Effect of integration vermicompost and Nano-fertilizer on *Ficus carica* fig seedlings growth and soil health

Abstract

This study was conducted with the aim of making a new approach to plant fertilization based on nano-fertilizers and vermicompost and its positive effect on soil health. This work was carried out in the experimental research shade house of National Research Centre, Dokki, Giza, Egypt during (2020- 2021). For this purpose, healthy 5 years old fig seedlings sultani cultivar. The seedlings were planted in black polyethylene pots with 30 cm diameter fooled. with use 10 kg washed sand mixed very good with use three constrations of Vermicompost 500 -1000 and 1500g/seedling ,with adding varied doses of Nano-NPK(20:20:20) fertilizers (200, and 400ppm) as foliar application. Nano-NPK fertilizers treatments were applied two times monthly during active season, also fig seedlings were irrigated twice weekly .At the end of each growth season, leaves were collected to record some vegetative parameters (leaf fresh and dry weight and leaf area) then these samples of leaves were dried and digested to determine nutrient statues under tested treatments. Moreover, Estimation of microbial and enzymatic activities of vermicompost .Obtained results indicated that, substituting half recommended dose of spraying with nano-fertilizers at (400 ppm) positively promote most of recorded vegetative growth parameters and without any deficiency symptoms on seedlings. Also, The microbial and enzyme activities of the soil are closely related to the organic matter content and influenced by all practices applied for soil including adding fertilizers. emphasize these impacts of organic matter as vermicompost and nano-fertilizers. Besides, all treatments (vermicompost + nano-fertilizers) resulted in increasing enzyme activity comparing with control treatment. Also, indicated that at the same level of nano-fertilizers, increasing vermicompost dosses lead to increase enzyme activity particularly in level 200ppm of fertilizers.

Keywords: nano-fertilizer, foliar application, fig (***Ficus carica)***, , nutrient status, seedlings, NPK.

Introduction

Figs (*Ficus carica* L.) belong to the family *Moraceae*, and it is clearly of the greatest importance as a source of food for humans. The fig tree is probably native to Western Asia and spread as far as the Mediterranean. Today, figs are a moderately important fruit tree around the world. The genus *Ficus* includes more than 1400 species classified into about 40 genera (Mehraj, *et al*., 2013).

Moreover Figs are a very important dietary fruit for human health due to its high nutritional value, fiber content and laxative properties. It lowers cholesterol, controls blood pressure, helps with weight loss, combats constipation, increases bone density, prevents cancer, is good for anemia and prevents asthma attacks. As a result, it is consumed fresh, dried, canned and preserved around the world. (Mehraj, H *et al*., 2013).

Also Fig trees are widely grown throughout the Mediterranean climate condition (and similar climates) and are well adapted to drought and high temperatures (FAO, 2006). Figs are well adapted to temperate subtropical and temperate climates. Besides, Figs may be grown on a wide variety of soils including heavy clay, loamy and light sandy soils, but ideally well drained. The tree is tolerant of wide range of environmental conditions, needs little cold, tolerates frost and is drought tolerant. Although it grows most strongly when there is a lot of water, but for fresh fruit, a dry climate, light rain is very necessary. Because heavy rain during fruiting and ripening is detrimental (Mehraj, H *et al*., 2013).

It is noteworthy the fig grows successfully in Egypt and their fruits are one of the major fruits for local consumption, the total Egyptian fig harvested area is 67740 acres with total production 214585 tons(The Agricultural Statistics, Part 2 Summer and Nili crops 2018/2019, Arab Republic of Egypt Ministry Of Agriculture, Economic affairs sector.(330-33).

More than 50% of the total fig tree area is located along the northwest coast of Alexandria this area have an arid climate with an average rainfall of about 120 mm. annual. Marsa-Matruh Governorate occupies the first rank in the area that planted for figs, with an area of 59867 acres with productivity about 2.4 tons / acres (Khamis *et al*., 2003). Noubaria governorate came in second rank with total area 4582 acres and productivity 11.2 tons/ acres. The observed differences in productivity/acres is due to Marsa- Matruh Governorate depend on cultivation rainfed system with applying low fertilization rate and poor soil fertility, comparing to applying traditional agricultural practices in the Noubaria (particularly irrigation and fertilization) (The Agricultural Statistics, Part 2,Summer and Nili crops 2018/2019, Arab Republic of Egypt Ministry Of Agriculture, Economic affairs sector. 330-33)

Under northwest coast conditions, productivity per acre under rainfed agriculture system may be increased through improving soil properties (soil fertility and its ability to water retention) by paying more attention to irrigation and fertilizing program in this region. (Cassman, 2002)

It is known that organic fertilization is considered as good source of nutrients, organic matter and microorganisms which helps to maintain the soil health (fertility, pH, porosity and microbial community). In addition, it may improve nutrient mobilization of organic and chemical sources, also promotes the colonization of soil microorganisms (i.e. mycorrhizae) which improves the supply of nutrients (i.e. phosphorus). It is also promote root growth due to its role in improving soil structure. It is worth mentioning that the organic fertilization helps to reinforce the organic matter content of the soil, thus improving the nutrient exchange capacity, increasing the water retention in the soil, enhancing the soil aggregates, and loosening the soil against acidity, alkalinity, salinity, pesticides and toxic heavy metals. In addition, organic fertilizers release nutrients slowly, loss of leaching and phosphorous fixation. Organic fertilizers can also provide micro-nutrients, as they provide nourishment and encourage the growth of beneficial microorganisms and earthworms, which suppresses certain plant diseases, soil-borne diseases and parasites. (Jen-Hshuan, 2006).

On the other hand, there are some disadvantages of using organic fertilizers, its nutrient content is relatively low and so a larger volume is required to provide enough nutrients for the growth of crops. Also, the nutrient release rate is slow to meet the requirements of the crops in a short time, thus some nutrient deficiencies may occur, as the main plant nutrients in the organic fertilizer may not be present in sufficient quantities to maintain the maximum growth of the crop. (Jen-Hshuan, 2006)

In addition, long-term or extensive use in agricultural soils may result in the accumulation of salt, nutrients or heavy metals, weed growth and nematode infestation, which may adversely affect the growth of plants, soil organisms, water quality and animals human health. (Jen-Hshuan ,, 2006)

Recently, “vermicompost got a lot of attention as a result of its environmentally friendly manner and several merits that can be achieved by using this type of organic fertilizers. Also, with utilizing vermicompost, a lot of disadvantages of traditional organic fertilizers may be avoided” (Moustafa *et al.*, 2020).

“Several studies have shown that vermicompost is rich in various nutrients (mainly nitrogen, potassium and phosphate), and various growth promoters” (Jeyabal and Kuppuswamy 2001) and “antibacterial agents” (Adhikary, 2012). Also many studies emphasized on “efficiency of vermicompost as organic fertilizers for several reasons, whereas studies of (Moustafa et al., 2020&2021) indicated that vermicompost is considered as an excellent product since it has desirable esthetics, plant growth hormones, higher level of enzymes, greater microbial population and tend to hold more nutrients over a longer period without adversely impacting the environment. The plant growth regulators and other plant growth influencing materials that include auxins, cytokinins, humic substances, etc. are produced by microorganisms in vermicompost” as has been reported by (Atiyeh *et a*l.,2002 & Muscolo *et al*. 1999)

In addition, Vermicompost has positive impact on growth performance as well as on soil condition , whereas vermicompost increased the total content of antioxidants, carotenes, lycopene, carbohydrates, vitamin C, protein, dry matter, iron and zinc in tomato , spinach and sweet corn (GutiérrezMicely *et al.*, 2007; Shankar *et al.*, 2009; Sinha *et al.*, 2011; Ghosh *et al.*, 2013).

Finally the importance of such this study, it came in context of increasing awareness of the ill effects of conventional farming/chemical faming. Moreover, recent years have seen renewed interest in the sustainability of our food production system by revitalizing and restoring soil fertility and reviving microbial activity to make the soil more lively and healthy.

The aim of this study to be one to be an evidence in chain of studies that indicate the importance of new approach in plant fertilization depending on Nano-fertilizers and vermicompost and its positive impact on soil health.

Material and Methods

Plant Material:

This work was carried out in the experimental research shade house of National Research Centre, Dokki, Giza, Egypt during (2020- 2021). For this purpose, healthy 3 years old fig seedlings Sultani cultivar. The seedlings were planted in black polyethylene pots with 30 cm diameter fooled, with use 10 kg washed sand mixed very good with use three levels of Vermicompost 500 -1000 and 1500g/seedling.Varied doses of Nano-NPK(20:20:20) fertilizers (200, and 400ppm) were applied as foliar treatments separately. Nano-NPK fertilizers treatments were applied twice weekly during growth season. Also, fig seedlings were irrigated twice weekly .Treatments were arranged in randomized complete block design with eight replicates for each treatment and each replicate was comprised of three seedlings. At the end of October

Nano-fertilizer preparation:

Nano-fertilizers had been produced by Dr. Hassan Sharway (chemical engineering and pilot plant Dept., Engineering Division, NRC).

The production steps of the nano-fertilizer are as follows: Addition of 20/20/20 NPK fertilizer in water and stirring till complete dissolution. Addition of citric acid and stirring till complete dissolution. Addition of sodium carbonate with vigorous stirring till an ash like solution formation, adjusting pH to 5. Nano-fertilizer morphology shape and size of the obtained nano fertilizer were characterized by means of a JEOL-JEM-1200 Transmission Electron Microscope (TEM). The TEM sample was prepared by adding a drop of the obtained nano fertilizer after sonication for 15minutes, on a 400 mesh copper grid coated by an amorphous carbon film and lifting the sample for drying in air at room temperature. The average diameter of the fertilizer particles was determined from the diameter of 100 nano-particles found in several chosen areas in enlarged microphotographs.

Measurements:

(a) Vegetative growth parameters:

(1) Leaf Fresh Weight (g)
(2) Leaf Dry Weight(g)
(3) Leaf Area (mm^2)

(b) Leaves mineral content:

Macronutrients were extracted using the dry ashing digestion method (Chapman and Pratt, 1978).Nitrogen was determined by using the Kjeldahl method, Phosphorus was spectro photometerically measured according to the method described by Jackson (1986), and K , Ca and Mg were analyzed by using Perkin-Elmer (1100 B) atomic absorption spectrometer.

(c) Total Microbial Activity of soil (Total Enzyme Activity).

The total microbial enzyme activities of soils were estimated based on the rate of fluorescein diacetate (FDA) hydrolytic activity according to the method described by **Patle et al., (2018)** with some modifications. In brief: Two grams of rhizosphere soil samples were placed (in triplicates) into 50-mL capped centrifuge tubes. A volume of 15 mL potassium phosphate buffer (60 mM, pH 7.6) and 0.2 mL of 0.1% FDA (in acetone) were added to initiate the reaction. Tubes were incubated horizontally at 30°C for 20 min in a rotary shaker. After incubation and color development, the reaction was stopped by adding 15 mL of chloroform/methanol (2:1) and vortexing for 1 min. Tubes were subjected to centrifuge (5000 rpm for 10 min) to spindown soil and turbidity and separate chloroform layer. The developed colored fluorescein in the chloroform layer was spectrophotometrically measured at 490 nm against fluorescein standers. Total soil microbial activity was expressed as FDA hydrolysis values (μg of released fluorescein g^{-1} soil).

(d) Data Analysis:

(e) Means were represented as the average of replicates of two seasons (as a combined analysis of two seasons). The least significant difference (LSD5%) test was used to compare among the means of treatments according to (Snedecor and Cochran, 1992).

Results

Generally gathering both vermicompost and nano-fertilizers have a positive effect on Vegetative growth parameters at all levels comparing with control.

Table (1): Impact of combination vermicompost and ano-fertilizer on growth performance of leaf fresh weight of fig

Vermicompost treatments /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	**400 ppm**	
Vermicompost (500g/seedling)	3.59	5.38	**4.49 b**
Vermicompost (1000 g/seedling)	4.45	5.56	**5.01 a**
Vermicompost (1500 g/seedling)	5	3.49	**4.25 c**
Control	3.49	3.49	**3.49 d**
Mean	**4.13 b**	**4.48 a**	
L.S.D. at 0.05	0.05		

In (table 1), data show that there a positive effect for both vermicompost and nano-fertilizer on leaf fresh weight. In regard to vermicompost all doses led to increase in leaf fresh weight comparing with control. Also, the highest value of leaf fresh weight was achieved with vermicompost treatment at 1000g/seedling. For nano-fertilizer data show that 400ppm of nano-fertilizer surpassed 200ppm of nano-fertilizer in its positive impact on leaf fresh weight. The interaction between vermicompost and nano-fertilizer indicated that treatment that consisted of vermicompost (1000g/seedling) + nano-fertilizer at 400ppm produced the highest value (5.56g) of leaf fresh weight followed by treatment vermicompost (500g/seedling) + nano-fertilizer at 400ppm with significant differences between both treatments. These results coincided with those (Mustafa. *et al* 2018) who reported that Nano-fertilizer at (400ppm) resulted in the highest value of fig leaf fresh weight. However, conventional fertilizer produced the lowest value of leaf fresh weight. Also (Laila Hagagg F., *et al* 2018) noted that olives leaf fresh weight has increased significantly with increasing Nano-fertilizers doses at same level of conventional fertilizer (whether 1, 0.5 or 0.25g/seedling/week).

Table (2): Impact of combination vermicompost and nano-fertilizer on growth performance on Leaf Dry Weight (g) of fig

Vermicompost Treatment /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	**400 ppm**	

Vermicompost (500g/seedling)	1.14	0.97	**1.06 c**
Vermicompost (1000 g/seedling)	2.32	4.82	**3.57 a**
Vermicompost (1500 g/seedling)	1.48	1.25	**1.37 b**
Control	0.62	0.62	**0.62 d**
Mean	**1.39 b**	**1.92 a**	
L.S.D. at 0.05	0.07		

Data in (table 2) shows that high level of nano-fertilizer increased lea dry weight of fig crop. Besides, vermicompost application had a positive impact on leaf dry weight in comparison with control plants. Combination vermicompost application to nano-fertilizers treatments resulted in increment in leaf dry weigh comparing to control treatment and the highest value of leaf dry weight (4.82g) obtained when vermicompost applied at (1000g/seedling) in combination to nano-fertilizer at (400ppm). Obtained results were in same line with finding of (Mustafa.,*et al* 2018) who noticed for fig leaf dry weight, the highest value of dry weight was recorded with both (300 and 400 ppm of Nano-fertilizer) and the lowest value for leaf dry weight was recorded with conventional fertilizers at(500 ppm) . In addition (Hagagg , *et al* 2018) reported that spraying nano-fertilizers at high level produced the highest value of olives leaf dry weight (19.8) comparing with other levels of nano-fertilizers.

Table (3): Impact of combination vermicompost and nano-fertilizer on growth performance on Leaf Area (mm^2) of fig crop

Vermicompost Treatment /seedling	**Nano-fertilizer Treatment**		**Mean**
	200 ppm	**400 ppm**	
Vermicompost (500g/seedling)	884.67	605.6	**745.13 c**
Vermicompost (1000 g/seedling)	494.91	1080.47	**787.69 b**
Vermicompost (1500 g/seedling)	1043.81	2936.33	**1990.07 a**
Control	649.18	649.18	**649.18 d**
Mean	**768.14 b**	**1317.90 a**	
L.S.D. at 0.05	6.2		

Table 3 showed that high level of nano-fertilizers resulted in high value of leaf are (1317.9mm^2) comparing with (768.14) that resulted from 200ppm of nano-fertilizer. In regard for vermicompost treatment, data indicated that high dose of vermicompost (1500gg/seedling) produced high value of leave area (1990.07) comparison with other treatments. For effect of combination treatments of vermicompost and nano-fertilizers, it may be noticed that the highest value of leaf area of fig crop

($2936.33 mm^2$) obtained when vermicompost applied at (1500g/seeding) + nano-fertilizer (400 ppm). Similarly (Mahajan et al. ،2011) worked on Sultani fig cultivar and found that applying Nano-fertilizes at treatment of 400 ppm resulted in increasing leaf area compared with conventional fertilizer.

Generally, these positive effects of nano-fertilizers incorporation with vermicompost may attribute for several factors first one concerns with nano-fertilizers, increasing efficiency of nano-fertilizer comparing to traditional fertilizers as reported by Naderi and Danesh-Shahraki, (2013). Efficiency of nano-fertilize may attribute to its tremendous specific surface area ratio to its volume which allow for raising its efficiency in plants metabolic process as stated by (Chhipa, 2017). From other view, nano-fertilizer work on slow release of nutrient to 60 day after application which mean nutrient will be available or plant in long period in comparison to traditional fertilizers that supply pant wit nutrient up to 30 days from date of application as mentioned by Kottegoda et al., (2011) who reported that nano-fertilizer showed an initial burst and a subsequent slow-release even on day 60 compared to the commercial fertilizer, which released heavily early followed by the release of low and non-uniform quantities until around day 30.

Second reason for these positive impacts is concerning role of vermicomposting in enhancing soil conditions. Whereas vermicompost work as amendment for soil, enrich soil with nutrients, and increase microbial activity. Besides, adding vermicompost work on elongation water retention period in soil which mean continuously nutrient uptake. These findings cam in harmony with obtained results of Lim et al. 2015 who referred to this positive effect of vermicompost application to the role of vermicompost in increasing soil minerals, water holding capacity, soil microorganisms and nutritional values of fruit yield as well as decreases plant pest populations.

Nutrient content:

Table (4): Impact of combination vermicompost and nano-fertilizer on growth performance on leaf N % content

Vermicompost Treatment /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	400 ppm	
Vermicompost (500g/seedling)	2.3	2.17	**2.24 b**
Vermicompost (1000 g/seedling)	2.13	2.53	**2.33 a**
Vermicompost (1500 g/seedling)	2.47	2.37	**2.42 a**
Control	1.9	2.4	**2.15 b**
Mean	**2.20 b**	**2.37 a**	
L.S.D. at 0.05	0.13		

Data in (Table 4) revealed that high levels of nano-fertilizer surpassed low level in its positive impact on leaf N content. Also high doses of vermicompost (1000 and 1500g/seedling) resulted in increased leaf N% content (2.24 7 2.33% respectively) more than other treatments. In respect for effect of gathering vermicompost and nano-fertilizers showed that treatment (vermicompost at 1000 g/seedling +400pp of Nano-fertilizer) and (vermicompost at 1500g/seedling+ 200ppm nano-fertilizer) resulted in higher content of N (2.53 & 2.47% respectively without markedly differences among these two treatments) in comparison to other treatments. However (Mustafa., *et al* 2018) reported that nitrogen content improved with applying Nano-fertilizers and no markedly differences with control. (Hagagg, *et al*., 2018) noted that level of nitrogen in olive leaves were raised with increasing doses of sprayed nano-fertilizer and higher results recorded with high concentration of nano-fertilizer (0.2%).

Table (5): Impact of combination vermicompost and nano-fertilizer on growth performance on leaf K content

Vermicompost Treatment /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	400 ppm	
Vermicompost (500g/seedling)	2.15	0.95	**1.55 c**
Vermicompost (1000 g/seedling)	2.22	1.05	**1.64 b**
Vermicompost (1500 g/seedling)	2.28	1.09	**1.69 a**
Control	1.9	0.89	**1.40 d**
Mean	**2.14 a**	**1.00 b**	
L.S.D. at 0.05	0.04		

In (Table 5), it can be noticed that low level of nano-fertilizers led to increasing in leaf K content (2.14%) comparing with high level of these type of fertilizer (15). In respect of effect of vermicompost on leaf K content, high dose of vermicompost (1500g/seedling) produced the highest of leaf K content (1.69%) comparing with control and low levels o vermicompost. For impact of gathering vermicompost and nano-fertilize on leaf K content, data showed that treatment (vermicompost at 1500g/seedling + 200 ppm on nano-fertilizer) resulted in the highest leaf K content than other treatments. On the other hand "the highest leaf potassium content produced with applying conventional fertilizers at (1g/seedling/week) in combination with nano-fertilizers at (0.2%) as foliar application" (Hagagg , *et al* 2018).

Table (6): Impact of combination vermicompost and nano-fertilizer on growth performance on leaf P content

Vermicompost Treatment /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	400 ppm	
Vermicompost (500g/seedling)	0.25	0.35	**0.30 b**
Vermicompost (1000 g/seedling)	0.28	0.38	**0.33 a**
Vermicompost (1500 g/seedling)	0.23	0.33	**0.28 c**
Control	0.26	0.36	**0.31 b**
Mean	**0.25 b**	**0.35 a**	
L.S.D. at 0.05	0.02		

Table 6 how that high level of nano-fertilizers (400ppm) produced higher level of leaf P content (0.35) comparing with 200ppm of nano-fertilizer that produced (0.25%). Vermicompost at 1000g/seedling surpassed both of 500, 1500g/seedling treatments and control treatment in its impact on leaf P content. Also, the highest leaf P content was obtained with treatment (vermicompost 1000g/seedling + 400 ppm nano-fertilizer). Hagagg ., *et al* (2018) noted that "high level of phosphorus was recorded with applying nano-fertilizer at (0.2%) without significances differences with other concentrations of nano-fertilizer. These results revealed that, there was a capacity for absorption foliar fertilizer through leaves and increasing concentration of foliar fertilizer will have a positive reflection on nutrient status in leaf".

Table (7): Impact of combination vermicompost and nano-fertilizer on growth performance on leaf Ca content

Vermicompost Treatment /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	400 ppm	
Vermicompost (500g/seedling)	0.68	1.52	**1.10 c**
Vermicompost (1000 g/seedling)	0.78	1.6	**1.19 b**
Vermicompost (1500 g/seedling)	0.89	1.7	**1.30 a**
Control	0.66	1.43	**1.04 d**
Mean	**0.75 b**	**1.56 a**	
L.S.D. at 0.05	0.07		

Table 7 showed that high level on nano-fertilizer 400ppm increased leaf Ca content comparing with low level 200ppm of nano-fertilizer. Besides, high doses of vermicompost produced high level of Ca than low doses of vermicompost. Meanwhile, applying vermicompost at 1500g/seedling and nano-fertilizer at 400ppm resulted in the highest leaf Ca content comparing to other treatment. (Liu *et al.*, 200 7Liu and Lal, 2014) they worked on Ca in Nano-particles' form, their results showed 20 and 33% enhancement in Glycine max seeds yield in comparison with conventional calcium.

Data in table 8 indicated that, obtained results showed that there was no significant difference among high and low level of nano-fertilizer in its effect on leaf Mg content. Also, vermicompost resulted in improving Mg status in leaf comparing with control treatment without any markedly differences among vermicompost treatments. Delfani *et al.*, (2014) found that developed magnesium (Mg) as Nanoparticles and used it as an alternative of normal Mg. It recorded 7% increase in *Vignaun guiculata* seed weight.

Table (8): Impact of combination vermicompost and nano-fertilizer on growth performance on leaf Mg content

Vermicompost Treatment /seedling	Nano-fertilizer Treatment		Mean
	200 ppm	**400 ppm**	
Vermicompost (500g/seedling)	0.27	0.28	**0.28 a**
Vermicompost (1000 g/seedling)	0.27	0.27	**0.27 a**
Vermicompost (1500 g/seedling)	0.28	0.26	**0.27 a**
Control	0.26	0.23	**0.25 b**
Mean	**0.27 a**	**0.26 a**	
L.S.D. at 0.05	0.02		

These positive impact of applying both f nano-fertilizer and vermicompost on nutrient content in fig leaves may referred to role of nano-fertilizers in facilitated nutrient in root zone for long period (60 days from application date) comparing with 30 day for tradition fertilizers. Moreover, there is a great roe for vermicompost in supplying pants with it nutrient requirement, increasing microbial activity in soil that work also, on facilitated nutrient in root zone. Finally, applying vermicompost work on enhancing water retention in sol for long period that mean in other word keep soil moisture which effect on solubility of nutrients in root zone and uptake of these nutrients. These findings agree with finding of Kottegoda et al., 2011, Chhipa, 2017, Mustafa et al., 2018 and Hagagg et al., 2018. They emphasized that applying nano-fertilizers work on slow release on nutrient and save time for plant roots t uptake nutrient thereby increased in nutrients content in plant leaves of olive and fig crops. Besides, applying vermicompost work as good source for nutrients and enhance water retention in soil that reflect o nutrient uptake.

C: Effect of combination vermicompost and nano-fertilizer on soil health:

The microbial and enzyme activities of the soil are closely related to the organic matter content and influenced by all practices applied for soil including adding fertilizers. Figure1emphasize these impacts of organic matter as vermicompost and nano-fertilizers. Besides, all treatments (vermicompost + nano-fertilizers) resulted in increasing enzyme activity comparing with control treatment. Also, Fig 1 indicated that at the same level of nano-fertilizers, increasing vermicompost dosses lead to increase enzyme activity particularly in level 200ppm of fertilizers. Atiyeh et al., (2002) showed that “the earthworms certainly fragment the organic waste substrates stimulate enhanced microbial activity and increase rates of mineralization, rapidly converting the wastes into humus-like substances”. Some microbial and enzyme activities are occurring within the gut of the earthworm (Alter and Mitchell, 1992).

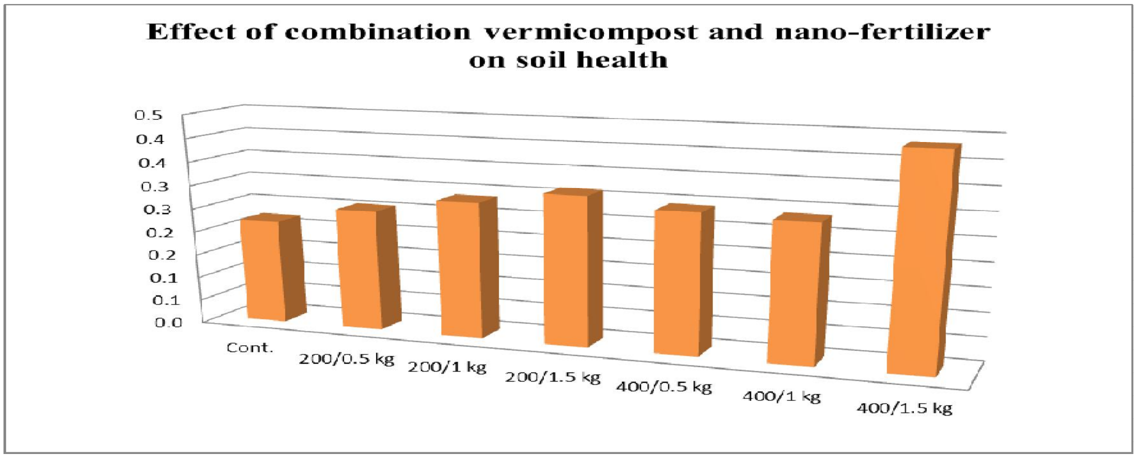

Fig 1: showed impact of combination of vermicompost and nano-fertilizers on microbial activity in soil as total enzyme activity.

Generally, these positive impact for both vermicompost (as organic matter) and nano-fertilizers may be interpret in following firstly, several studies showed that vermicompost as organic fertilizers possess several merits. It is not only rich in nutrient but it contains amino acids and growth promoters (Auxin, gibberellic aids …etc). All these may be resulted in direct positive effects on plants. From other side, vermicompost as organic matter works on enhance soil health (structure, porosity, water retention and increase beneficial microorganism activity in soil) all these effects on soil health will reflect indirectly on plants health.

For nano-fertilizers, several fertilizes had been converted into nano-forms and subjected to study (Ghafariyan et al., 2013; Mahajan et al., 2011). Their results indicated for promising future and results for these new forms on levels (seed germination, growth rate and nutrients content in treated plants) as compared with conventional forms. Applying nano-fertilizers reinforce decreasing environmental pollution through decreasing mineral fertilizers usage, this fact supported with what stated by Solanki et al., (2015) who stated that nano-tools (nano-fertilizers) performed smart deliver and can be utilized as remediating eco-balance, soil degradation, and environmental pollution. Besides, reducing amount of mineral fertilizer will have a positive impact on soil-microorganisms activity.

Finally the importance of such these study came in context on with increasing awareness of the ill effects of conventional farming/chemical faming. Moreover, recent years have seen renewed interest in the sustainability of our food production system by revitalizing and restoring soil fertility and reviving microbial activity to make the soil lively and healthy.

Consequently, of increasing awareness with recycling of available organic residues (wastes) to produce vermicompost and integration these valuable organic fertilizers with nano-fertilizers is promising step toward reducing mineral fertilizers doses (that mean decrease risk of environmental pollution), recovery soil health (fertility & microorganisms activity) thereby reducing soil degradation.

Conclusion

Nano-fertilizers has a positive impact on plant growth performance without any rsk on soil health. Besides, these positive impacts were imprvoed due to integration nano-fertilizers with vermicompost application. All these results may be attributed to role of nanofertilizer inenhancing nutrients efficiency in increament metabolic activities. From other side, vermicompost in enhancing soil microorgansims actvity, water retention in soil tha help in up take nutrients for long time and raising soil fertlity.

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Conflicts of Interest . No conflict of interest

Author’s contribution

N. S. A. Mustafa: setting up the experiment, supervision all stages of study and participating in writing the article

Ahmed.A. Khouder: monitoring experiment and participate in measuring parameters.

Mohamad F. El-Dahshour: supervision for all analysis processes

Raghda Zuhair; arried out microbiological analysis

Lixin Zhang: revise the article

Yasse Thabet A. Moustafa: producing vermicompost

H.H. Shaarawy: producing nano-fertilizers

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