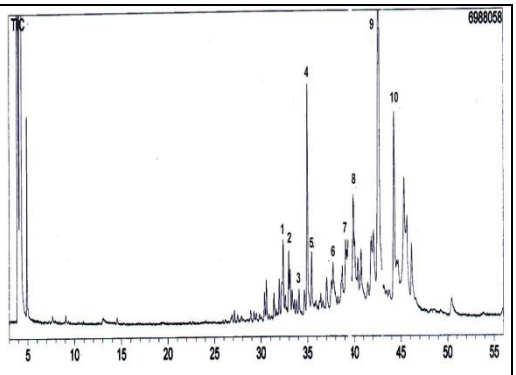


Fig. (4).Chromatogram of essential oil of Vetiver plants distilled from compost at 5 ton / fed.
plants in 2013.

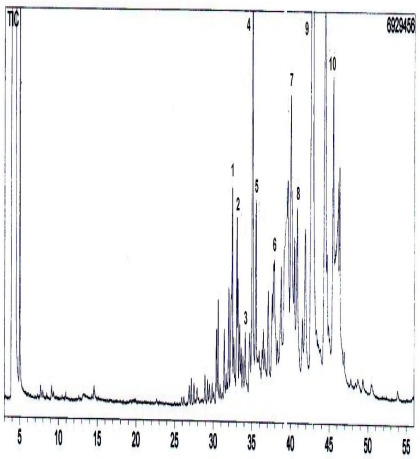


*Fig. (5).Chromatogram of essential oil of Vetiver plants distilled from Chicken manure at 2 ton /fed. + 50kg.feldspar + 50kg rock phosphate + microorganism plants in 2013.*

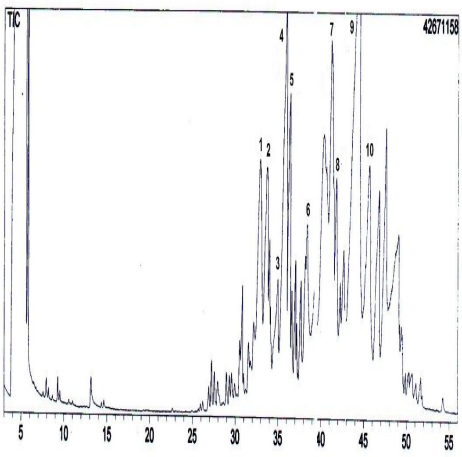


*Fig. (6).Chromatogram of essential oil of Vetiver plants distilled Compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism plants in 2013.*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | preziza-7(15)-en-3α-ol | 3 | khusian-2- ol (helifolan - ol) | 5 | ziza-5-en-12- ol | 7 | preziza-7(15)-en-12-ol | 9 | prezizan oic acid |
| 2 | prezizaan- l5- al | 4 | cedren-8-en-15-ol | 6 | ziza-6(13)-en-12- ol (khusirnol) | 8 | zizanoic acid | 10 | Hexadec anoic acid |

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# تأثير التسميد العضوى والحيوى علي نبات الفيتيفير

**خالد عبد المنعم همام[١] – عماد عبد القادر حسن[٢]**

١ . *قسم بحوث النباتات الطبية والعطرية – معهد بحوث البساتين – مركز البحوث الزراعية*
٢ . *المعمل المركزي للزراعه العضويه – مركز البحوث الزراعية*

أجريت هذه الدراسة خلال الموسمين المتتاليين ٢٠١٢ / ٢٠١٣ في مزرعة قسم بحوث النباتات الطبية والعطريه بالقناطر الخيرية لدراسة تأثير التسميد العضوي والحيوى (كمبوست ، سماد الدجاج) + الفلسبار ($K_2O$ % 12) + صخر الفوسفات ($P_2O_5$ % 20) +microorganism

**أوضحت الدراسة النتائج التالية :**

– أدي التسميد بمعدل ٢ طن / فدان كمبوست + ٢ طن سماد الدجاج + ١٠٠ كجم فلسبار + ١٠٠ كجم صخر الفوسفات +microorganism الى أفضل النتائج من حيث ارتفاع النباتات ، عدد الخلفات ، طول الجذر ، الوزن الطازج والجاف للجذور والاوراق وكذلك نسبة الزيت ومحصول الزيت في كلا الموسمين، كذلك ادت نفس المعامله الى الحصول على اعلى محتوي من النتروجين والفوسفور و البوتاسيوم.

– اما بالنسبه للتركيب الكيماوي للزيت اوضحت الدراسة ان الزيت يحتوي على المركبات التاليه:

(1) preziza-7(15)-en-3α-ol (2) prezizaan- l5- al (3) khusian-2- ol (helifolan- ol (4) cedren-8-en-15-ol (5) ziza-5-en-12- ol (6) ziza-6(13)-en-12-ol (khusirnol) (7) preziza-7(15)-en-12-ol (8) zizanoic acid (9) prezizanoic acid 10-Hexadecanoic acid.

وان هذه المركبات العشر تكون مايقرب من ٦٨ % من الزيت في معاملة (control) الى ٨٩ % من الزيت الناتج من النباتات المعامله ب :

(compost at 2 ton /fed. + chicken manure at 2 ton /fed +100kg feldspar + 100 kg rock phosphate + microorganism (*Bacillus megatherium var. phosphaticum* and *B. circulanse* at 2 kg/ fed. for each).

اوضحت الدراسه ايضاً ان المركب الرئيسي فى زيت الفيتيفير هو مركبprezizanoic acid الذي تراوحت نسبته ما بين % ٣١.٥٤ الى % ٣٨.٧٣.