Effect of organic and mineral fertilization and mulching soil on some soil traits

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ABSTRACT

In order to study the effect of organic and mineral fertilization and mulching soil on some soil traits cultivated with broccoli plant, a field experiment was conducted for the season of (2013-2014) in the field of vegetables, Department of Horticulture, College of Agriculture, Abu Ghraib, University of Baghdad. The randomized complete block design (RCBD) was used within the split-plot order. The main plots included mulching soil (without M0, with black plastic M1, with blue plastic M2, with red plastic M3). While the sub-plots included five treatments: T1 Recommended chemical fertilizers (RCF), T2 Spent Mushroom Compost (SMC) 5% of soil volume + 75% mineral fertilizer, T3 Spent Mushroom Compost (SMC) 10% of soil volume + 50% mineral fertilizer, T4 Spent Mushroom Compost (SMC) 15% of soil volume + 25% mineral fertilizer, T5 Spent Mushroom Compost (SMC) 20% of soil volume. The results showed the superiority of the T5 treatment by giving it the highest soil content of organic matter (18.37 $g.kg^{-1}$ soil) and the highest concentration of ammonium, nitrate, phosphorus and potassium availability in the soil (16.43 $mg.kg^{-1}$ soil, 25.70 $mg.kg^{-1}$ soil, 18.81 $mg.kg^{-1}$ soil, 293.8 $mg.kg^{-1}$ soil), respectively. The lowest value of electrical conductivity (EC) and pH compared to the T1 treatment. The M1 treatment was characterized by rasing a content of organic matter in soil (11.55 $g.kg^{-1}$ soil), ammonium (14.12 $mg.kg^{-1}$ soil), nitrate (23.07 $mg.kg^{-1}$ soil), phosphorus availability (14.89 $mg.kg^{-1}$ soil) and potassium availability (257.0 $mg.kg^{-1}$ soil) compared to the lowest value at the M0 treatment.

Keyword: Spent Mushroom Compost (SMC), Mulching, Ammonium, pH Soil.

*Research paper from PHD thesis for first author.

تأثير التسميد العضوي والمعدني وتغطية التربة في بعض صفات التربة

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المستخلص

لدراسة تأثير التسميد العضوي والمعدني وتغطية التربة في بعض صفات تربة مزروعة بنبات البروكولي نفذت تجربة حقلية للموسم 2013 و2014 في حقل الخضر– قسم البستنة – كلية الزراعة–أبو غريب– جامعة بغداد. استخدم تصميم القطاعات الكاملة المعشاة (RCBD) ضمن ترتيب القطع المنشقة Split-plot. تضمنت الألواح الرئيسة أغطية التربة (بدون تغطية M_0، بلاستك أسود M_1، بلاستك أزرق M_2، بلاستك أحمر M_3) بينما تضمنت الألواح الثانوية خمس معاملات T_1 سماد كيميائي حسب الموصى به، T_2 سماد فطر 5% من حجم التربة+75% سماد معدني، T_3 سماد فطر 10% من حجم التربة+50% سماد معدني ، T_4 سماد فطر 15% من حجم التربة+25% سماد معدني ، T_5 سماد فطر 20% من حجم التربة. أظهرت النتائج تفوق المعاملة T_5 بإعطائها أعلى محتوى للتربة من المادة العضوية (18.37 غم.كغم$^{-1}$تربة) وأعلى تركيز للأمونيوم والنترات والفسفور والبوتاسيوم الجاهز بالتربة (16.43 ملغم.كغم$^{-1}$تربة، 25.70 ملغم.كغم$^{-1}$تربة، 18.81 ملغم.كغم$^{-1}$تربة، 293.8 ملغم.كغم$^{-1}$تربة) بالتتابع وأقل قيمة للـ EC وأقل pH مقارنة بالمعاملة T_1. تميزت المعاملة M_1 بارتفاع محتواها من المادة العضوية في التربة (11.55 غم.كغم$^{-1}$تربة) والأمونيوم (14.12 ملغم.كغم$^{-1}$تربة) والنترات (23.07 ملغم.كغم$^{-1}$تربة) والفسفور الجاهز (14.89 ملغم.كغم$^{-1}$تربة) والبوتاسيوم الجاهز (257.0 ملغم.كغم$^{-1}$تربة) مقارنة بأقل قيمة عند المعاملة M_0.

الكلمات المفتاحية: سماد الفطر، تغطية التربة ، الامونيوم ، pH التربة . * بحث مستل من أطروحة دكتوراه للباحث الأول.

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1. INTRODUCTION

The challenge facing farmers and investors in the field of agriculture is the proper diagnosis of all factors delimiting the production and work to reduce or eliminate them by adopting proper management and using modern methods to ensure the availability of nutrients required for the plant in sufficient quantities and at appropriate times so as not to be specific to production. Because of this vital role of fertilization, the use of organic fertilizers has increased as a substitute for chemical fertilizers or supplemented in order to obtain a clean and pollution-free crop. where the irrational addition of chemical fertilizer is uneconomical, which adversely affects the environment and the plant, so there are attempts to reduce it as much as possible and using balanced and environmentally correct fertilization, thus ensuring high-quality products and reducing the negative impact on the environment (18, 2, 23). Recently, a system of fertilization combining chemical and organic fertilization has been adopted to determine the extent to which these natural fertilizers compensate for chemical fertilizer, maintain a balanced soil supply capacity and ensuring the sustainability of crop production (15, 14). Stamatiadis et al., (40); Mader et al., (24) showed that the chemical and physical traits for the soil are affected when fertilization is added. it was observed an increase in nutrients availability, increasing the activity of microorganisms, as well as increasing carbon and nitrogen content in the soil, and increasing phosphorus availability for organic and mineral fertilizers. Spent Mushroom Compost has been used because of its positive and effective role in improving soil properties. Onal and Topcuoglu, (34) found that adding Spent Mushroom Compost to clay soil played an important role in improving soil properties by improving the majority of its properties such as increasing its organic content and increasing the availability of nutrients by improving its composition and biomass, which positively reflected in plant growth. Stewart, (41) explained that the use of Spent Mushroom Compost on three different vegetable crops (Cabbage, potatoes and yellow corn) at four levels (0, 20, 40, 80 tons.ha^{-1}) for two years led to an increase in the percentage of total nitrogen, phosphorus, and potassium availability in the soil and to improve the stability of their totals. It also increased soil susceptibility to the exchange of positive and negative ions. It was also observed a decrease in soil bulk density and increasing its moisture content. Soil Mulching is known as an agricultural process to improve soil properties and increasing plant growth because it effects on the thermal system for soil due to the color of the Mulching or its ability to be thermal conductivity, which in turn affects incident and reflected rays, as well as it works to reduce loss by evaporation and reducing soil surface temperatures, thus increasing the moisture content of the soil (4). Mulching also affects the increased biological activity for microorganisms in the soil that increase the availability of a number of nutrients, particularly nitrogen, through maintaining soil moisture and improving their aeration (45, 43). Changes in soil or plant may vary depending on the types of mulching and different colors, they may be inorganic mulches such as plastic mulches, which are available in several colors, including white, silver, transparent, black, red, blue, etc. Or they may be organic mulches such as straw, hay, sawdust, compost, etc. (48, 22). The use of plastic mulches to mulch the surface of the most common soil surface, which are highly flexible and durable and can be extended in the field (automatically or manually) and removing it from it very easily, It also keeps the crop cleanliness that contact with it (17, 28). Al-Hadithi (6) showed that dark mulches have a role in increasing the moisture stock for the soil where it reduces evaporation of the soil surface, thus increases the amount of moisture in the area of effective absorption for roots.

2. MATERIALS AND METHODS

A field experiment was conducted for the season of (2013-2014) in the field of vegetables belonging to Department of Horticulture, College of Agriculture, Abu Ghraib, University

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of Baghdad in a silty clay loam soils which their physical and chemical properties shown in Table (1), In order to study the role of organic and mineral fertilization and mulching soil in improving soil traits.

Table 1: Chemical and Physical traits for the field soil of the experiment.

Traits	Unit	Spent Mushroom Compost (SMC)
electrical conductivity (EC)	$dS.m^{-1}$	2.35
pH	———	7.43
Organic matter	$g.kg^{-1}$	10.3
Nitrogen availability	$mg.kg^{-1}$	35.11
phosphorus availability	$mg.kg^{-1}$	11.60
Potassium availability	$mg.kg^{-1}$	202.6
percentage of Sand	$g.kg^{-1}$	238
percentage of Silty	$g.kg^{-1}$	542
percentage of Clay	$g.kg^{-1}$	220
Soil texture		**Silty clay loam**

The randomized complete block design (RCBD) was used within the split-plot order, with three replicates (9). The main plots included mulching soil (without M0, with black plastic M1, with blue plastic M2, with red plastic M3). While the sub-plots included five treatments: T1 Recommended chemical fertilizers (RCF), T2 Spent Mushroom Compost (SMC) 5% of soil volume + 75% mineral fertilizer, T3 Spent Mushroom Compost (SMC) 10% of soil volume + 50% mineral fertilizer, T4 Spent Mushroom Compost (SMC) 15% of soil volume + 25% mineral fertilizer, T5 Spent Mushroom Compost (SMC) 20% of soil volume. The land was divided into three replicates, each replicate includes 20 experimental unit, where each unit represented three furrows, with a length of 3 m, leaving a distance of 0.75 between the units as a barrier to prevent the mixing of the treatments. Mushroom Spent Compost was added to the experimental units according to the treatments and then the experimental units were mulched with colored mulches. The soil was irrigated using a drip irrigation system, The chemical traits for the wastes of Spent Mushroom Compost used in the study were measured as shown in Table (2). The quantities added to the experimental units were then calculated on the basis of soil size by calculating the dimensions of the furrow (depth of furrow 0.30 cm × width of furrow 0.75 cm × length of the furrow 3 m) and then multiply the result by the level of fertilizer used and then converted to liters to facilitate the process of adding fertilizer.

Table 2: Chemical traits for Spent Mushroom Compost After decomposition.

Traits	Units	Values
EC	$dS.m^{-1}$	4.20
pH	———	7.3
Organic carbon	$g.kg^{-1}$	335
Total nitrogen	$g.kg^{-1}$	25.0
N / C ratio	———	13.4
Total phosphorus	$mg.kg^{-1}$	12.3
Total potassium	$mg.kg^{-1}$	13.5

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Soils were sampled after the end of the experiment from each experimental unit for the purpose of calculating the soil content of organic matter, which was estimated through Oxidation by hydrogen peroxide at a concentration of 30% (20).

Ammonium and nitrate: Ammonium and nitrate were estimated in the soil after the end of the experiment by Kjeldahl device according to (13, 12).

Potassium availability: It was estimated after the end of the experiment in soil extract using a flame photometer (Knudsen et al., 21).

phosphorus availability: It was estimated after the end of the experiment using the spectrophotometer as shown in (Olsen, 33; Black, 13).

Soil reaction (pH): The degree of soil reaction was estimated after the end of the experiment in saturated paste extract using the pH-meter device.

Electrical conductivity (EC): The electrical conductivity of the soil was measured after the end of the experiment in the saturated paste extract using the electrical conductivity bridge device according to the mothed mentioned in (Jackson, 20).

3. RESULTS AND DISCUSSION

Organic matter

Table (3) shows that the soil content of Organic Matter was significantly affected by adding fertilizer and increasing the level used from it, where noted that the soil content of organic matter in the T5 treatment increased to (18.37 $g.kg^{-1}$ soil) followed by the T4 treatment which their content amounted to (14.52 $g.kg^{-1}$ soil) and the T3 treatment amounted to (10.06 $g.kg^{-1}$ soil), while the lowest content was at the fertilization treatment (T1) which amounted to (5.33 $g.kg^{-1}$ soil). As for the effect of mulches on soil content of organic matter (SOM), the results showed that the mulches significantly affected on the SOM. The mulching treatment with black color (M1) was characterized by a high content of organic matter, which amounted to (11.55 $g.kg^{-1}$ soil) followed by the mulching treatment with blue color (M2), with its content of SOM amounted to (11.35 $g.kg^{-1}$ soil). While the content of organic matter at the M0 treatment (without Mulch) decreased, which amounted to (10.84 $g.kg^{-1}$ soil), Regarding the interaction between fertilizer treatments and mulches, the results of the statistical analysis showed the variation of the treatments in the content of organic matter, The highest soil content of O.M amounted to (19.39 g. Kg^{-1} soil) in the M2T5 interaction treatment. while the M1T1 treatment gave the lowest content of SOM amounted to (4.84 $g.kg^{-1}$ soil). The effect of Spent Mushroom Compost used in soil content of organic matter was more pronounced in the treatments (T5, T4) compared to other treatments due to it contains a high content of organic matter, which positively reflects on increasing the numbers and activity of microorganism, which encourages further decomposition of organic matter in soil and Increasing the availability of the nutrients and regulating their release at a rate commensurate with the need of the plant as well as improving the soil texture and their physical properties (47, 5). These results agree with (Rivero et al., 37; Hussein, 19; AL-Mharib, 8) who have found that adding organic fertilizer is an important and effective factor in soil enrichment with organic matter, which positively reflects on crop growth and It increases the frequency of bio-activity in the soil. The role of the mulches in increasing the content of organic matter in the soil may be attributed to the difference of the penetrated radiation to the soil because of the color of the mulch, which affects on the thermal system of the soil, where it acts as a barrier for the transfer of heat and air, which leads to increase the temperature and increase the moisture content and improving ventilation, which is reflected on the increase of bio-activity for living organisms in the soil, which makes it easier for the plant to obtain its need from water and nutrients as well as its effect on changing

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the secretions of the roots, which is affected by any decrease or rise in temperature, which contributes to reducing the soil content of organic matter. These results agree with (Rahaman et al., 36; Pinton et al., 35; Hussein, 19).

Table 3: Effect of organic and mineral fertilization and mulching soil on soil content of organic matter ($g.kg^{-1}$ soil) for the season of (2013-2014).

Soil content of organic matter ($g.kg^{-1}$ soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	5.91	4.84	5.58	4.99	5.33
T_2	6.15	8.59	7.02	8.05	7.45
T_3	9.24	11.13	10.22	9.65	10.06
T_4	15.15	14.73	14.56	13.64	14.52
T_5	17.75	18.44	19.39	17.91	18.37
Average of mulches treatments	10.84	11.55	11.35	10.85	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
1.371		1.012		0.579	

Concentration of ammonium in soil ($mg.kg^{-1}$ soil)

Table (4) indicates that the concentrations of ammonium in soil were significantly affected by the addition of Spent Mushroom Compost where the soil content of ammonium increased especially at the T5 treatment which amounted to (16.43 $mg.kg^{-1}$ soil). It was followed and without significant difference for the T4 treatment at a concentration of ammonium amounted to (15.91 $mg.kg^{-1}$ soil) whereas the concentration of ammonium in the T1 treatment decreased to (11.26 $mg.kg^{-1}$ soil). As for the role of the mulches, the results of the table show their significant effect on the concentrations of ammonium in the soil and increase its availability, where the mulching treatment with black color M1 has excelled by giving it the highest concentration of ammonium amounted to (14.12 $mg.kg^{-1}$ soil) compared to the M0 treatment which gave the lowest concentration amounted to (13.71 $mg.kg^{-1}$ soil), As for the effect of interaction between treatments, the results show that the M1T5 interaction treatment has excelled by giving it the highest concentration of ammonium in soil amounted to (16.64 $mg.kg^{-1}$ soil), while the lowest concentration was at the M0T1 treatment which amounted to (11.11 $mg.kg^{-1}$ soil). The increase in the level of ammonium in the fertilized soil with Spent Mushroom compost compared to the treatment of mineral fertilization may be attributed to the role of organic matter in the release of ammonium in soil solution and the continuity of processing over time, where ammonium is the preferred nitrogen formula for the plant (47, 44). These results agree with (Marriott and Michelle, 27; Abbas, 1; Hussein, 19) who found that the addition of organic fertilizers with different sources and levels to the soil caused a significant increase in the concentration of ammonium, which contributes to supplying the soil with large amounts of nitrogen. The increase in the concentration of ammonium in the mulching treatment with black color has been attributed to the effect of this color on the absorption of short waves significantly. Therefore, it works to increase the temperature of the soil higher than the rest of the colors as well as increase its moisture content, which provides a suitable environment that contributes to increasing the activity of microorganisms, thus the release of ammonium.

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Table 4: Effect of organic and mineral fertilization and mulching soil on the concentration of ammonium in soil (mg.kg^{-1} soil) for the season of (2013-2014).

Concentration of ammonium in soil (mg.kg^{-1} soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	11.11	11.48	11.25	11.19	11.26
T_2	12.32	12.54	12.46	12.41	12.43
T_3	13.37	13.62	13.49	13.44	13.48
T_4	15.53	16.34	16.18	15.60	15.91
T_5	16.20	16.64	16.51	16.38	16.43
Average of mulches treatments	13.71	14.12	13.98	13.80	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
1.07		0.97		0.13	

Nitrate concentration in soil (mg.kg^{-1} soil)

Table (5) shows that the concentration of nitrates in the soil increased significantly when Spent Mushroom Compost was added, where the T5 treatment gave the highest concentration of nitrate in the soil amounted to (25.70 mg.kg^{-1} soil) followed by the T4 treatment which their concentration amounted to (23.78 mg.kg^{-1} soil), which did not differ significantly from the T3 treatment, with a concentration amounted to (23.46 mg.kg^{-1} soil). While the T1 treatment gave the lowest concentration of nitrate amounted to (20.12 mg.kg^{-1} soil), as for the mulching treatments, the results of the table showed the significant effect for mulches colors on the increase of nitrate concentration in the soil, especially the mulching with black color M1 gave the highest concentration amounted to (23.07 mg.kg^{-1} soil) followed by the mulching treatment with blue color (M2) which gave a concentration amounted to (22.99 mg.kg^{-1} soil). The lowest nitrate concentration in soil has appeared at the M0 treatment (without mulching) which amounted to (22.42 mg.kg^{-1}). As for the effect of interaction, it was observed the highest concentration of nitrate amounted to (25.91, 25.83 mg.kg^{-1} soil) at the treatments (M1T5, M2T5) compared to the lowest concentration at the M0T1 treatment which amounted to (19.28 mg.kg^{-1} soil). The increase of nitrate concentration in organic fertilizer treatments may be attributed to the role of organic matter in supplying nitrates continuously over time, The organic material also provides ammonium which oxidizes the nitrate continuously over time. These results agree with (Stamatiadis et al., 40; Hussein, 19). The high nitrate concentration in the mulching treatment M1 may be attributed to the role of the mulch in absorbing the short waves which in turn affect the thermal system for the soil, increasing its temperature as well as its effect on increasing the activity of microorganisms in the soil, which converts organic matter to nitrate, which is the nitrogenous form that is readily absorbable, thus increases the nitrate concentration (43). It may also be attributed to the role of mulching in minimizing loss of elements by washing, thus increasing them in the soil (38).

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Table 5: Effect of organic and mineral fertilization and mulching soil on the concentration of nitrate concentration in soil (mg.kg^{-1} soil) for the season of (2013-2014).

Concentration of nitrate concentration in soil (mg.kg^{-1} soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	19.28	20.17	20.63	20.41	20.12
T_2	20.53	21.76	21.18	21.09	21.14
T_3	23.64	23.16	23.75	23.29	23.46
T_4	23.26	24.33	23.58	23.95	23.78
T_5	25.40	25.91	25.83	25.67	25.70
Average of mulches treatments	22.42	23.07	22.99	22.88	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
2.13		1.56		0.61	

Concentration of Phosphorus availability (mg.kg^{-1} soil)

Table (6) indicates that the concentration of Phosphorus availability in soil was significantly affected by the fertilization treatments where all fertilization treatments showed significant superiority in phosphorus concentration especially the T5 treatment which gave the highest concentration of Phosphorus availability amounted to (18.81 mg.kg^{-1} soil). followed by the T4 treatment with a concentration amounted to (16.79 mg.kg^{-1} soil), while phosphorus concentration was (9.72 mg.kg^{-1} soil) in the T1 treatment. As for the role of the mulches, the mulching treatment with black color M1 was characterized by a high level of phosphorus availability in the soil which amounted to (14.89 mg.kg^{-1} soil) followed by the mulching treatment (M2) which amounted to (14.03 mg.kg^{-1} soil) compared to the lowest concentration of phosphorus availability in the M0 treatment which amounted to (13.72 mg.kg^{-1} soil). As for the effect of interaction between treatments, the results show that the M1T5 interaction treatment has excelled by giving it the highest concentration of phosphorus availability in soil amounted to (20.30 mg.kg^{-1} soil) compared to the lowest concentration was at the M2T1 treatment which amounted to (9.47 mg.kg^{-1} soil). The difference in soil phosphorus concentration may be attributed to the role of the added fertilizer and different its levels, which had a significant effect in increasing the phosphorus concentration in organically fertilized treatments, The superiority of the treatments (T5, T4) with their content of phosphorus availability may be attributed to the continuous supplying soil with organic matter for phosphorus element, which leads to the soil retaining a high level of phosphorus availability compared to other treatments, The decomposition of organic fertilizer produces carbonic acid with several organic acids that reduce the degree of soil reaction which leads to the dissolution of some compounds containing phosphorus and released to the soil solution, as well as encapsulation of these compounds to clay colloids, which reduces the phosphorus sedimentation reactions (25, 16). These results indicate the role of organic matter in increasing the quantity of phosphorus availability in the soil solution to ensure a sufficient quantity for the plant at the required productivity level. These results agree with (Mahmood, 26; Ohno et al., 32; Ahmed, 5; Mgual et al., 29). The high content of the phosphorus availability for the M1 treatment compared to the rest of the mulching treatments may be due to the high content of organic matter which serves for continuous supplying with phosphorus. The mulching also affects in increasing biological activity for soil microorganisms that increase nutrient availability by maintaining soil moisture and improving its aeration.

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Table 6: Effect of organic and mineral fertilization and mulching soil on the concentration of Phosphorus availability in soil (mg.kg^{-1} soil) for the season of (2013-2014).

Concentration of Phosphorus availability (mg.kg^{-1} soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	9.60	10.30	9.47	9.50	9.72
T_2	11.27	12.77	12.70	11.65	12.10
T_3	13.07	13.80	13.00	13.60	13.37
T_4	16.57	17.30	16.90	16.37	16.79
T_5	18.07	20.30	18.07	18.80	18.81
Average of mulches treatments	13.72	14.89	14.03	13.98	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
1.65		0.86		0.72	

Concentration of Potassium availability (mg.kg^{-1} soil)

Table (7) shows the significant effect of the added fertilizer in increasing the concentration of Potassium availability in soil, where the T5 treatment gave the highest concentration of potassium availability amounted to (293.8 mg.kg^{-1} soil) followed by the T4 treatment with a potassium concentration amounted to (271.9 mg.kg^{-1} soil), while the lowest concentration of potassium was observed at the T1 treatment which amounted to (209.0 mg.kg^{-1} soil). As for the treatments of colored mulches, It is noted from the values in the table that the mulching with black and blue led to a significant increase in the concentration of potassium in the soil, where its concentration at the M1 treatment amounted to (257.0 mg.kg^{-1} soil), and (256.5 mg.kg^{-1} soil) at the M2 treatment compared to the two treatments (M0, M3) which amounted to (247.3, 246.1 mg.kg^{-1} soil), As for the effect of the interaction between the fertilizer treatments and the mulches, the treatments differed in their content of potassium availability, where the interaction treatment (M1T5) gave the highest concentration of potassium at the end of the experiment amounted to (298.3 mg.kg^{-1} soil), while the lowest concentration was at the M0T1 treatment which amounted to (206.7 mg.kg^{-1} soil). The decrease in potassium availability in the treatment of mineral fertilizer (T1) may be attributed to the absence of any organic matter as well as the lack of continuous supplying the mineral fertilizers, especially in the formation stage of the curd and with the continued absorption of potassium by the plant led to a decrease in its concentration compared to other treatments. The continuous increase in potassium availability with increasing levels of organic fertilization is due to the role of organic acids resulting from the decomposition of added organic fertilizers in the release of potassium from soil minerals by substituting the H^+ ion resulting from the ionization of those organic acids instead of the K^+ ion (39), The positive ion exchangeability increases with increasing organic fertilization, therefore the exchanged potassium storage in the soil increases (42). In addition, the decomposition of organic fertilizer in the soil dissolves some potassium-containing minerals through forming organic acids such as humic acid and fulvic acid, which contribute to the release of potassium ions from these minerals to the soil solution (31). Increasing nitrogen in the form of ammonium radical ($NH4^+$) leads to displaces K^+ from the adsorption surfaces to the soil solution, thus the dissolved potassium increase (47, 25). These results agree with (Ahmed, 5; Mgual et al., 29).

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Table 7: Effect of organic and mineral fertilization and mulching soil on the concentration of Potassium availability in soil (mg.kg^{-1} soil) for the season of (2013-2014).

Concentration of Phosphorus availability (mg.kg^{-1} soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	206.7	209.0	212.7	207.7	209.0
T_2	222.3	253.7	235.3	221.0	233.1
T_3	243.0	256.7	261.0	242.7	250.9
T_4	272.7	267.3	281.3	266.3	271.9
T_5	292.0	298.3	292.0	293.0	293.8
Average of mulches treatments	247.3	257.0	256.5	246.1	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
13.18		6.18		8.30	

Electrical Conductivity (EC) (dS.m^{-1})

Table (8) indicates that adding organic fertilizer caused a decrease in the values of electrical conductivity to reach the lowest level at the T5 treatment which amounted to (2.27 dS.m^{-1}), which did not significantly differ with the two treatments (T4, T3) which amounted to (2.32, 2.30 dS.m^{-1}). while the treatments (T1, T2), in which the EC has increased from (2.11, 2.41 dS.m^{-1}) when cultivating to (2.45, 2.43 dS.m^{-1}) at the end of the experiment and for the two treatments, respectively. As for the colored mulching treatments, It did not significantly affect on the EC values, although the mulching treatment with black color (M1) gave the lowest EC value amounted to (2.26 dS.m^{-1}) compared to the treatment without mulching (M0) which gave the highest EC value amounted to (2.46 dS.m^{-1}). As for the effect of the interaction, the M1T4 treatment has excelled by giving it the lowest EC value amounted to (2.07 dS.m^{-1}) at the end of the experiment, while the highest EC value amounted to (2.60 dS.m^{-1}) at the M0T1 treatment. The reason for the low electrical conductivity of the soil when treated with organic fertilizer may be due to the possibility of improving the physical traits for the soil, thus increase the stability and permeability of their aggregates and increasing the porosity and improving soil construction, which helps to high water movement through the soil, and increase the speed of leaching in it and then reduce the movement of salts to the surface of the soil in addition to ions absorbed by plants, as well as dilution of soil solution resulting from increased water retention when treated with organic fertilizer (3); The higher EC values in the treatments (T1, T2), which were fertilized with mineral fertilizer only and 5% Spent Mushroom Compost + 75% mineral fertilizer, may be attributed to the solubility of salts in these fertilizers and its reflection on the increased concentration of dissolved ions. As for the effect of mulching soil, it is noted reducing the values of electrical conductivity, which shows the role of mulching in maintaining a high moisture content, which contributed to reduce the concentration of salts and reducing evaporation rates from the soil surface and disrupt the capillary property, which impedes the return of salts to the surface (7).

Degree of soil reaction (pH)

Table (9) shows that the degree of soil reaction decreased with increasing the levels of added mushroom fertilizer reaching to the lowest reaction level at the T5 fertilization treatment which amounted to (7.26) followed by the T4 treatment which amounted to (7.38), while the highest pH was at fertilization

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treatments (T1, T2) which amounted to (7.61, 7.58), respectively. As for the effect of colored mulches, the results of the statistical analysis showed that the pH values were reduced when mulching the soil, but this effect did not reach a significant level. As for the interaction between the treatments, it was observed from the results of the table that the degree of soil reaction was reduced at the M1T5 treatment which amounted to (7.21) compared to the M0T1 treatment which gave the highest pH value amounted to (7.66). These results indicate that the addition of organic matter to the soil leads to lower values of the pH for the soil and this is an important factor contributes to increasing the availability of the elements for the plant. The reduction of pH in the soil may also provide evidence for the decomposition of organic matter, which leads to the production of water-soluble acids, compounds and organic complexes that interact with different soil constituents, which are effective in reducing the soil pH. In addition, oxidation of organic fertilizer and the release of carbon dioxide which when dissolving it in water reduces the degree of soil reaction. In addition, the mineralization of organic fertilizer leads to the release of some organic acids that are effective in reducing the degree of soil reaction. The bio-oxidation of ammonium ion resulting from the decomposition of organic fertilizer will lead to the release of hydrogen ions to the soil solution that is involved in reducing the degree of their reaction. These results agree with (Mohammed, 30; Ashraf and Gill, 10; Bailey, 11; Hussien, 19).

Table 8: Effect of organic and mineral fertilization and mulching soil on the Electrical Conductivity (EC) ($dS.m^{-1}$)for the season of (2013-2014).

Concentration of Phosphorus availability ($mg.kg^{-1}$ soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	2.60	2.45	2.40	2.33	2.45
T_2	2.56	2.32	2.37	2.45	2.43
T_3	2.34	2.24	2.17	2.46	2.30
T_4	2.41	2.07	2.21	2.58	2.32
T_5	2.39	2.21	2.33	2.16	2.27
Average of mulches treatments	2.46	2.26	2.30	2.40	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
0.32		0.16		N.S	

Table 9: Effect of organic and mineral fertilization and mulching soil on the degree of soil reaction (pH) for the season of (2013-2014).

Concentration of Phosphorus availability ($mg.kg^{-1}$ soil)					
Mulches / Treatments	**M_0**	**M_1**	**M_2**	**M_3**	Average of fertilizer treatments
T_1	7.66	7.56	7.58	7.65	7.61
T_2	7.63	7.51	7.57	7.62	7.58
T_3	7.51	7.41	7.44	7.46	7.46
T_4	7.43	7.33	7.37	7.39	7.38
T_5	7.31	7.21	7.24	7.28	7.26
Average of mulches treatments	7.51	7.40	7.44	7.48	
L.S.D. 0.05 M.T		**L.S.D. 0.05 T**		**L.S.D. 0.05 M**	
0.169		0.075		N.S	

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