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# Comparative Studies of Using Compost Combined with Plant Guard and Flespar on the Morphological, Physiological and Rhizospheric Microflora of Olive Seedlings

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**Abstract:** The work was carried out during the two successive seasons (2008 and 2009) on two years old koronaki olive seedlings grown in the National Research Centre (NRC) orchard at El-Nobaria district, Beheira Governorate, Egypt. Uniform and healthy olive seedlings were planted on sandy soil under drip irrigation system. The experiment was carried out to evaluate the effectiveness of plant guard as a commercial biofertilizer and feldspar as a natural source of potassium combined with compost on vegetative growth and nutritional parameters of olive seedlings and rhizosphere microflora in the root regions. The experimental results revealed a significant increase in seedling height of main stem, branch stem length, number of branches, main stem diameter and leaf area of olive seedling treated with compost fortified with plant guard and felspar at two recommended levels compared with the control treatment. Application of olive seedlings with compost fortified with the highest level of plant guard 1% and feldspar 25g increased the plant height from 43.1 cm in the control to 72.2cm (67.52% increase). Also, application of olive seedlings with compost fortified with the highest level of plant guard 1% and felspar 25g increased the chlorophyll a and b content. The same trend was also observed concerning the application of compost, plant guard and felspar on micro and macronutrients content in the leaves of olive seedlings. Generally, the total number of bacteria in the rhizosphere of olive seedlings ranged from 10.04 to 155.50 cfu x $10^4/g^{-1}$, while the total number of fungi ranged between 7.17 and 129.00 cfu x $10^3/g^{-1}$. Application of olive seedlings with compost fortified with plant guard or felspar increased the total fungal count from 7.17 cfu x $10^3/g^{-1}$ in the non- treated (control) to 129.00 and 105.22 cfu x $10^3/g^{-1}$ ( 17.99 and 14.67 folds respectively) in olive root applied with compost + Plant guard (1.0 %) + felspar (25 g), plant guard (0.5%) + felspar (12.5g), respectively. Plant guard (1.0 %) + felspar (25 g) treatment reduced the growth of *A. flavus* from 25.0 to 11.6%, *Aspergillus spp.* from 37.5 to 18.60%, *Fusarium spp.* from 12.5 to 2.33% and *Penicillium* spp. from 12.5 to 9.30%. While, the same treatment stimulated the growth of *Alternaria spp*, *A. glaucus*, *A. niger*, *A. terreus* and *T. harzianum* from 0.0 in the control to 9.30%, 10.8%, 6.20%, 6.98% and 24.8 %, respectively.

**Key words:** Olive · Plant guard · Felspar · Compost · Rhizosphere bacteria and fungi

## INTRODUCTION

The olive tree is one of the most important fruits in Egypt. Olive (*Olea europaea*) is considered the most popular fruit and occupies the third place in acreage after citrus and grapes [1]. The olive tree is an evergreen tree or shrub native to the Mediterranean, Asia and parts of Africa. It is short and squat and rarely exceeds 8–15,meters in height. Despite of the great healthy advantages of olive crop, whereas it protects human from arteriosclerosis, heart diseases and blood cycle diseases, the interest of the Egyptian consumer to buy and use it is weak, except in its production regions. Organic amendments of soil are not only important in increasing the soil fertility and intensifying the crop yield but also changing the microbial make up in the region of the plant [2, 3].Ferrini *et al.* [4] indicate that shoot growth, leaf area and chlorophyll content in fertilized English oak plants with compost were higher than the control especially during the second and third year after planting. Compost applied to soil improve its quality by altering the chemical and physical properties, increase organic matter content, water holding capacity, overall diversity of microbes, provide macro- and micronutrients essential for plant growth and suppress diseases which indirectly contribute to plant growth enhancement [5-7]. As reported by Harris [8], the principal advantage of natural organic fertilizers is that they improve soil structure if

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incorporated into surface soils, also release inorganic ions, but more slowly as the molecules are hydrolyzed or decomposed in the soil, thus reducing losses through leaching.

Additional work by Devitt, *et al.* [9] on periwinkle shows that compost can result in greater plant growth. More recent work by Stino, *et al.* [10] shows that compost in combination with biofertilizers reflected best results to vegetative growth parameters, i.e., number of shoots, shoot length, number leaf/shoot and leaf area. El-Mohamedy and Ahmed [11] concluded that plant guard as soil treatment may be successfully used in controlling root rot pathogens on citrus and increased plant growth in commercial greenhouse production or under field conditions. Phosphorus and potassium are essential elements for plant nutrition. However, in natural conditions, most of soil P and K contents are found in both mineral (rock phosphate and K-felspar) and organic forms which are poorly soluble [12]. Certain microorganisms present in the compost such as *Trichoderma* spp. are known to stimulate plant growth [6, 13]. These microbes benefit the plant through different mechanisms action, including the production of secondary metabolites, antibiotics and hormone like substances [13, 14]. The production of siderophores, antagonistic to soil borne root pathogens [15, 16] has been also reported. Negozi *et al.* [17] recommended the use of poultry manure with rate 100% + biofertilization to fertilize the olive trees planted. Numerous studies have identified microbial groups which could solubilize mineral phosphate and improved plant phosphorus nutrition [18]. Furthermore, plants inoculated with AM fungi utilized more soluble phosphorus from rock phosphate and induced good stimulations of the plant growth and phosphorus foliar content than uninoculated plants [19, 20].

The use of biofertilizers and compost would permit a reduction in the use of agrochemicals such as fungicides and mineral fertilizers. So, this investigation was done to evaluate effectiveness of plant guard as a commercial biofertilizer and felspar combined with compost on growth parameters of olive seedlings and rhizosphere microflora in the root regions.

## MATERIALS AND METHODS

The work was carried out during 2008 and 2009 seasons on two years old koronaki olive transplants grown in the National Research Centre (NRC) orchard at El-Nobaria district, Beheira Governorate, Egypt. Uniform and healthy olive transplants were planted on sandy soil under drip irrigation system. The following treatments per olive seedlings were used:

1. Control (untreated)
2. Plant guard (biofertilizer at 0.5 %,)
3. Plant guard (biofertilizer at 1 %,)
4. Compost + felspar at 12.5 g/seedling
5. Compost + felspar at 25g/ seedling
6. Compost + felspar at 12.5 g + plant guard 0.5%.
7. Compost + felspar at 12.5 g + plant guard 1%.

**Compost (Farmyard Manure):** One year old farmyard manure produced by National Research Centre, Cairo, Egypt was used and analyzed. The chemical properties were determined using the method described by A.O.A.C. [21]. The chemical analysis are summarized in Table 1.

**Plant Guard Biofertilizer:** Commercial liquid materials contain spores of *Trichoderma harzianum* fungi.

**Felspar:** The felspar was obtained from location represents the sediments of potash in eastern desert of Egypt. The felspar is essentially silicates of alumina together with potash, soda, or lime. Orthoclase and microcline are potash felspar ($K_2O$, $Al_2O_3$, $SiO_2$)

**Soil:** a representative soil sample taken from the used soil was analyzed also and listed in the Table 2.

**Plant Growth Analysis:** On the late of September, plant height (cm), branch length (cm) and stem thickness at 5 cm above the crown were measured by gauge (mm). Leaf area was measured using Li- 3100 area meter. Number of mature leaves was counted on each seedling.

**Chemical Characteristics**

**Chlorophyll (a and b):** Chlorophyll a and chlorophyll b content were determined using a spectrophotometer at a wave length, 647 and 664 nm proposed by Coombs, *et al.* [22].

**Macro and Micronutrients Analysis:** To analyze macro and micronutrients in olive leaves, a leaf sample of 10 leaves was taken from the mid shoots seedling according to Jones *et al.* [23] and dried at 70°C, finally it grounded using stainless steel equipments. From each sample 0.2 g was digested using 5 $cm^3$ from the mixture of sulfuric acid ($H_2SO_4$) and perchloric acid ($HClO_4$) substances (1:1) as described by Peterburgski [24]. Total nitrogen was

Table 1: Chemical analysis of the used compost (farmyard manure)

| pH | EC $dSm^{-1}$ | C% | N% | C/N ratio | Total P% | Total K% | OM% |
|---|---|---|---|---|---|---|---|
| 6.90 | 4.30 | 17.60 | 1.18 | 14.92 | 0.41 | 1.07 | 26.38 |

Table 2: Some physical and chemical properties of the experimental soil

| Particle size distribution (%) | | | | | | Available nutrients ($mg\ L^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sand | Silt | Clay | Texture soil | EC $dSm^{-1}$ | pH | N | P | K | Fe | Mn | Zn | Cu |
| 41.18 | 30.95 | 27.87 | Clay loam | 2.3 | 7.8 | 30 | 10 | 286 | 5.8 | 4.7 | 0.9 | 0.31 |

determined by micro-Kjeldahl method and phosphorus was determined calorimetrically at wavelength 680 nm using spectrophotometer (Spekol) as well as potassium was determined by using Gallen Kamp flame photometer. Micronutrients i.e., Zn, Fe, Mn and Cu were determined using atomic absorption spectrophotometer Perkin Elmer model 5000 according to Cottenie [25].

**Microbiological Analysis:** The total bacterial and fungal counts in the rhizosphere of olive seedlings were obtained from each treatment at the end of experiment. The method adopted by Louw and Weblely [26] for studying the microorganisms of rhizosphere soil region was used. A portion of root system was taken with great care to obtain soil very closed to root-system as much as possible and transferred to a wide mouth reagent bottle of known weight containing 90 ml distilled water under aseptic conditions. The plate count technique according to Allen [27] was followed for total count of bacteria and fungi.

Soil extract agar medium [28] and dilutions of $1/10^5$ to $1/10^7$ were used for bacteria and incubated at 35°C±2 for 48 hrs. While, martins medium [27] was used for fungi at dilutions of $1/10^3$ to $1/10^5$. Plates were incubated at 28°C±2 for 5-7 days.

**Microscopic Examination and Identification of Fungal Isolates:** Microscopic examination of mould growth was done by observing the colonial morphology- color of colony, texture, shape and surface appearance. and cultural characteristic- asexual and sexual reproductive structures like sporangia, conidial head, arthrospores, the vegetative mycelia, septate or non-septate [29-31]. Microscopic examination of the moulds was done by using needle mount method.

**Statistical Analysis:** The data were subjected to analysis of variance and Duncan's multiple range test was used to differentiate means by Duncan [32].

## RESULTS AND DISCUSSION

It could be noticed from data presented in Table (3) that different growth parameters of all treatments were significantly increased over those of non treated (control). As, data of the first season showed that compost fortified with plant guard at 1% and felspar at 25g/seedling significantly increased the main stem level from 43.1 to 72.2 cm (67.5% increase), branch stem length from 9.5 to 18.3 cm (92.6 % increase), number of branches from 1 to 4 (300.% increase), number of leaves from 20 to 35 (75% increase), main stem diameter from 0.65 to 1.16 cm (78.5 % increase) and leaf area from 4.1 to 5.3 $cm^2$( 29.3% increase).

In addition, olive seedlings treated with compost combined with plant guard at 0.5% + felspar at 12.5g/ seedling also exhibited a highly significant effect on all growth parameters compared with olive seedlings applied with compost + plant guard at 5% or compost + felspar at 12.5%. Whereas, soil applied with plant guard at the two concentrations revealed the same trend reflecting a significant increase on seedling growth over the control Data also showed that the combined action of either compost with felspar at 12.5 and 25 g /seedling exhibited a highly significant effect on plant growth.

Moreover, the highest values were obtained with supplementary addition of plant guard at 1% to compost and felspar at 25g/seedling induced high stimulatory effect compared with growth parameters of olive applied with the low levels. As, the supplementary addition of plant guard at 1% + felspar at 25 g/ seedling increased the main stem level by 10.4%, branch stem length by 11.6 %, number of leaves by 6.1%, main stem diameter by 24.7 % and leaf area by 3.9 % than the corresponding figures of the treatment with compost in combination with plant guard at 5% + felspar at 12.5%.

Concerning the effect of treatments on main stem length, the olive seedlings applied with compost + plant guard at 0.5 and 1% exhibited a highly significant effect. As, the stem height of olive seedlings treated with

Table 3: Effect of compost combined with plant guard and felspar on the growth parameters of olive seedlings cultivated in sandy soil during 2008 and 2009

| Treatments | | Main stem length (cm) | Branch stem length (cm) | No. of branches | No. of leaves | Main stem diam. (cm) | Leave area (cm) | Chlorophyll A | Chlorophyll B |
|---|---|---|---|---|---|---|---|---|---|
| The first season (2008) | | | | | | | | | |
| Soil treated | Untreated | 43.1$^{b}$ | 9.5$^{g}$ | 1$^{c}$ | 20$^{g}$ | 0.65$^{e}$ | 4.1$^{e}$ | 71.03$^{f}$ | 25.57$^{d}$ |
| with compost | Plant guard (0.5%) | 60.4$^{ab}$ | 12.5$^{d}$ | 3$^{b}$ | 29$^{d}$ | 0.80$^{bcd}$ | 4.6$^{c}$ | 80.83$^{d}$ | 28.36$^{bc}$ |
| fortified with | Plant guard (1.0%) | 63.2$^{ab}$ | 14.4$^{bc}$ | 3$^{b}$ | 31$^{c}$ | 0.85$^{bc}$ | 4.7$^{c}$ | 83.43$^{c}$ | 29.41$^{bc}$ |
| | Felspar (12.5g) | 50.3$^{ab}$ | 10.4$^{f}$ | 2$^{bc}$ | 25$^{f}$ | 0.70$^{de}$ | 4.40$^{d}$ | 75.46$^{e}$ | 27.53$^{c}$ |
| | Felspar (25.0g) | 56.4$^{ab}$ | 11.5$^{e}$ | 2$^{bc}$ | 27$^{e}$ | 0.74$^{cde}$ | 4.47$^{d}$ | 79.4$^{d}$ | 28.26$^{bc}$ |
| | Plant guard (0.5%) + Felspar (12.5g) | 65.4$^{ab}$ | 16.4$^{b}$ | 4$^{a}$ | 33$^{b}$ | 0.93$^{b}$ | 5.1$^{b}$ | 87.33$^{b}$ | 30.26$^{b}$ |
| | Plant guard (1.0%) + Felspar (25.0g) | 72.2$^{a}$ | 18.3$^{a}$ | 4$^{a}$ | 35$^{a}$ | 1.16$^{a}$ | 5.3$^{a}$ | 90.90$^{a}$ | 33.11$^{a}$ |
| The second season (2009) | | | | | | | | | |
| Soil treated | Un-treated | 45.10$^{g}$ | 11.5$^{g}$ | 2.0$^{c}$ | 22.0$^{g}$ | 0.75$^{d}$ | 4.5$^{e}$ | 72.07$^{f}$ | 26.57$^{d}$ |
| with compost | Plant guard (0.5%) | 62.4$^{d}$ | 14.5$^{d}$ | 4.0$^{ab}$ | 31.0$^{d}$ | 0.90$^{cd}$ | 4.8$^{c}$ | 81.83$^{d}$ | 29.36$^{bc}$ |
| fortified with | Plant guard (1.0%) | 65.2$^{c}$ | 16.47$^{c}$ | 4.0$^{ab}$ | 33.0$^{c}$ | 0.95$^{c}$ | 4.9$^{c}$ | 84.43c | 30.41$^{bc}$ |
| | Felspar (12.5g) | 52.31$^{f}$ | 12.76$^{f}$ | 3.0$^{b}$ | 27.0$^{f}$ | 0.80$^{cd}$ | 4.6$^{de}$ | 76.47$^{e}$ | 28.53$^{c}$ |
| | Felspar (25.0g) | 58.38$^{e}$ | 13.45$^{e}$ | 3.0$^{b}$ | 29.0$^{e}$ | 0.84$^{cd}$ | 4.7$^{d}$ | 80.4$^{d}$ | 29.26$^{bc}$ |
| | Plant guard (0.5%) + Felspar (12.5g) | 67.35$^{b}$ | 18.40$^{b}$ | 5.0$^{a}$ | 35.0$^{b}$ | 1.17$^{b}$ | 5.5$^{b}$ | 88.33$^{b}$ | 31.27$^{b}$ |
| | Plant guard (1.0%) + Felspar (25.0g) | 74.2$^{a}$ | 20.27$^{a}$ | 5.0$^{a}$ | 37.0$^{a}$ | 1.5$^{a}$ | 5.7$^{a}$ | 91.6$^{a}$ | 31.27$^{a}$ |

Means values followed by the same letter within the treatments are not significantly different ($P < 0.05$) according to the Duncan's multiple range tests

compost + plant guard at 0.5% and 1% was increased from 43.1 to 60.4 cm (40.14% increase) and from 43.1 to 63.2 cm (46.64% increase) than seedlings of control treatment, respectively. The same trends were also observed with the other treatments. As plants survived in soil treated with compost fortified with felspar at the two levels increased plant height of olive seedlings from 43.1 to 50.3cm (16.71% increase) and from 43.1 to 56.4 (30.86% increase), respectively.

Chlorophyll a and b contents recorded in olive leaves applied with compost in combination with different levels of plant guard and flespar were higher than corresponding figures in the control. Since, chlorophyll a in the leaves of olive seedlings treated with compost + plant guard at 0.5 and 1.0 % was increased from 71.03 to 80.83 (13.79% increase) and from 71.03 to 83.43 (17.46% increase), respectively compared with the control. Also, application of olive seedlings with compost fortified with the high levels of plant guard 1% and felspar 25g increased the chlorophyll a content from 71.03 in the control to 90.90 (27.97% increase).

The same trend was also observed concerning the application of compost, plant guard and flespar on chlorophyll b content in the leaves of olive seedlings.

The same trends observed in the first season were also obtained in the second season of experiment. Moreover, the same trend was also observed concerning the application of compost, plant guard and flespar on chlorophyll b content in the leaves of olive seedlings. The improvement may be as a result of the important role of biofertilizer in improving soil fertility and plant development and releasing certain elements (P, Fe, Zn, Mn and K), in addition to contributing with some plant growth substances [8-11].

Results on the effect of compost and plant guard on the growth of other plants were also reported by Ozbay and Newman [13], Sylvia [6] and Stino *et al*. [10]. These microbes benefit the plant through different mechanisms action, including the production of secondary metabolites, antibiotics and hormone like substances [13, 14].

**Effect of Compost Combined with Felspar and Plant Guard Substances on Leaf Mineral Content:** The effect of compost in combination with felspar and plant guard application levels on nutrients concentration in leaf of olive seedling was highly significant ($p<0.05$) during the two seasons as shown in Table 4. The application level of compost in combination of felspar (25g/seedling) and

Table 4: Effect of compost combined with plant guard and feldspar substances on macro and micronutrients of olive seedlings cultivated in sandy soil during 2008 and 2009

| Treatment | N% | P% | K% | Ca% | Mg% | Fe ppm | Mn ppm | Zn ppm |
|---|---|---|---|---|---|---|---|---|
| The first season (2008) | | | | | | | | |
| Untreated | 1.85$^{g}$ | 0.08$^{d}$ | 1.25$^{f}$ | 1.61$^{e}$ | 0.25$^{e}$ | 211$^{g}$ | 53.42$^{e}$ | 21.49$^{g}$ |
| Plant guard (0.5%) | 2.26$^{d}$ | 0.13$^{abc}$ | 1.43$^{d}$ | 1.99$^{b}$ | 0.39$^{bcd}$ | 246$^{d}$ | 64.40$^{d}$ | 30.67$^{d}$ |
| Plant guard (1.0%) | 2.35$^{c}$ | 0.15$^{abc}$ | 1.51$^{c}$ | 2.01$^{ab}$ | 0.40$^{bc}$ | 253$^{c}$ | 75.46$^{c}$ | 32.50$^{c}$ |
| Felspar (12.5g) | 1.97$^{f}$ | 0.11$^{cd}$ | 1.33$^{e}$ | 1.76$^{d}$ | 0.35$^{d}$ | 223$^{f}$ | 59.33$^{d}$ | 26.47$^{f}$ |
| Felspar (25.0g) | 2.17$^{e}$ | 0.12$^{bcd}$ | 1.35$^{e}$ | 1.85$^{c}$ | 0.37$^{cd}$ | 237$^{e}$ | 58.93$^{d}$ | 28.43$^{e}$ |
| Plant guard (0.5%) + Felspar (12.5g) | 2.54$^{b}$ | 0.17$^{ab}$ | 1.58$^{b}$ | 2.04$^{ab}$ | 0.41$^{b}$ | 263$^{b}$ | 86.30$^{b}$ | 37.33$^{b}$ |
| Plant guard (1.0%) + Felspar (25.0g) | 2.65$^{a}$ | 0.18$^{a}$ | 1.63$^{a}$ | 2.06$^{a}$ | 0.51$^{a}$ | 271$^{a}$ | 97.50$^{a}$ | 38.97$^{a}$ |
| The second season (2009) | | | | | | | | |
| Untreated | 1.87$^{g}$ | 0.09$^{d}$ | 1.45$^{f}$ | 1.63$^{f}$ | 0.27$^{d}$ | 213$^{g}$ | 55.4$^{f}$ | 23.59$^{e}$ |
| Plant guard (0.5%) | 2.46$^{d}$ | 0.14$^{b}$ | 1.63$^{d}$ | 2.00$^{c}$ | 0.41$^{bc}$ | 248$^{d}$ | 66.45$^{d}$ | 32.78$^{b}$ |
| Plant guard (1.0%) | 2.55$^{c}$ | 0.16$^{ab}$ | 1.71$^{c}$ | 2.03$^{bc}$ | 0.42$^{b}$ | 255$^{c}$ | 77.53$^{c}$ | 34.44$^{b}$ |
| Felspar (12.5g) | 1.99$^{f}$ | 0.12$^{cd}$ | 1.53$^{e}$ | 1.78$^{e}$ | 0.37$^{c}$ | 225$^{f}$ | 58.37$^{f}$ | 28.48$^{c}$ |
| Felspar (25.0g) | 2.37$^{e}$ | 0.13$^{bc}$ | 1.55$^{e}$ | 1.88$^{d}$ | 0.39$^{bc}$ | 239$^{e}$ | 62.47$^{e}$ | 30.71$^{bc}$ |
| Plant guard (0.5%) + Felspar (12.5g) | 2.74$^{b}$ | 0.18$^{a}$ | 1.78$^{b}$ | 2.06$^{ab}$ | 0.34$^{b}$ | 265$^{b}$ | 88.40$^{b}$ | 39.38$^{a}$ |
| Plant guard (1.0%) + Felspar (25.0g) | 2.83$^{a}$ | 0.19$^{a}$ | 1.83$^{a}$ | 2.08$^{a}$ | 0.53$^{a}$ | 273$^{a}$ | 99.03$^{a}$ | 41.38$^{a}$ |

plant guard (1%) manifested the highest concentration of plant nutrients in olive leaves compared with other treatments and untreated control.

Concerning the effect of compost fortified with plant guard alone, data show that the two levels of application generally increased with significant difference the nutrients concentration in olive seedling leaves compared with control. The concentration of nutrients in olive seedling was also increased by increasing the level of plant guard from 0.5 to 1%. The same trend was also obtained during the second season. Application of felspar in combination with compost also raised up the macro and micronutrients percentage in leaves of olive than the control during the two seasons of the experiment. The effect of the interaction between plant guard and felspar at the two tested levels in the presence of compost was highly significant ($p < 0.05$). It is obvious that application of plant guard at 1% + felspar at 25g/ seedling was the superior treatment which increased the micro and macronutrients in the leaves of olive seedling followed by treatment of plant guard at 0.5%+ felspar at 12.5g/ seedling.

As the first treatment (plant guard at 1% + felspar at 25g/ seedling), significantly increased the percentage of nitrogen from 1.85 to 2.65% (43.2 % increase), phosphorus from 0.08 to 0.18% (125.0% increase), potassium from 1.25 to 1.63% (30.4% increase), calcium percentage from 1.61 to 2.06% (27.95% increase) and magnesium from 0.25 to 0.51 % (104% increase),

Concerning micronutrients in the leave, results cleared that the treatment of compost + plant guard at 1% + feldspar at 25g/ seedling significantly increased Fe from 211 to 271 ppm (28.44 % increase), manganese from 53.42 to 97.50 ppm (82.16% increase) and Zn from 21.49 to 38.97 ppm (81.34% increase) during the first season, moreover the same trends were also obtained in the second season.

The great promotion on growth and nutritional status of the olive seedlings in response to application of organic fertilizer and plant guard gave good evidence for the present results. The beneficial effect of compost on stimulating microflora populations, natural hormones and availability of nutrients and organic matter and reducing soil pH [33, 34] could explain the present results.

Effect of compost, plant guard and felspar on numbers of total bacteria and fungal counts in the rhizosphere of olive seedlings.

Table 5: Total bacterial and fungal counts in the rhizosphere of olive seedlings cultivated in soil applied with compost, plant guard and felspar

| | Total counts of rhizospheric microflora* | |
|---|---|---|
| Treatments | Bacteria ($10^4$/g) | Fungi ($10^3$/g) |
| Untreated | 10.04 | 7.17 |
| Plant guard (0.5%) | 6.03 | 11.15 |
| Plant guard (1.0%) | 2.44 | 14.65 |
| Felspar (12.5 g) | 41.26 | 31.68 |
| Felspar (25 g) | 70.57 | 44.34 |
| Plant guard (0.5%) + Felspar (12.5 g) | 119.21 | 105.22 |
| Plant guard (1.0 %) + Felspar (25 g) | 155.50 | 129.00 |

Counts represent the number of microorganisms in one gram rhizospheric soil on dry weight basis. Counts of bacteria were on soil extract agar medium and those of fungi were on Martin's medium. Three plates used for each count

**Fungi and Bacteria Occurrence:** Results of a laboratory microbiological analysis of particular rhizosphere samples of olive showed different numbers of bacteria and fungi (Table 5). The total number of bacteria in the rhizosphere (d.w.) ranged from 10.04 to 155.50 cfu x $10^4/g^{-1}$. Osman, *et al.* [35] reported that the decomposable root debris and root exudates had supplied the microorganisms with available sources of nutrients to grow and proliferate. Similar results were also obtained on rhizosphere of other plants by Kurek and Kobus [36] and Obied [37].

The greatest number of bacteria was observed in the rhizosphere taken from the root of olive applied with compost + Plant guard (1.0 %) + Felspar (25 g) followed by root of olive applied with plant guard (0.5%) + Felspar (12.5g). On the other hand, the number of bacteria decreased from 10.04 cfu x $10^4/g^{-1}$ in the control (non treated plants) to 6.03 and 2.44 cfu x $10^4/g^{-1}$ (39.94 and 79.28% decrease) in the roots of seedlings applied with compost + plant guard at 0.5% and 1.0%, respectively. It seems therefore, that compost combined with plant guard or flespar may activate some groups of fungi which may compact the bacterial proliferation in the rhizosphere of olive seedlings. This observation confirms the findings of Venkatazan [38].

The total number of fungi in the rhizosphere of olive ranged between 7.17 and 129.00 cfu x $10^3/g^{-1}$. Application of olive seedlings with compost fortified with plant guard or felspar increased the total fungal count from 7.17 cfu x $10^3/g^{-1}$ in the non- treated (control) to 129.00 and 105.22 cfu x $10^3/g^{-1}$ ( 17.99 and 14.67 folds) in olive root applied with compost + plant guard (1.0 %) + felspar (25 g) and plant guard (0.5%) + felspar (12.5g), respectively. On the other hand, the number of fungi increased from 7.17 cfu x $10^3/g^{-1}$ in the control (non treated plant) to 11.15 and 14.65 cfu x $10^3/g^{-1}$ (55.51 and 104.32 % increase) in the roots of olive applied with compost + plant guard at 0.5 and 1.0%, respectively. On the other side, growing olive seedlings in soil treated with compost + felspar at 12.5 and 25.0g greatly increase the total fungal count by 341.8% and 518.4%, respectively. The dynamic increase of the microorganisms in the rhizosphere of olive applied with compost, plant guard and felspar can be explained by the favorable quantitative and qualitative composition of organic compounds provided in the form of root exudates and crop residues. This fact is confirmed by earlier information from the previous investigators [39, 40]. The application of compost in combination with plant guard or flespar may cause an increase in the organic matter secreted by the plants, which may be responsible for such stimulation of fungal counts.

**Frequency and Identification of Rhizospheric Fungi:** The genera and species from the rhizosphere of olive seedlings treated with compost or non treated were isolated and identified (Table 6).

Depending upon their frequency of occurrence genera were grouped as major and minor components. Major components include most frequently encountered genera such as *Aspergillus flavus, A. niger Aspergillus spp., Fusarium spp. and Trichoderma harzianum.* While, minor components include less frequent and sporadic types such as *Alternaria spp., Aspergillus glaucus, A. sulphoreus, A. terreus, Mucor spp., penicillium spp., Rhizopus nigricans and T. viride.*

Fungal species in the rhizosphere of non-treated plants (control) recorded four genera namely, *Aspergillus spp.* (62.5%), *Fusarium sp* (12.5%), *Mucor spp.* (12.5 %) and *Penecillium spp.* (12.5%). On the other hand, some

Table 6: Percentage of frequency of fungal genera and species in the rhizosphere of olive seedlings cultivated in soil applied with compost, plant guard and feldspar

| Genera and species | *Alternaria* spp. | *Aspergillus flavus* | *A. glaucus* | *A. niger* | *A. sulphoreus* | *Aspergillus* spp. | *A. terreus* | *Fusarium* spp. | *Mucor* spp. | *Penicillium* spp. | *Rhizopus nigricans* | *Trichoderma harzianum* | *T. viridi* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Untreated | - | 25.0 | - | - | - | 37.5 | - | 12.5 | 12.5 | 12.5 | - | - | - |
| Plant guard (0.5%) | 16.7 | - | - | 16.7 | - | 8.3 | - | - | - | 8.3 | 8.3 | 41.7 | - |
| Plant guard (1.0 %) | 12.5 | 12.5 | - | 13.33 | - | 12.5 | - | 6.25 | 6.25 | 6.25 | - | 73.8 | - |
| Felspar (12.5g) | 6.25 | 6.25 | 9.38 | 9.38 | | 25.0 | 1.32 | 25.0 | - | 15.63 | 6.25 | - | 3.12 |
| Felspar (25g) | 9.09 | 2.27 | 2.27 | 13.63 | 6.82 | 20.45 | 9.09 | 9.09 | - | 18.18 | 8.82 | 2.27 | 2.27 |
| Plant guard (0.5%) + Felspar (12.5g) | 9.52 | 11.4 | 4.76 | 12.38 | 4.76 | 20.0 | 11.4 | 5.71 | - | - | - | 20.0 | - |
| Plant guard (1.0%) + Felspar (25 g) | 9.30 | 11.6 | 10.8 | 6.20 | - | 18.60 | 6..98 | 2.33 | - | 9..30 | - | 24.8 | - |
| Mean | 5.29 | 12.8 | 3.88 | 10.18 | 1.65 | 20.33 | 4.11 | 8.69 | 2.67 | 3.33 | 2.33 | 23.2 | 0.77 |

fungi were completely disappeared in the rhizosphere of olive non treated plants including *Alternaria* spp., *Aspergillus glaucus*, *A. terreus*, *A. sulphoreus, Rhizopus nigricans, T. harzianum* and *T. viride*.

In general, the quantitative and qualitative differences in frequent occurrence of fungal genera or species between different treatments were recorded. For example: plant guard (1.0 %) + Felspar (25 g) treatment reduced the growth of *A. flavus* from 25.0 to 11.6%, *Aspergillus spp.* from 37.5 to 18.60%, *Fusarium spp.* from 12.5 to 2.33% and *Penicillium* spp. from 12.5 to 9.30%. While, the same treatment stimulated the growth of *Alternaria spp, A. glaucus*, *A. niger*, *A. terreus* and *T. harzianum* from 0.0 in the control to 9.30%, 10.8%, 6.20%, 6.98% and 24.8 %, respectively (Table 6).

Root exudates are known to either stimulate or inhibit the growth of different species of microorganisms. For example, root exudates of *Crotalaria medicaginea* stimulated the growth of *Penicillium herquei, Aspergillus niger* and *Alternaria humicola* but significantly reduced the growth of *Trichoderma lignorum* [41]. Such variations in fungi genera and species as response to different levels of compost in combination with plant guard or flespar may be due to the effect on the chemical and physiological properties of the plant which may differed by affect the microbial make up in the root region of the plant.

So, our study supports the new trend of using biofertilizer and chemical alternatives as beneficial cheap source of fertilization for sustainable agriculture.

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