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Effect of Fresh and Fermented Olive Solid Waste and Cow Manure on Zinc Forms in Calcareous Soil and Wheat Plant Productivity

Abd Al Karim Jaafar

Department of Soil Sciences, Faculty of Agriculture, Damascus University, Damascus, Syria

Email address:
a.karimjaafar@gmail.com

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Abstract: A field experiment was conducted at the farm of Abu Jarash in Agricultural College, using different rates of olive solid waste and cow manure, as follows: (control, Mineral fertilizer +NPK, fresh olive solid waste100%, fresh olive solid waste 75%+ cow manure 25%, fresh olive solid waste 50%+ cow manure 50%, fermented olive solid waste 100%, fermented olive solid waste 75%+ cow manure 25%, fermented olive solid waste 50%+ cow manure 50%, cow manure 100%) the Zink ground fertilizers added for all previous treatments, and cultivation of wheat, the forms of zinc were followed by serial extraction and the study led to the following results: the fermented olive solid waste 100% treatment was Superiority in the amount of zinc forms as following: (total, soluble, exchanged, linked with carbonate, linked with organic matter linked with iron and manganese oxides and residual) the amounts of Zinc were (114.14, 0.19048, 1.0710, 6.329, 9.433, 21.04, 76.10) mg/kg in the same previous order. While the zinc values in the control treatment were (62.90, 0.03847, 0.6081, 3.29, 6.083, 15.03, 37.2) mg/kg for the same forms and in the same previous order. The fermented olive solid waste treatment 100% had the highest yield (5.980) ton/h. The control treatment had the lowest value (3.987) ton/h.

Keywords: Olive Solid Waste, Cow Manure, Serial Extraction, Zinc, Calcareous Soil

1. Introduction and Literature Review

Organic compost plays an important role in improving soil properties in addition to providing it with fertile elements necessary for the growth of agricultural crops [6]. The importance of olive solid waste fertilizer is to increase the soil's organic matter content and raise its fertility. showed in a study on the effect of olive solid waste on the growth of bean by adding different rates (0, 10, 20, 30 and 40) $t.h^{-1}$ to increase the yield and the best growth of the bean plant was at the rate of adding 20 $t.h^{-1}$. [15] Indicated that olive solid waste contains nutritious mineral elements such as nitrogen, phosphorous, potassium and manganese. Showed that one ton of olive solid waste contains 1–3.5 kg K_2O, 0.6–2 kg P_2O_5 and 0.15-0.5 kg MgO and can be added to the soil at rates ranging from 30 to 100 $t.h^{-1}$ annually as fertilizer for crop production [3].

and adding olive solid waste ash to the soil increased the soil's available potassium content compared to the ash of vegetable residues and showed that olive solid waste ash can be used as an inexpensive potassium fertilizer.

Zinc is present in the soil in several forms, some of which are bound to iron and manganese oxides, others dissolved in the soil solution In addition to the intercalated form and another in the form of organic complexes and that the proportion of zinc bound with iron and manganese oxides constitutes 14-38% of total zinc, and that is bound to clay minerals 24-63%, while the soluble 1-2% related with organic matter is 1.5-2.3%. Showed that zinc fixation in soils is slow, and is highly dependent on the pH and form of the additive [22, 18]. found that selective adsorption is highest on iron oxides and below on Montmorillonite, so clay minerals, aqueous oxides, and pH are important factors in influencing zinc mobility, while the effect of organic complexes and precipitation (in the form of hydroxide or carbonate or sulfide) come second in terms of effect [1]. found that soil pH is an important factor for determining zinc solubility, and thus its concentration in the soil solution, as higher pH reduces the beneficial forms of organic zinc, increases zinc absorption into soil colloids, stabilizes zinc on iron oxides and manganese, and leads to deposition. Zinc is in the form of Zn $(OH)_2$ when it is present in a large concentration in the soil [10].

The [19] method is one of many of the most widely used serial extraction methods. Depending on this method, zinc forms are divided into (water soluble, interchangeable, carbonate bonded, iron and manganese oxides bonded, organic matter bound, and residual fraction). Where the mutual form is fast-moving and easy for the plant, while the residual form represents the inactive part. As for the elements associated with carbonates, iron and manganese oxides and organic matter, they are relatively active, and their activity depends on the physical and chemical properties of the soil.

2. Research Justifications

The olive oil industry has spread in our area, and this industry produces solid waste that affects the environment. Utilizing this waste as an organic fertilizer contributes to improving some of the soil's chemical properties through its chemical elements and organic matter, and this is reflected in the properties of the soil and thus in the productivity of the wheat plant.

3. Research Objective

Study of the effect of fresh and fermented olive solid waste and cow manure on zinc forms in calcareous soil and wheat plant productivity

4. Research Materials and Methods

Research materials:

4.1. Study Area

Abi Jarash farm fields of the Agriculture College.

4.2. Soil

The research conducted on calcareous soil.

Organic waste: fresh and fermented olive solid waste brought from Najha area, south of Damascus, in addition to cow manure brought from the Agriculture college farm in Damascus, added according to the N ratios in it and the needs of the wheat crop. showed Tables 1 and 2 the physical and chemical properties for used soil and organic waste.

Mineral fertilizer NPK nitrogen at a rate of 100 kg $N.h^{-1}$, phosphorus 80 kg P_2O_5/h^{-1} and potassium 80 kg K_2O/h^{-1} (as recommended by the Ministry of Agriculture for irrigated wheat).

4.3. Cultivated Plant: Wheat

The seeds of wheat class Sham 3 were planted in strewing on 12/29/2017 within ponds of 1 x 1 m. Soil samples were taken before planting and after harvest, as the harvest took place on 6/15 2018 and samples of plants were taken for analysis. The amount of fertilizer added from the major elements was determined according to soil analysis according to the fertilizer recommendation of the General Authority for Scientific Agricultural Research. In addition, organic fertilizers were added after carrying out an experiment with pans to determine the utilization factor of nitrogen from them.

5. Sample Collection and Processing

Samples of added organic (fresh and fermented olive solid waste and cow manure) were prepared as well as soil sampling before planting and after harvesting.

Table 1. *Some properties of soil studied.*

Zn available	K_2O available	P_2O_5 Available Joret Hebert	Total nitrogen	Organic matter	Total carbonates	Total propensity
170			**g/gk-1**			
0.5	250	170	0.14	2.21	50	57.85

Table 1. *Contiuned.*

Real density	Bulk destiny	EC extract 5:1	pH unsettled	texture	Mechanical composition of soil			soil
g/cm^3		dS/m			clay	silt	sand	
2.61	1.1	0.45	8.1	Loam clay	39.25	30.95	29.8	Agriculture farms soil (Abi Jarash)

It is clear from Table 1 that the soil has loam clay and it had a low bulk density and good porosity. The soil is characterized by an alkaline pH of 8.10 and non-saline, with a salt conductivity 0.45 dS/m. as the Soil has characterized in high content of carbonate 500 gkg^{-1}. In addition, it is noted that the soil is medium content of organic matter, which amounted to 2.21gkg^{-1} and may be due to the annual additions of organic waste to the soil where it was 2.21 gkg^{-1}. As for the soil content of the fertility elements, it was characterized by an average content of total nitrogen with 0.14% and average content of phosphorus and potassium available at 170 and 250 mg/kg respectively while the amount of zinc was (0.5) gkg^{-1}.

As shown in Table 2, the pH of both fresh and fermented olive solid waste was less than 7, while cow manure was 7.70 and EC 2.62 dS/m and 3.38 dS/m 1.30 dS/m in both fresh and fermented olive solid waste and cow manure respectively. As for the organic matter, it was found in both fresh and fermented olive solid waste and cow manure, 92.73, 76.08 and 41.52%, in the same previous order itself. As shown in Table 2, there is an increase in the content of cow manure from the fertility elements, such as nitrogen and phosphorus, compared with the fresh or fermented olive solid waste. While the amount of Zink was (47) mg/kg in fermented olive solid waste and (38) mg/kg in cow manure and (20) mg/kg in the fresh olive solid waste.

Table 2. *Some chemical and fertility properties of olive solid waste and cow manure.*

Zn total mg kg^{-1}	N ratio/C	K	P	N	OC	OM %	EC extract dS/m (5:1)	pH unsettled (5:1)	Organic waste
20	44.82	2.4	0.37	1.2	53.78	92.73	2.62	5.6	Fresh olive solid waste
47	29.42	1.5	0.5	1.5	44.13	76.08	3.38	6.1	Fermented olive solid waste
38	14.16	1.13	0.54	1.7	24.08	41.52	1.3	7.7	Cow manure

6. Research Methods

6.1. Physical Analysis of Soil

Mechanical analysis in a hydrometer method - bulk density in a cylinder way the real density in pycnometer and porosity computationally.

6.2. Chemical Analysis of Soil and Organic Waste

6.2.1. pH

Unsettled 1: 2.5 for soil and 1: 5 for organic waste and pH measurement, according to the method mentioned [14].

6.2.2. EC

Extract 5: 1 for soil and organic waste and measurement of electrical conductivity. [14]

6.2.3. Total Carbonates

Calcimeter device.

6.2.4. Organic Carbon

Soil and organic waste by oxidation.

6.2.5. Potassium Dichromate

Wackily and Black described in [8].

6.2.6. Organic Matter

Soil oxidation by potassium dichromate, and organic waste: bromide.

6.2.7. Total Nitrogen

The Kjeldahl method, [13].

6.2.8. Available Phosphorus and Potassium

Joret-Hebert method for P_2O_4.

Ammonium acetate method, then measurement using (Flame photometer) device for K.

6.2.9. Total Phosphorus and Potassium

Digestion by thermodynamics and then measurement on the flamephotometre of potassium.

6.2.10. Zn Exchanged DTPA and Total Zn

Diethylene tetra amine Penta acetic acid.

1:3 nitrogen acid and hydrochloric acid (digestion with royal water) [11].

Determination the forms of zinc in the soil by the method of serial extraction according to the method of [19]. Depending on this method, the element forms are divided into dissolved, available, linked to carbonates, linked to iron and manganese oxides, linked to organic matter, and the residual. Add the first extraction solution to the soil (magnesium chloride at a concentration of M1+shaking for an hour, then centrifugation and filtration to extract the reciprocal form), then add the second solution (sodium acetate M1+shake for five hours, then vacuum and filter to extract the carbonate bound form), then the third solution (hydrochloric amine hydroxide+ Shake for 6 hours at 96 ° C, then vacuum and filter to extract the form associated with iron and manganese oxides).

Then the fourth solution (nitrogen acid 0.02N+30% oxygen water+ ammonium acetate shake 2.45 hours, then centrifugation and filtration to extract the form associated with the organic matter), taking into account washing the soil between each stage well with distilled water to remove traces of the previous solution, the extracted solutions were kept in containers. Plastic, after adding 1% of nitrogenous acid, then estimating the following trace element (Zn) in various soil samples using the atomic absorption device type AA6800 using acetylene gas at wavelengths 228.8 nanometers for zinc.

7. Treatments

1. Control
2. Mineral fertilizer NPK
3. Fresh olive solid waste 100% (2.55 kg/1m^2)
4. Fresh Olive solid waste 75% (1.912 kg/1m^2)+cow manure25% (0.425 kg/1m^2)
5. Fresh Olive solid waste 50% (1.27.5 kg/1m^2) +cow manure50% (0.85 kg/1m^2)
6. Fermented Olive solid waste 100% (1.6 kg/1m^2)
7. Fermented Olive solid waste 75% (1.2 kg/1m^2) +cow manure25% (0.425 kg/1m^2)
8. Fermented Olive solid waste 50% (0.8 kg/1m^2) +cow manure50% (0.85 kg/1m^2)
9. Cow manure 100% (1.7 kg/1m^2)

Ground Zinc fertilizer was added to all treatments including the control, as zinc sulfate form at rate 10 kg Zn/h^{-1}, and sprinkle 0.5 kg Zn/h^{-1e}.

The land was lined and the treatments were planted randomized according to the design of the complete random sectors with three replicates per treatment.

8. Results and Discussion

The effect of fresh and fermented olive solid waste and cow manure on the zinc forms in the soil after harvest for an average of two seasons:

8.1. Total Zinc

showed Table 3 the effect of fresh and fermented olive solid waste and cow manure on the forms of zinc in the soil after harvest for an average of two seasons, and for the total zinc form, Table 3 showed the superiority of the treatment of fermented olive solid waste 100%, as the total zinc amount in it reached 114.17 mg.kg. The lowest amount was in the control is 62.90 mg.kg.

The treatments were as the following: Treatment of fermented olive solid waste 100% > fermented olive solid waste 75% + cow manure 25% > fresh olive solid waste 100% > fermented olive solid waste 50% + cow manure 50% <fresh cow manure 75% + cow manure 25% <Fresh olive solid waste 50% + cow manure 50% > cow manure 100% > Mineral, compared to the control, where the total amount of zinc was (114.17, 106.22, 103.38, 102.72, 95.86, 91.72, 81.37, 64.05, 62.90) mg.kg with the same Arrangement. The superiority of the treatment of fermented olive solid waste 100% in the total form is due to its high zinc content compared to other treatments. The high soil content of this form of zinc is also due to climatic factors.

8.2. Dissolved Zinc

showed Table 3 that the amount of dissolved zinc ranged between 0.03847 mg.kg in the control and 0.19048 mg.kg in the treatment of fermented olive solid waste 100%, and the dissolved zinc percentage from total zinc ranged from 0.0612% in the control treatment to 0.1668% in The fermented olive solid waste 100% due to the fermentation and decomposition of organic matter, which was reflected in the increase in the proportion of humic and fulvic acids in this treatment. Table 3 showed the presence of significant differences in the soil content of dissolved zinc in all treatments, where the arrangement of the treatments was as the following:

Fermented olive solid waste 100% > fermented olive solid waste 75% + cow manure 25% > fermented olive solid waste 50% + cow manure 50% > fresh olive solid waste 75% cow manure 25% > fresh olive solid waste 50% + cow manure 50% The amount of dissolved zinc were (0.19048, 0.09877, 0.08887, 0.08655, 0.08413, 0.08197, 0.04155, 0.03847) mg.kg in the same order.

Soil pH is an important factor in determining the solubility of zinc, and thus its concentration in the soil, as high pH reduces the beneficial forms of zinc, increases the absorption of zinc on soil colloids, the fixation of zinc on iron and manganese oxides, and zinc deposition in the form of $Zn(OH)_2$. And that when it is present in a large concentration in the soil.

8.3. Zinc Exchanged

It is noted from Table 3 that the amount of exchanged zinc ranged between the lowest value 0.5914 mg.kg in the treatment of mineral fertilization and the highest value of 1.0710 mg.kg in the treatment of fermented olive solid waste 100%, and the zinc ratio of total zinc ranged between 0.92% in the treatment of mineral fertilization. To 0.94% in the treatment of fermented olive solid waste 100%, and the lowest significant difference test LSD at the level of 5% in the soil content of exchanged zinc indicates the presence of significant differences between the various treatments, as their arrangement was as the following:

Treatment of fermented olive solid waste 100% > fermented olive solid waste 75% + cow manure 25% > fresh olive solid waste 100% > fresh olive solid waste 75% + cow manure 25% > fermented olive solid waste 50% + cow manure 50% <Fresh olive solid waste 50% + cow manure 50% > Control > Mineral, where the amount of exchanged zinc was (1.0710, 0.9210, 0.8499, 0.7442, 0.7099, 0.6683, 0.6568, 0.6081, 0.5914) mg.kg in the same order. This is due to the fermentation and decomposition of organic materials, which was reflected in an increase in the percentage of humic and fulvic acids in this treatment and the association of zinc with its humic and fulvic acids, which led to an increase in the reciprocal, and this is in agreement with [16]. The available form includes zinc that is weakly adsorbed in the soil and in particular zinc that is bound to surfaces.

Table 3. *The effect of fresh and fermented olive solid waste and cow manure on Zinc forms in soil after the harvest for the average of two seasons.*

residual	Linked with iron and manganese oxides	Linked with organic matter	Linked with carbonates	exchanged
g37.2	15.03b	6.083d	3.294f	0.6081ef
g32.98	16.94ab	6.184d	4.313de	0.5914ef
68.29b	20.06ab	8.628ab	5.448bc	0.8499bc
61.52cd	20.21a	7.965bc	5.334bc	0.7442cd
57.75de	20.31a	7.839bc	5.071c	0.6568def
76.10a	21.04a	9.433a	6.329a	1.0710a
70.11b	20.57a	8.602ab	5.925ab	0.9210b
69.07b	20.04ab	7.895bc	4.913cd	0.7099de
50.43f	18.57ab	7.507c	4.108e	0.6683def
4.98	5.125	0.9673	0.6099	0.1192

Table 3. *Continued.*

residual	soluble	Total $Mg.kg^{-1}$	treatment
g37.2	0.03847b	62.90i	control
g32.98	0.04155b	64.05i	Mineral NPK
68.29b	0.09877ab	103.38c	Fresh olive solid waste% 100

residual	soluble	Total Mg.kg^{-1}	treatment
61.52cd	0.08655ab	95.86d	Fresh olive solid waste% 75++ cow manure %25
57.75de	0.08413ab	91.72e	Fresh olive solid waste 50%+cow manure %50
76.10a	0.19048a	114.17a	fermented olive solid waste 100%
70.11b	0.08953ab	106.22b	fermented olive solid waste %75+ Cow manure 25%
69.07b	0.08887ab	102.72c	fermented olive solid waste 50%+Cow manure %50
50.43f	0.08197ab	81.37g	Cow manure %100
4.98	0.1236	2.724	LSD%5

Soil with electrostatic forces and zinc that is liberated by ion exchange process. This concentration is less than what the plant needs [17], so it is expected that the plant will depend on other forms of zinc (linked to carbonate and linked to organic matter) to meet its needs, and this corresponds to [16]. In general, a decrease in the cross-zinc concentration is observed due to a high concentration of calcium carbonate and a high pH, which reduces its availability to the plant [7].

8.4. Zinc Linked to Carbonate

It is noticed from Table 3 that the amount of zinc bound to carbonates ranged between the lowest value of 3.294 mg.kg in control and the highest value of 6.329 mg.kg in the treatment of fermented olive solid waste 100%, and the percentage of zinc bound to carbonate from total zinc ranged between 5.237% in the treatment of control to 5.543% in the treatment of fermented olive solid waste 100%, and the lowest significant difference test LSD at the level of 5% in the soil zinc content associated with carbonates indicates that there are significant differences between the various treatments, as their arrangement was as the following:

Treatment of fermented olive solid waste 100% > fermented olive solid waste 75% + cow manure 25% > fresh olive solid waste 100% > fresh olive solid waste 75% + cow manure 25% > fresh olive solid waste 50% + cow manure 50% > fermented olive solid waste 50% + cow manure + 50% > Mineral > cow manure 100%, compared to the control, where the amount of zinc bound to carbonate was (6.329, 5.925, 5.448, 5.334, 5.071, 4.913, 4.313, 4.108, 3.294) mg.kg in the same order. The higher percentage of the carbonate-bound form of zinc can be explained by the reduction in the formation of oxides and hydroxides [2]. This is likely to be an indication of the role of this form in supplying the plant with zinc. The amount of this form of zinc is low compared to total zinc.

8.5. Zinc Linked to Organic Matter

It is noted from Table 3 that the amount of zinc bound to the organic matter ranged between the lowest value in the treatment of control, 6.083 mg.kg, and the highest value of 9.433 mg.kg in the treatment of fermented olive pomace 100%, and the percentage of zinc attached to the organic matter from the total zinc ranged between 9.67% in The treatment of the control reached 8.26% in the treatment of fermented olive pomace 100%, and the LSD test at the level of 5% in the soil content of zinc associated with the organic matter indicates that there are significant differences between the various treatments, as their arrangement was as the following:

Treatment of fermented olive solid waste 100% > fresh olive solid waste 100% > fermented olive solid waste 75% + cow manure 25% > fresh olive solid waste 75% + cow manure 25% > fermented olive solid waste 50% + cow manure 50% > fresh olive solid waste 50%+ cow manure 50% > cow manure 100% > mineral, compared to control. The amount of zinc linked to organic matter was (9.433, 8.628, 8.602, 7.965, 7.895, 7.839, 7.507, 6.184, and 6.083) mg.kg, in the same order as before. The increase in the amount of zinc bound to the organic matter is due to the formation of organic complexes with zinc, and the amount of this form decreases after years of planting crops [5]. Therefore, organic matter is important as a buffer for zinc in the soil, and the reason for this is the formation of a complex substance. Organic-zinc, the soils content of this form of zinc increases with the content of organic matter [20].

8.6. Zinc Linked to Iron and Manganese Oxides

This form of zinc is considered a non-residual Fraction form. It is noted from Table 3 that the amount of zinc bound with iron and manganese oxides ranged between the lowest value in the control treatment of 15.03 mg.kg and the highest value of 21.04 mg.kg in the treatment of fermented olive solid waste100%. This form of zinc is the highest value of the soluble, the exchange and the carbonate associated with the organic matter, and this form is referred to as the most stable. The lowest significant difference test LSD at a level of 5% in the soil zinc content associated with iron and manganese oxides indicates that there are significant differences between the various treatments as their arrangement was as the following:

Treatment of fermented olive solid waste 100% > fermented olive solid waste 75% + cow manure 25% > fresh olive solid waste 50% + cow manure 50% > fresh olive solid waste 75% + cow manure 25% > fresh olive solid waste 100% > fermented olive solid waste 50% + cow manure 50% > cow manure 100% > mineral, compared to control. The amount of zinc bound to iron and manganese oxides were (21.04, 20.57, 20.31, 20.21, 20.06, 20.04, 18.57, 16.94, 15.03) mg.kg, in the same order. These results are consistent with what was reported by [12]. The increase in this form of zinc associated with iron and manganese oxides in the treatment of fermented olive solid waste 100% is due to the increase in the exchange capacity of the soil in this treatment compared to other treatments. These results are consistent with those reported by [21].

8.7. Residual Zinc

It is noted from Table 3 that the high quantities of zinc remained without extraction, and the residual zinc refers to the difference between the total form and the sum of other forms, and ranged between the lowest value in control 37.20 mg.kg, and the highest value of 076.1 mg.kg in the treatment of fermented olive solid waste 100%. The percentage of residual zinc from total zinc ranged between 59.14% in the control treatment to 66.65% in the treatment of fermented olive solid waste 100%, and the LSD test at a level of 5% in the soil content of the residual zinc indicated that there were significant differences between the various treatments. Arrange them as the following:

Treatment of fermented olive solid waste 100% > fermented solid waste 75% + cow manure 25% <fermented solid waste 50% + cow manure 50% > fresh olive solid waste 100% > fresh olive solid waste 75% + cow manure 25% > fresh olive solid waste 50% + cow manure 50% > 100% cow manure > control > Mineral, where the amount of residual zinc amounted to (76.10, 70.11, 69.07, 68.29, 61.52, 57.75, 50.43, 37.20, 32.98) mg.kg and the same previous order. This form of zinc forms a large part of total zinc, and this large amount of zinc indicates its tendency to become unavailable in the soil, because these parts require a long time to become available to the plant. These results are in agreement with [4].

9. The Productivity

The effect of fresh and fermented olive solid waste and cow manure on wheat yield (grain t.h^{-1}) for an average of two seasons.

Table 4 showed the productivity values in the different treatments, and it was noticed that there are significant differences between the different treatments, as the study showed that the treatment of fermented olive solid waste 100% (5,980) t.h^{-1} and decreased the productivity in the control treatment (3,987) t.h^{-1} while the order of the treatments was as The following:

Treatment of fermented olive solid waste 100% > treatment of fermented olive solid waste 75% + cow manure 25% > fermented olive solid waste 50% + cow manure 50% > cow manure 100% > fresh olive solid waste 50% + cow manure 50% > Fresh olive solid waste 75% + 25% cow manure > 100% fresh olive solid waste > mineral fertilization, compared to control.

As the productivity reached t.h^{-1} (5.980, 5.827, 5.760, 5.707, 4.917, 4.703, 4.607, 4.47, 3.987)%, in the same previous arrangement. The superiority of the treatment of fermented olive pomace 100% is due to its high content of fertility elements N, P and K before addition, as well as to its fermentation and liberation of these elements, which contributed to increasing the soil content of it and this reflected an increase in plant absorption of it, which increased the productivity of wheat (grains) in it compared to the treatments. The other, and this is in agreement with [9], that the addition of solid residues of olive pomace improved the morphological and productive properties of the plant compared to the control.

Table 4. *Effect of fresh and fermented olive solid waste and cow manure in wheat productivity (grains t/h^{-1}) for average of two seasons.*

Production grain (t/h^{-1})	treatment
3.987 d	Control
4.147 cd	Mineral fertilizer NPK
4.607 bcd	Fresh olive solid waste 100%
4.703 bcd	Fresh Olive solid waste 75%+cow manure25%
4.917 bc	Fresh Olive solid waste 50%+cow manure50%
5.980 a	Fermented Olive solid waste 100%
5.827 a	Fermented Olive solid waste 75%+cow manure25%
5.760 a	Fermented Olive solid waste 50%+cow manure50%
5.707 a	Cow manure 100%
0.4108	LSD%5

10. Conclusions

The treatment of fermented olive solid waste was 100% in the forms of total and zinc associated with carbonate and associated with organic matter and associated with iron and manganese oxides over the other treatments, as the total amount of zinc was (114.17) mg.kg, the exchanged zinc (1.0710) mg.kg and associated with carbonate (6.329) mg. Kg associated with organic matter (9.433) mg.kg and associated with iron oxide and manganese (21.04) mg.k.

The treatment of fermented olive solid waste 100% gave the highest productivity in grain weight as the productivity reached 5,980 t.h^{-1} compared to the control 3,987 t.h^{-1}.

The Proposals

Add fermented olive solid waste as an organic fertilizer to the soil without mixing or mixing it with other organic fertilizers (cow manure...).

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