Effect of Organic Fertilizers on Growth and Yield of Faba Bean (*Vicia faba L.*)

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ABSTRACT

This study investigated the effects of compost, compost tea (CT), vermicompost tea (VCT) and humic substances (HS) as organic fertilizers integrated with synthetic inorganic NPK, on the rhizosphere biological activity, growth and productivity of faba bean (*Vicia faba L.*) in clay soil. The experiment was carried out at El Sharkiya Governorate during the two successive seasons of 2017/2018 and 2018/2019 to study the effects of different organic amendments on growth, nodulation, yield and nutrients uptake of three varieties of faba bean namely Giza 3, Nobaryia 1 and Giza 716. Compost and HS were applied as soil application while CT and VCT were applied as foliar spray. The data revealed that VCT combined with 50% mineral NPK fertilizers achieved the highest significant increase in plant height and branch number traits in all varieties during the two seasons and significantly increased yield reaching 11.3, 10.5 and 10.6 ard. /fed. for Giza 3, Nobaryia 1 and Giza 716, respectively. Compost and vermicompost tea applications resulted in a substantial increase of both the number and fresh weight of nodules traits. Meanwhile, amendment with VCT improved nitrogenase activity during the second growing season. Compost treatment in the cultivar Giza 716 achieved the highest biological activities of enzymes in soil of faba bean plants. Also, the CT and VCT application recorded the highest NPK uptake in shoots and grains of plants as well as a significant increase in protein content in grains of all varieties during the two seasons studied.

Keywords: faba bean, humic substances, compost tea, vermicompost tea and compost derivatives.

Introduction

Faba bean (*Vicia faba* L.,) is one of the most important legumes. It has become one of the strategic crops due to its income to the farmers. It is also a popular legume food used worldwide as an important source of protein and carbohydrates for animal and human nutrition (Cazzato *et al*., 2012). Besides, the faba bean has the ability to fix atmospheric nitrogen and can grow well in marginal lands (Farag and Afiah, 2012).

The growth and productivity of the faba bean are affected by many factors, including chemical and organic fertilizers, where nitrogen, phosphorus and potassium (NPK) fertilizers are necessary to increase production. Plant nutrition is one of the most important factors affecting growth and yield. Phosphorus is an essential element that plays an important role in many metabolic processes of the plant, as well as its role in improving the quality of the fruit (Ramadan and Adam, 2007). Potassium is an essential nutrient and is involved in plant metabolism by activating many enzymes and it plays important role in water management of plants (Zörb *et al*., 2014). Faba bean often responds positively to K application, especially in dry growing seasons (Barłóg *et al*., 2018). Availability of adequate K to faba bean plants has a positive effect on N fixation (Römheld and Kirkby, 2010; Gucci *et al*., 2019).

The application of bio-organic fertilizers such as organic manure, biofertilizers and biogas manure as well as compost and its derivatives could resolve these issues and make our ecosystem healthier (Ritika and Utpal, 2014). Thus, it is important to develop credible and usable alternatives to overcome the limitation of chemical inputs. Many organic materials have been proposed as a source of nutrients for plant crops. Humic substance and compost are among the most promising sources of bio-stimulants (Mupambwa *et al*., 2015). Many recent studies stated that compost, HS, CT and VCT could be used to improve and regulate plant growth and to enhance stress tolerance and resilience (Nardi *et al*., 2002; Siddiqui *et al*., 2008).

Olivares *et al.* (2015) emphasized the interest in the use of VCT as a foliar spray on tomatoes. However, to the best of our knowledge, no information on the effect of VCT as a foliar fertilizer on faba bean growth and yield was found in the literature. Humic substance effects may be attributed to many factors, including the natural source and concentration of HS, soil pH, and plant species, the humic compounds may be absorbed by the roots and transported to shoots, enhancing the growth of the whole plant (Lulakis and Petsas, 1995). Compost tea can be prepared in a short period of time and can be applied directly onto the plant surface. However, the effects of compost tea are short lived and frequent and thus repeated applications are required to replenish plant or soil surface with nutrient and/or beneficial microbes (Scheuerell and Mahaffee, 2002 and Ingham, 2005). Humic substances and CT have a contributable role in diminishing the unsustainable application of synthetic-based pesticides and/or fertilizers in agriculture. So, HS and CT are promising in sustainable horticultural crop management, it is necessary to provide further insights into their application and functionality (Zandonadi *et al.,* 2007). Therefore, the aim of this study was planned to examine the impact of various organic amendments i.e., compost, HS (soil application), CT and VCT (as foliar application) on the growth and yield of faba bean (*Vicia faba L.)* as well as the soil biological activity of the plant.

MATERIALS AND METHODS

Materials:

This study was conducted on clay soil planted with three faba bean (*Vicia faba L.*) varieties (Giza 3, Nobaryia 1 and Giza 716 from Field Crops Research Institute, Agriculture Research Center, Egypt.) at a private farm in Belbeis city, El Sharkiya Governorate, Egypt during the 2018 and 2019 winter seasons. Interaction effects of some organic fertilizers (compost, CT, VCT and HA on the growth and yield of faba bean were studied.

Soil:

The physicochemical properties of the experimental soil were estimated according to Horneck *et.al.* (2011). Details of these physicochemical prosperities are presented in Table (1).

Organic amendments:

Compost:

A mixture of cattle dung with various agricultural wastes composted for 12 weeks was used as a compost material in this work. Physical, chemical and biological analyses of the compost are shown in Table (3). The physical and chemical properties were determined in raw materials according to APHA (1989). Total nitrogen, phosphorus and potassium in dry yield were also estimated to Black (1965). Total, fecal coliform bacteria, Salmonellae and Shigella in compost were determined according to Difico Manual (1985). Parasitic organisms were determined in CT according to Jirillo *et al*. (2014). Weed seeds in compost were examined according to Yu *et al*. (2010) and nematodes were examined according to Rice *et al*. (2017).

- **Compost Tea Preparation:**

Compost tea was prepared by mixing mature compost with tap water in an open container at a ratio of 1:10. It was steeped at ambient temperatures for a week with a continuous stirring of the mixture is. After that CT was mixed with additional 0.5% (V/V) molasses for increasing the microbial population densities during production. CT was prepared according to the method described by Scheuerell and Mahaffee (2002) and Ingham (2005).

The chemical characteristics of the CT were as follows: total N 0.03%, total P 0.16%, and total K, 0.23% ammoniacal nitrogen 38 mg/L, nitrate-nitrogen 46 mg/L, pH 7.01 and E.C. 19.95 $dS.m^{-1}$. CT was applied as a foliar spray at a rate of 75 L/Fed., divided on three equal doses after 2, 7 and 11 weeks from sowing.

Vermicompost and vermicompost tea preparation:

Vermicompost was prepared from previous compost after finishing the thermophilic phase using Earthworm (*Eisenia fetida)* worms from vermicompost farm at Environment and Bio-Agriculture Department, Faculty of Agriculture, Al-Azhar University. VCT was prepared by the same method CT prepared as described by Shrestha and Mizutani (2013).

Preparation of humic substances:

The humic substances were extract after the compost maturation phase according to the methods described by Sanchez *et al*. (2002). Data presented in Table (2) clear that elemental analysis (C, N, H, O and S) of humic substances. Total acidity was determined as mentioned by Dragunova (1958). Carboxyl groups were determined according to Schintzer and Gupta (1965). Phenolic groups were determined as described by Kononova (1966).

Measurements:

Physio-chemical determinations for vermicompost and their teas were done to determine the extent of stabilization according to the method of A.O.A.C. (2000). Organic matter and organic carbon were measured after igniting the sample in a muffle furnace at

550°C for 60 min. as described by Nelson and Sommers (1996).

The method described by John (1970) was employed for measuring the total phosphorus using a spectrophotometer (Jenway, Model 6705 UV/Visible, Designed and Manufactured in the UK) and total potassium was measured by using flame photometer (Jenway, Model PFP7, Designed and Manufactured in the UK) after digesting the samples. Meanwhile, microbiological assays were run according to the Difico manual (1985). Parasitics were determined according to Jirillo *et al*. (2014), seed germination percentage was estimated as detailed in Yu *et al.* (2010) and nematodes were examined according to Lenore *et al.* (1999).

Humification parameters for the assessment of organic matter stabilization in compost were also calculated: humification rate (HR) % = C (HA+FA)/TOC x100, humification index (HI) = TC extract- C (HA +FA) /C (HA + FA) and humification degree (HD) % = C(HA+FA)/TC extract x100 (Ciavatta *et al*., 1990).

Total bacteria count (cfu. g^{-1} soil rhizosphere) (Allen, 1959), fungi (cfu g^{-1} soil rhizosphere) (Martin, 1950) and actinomycetes (cfu g^{-1} soil rhizosphere) (Williams and Davis, 1965), were determined at the end of the experiment.

Enzymes., Plant roots were sampled after 7 and 11 weeks from sowing for determination of the numbers and fresh weight of nodules, nitrogenase activity (µmole C_2H_4 mg for nodules) while nitrogenase activity in the rhizosphere (µmole C_2H_4/gm. soil) was estimated according to the methods of Somasegaran and Hoben (1994). Also, dehydrogenase enzyme activities were determined according to Page *et al.* (1982).

Plants were sampled at harvest to determine the total nitrogen, phosphorus and potassium contents in shoots and seeds (Jakson, 1973), plant height (cm), number of branches/plant, number of pods /plant, number of seeds/plant, seed weight/plant (g), and seed yield ard. / Fed. (ard. =155 Kg of faba bean yield).

Experimental treatments:

The experimental treatments were arranged in split block design with three replications as the following: T1: Compost (soil application) +50% NPK; T2: HS (soil application) +50% NPK; T3: CT (foliar application) +50% NPK; T4: VCT (foliar application) + 50% NPK; T5: Mix (compost + CT+ HS+ VCT); T6: Full NPK (control). Control as recommended dose of NPK, as following, Nitrogen (15 kg nitrogen/Fed., is divided into three doses after 2, 7 and 11 weeks of sowing, Phosphorus (200 kg/Fed.) and potassium (50 kg/Fed.). Both phosphorus and potassium were added once during soil preparation before sowing. All treatments except the control one as a half-recommended dose, whereas the fifth treatment didn't receive any mineral fertilizer.

Statistical Analysis

The data collected were evaluated using the combined two-way ANOVA (years and treatments) of design with three replications and the significant differences were identified using the Fisher’s least significance difference (LSD) method when the ANOVA suggested a significant difference at $p \leq 0.05$ (Steel and Torrie, 1980). Statistical analysis was performed using SPSS 20.0 program.

RESULTS AND DISCUSSION

Compost and vermicompost were suitable for tea extract because they reached to maturation degree where their organic matter contents recorded 34.82 and 38.98% respectively. Also, both compost and vermicompost were free from pathogenic bacteria, parasitic, nematode and weed seeds, as shown in Table (3).

Results are in harmony with Afifi, *et al.* (2012) where they reported that compost reaches maturation when it is free of any pathogen bacteria and parasitic with a low HI 1 and the HR and HD% reach more than 50% . Besides, the percentage of humic acid is greater than fulvic acid.

Data in the Table (4) presented the overall results on biochemical composition analysis for both compost and vermicompost. The pH and electric conductivity in compost than vermicompost. On the other hand, organic matter in vermicompost was higher than compost and also contents of total nitrogen, phosphorus and potassium in vermicompost were higher than compost. The proportion of total coliform, fecal coliform, salmonella and shigella bacteria have not been detected neither in compost nor vermicompost which means raw materials of compost and vermicompost which manufactured tea were mature. Quality of compost or vermicompost tea depends on microbial food sources, compost to water ratio, levels of aeration, degree of maturation, compost age, duration of incubation, and the quality of water used. Also, consistent compost quality is necessary.

Sugar or molasses, are commonly used as amendments for CT or VCT to increase quality (Ingham, 2005).

Data presented in Table (5) indicated that all plants that received the organic amendments were taller than those supplied with the full NPK-dose application. Giza3 plants measured up to 95.54 and 96.7 cm/plant during 2018 and 2019, respectively. Meanwhile, the treatments were humic substances during the first season (87.83 cm/plant) while compost tea (84.63 and 90.5 cm/plant) during season 2018 and 2019 respectively. Compost tea and VCT applications with Giza3 achieved the highest values of plant height during 2019 measuring 101and 101.3cm in height, respectively. It is worthy to mention, the treatment which contents mix of organic fertilizers only obtained 78.03 and 80.33 cm during two seasons, respectively and it achieved values greater than full NPK. Plant height increase was already observed on other legume species treated by vermicompost (Sinha *et al*., 2010).

Vermicompost tea application significantly increased the mean number of branches in plant genotypes and seasons. Due to the VCT application, a maximum mean of 7.46 branches /plant was enumerated in 2019 compared to a maximum of 6.46 branches/plant in 2018. Giza 3 plants attained more branches than Nobaryia1 and Giza 716. The positive effect of VCT might be due to its growth-promoting effect on roots which enhanced nutrient uptake and improved plant growth vigor. This is in harmony with the results reported by Chaichi *et al.* (2018) who found that foliar application of VCT to faba bean plants resulted in enhanced plant growth, earlier flowering and higher number of pods per plant, which probably favored higher yield. It appears that foliar application of VCT had a beneficial effect on growth and production in faba bean plants.

Also, data presented in Table (5) refer to increased numbers of pods and seeds/plants as a result of foliar application of VCT. Plants sprayed with VCT had maximum numbers of 25.08 pods/plant and 75.56 seeds/plant as well as maximum seeds weights of 55.43g seeds/plant during 2019 season. Similar results using vermicompost tea in the substrate or as a spray or drench applied to the roots have been reported in cereals, fruits, and legumes (Doan *et al*., 2013, Amiri *et al*., 2017; Khan *et al*., 2015; Yang *et al*., 2015; Zhang *et al*., 2011), or as a foliar spray (Kim *et al.* 2015), or both (Olivares *et al*., 2015). A superior increase in seed yield/fed was scored by plants sprayed with VCT. The yield of these plants reached up to 8.8 and 10.8 ard. /fed. during the two seasons, respectively, compared with amounts of 4.66 and 7.19 ard. /Fed for full NPK in both varieties during the two seasons, respectively. Variety produced higher pod number/plant as well as seed numbers and weights compared with Giza 3 and Giza 716. In addition, it achieved significantly higher seed productivity than other cultivars (9.55 seed yield ard. /fed.), during 2019 season.

Metallic minerals simply dissolve into the CT structure and become bio-chemically reactive and mobile. It is worth mentioning that plants treated with a mixture of the organic amendments only achieved significantly higher yield/fed (5.33 and 8.53 ard. /fed.) than those received the full NPK fertilizer in both seasons. However, the mechanism of CT, VCT and HS for promoting plant growth is not completely known. Many authors reported that increasing cell membrane permeability, oxygen uptake, respiration, photosynthesis, phosphate uptake and root cell elongation of plant growth factors while, Kim (2014) explained the positive effect of humic substances.

Numbers and fresh weight of nodules and nitrogenase enzyme in nodules.

The full dose of chemical NPK fertilizer had a low effect on nodule formation by the three examined plant genotypes. In contrast, all the applied organic treatments had a consistent favorable effect on nodule formation by the examined plant varieties when compared with the chemical NPK fertilizer application. Vermicomposting tea application was superior in this respect resulting in the formation of the highest nodule numbers in both varieties grown through two seasons. For instance, Nobaryia 1 plants treated with vermicompost tea formed as high as 226.6 and 229.5 nodules/plant in the 1^{st} and 2^{nd} seasons, respectively (Table 6).

In the soil amended with compost or HS, nodule fresh weights were higher than nodules formed by plants supplemented with the full dose of chemical fertilizer. The highest nodules formed by the variety Giza 716 during the first season where, nodules fresh weight (mg/plant) were 2904. Meanwhile, the variety of Nobaryia 1 treated by humic substances was superior in the second season (3422.3 nodules fresh weight mg/ plant). These results agree with those of Ahmed and El-Abagy (2007) who attributed the differences among faba bean cultivars in growth characters to the differences in the number of nodules formed on the root of the tested cultivars, consequently, the growth of each cultivar may depend mainly on nitrogen fixation, and the differences in partition and migration of photosynthates between cultivars and the endogenous.

The positive effect of organic fertilizer in some vegetative growth characteristics and more yield characteristics may be due to the organic fertilizer content of various sources on the organic compounds dissolved in water, such as sugars, amino acids, humic acids and organic acids, all these compounds contribute directly or indirectly to the growth and development of the plant are encouraging growth by enzymatic or hormonal as it contains nutrients needed by the plant or they affect the nutrient availability already present in the soil by improving soil pH and thus improving plant productivity (Al-Bayati and Kammel, 2014).

VCT treatment was the superior amendment provoking the highest nitrogenase activity. Giza 3 achieved higher nitrogenase activity during the first season (0.98 µmole C_2H_4/g dry nod) while, G3 and Nobaryia 1 were the best in the second season they recorded 1.03 and 1.04 µmole C_2H_4/g dry nod) respectively. The mixed organic fertilizers supported higher nodule formation than full NPK (control) treatment, as shown in Table (6).

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Dehydrogenase enzyme activities reflect the living microbial cell in the soil; it is considered the best indicator of microbiological redox systems Bhaduri *et al.,* (2019). The dehydrogenase activity was increased due to compost application over other treatments when determined at 7 and 11 weeks after sowing. The dehydrogenase activity during the season 2019 exhibited higher values than in 2018. The maxima dehydrogenase activities (25.5 and 30.65 µTPF/g dry rhizosphere) were estimated in compost soil cultivated with variety Giza 716 as shown in Table (7). Meanwhile, compost and HS were superior for increasing nitrogenase activities in all plant rhizosphere during 2019. Both amendments resulted in significantly higher values of N_2-ase activities with compost treatment and Giza 716 than Nobaryia 1 and Giza 3, recording 34.6 µmole C_2H_4/g dry rhizosphere while Nobaryia 1 cultivar with HS was higher than other treatments 36.3 µmole C_2H_4/g. Moreover, N_2-ase through period 11 weeks was higher than 7 weeks during season 2018 and 2019 respectively. when HS tested with 50 % NPK, it gave the highest activities of both nitrogenase and dehydrogenase enzymes at 75 days from sowing of wheat plant respectively, as reported by Massoud *et al.* (2013).

Data in Table (8) show that the nitrogen achieved with foliar application of VCT 4.01, 4.91 and 4.07 % with Giza 3, Nobaryia 1 and Giza 716 verities in the 2018 season, respectively. Total phosphorus was (0.23, 0.26), (0.26, 0.27) and (0.25, 0.28) % in plants treated with CT during both seasons with three verities. Meanwhile, the values of total potassium in shoots of Giza 3, Nobaryia 1 and Giza716 plants received with foliar application of CT were (3.60, 3.67), (3.68, 3.76) and (3.64, 3.69) % in 2018 and 2019, respectively. Other studies have attributed the effect of CT and VCT application to the availability of minerals, mostly nitrogen, which can be used quickly by plants (Amiri *et al.*, 2017; Khan *et al.,* 2015; Sinha *et al.,* 2010; Yang *et al.,* 2015).

Percentages of NPK in faba bean grains increased NPK with CT treatment in plant uptake and reflected their increase in seeds as shown in table (9). Total NPK were the highest in seeds with variety Nobaryia 1 achieved (4,10 and 4.81%) total nitrogen and (0.56 and 0.96 %) total phosphorus, while variety G 3 was the best when spray by CT (1.40 and 1.45) total potassium for CT (foliar application) +50% NPK treatment, during seasons 2018 and 2019, respectively. A similar finding was gained by Khaled *et al*., (2012) who reported that the highest values of K contents in sesame seeds were achieved by soil application of humic acid combined with the high rate of mineral N fertilizer.

The moral role when adding half the amount of chemical fertilizer with the amount of organic manure in each of the contents of total nitrogen, phosphorus, potassium and protein percentages in faba bean grains. Nobaryia 1 variety achieved the highest significant value of protein percentage than other two varieties as shown in tables (9). This may be due to the contribution of both mineral and organic fertilizer to each other to reach the state of optimal nutritional balance suitable for the growth and development of the plant because they equipped the plant with the necessary nutrients, which was reflected in significant increases in most of the indicators of the studied factor (El-Shakry, 2005; Al-Habar *et al*., 2014).

CONCLUSION:

Use of compost, CT, VCT and HS as organic fertilizers integrated with synthetic inorganic NPK fertilizer contribute to lowering pollution of mineral NPK fertilizers and decreased the cost by using environmentally friendly organic and bio-organic fertilizers and compensate compensation NPK fertilizer for faba bean. Organic fertilizers in clay soils have key role in enhancing physiochemical and biological soil properties. All treatments recorded the highest NPK uptake in shoots and grains of plants as well as a significant increase in protein content in grains of all varieties during the two seasons of study.

REFERENCES

Afifi, M.M.I., Estefanous, A.N., El-Akshar, Y.S. 2012. Biological, chemical and physical properties of organic wastes as indicators maturation of compost. J. Appl. Sci. Res., 8(4): 1857-1869.

Ahmed, M.A., El-Abagy, H.M.H. 2007. Effect to bio-mineral phosphorus fertilizer on the growth, productivity and nutritional value of some faba bean (*Vicia faba L.*) cultivars in newly cultivated. J. Appl. Sci. Res., 3:408-420.

Al-Bayati, H.J.M., Kammel, T.J. 2014. Improving growth and yield by application organic fertilizers compared with chemical fertilizers on two cucumber (*Cucumis sativus* L.) cultivars which grown under unheated plastic house. Mesopotamia J. Agric., 42 (1):168-176.

AL-Habar, M.T., Hussein, J.M., Fathel, F.R.I. 2014. Possibility study of humic acid using as compensation or reduce of chemical fertilizer addition on potato (*Solanum tuberosum* L.). Mesopotamia J. Agric., 42 (1): 68-74.

Allen, O.N. 1959. Experiments in Soil Bacteriology.1st ed. Burges Publ. co. Minnesota USA, 117 p.

Amiri, H., Ismaili, A., Hossein zadeh, S.R. 2017. Influence of vermicompost fertilizer and water deficit stress on morpho-physiological features of chickpea (*Cicer arietinum* L. cv. karaj). Compost Science and Utilization, 25(3):152–165.

AOAC. 2000. Official methods of the Association of Official Analytical Chemists,

APHA. 1989. Standard Methods for Examination of Water and Wastewater. 17th Edition. American Public Health Association, Washington, DC. USA.

Barłóg, P., Grzebisz, W., Łukowiak, R. 2018. Faba bean yield and growth dynamics in response to soil potassium availability and sulfur application. Field Crops Res, 219: 87-97.

Bhaduri, A., Chatterjee, S., Bakuli, K., Hazra, D., Pandey, S. 2019. Nutrient cycling and metabolic activity of soil microbes in pristine forests in comparison to a monoculture. Vegetos Int. J. Plant Res., (32) 324-332.

Black, C.A. 1965. Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties. American Society of Agronomy, Inc., Madison, Wisconsin, USA.

Cazzato, E., Tufarelli, V., Ceci, E., Stellacci, A.M., Laudadio, V. 2012. Quality, yield and nitrogen fixation of faba bean seeds as affected by Sulphur fertilization. Acta Agriculturae Scandinavica Section B: Soil and Plant Science, 62, 732-738.

Chaichi, W., Djazouli, Z., Zebib, B., Merah, O. 2018. Effect of vermicompost tea on faba bean growth and yield. Compost Science and Utilization, 26:(4) 279-285.

Ciavatta, C., Govi, M., Vittori, A., Sequi, P. 1990. Characterization of humified compounds by extraction and fractionation on solid polyphnilpyrrolidone. J. Chromatogr., 509: 141-146.

Difico, 1985. Difico Manual of Dehydrated Culture Media and Reagents of Microbiology. 10th Ed. Difico Laboratories, Detroit, MI, USA.

Doan, T.T., Ngo, P.T., Rumpel, C., Nguyen, B.V., Jouquet, P. 2013. Interactions between compost, vermicompost and earthworms influence plant growth and yield: a one-year greenhouse experiment. Scientia Horticulturae 160:148-154.

Dragunova, A.F. 1958. A rapid method for determining functional groups in humic acids. Nauch. Trudy, Mosk. In Zh. Chonon Inst. Ser. Khinprioz-vod., 110. c.f. Kononova (1966) ttps://books.google.com.eg/books?isbn=1483185680.

EL-shakry, M.F.Z. 2005. Humic materials for agriculture plants. Better Crops. 89 (3):1023-1025.

Farag, H.I.A., Afiah, S.A. 2012. Analysis of gene action in diallel crosses among some faba bean (*Vicia faba* L.). genotypes under Maryout conditions. Annals of Agric., sci., 57 (1): 37-46.

Gucci, G., Lacolla, G., Summo, C., Pasqualone, A. 2019. Effect of organic and mineral fertilization on faba bean (*Vicia faba L.*). Sci. Hortic, 243: 338-343.

Horneck, D.A., Sullivan, D.M., Owen, J.S., Hart, J.M. 2011. Soil Test Interpretation Guide. Technical report. Oregon State University. See discussions, stats, and author profiles for this publication at: https://www.researchgate.net / publication/ 265097991.

Ingham, E.R. 2005. The compost Tea Brewing Manual 5th Ed. Soil Food Web Incorporated, Corvallis, OR., USA.

Jakson, M.L. 1973. Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi., pp175-285.

Jirillo, E., Magrone, T., Miragliotta, G. 2014. Immuno Modulation by Parasitic Helminths and its Therapeutic Exploitation. In: M. A. Pineda and W. Harnett (eds) Immune Response to Parasitic Infections, Volume 2- Immunity to Helminths and Novel Therapeutic Approaches. Bentham Science Publishers Ltd., U.A.E, PP 175-212.

John, M.K. 1970. Colorimetric determination of phosphorus in soil and plant material with ascorbic acid. Soil Sci. 109:214-220.

Khaled, A.S., Mona, G.A., Zeinab, M.K. 2012 Effect of soil amendments on soil fertility and sesame crop productivity under newly reclaimed soil conditions. J. App. Sci. Res., 8 (3): 1568-1575.

Khan, K., Pankaj, U., Verma, S.K., Gupta, A.K., Singh, R.P., Verma, R.K. 2015. Bio-inoculants and vermicompost influence on yield, quality of *Andrographis paniculata* and soil properties. Industrial Crops and Products 70: 404-409.

Kim, H.T. 2014. Humic Matter in Soil and Environment: Principles and Controversies. CRC Press, Boca Raton, FL. Book 439 P.

Kim, M.J., Shim, C.K., Kim, Y.K., Hong, S.J., Park, J.H., Han, E.J., Kim, J.H., Kim, S.C. 2015. Effect of aerated compost tea on the growth promotion of lettuce, soybean, and sweet corn in organic cultivation. Plant Pathol. J., 31 (3):259-268.

Kononova, M.M. 1966. Soil Organic Matter. Pergmon Press, Oxford, London, Edinburgh, New York pp. 544

Lenore, S.C., Arnold, E.G., Andrew, D.E. 1999. Standard Methods 20th Edition for the examination of Water and Wastewater. American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation (WEF).

Lulakis, M.D., Petsas, S.I. 1995. Effect of humic substances from vine-canes mature compost on tomato seedling growth. Bioresour. Technol., 54: 179-182.

Martin, J.P. 1950. Use of acid Rose Bengal and Streptomycin in the plate method for estimating soil fungi. Soil Sci., 69: 715-732.

Massoud, O.N., Afifi, M.M.I., El-Akshar, Y.S., El-Sayed, G.A.M. 2013. Impact of biofertilizers and humic acid on the growth and yield of wheat grown in reclaimed sandy soil. J. Agric. Bio. Sci., 9(2): 104-113.

Mupambwa, H.A., Dube, E., Mnkeni, P.N.S. 2015. Fly ash composting to improve fertilizer value -A review. South Afr. J. Sci. 111:(7/8) 1-6

Nardi, S., Pizzeghello, D., Muscolo, A., Vianello, A. 2002. Physiological effects of humic substances on higher plants. Soil. Biol. Biochem., 34: 1527-1536.

Nelson, D.W., Sommers, L.E. 1996. Total carbon and organic carbon and organic matter. In: Page AL, Miller RH, Keeney DR (ed) Method of Soil Analysis. American Society of Agronomy, Madison, Wilcosin, pp. 961-1010.

Olivares, F.L., Aguiar, N.O., Rosa, R.C.C., Canellas, L.P. 2015. Substrate biofortification in combination with foliar sprays of plant growth promoting bacteria and humic substances boosts production of organic tomatoes. Scientia Horticulturae 183:100-108.

Page, A.L., Miller, R.H., Keeney, D.R. 1982. Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties. Soil Sci. Amer., Madison Wisconsin, USA.

Ramadan, M.A.E., Adam, S.M. 2007. The Effect of chicken manure and mineral fertilizers on distribution of heavy metals in soil and tomato organs. Aust. J. Basic and App. Sci., 1 (3): 226-23.

Rice, E.W. Baird, R.B., Eaton, A.D. 2017. Standard Methods for Examination of Water and Wastewater, 23rd Edition. American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation (WEF), USA.

Ritika, B., Utpal, D. 2014. Biofertilizers, a way towards organic agriculture: A review. Afr. J. Microbiol. Res., 8: 2332-2343.

Römheld, V., Kirkby, E.A. 2010. Research on potassium in agriculture: needs and prospects. Plant Soil, 335: 155-180.

Sanchez, A., Ysunza, F., Beltran-Garcia, M.J., Esqueda, M. 2002. Biodegradation of viticulture wastes by Pleurotus: a source of microbial and human food and its potential use in animal feeding. J. Agric. Food Chem., 50: 2537-2542.

Sanchez-Monedero, M.A., Roid, A., Cegarra, J., Bernal, M.P., paredes, C. 2002. Effects of HCL-HF purification treatment on chemical composition and structure of humic acids. Eur. J. Soil Sci., 53: 375-381.

Scheuerell, S., Mahaffee, W. 2002. Compost tea: principles and prospects for plant disease control. Compost Sci. Utilization, 10: 313-338.

Shrestha, A.K., Mizutani, F. 2013. Influence of Organic Mulches on Fruit Quality, Soil Nutrition and Weed Control in Miyauchiiyo. Green Farming 4 (1): 1-6.

Siddiqui, Y., Meon, S., Ismail, R., Rahmani, M., Ali, A. 2008. Bio-efficiency of compost extracts on the wet rot incidence, morphological and physiological growth of okra (*Abelmoschus esculentus L.*) Moench. Scientia Horticulturae, 117: 9-14.

Sinha, J., Biswas, C.K., Ghosh, A., Saha, A. 2010. Efficacy of vermicompost against fertilizers on *Cicer* and *Pisum* and on population diversity of N_2 fixing bacteria. J. Env. Bio., 31:28-92.

sixteenth ed. Association of Official Analytical Chemists, Arlington, VA.

Somasegaran, P., Hoben, H.J. 1994. Handbook for Rhizobia: Methods in Legume-Rhizobium Technology. Springer, New York, USA.

Steel, R.G.D., Torrie, J.H. 1980. Principles and Procedures of Statistics. McGraw-Hill Publishing Company, New York. N. Y.481 pp. 10-50.

Williams, S.T., Davis, F.L. 1965. Use of antibiotics for selected isolation and enumeration of actinomycetes in soil. J. Gen. Microbiol., 38: 251-261.

Yang, L., Zhao, F., Chang, Q., Li, T., Li, F. 2015. Effects of vermicomposts on tomato yield and quality and soil fertility in greenhouse under different soil water regimes. Agricultural Water Management, 160:98-105.

Yu, G., Luo, H.Y.H., Wu, M.J., Tang, Z., Liu, D.Y., Yang, X.M., Shen, Q.R. 2010. PARAFAC modeling of fluorescence excitation-emission spectra for rapid assessment of compost maturity. Bioresource. Technol., 101: 8244-8251.

Zandonadi, D.B., Canellas, L.P., Facanha, A.R. 2007. Indoleacetic and humic acids induce lateral root development through a concerted plasmalemma and tonoplast pump activation. Planta, 225: 1583-1595.

Zhang, N., Ren, Y., Shi, Q., Wang, X., Wei, M., Yang, F. 2011. Effects of vermicompost on quality and yield of watermelon. China Vegetables, 6:76-79.

Zörb, C., Senbayram, M., Peiter, E. 2014. Potassium in agriculture–status and perspectives. J. Plant Physiol., 171: 656-669.

Table 1: The physicochemical properties of the experimental soil.

Physical properties										
Sand%	Silt %	Clay %	Soil texture							
18.35	15.75	65.9	Clay							
Chemical properties										
pH	EC dS.m^{-1}	Na^+ meq l^{-1}	Ca^{++} meq. l^{-1}	Mg^{++} meq l^{-1}	K^+ meq l^{-1}	$CO_3^=$ meq l^{-1}	HCO_3^- Meq l^{-1}	Cl^- meq l^{-1}	SO_4^- meq l^{-1}	ESP
7.68	2.95	13.16	6.32	9.73	0.10	0.00	7.13	10.13	12.01	7.46
Available elements										
N mg/kg$^-$	P mg kg$^-$	K mg kg$^-$	Fe mg kg$^-$	Mn mg kg$^-$	Zn mg kg$^-$	Cu mg kg$^-$	B mg kg$^-$	Cd mg kg$^-$	Ni mg kg$^-$	Pb mg -
95.2	36.88	642.25	43.948	13.000	1.11	2.682	0.00	0.00	0.063	1.86

Table 2: Characteristics of humic substances extracted from compost.

Carbon %	Nitrogen %	Hydrogen %	Oxygen%	Sulfur%	Total Acidity (mmol/100g)	Total Carboxylic groups (mmol/100g)	Total Phenolic groups (mmol/100g)
50	4.1	5.0	39.9	1.0	600	290	310

Table 3: Physical, chemical and biological analyses of compost and vermicompost.

Type of analysis	Compost	Vermi.,		Compost	Vermi.,
Physical and chemical analysis					
Density (kg/m^3)	536	400	Total nitrogen (%)	1.3	1.6
Moisture content (%)	18	27	Organic matter (%)	34.82	38.98
Dry matter (%)	82	73	Organic carbon (%)	20.19	22.61
pH (1:10)	7.5	7.2	Ash (%)	65.18	61.02
EC dS/m (1:10)	5.2	3.7	C/N ratio	16: 1	14 :1
Ammonia (ppm)	90	58	Total phosphorus (%)	0.69	1.2
Nitrate (ppm)	277	402	Total potassium (%)	0.58	0.89
Biological analysis					
Total bacterial count (cfu/g x10^6)	60	120	Total coliform (cfu/g x10^3)	Nd	Nd
Total actinomycetes (cfu/g x10^4)	12	10	Fecal coliform (10^3)	Nd	Nd
Total fungi (cfu/g x10^4)	9	13	Salmonella *&* Shigella (cfu/gx10^3)	Nd	Nd
Nematode (larva/200g)	nd	nd	Weed Seeds	Nd	Nd
Parasitic	nd	nd	Germination percentage	78	83

Vermi: Vermicompost Nd: not detected; C/N: Carbon / Nitrogen ratio; cfu: colony forming unit

Table 4: Chemical and biological determinations of compost and vermicompost tea**.**

Type of analysis	Compost tea	
Chemical analysis		
pH	6.96	8.05
EC (dS/m)	4.96	2.70
Organic matter (%)	8.8	12.6
Organic-Carbon (%)	5.14	7.3
N-NH^+_4 (ppm)	93	8.0
N-NO^-_3 (ppm)	115	36
Total-N(ppm)	369	810
Available-P(ppm)	88	11200
Available-K(ppm)	118	13200
Biological determination (cfu/ml)		
Total coliform	Nd	Nd
Fecal coliform	Nd	Nd
Salmonella and shigella	Nd	Nd

Nd: not detected

Table 5: Response of three faba bean varieties to organic amendments and their interactions on plant height, yield and yield components during two successive winter seasons.

V / Tr.	Plant height (cm)								No. of branches/plant							
	2018				2019				2018				2019			
	G.3	Nub.1	G.716	Mean	G.3	Nub.1	G.716	Mean	G.3	Nub.1	G.716	Mean	G.3	Nub.1	G.716	Mean
T1	91	62.8	75.3	77.03	94.3	62.5	84.8	80.53	6.3	3.6	5	4.96	8	4.9	6.6	6.5
T2	100	78.3	85.2	87.83	100.4	77.4	90	89.26	7.6	4.3	6.3	6.06	8	5.8	7	6.93
T 3	98.6	71.7	83.6	84.63	101	74.1	96.4	90.5	7.3	3	5.8	5.36	8.1	4	5.5	5.86
T4	100.06	72.1	87.2	86.45	101.3	76.5	90.3	89.36	8.2	3.8	7.4	6.46	8.4	7	7	7.46
T5	91.2	65.3	77.6	78.03	91.6	67.2	82.2	80.33	7	3.3	5.7	5.33	6.3	4	6.3	5.53
T6	92.4	62.1	74.3	76.26	91.6	64.8	78	78.13	5.3	2.6	5.5	4.46	6	3.5	4	4.5
Mean	95.54	69.55	80.53	82.54	96.7	70.41	86.95	84. 68	6.95	3.43	5.95	5.44	7.46	4.86	6.06	6.13
LSD 0.05	V:36, T:51, VT: 0.88								V:37, T:52, VT: NS							
	No. of pods/plant								No. of seeds/plant							
T1	23	22	21.1	22.03	23.6	19.6	24.4	22.53	73.1	72.2	71.3	72.2	74.08	69.9	74.6	72.86
T2	19.3	24.07	23	22.12	21.5	22.6	20.5	21.53	69	74.1	73.3	72.13	71.1	71.3	70.3	70.90
T 3	21.5	24.7	22.2	22.8	25	21	20.2	22.06	71.01	74.9	72.1	72.67	74.7	75.4	70.1	73.40
T4	24.2	25.8	24.3	24.76	25	24.2	26.06	25.08	74.1	75.9	74.4	74.8	75.3	75.1	76.3	75.56
T5	19.6	19.1	20.6	19.76	20.04	20.1	17.2	19.11	69.2	69.2	70.1	69.5	70.2	70.07	66.3	68.85
T6	18	18.7	18.1	18.26	16.3	16.3	18	16.86	68	67.8	67.8	67.86	65.5	66.03	68	66.51
Mean	20.93	22.40	21.55	21.62	21.90	20.63	21.06	21.19	70.73	72.35	71.5	71.52	71.81	71.3	70.93	71.34
LSD 0.05	V:NS, T:59, VT: 1.02								V:0.46, T:64, VT: 1.12							
	Seed weight (g/plant)								Seed yield (ard. /fed)							
T1	52,6	52.1	51.4	52.03	52.2	50.1	54.7	52.33	6.7	8.7	7.4	7.6	8.5	11	9.1	9.53
T2	50.4	54.3	52.7	52.46	51.3	51.3	50.3	50.96	7.3	7.6	8.9	7.93	8.7	9.4	10.5	9.53
T 3	51.2	54.5	52.5	52.73	54.8	54.8	50.2	53.26	7.1	8.1	8.3	7.83	9	10.3	10.6	9.96
T4	54	56.1	54.3	54.8	55.1	55.1	56.1	55.43	8.6	9.5	8.3	8.8	11.3	10.5	10.6	10.8
T5	48.3	49.01	50.1	49.13	50.3	50.3	47	49.2	5.1	5.7	5.2	5.33	8.3	9.1	8.2	8.53
T6	48.2	47.6	48.03	47.94	45.5	45.5	48	46.33	5.1	4.8	4.1	4.66	7.5	7.03	7.05	7.19
Mean	50.78	52.26	51.50	51.51	51.53	51.18	51.05	51.25	6.65	7.4	7.03	7.02	8.88	9.55	9.34	9.25
LSD 0.05	V:NS, T:4.74, VT: NS							V: NS, T: NS, VT: NS								

T: treatment, V: variety and VT interaction between treatment and variety.

Table 6: Effect of compost, humic substances, compost and vermicompost tea on number, fresh weight and nitrogenase activity in nodules of three faba bean varieties after 7 and 11 weeks from culture during two successive winter seasons.

Variety	Treatments	Nodules number						Nodule fresh weight(mg/plant)						Nitrogenase activity (µmole C_2H_4/g dry nod.)					
		2018			2019			2018			2019			2018			2019		
		7	11	Mean	7	11	Mean	7	11	Mean	7	11	Mean	7	11	Mean	7	11	Mean
G 3	T1	116	119	117.5	118	121	119.5	2350	2375	2362.5	3190	3235	3212.5	0.65	0.77	0.71	0.55	0.65	0.60
	T2	173	181	177	176	180	178	2017	2203	2110	2379	2394	2386.5	0.62	0.72	0.67	0.52	0.61	0.56
	T 3	200	205	202.5	192	196	194	1095	1003	1049	1211	1253	1232	0.5	0.6	0.55	0.74	0.83	0.78
	T4	212	214	213	129	120	124.5	1261.6	1401	1331.3	2275	2295	2285	0.94	1.03	0.98	0.99	1.08	1.03
	T5	55	61	58	74.3	77	75.65	563.3	576	569.6	511	230.6	370.8	0.47	0.66	0.56	0.53	0.68	0.60
	T6	42	49	45.5	49	58.6	53.8	515.3	531.6	523.4	516	536	526	0.45	0.52	0.48	0.52	0.61	0.56
	Mean	133	138.1	135.5	123.05	125.43	124.24	1300.3	1348.2	1324.3	1680.3	1657.2	1668.8	0.60	0.71	0.65	0.64	0.74	0.69
	LSD 0.05	Y:0.50, T:0.87, YT: 1.23						Y:4.79, T:8.3, YT: 11.7						Y:0.005, T:0.008, YT: 0.012					
Nobaryia 1	T1	111	113.6	112.3	119	122.6	120.8	2730	2792	2761	3130.6	3286	3208.3	0.55	0.62	0.58	0.646	0.68	0.66
	T2	207	209	208	208.3	209.6	208.9	2407	2521.3	2464.1	3364.6	3480	3422.3	0.50	0.64	0.57	0.75	0.98	0.86
	T 3	211	214	212.5	216	220	218	1660	1765	1712.5	1777	1851	1814	0.64	0.98	0.81	0.986	1.10	1.04
	T4	225	228.3	226.6	228	231	229.5	1802	1903	1852.5	2100.6	2213	2156.8	0.50	1.04	0.90	0.983	1.06	1.02
	T5	66	62	64	71.3	75.3	73.3	616	650.3	633.1	750	859	804.5	0.41	0.52	0.46	0.46	0.64	0.55
	T6	59	61	60	65	67.3	66.15	584	633	608.5	715	749.6	732.3	0.32	0.36	0.34	0.37	0.45	0.41
	Mean	146.5	147.9	147.2	151.2	154.3	152.7	1633.1	1710.7	1671.9	1972.9	2073.1	2023	0.53	0.69	0.61	0.69	0.81	0.75
	LSD 0.05	Y:0.47, T:.081, YT: 1.15						Y:0.53, T:0.93, YT: 1.31						Y:0.004, T:0.008, YT: 0.011					
Giza 716	T1	116	122	119	123	126	124.5	2477	3331	2904	2862	2774.3	2818.1	0.55	0.7	0.62	0.59	0.68	0.63
	T2	211	233	222	224	227	225.5	2389	3233	2811	2395	2401	2398	0.73	0.79	0.76	0.76	0.85	0.80
	T 3	127	181	154	229.6	233.6	231.6	1130.3	1593.3	1361.8	1237	1519	1378	0.74	0.98	0.86	0.88	1.01	0.94
	T4	210	212.6	211.3	228.6	233	230.8	2015	2201.3	2108.1	2767	2931	2849	0.8	1	0.90	0.85	1.07	0.96
	T5	53	76	64.5	75	78	76.5	580.6	600.3	590.4	593	609	601	0.42	0.45	0.43	0.49	0.52	0.50
	T6	48	53.3	50.6	64.3	74	69.15	571	581	576	592	607	599.5	0.34	0.38	0.36	0.43	0.49	0.46
	Mean	127.5	146.3	136.9	157.4	161.9	159.6	1527.1	1923.3	1725.2	1741	1806.8	1773.9	0.59	0.71	0.65	0.66	0.77	0.71
	LSD 0.05	Y:40.4, T:70.05, YT: 99.07						Y:56.2, T:97.3, YT: 137.6						Y:0.005, T:0.010, YT: 0.014					

Y: year, T: treatment and YT interaction between and year treatment

Table 7: Changes in dehydrogenase and nitrogenase activities in the rhizosphere of faba bean varieties treated with different treatments during two successive winter seasons.

Variety	Treatments	Dehydrogenase activity (µg TPF/g dry rhizosphere)						Nitrogenase activity (µmole C_2H_4/g dry rhizosphere)					
		2018			2019			2018			2019		
		7	11	Mean	7	11	Mean	7	11	Mean	7	11	Mean
G 3	T1	20.6	22.3	21.4	24.4	26.5	25.4	18.4	20.8	19.6	`19.7	29.9	29.9
	T2	18.4	19.4	18.9	19.8	24.8	22.3	17.6	21.6	19.6	14.5	24.7	19.6
	T 3	16.5	18.6	17.5	10.5	13.5	12	14.6	18.4	16.5	16.6	20.2	18.4
	T4	14.4	16.6	15.5	18.4	21.4	19.9	12.3	16.4	14.3	16.1	20.1	18.1
	T5	4.3	6.7	5.5	5.3	11.2	8.2	4.4	8.7	6.5	5.8	7.8	6.8
	T6	4.2	6.1	5.1	5.2	10.9	8.	4.5	9.7	7.1	7.6	8.6	8.1
	Mean	13.06	14.9	13.98	13.9	18.05	15.9	11.9	15.9	13.9	12.1	18.5	16.8
	LSD 0.05	Y:0.37, T:0.64,.YT: 0.91						Y:0.52, T:0.90, YT:1.28					
Nobaryia 1	T1	22.4	24.5	23.4	26.4	28.1	27.2	21.6	25.03	23.3	20.6	27.3	23.9
	T2	22.1	24	23	26.2	29.2	27.7	20.6	22.3	21.4	26.4	46.2	36.3
	T 3	20.3	22.5	21.4	17.7	20.4	19	18.6	20.3	19.4	29.2	32.4	30.8
	T4	16.5	18.8	17.6	17.4	22.6	20	18.4	22.4	20.4	19.5	29.2	24.3
	T5	7.7	8.9	8.3	8.3	15.4	11.8	7.5	11.5	9.5	6.6	8.8	7.7
	T6	5.6	7.7	6.6	6.5	11	8.7	4.6	8.7	6.6	6.5	7.5	7
	Mean	15.7	17.7	16.7	17.08	21.1	19.06	15.2	18.3	16.7	18.1	25.2	21.6
	LSD 0.05	Y:0.45, T:0.78, YT: 1.1						Y:0.44, T:0.77, YT: 1.09					
Giza 716	T1	23.4	27.6	25.5	29.7	31.6	30.65	24.5	33.6	29.05	28.5	40.7	34.6
	T2	23.4	25.9	24.65	26.6	29.3	27.95	21.3	23.4	22.35	20.6	30.5	25.55
	T 3	21.4	24.03	22.71	19.8	22.3	21.05	20.3	23.2	21.75	20.5	26.2	23.35
	T4	14.4	16.5	15.45	15.5	20.4	17.95	17.5	22.4	19.95	15.7	19.7	17.7
	T5	8.3	11.4	9.85	9.4	16.4	12.9	5.6	6.5	6.05	7.1	11.06	9.08
	T6	5.5	8.5	7	6.4	11.6	9	4.4	6.4	5.4	5.2	10.4	7.8
	Mean	16.06	18.98	17.52	17.9	21.9	19.9	15.6	19.25	17.42	16.26	23.09	19.68
	LSD 0.05	Y:0.45, T:0.78, YT: 1.10						Y:0.38, T:0.66, YT: 0.93					

Y: year, T: treatment and YT interaction between and year treatment

Table 8: Effect of compost, humic substances, compost and vermicompost tea on the contents of total nitrogen, phosphorus and potassium % in faba bean shoots during two seasons.

Variety	Treatment	Total nitrogen %		Total phosphorus %		Total potassium %	
		2018	2019	2018	2019	2018	2019
Giza3	T1	3.00	2.97	0.13	0.16	2.70	2.75
	T2	3.51	3.95	0.18	0.20	2.75	2.80
	T 3	3.93	3.83	0.23	0.26	3.60	3.67
	T4	4.01	4.01	0.23	0.25	3.40	3.44
	T5	2.85	2.59	0.13	0.14	2.40	2.44
	T6	2.37	2.37	0.11	0.14	2.44	2.46
Nobaryia1	T1	3.10	3.00	0.19	0.19	3.18	3.23
	T2	4.01	3.95	0.22	0.24	3.29	3.36
	T 3	4.12	4.00	0.26	0.27	3.68	3.76
	T4	4.91	4.12	0.27	0.29	3.59	3.65
	T5	2.89	2.95	0.15	0.16	3.10	3.16
	T6	2.39	2.38	0.11	0.14	2.92	2.99
Giza716	T1	3.05	2.99	0.15	0.18	2.73	2.78
	T2	3.66	4.00	0.20	0.23	2.78	2.82
	T 3	4.03	3.92	0.25	0.28	3.64	3.69
	T4	4.07	4.03	0.18	0.28	3.42	3.48
	T5	2.87	2.77	0.12	0.15	2.42	2.46
	T6	2.40	2.38	0.12	0.14	245	2.51

Table 9: Effect of compost, humic substances, compost and vermicompost tea on the contents of total nitrogen, phosphorus, potassium and protein percentages in faba bean grains during seasons 2018/2019.

Variety	Treatment	Total nitrogen %		Total phosphorus %		Total potassium %		protein %	
		2018	2019	2018	2019	2018	2019	2018	2019
Giza3	T1	2.50	3.40	0.17	0.20	1.12	1.25	16.00	22.61
	T2	2.59	3.64	0.19	0.21	1.14	1.26	17.00	23.73
	T 3	3.90	4.01	0.31	0.41	1.40	1.45	23.61	26.31
	T4	3.45	3.98	0.30	0.41	1.37	1.32	22.50	25.00
	T5	3.12	3.27	0.14	0.17	1.10	1.16	17.50	19.81
	T6	2.93	3.11	0.12	0.15	1.11	1,15	17.90	19.93
Nobaryia1	T1	3.60	3.71	0.32	0.74	1.10	1.16	24.00	24.89
	T2	3.68	3.84	0.50	0.94	1.12	1.19	24.00	25.10
	T 3	4.10	4.81	0.56	0.96	1.23	1.35	26.10	29.00
	T4	4.00	4.10	0.56	0.92	1.19	1.28	18.66	28.54
	T5	3.17	3.22	0.28	0.31	1.09	1.11	19.00	21.91
	T6	2.85	3.20	0.23	0.26	1.04	1.09	18.13	20.31
Giza716	T1	3.10	3.46	0.25	0.45	1.13	1.20	21.00	23.71
	T2	3.30	3.64	0.35	0.59	1.14	1.21	20.00	24.00
	T 3	4.01	4.12	0.46	0.69	1.35	1.40	24.66	26.64
	T4	3.78	4.06	0.44	0.67	1.30	1.33	21.00	27.10
	T5	3.15	3.26	0.20	0.24	1.10	1.14	18.20	20.00
	T6	2.90	3.15	0.18	0.21	1.08	1.12	17.62	20.12

تأثير الأسمدة العضوية على نمو ومحصول الفول البلدي (*Vicia faba L.*)

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الملخص العربي:

تم دراسة تأثير الكومبوست وشاي الكومبوست وشاي الفيرميكومبوست والمواد الهيومية كأسمدة عضوية مخلوطة مع الأسمدة غير العضوية ((NPK على النشاط البيولوجي والنمو والإنتاجية لنبات الفول البلدي (Vicia faba L.) في التربة الطينية. وتم تنفيذ التجربة بمحافظة الشرقية خلال الموسمين المتتاليين 2018/2017 و2019/2018 لدراسة تأثير الإمدادات العضوية المختلفة على النمو وتكوين العقد الجذرية والمحصول وامتصاص النبات للعناصر فى ثلاثة أصناف من الفول البلدي هي: جيزة 3 ونوبارية 1 وجيزة 716. تم إستخدام الكومبوست والمواد الهيومية كسماد للتربة بينما تم تطبيق شاي الكومبوست وشاي الفيرميكومبوست كسماد ورقي. وتم قياس إرتفاع النبات وعدد الأفرع والقرون والبذور لكل نبات بعد 7 و11 أسبوع من المعاملة.

وأظهرت النتائج أن المعاملة بشاي الفيرميكومبوست مع 50٪ من الأسمدة المعدنية حققت أعلى زيادة في إرتفاع النبات وعدد الأفرع للأصناف الثلاثة خلال الموسمين. كما أدت المعاملة إلي زيادة كبيرة في المحصول وصلت إلى 11.3 و10.5 و10.6 أردب للفدان للأصناف جيزة 3 ونوبارية 1 وجيزة 716 على التوالي. كما سجلت المعاملة بالكومبوست وشاي الفيرميكومبوست زيادة معنوية في كل من الوزن الطازج والعقد الجذرية. كما أدت المعاملة بشاي الفيرميكومبوست إلي زيادة نشاط إنزيم النيتروجينز خلال الموسم الثاني 2019. وأظهرت النتائج أن المعالملة بالكومبوست مع الصنف Giza 716 سجلت أعلي نشاط حيوي للإنزيمات في التربة، وأن أعلى معدل إمتصاص من NPK في كلا من السيقان والحبوب كان مع المعاملة بشاي الكومبوست كما أشارت النتائج إلى أن استخدام شاي الكومبوست وشاي الفيرميكومبوست كسماد ورقى أدى إلى زيادة معنوية في محتوى الحبوب من البروتين في الأصناف الثلاثة خلال موسمي الدراسة.

الكلمات الاسترشادية: الفول البلدى والمواد الهيومية وشاى الكومبوست وشاي القيرميكومبوست ومشتقات الكومبوست.