Effect of adding different types of organic wastes on some soil traits, growth and yield of eggplant (Solanum melongena L.)

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ABSTRACT

The experiment was conducted for the autumn season (2018 - 2017) in one of the greenhouses belonging to the Department of Horticulture, College of Agriculture, Al-Qasim Green University, in the soil with a sandy texture. The randomized complete block design (RCBD) was used, with three replicates. The experiment included 3 replicates and for each replicate is a 9 treatments to became the total number of experimental units are 27 treatment: The drainage wastes which is symbolized by (M), poultry wastes which is symbolized by (D), cow manure which is symbolized by (A), and peat moss which is symbolized by (P) randomly distributed on the experimental units, with a rate of (20, 40 tons.ha^{-1}) for each treatment, with three replicates in addition to the control treatment (without any adding). The results showed that the organic wastes from plant origin (peat moss) were characterized by raising their content of organic matter, organic carbon and humin than the rest of the wastes, where their concentrations amounted to (479.4, 206.54, 312.0 g.kg^{-1}), respectively. while the highest concentration of humic acid amounted to (17.52 g.kg^{-1}) and the lowest C: N ratio amounted to (8.96) in poultry wastes compared to other wastes. The eggplant yield increased with adding organic wastes compared to the control treatment. Poultry wastes gave the highest yield of eggplant amounted to (100.00, 178 ton.ha^{-1}) for 20 and 40 ton.ha^{-1}, respectively.

Keywords: Humic acid, Organic wastes, Solanum melongena.

تأثير إضافة نوعيات مختلفة من المخلفات العضوية في بعض صفات التربة ونمو وحاصل الباذنجان *Solanum melongena L*

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المستخلص

نفذت التجربة للموسم الخريفي (2017 – 2018) في احد البيوت البلاستيكية التابعة الى قسم البستنة كلية الزراعة جامعة القاسم الخضراء في تربة ذات نسجه رملية. استخدم تصميم القطاعات العشوائية الكاملة RCBD وبثلاث مكررات. تضمنت التجربة 3 مكررات ولكل مكرر9 معاملات ليصبح العدد الكلي للوحدات التجريبية 27 معاملة وهي مخلفات المجاري ويرمز بالرمز M و مخلفات الدواجن ويرمز لها بالرمز D و مخلفات الابقار ويرمز لها بالرمز A و البتموس و يرمز لها بالرمز P موزعة بصورة عشوائية على الوحدات التجريبية وبمعدل 20 و 40 طن هكتار$^{-1}$ لكل معاملة و بثلاث مكررات اضافة الى معاملة المقارنة بدون اضافة. بينت النتائج ان المخلفات العضوية من اصل نباتي (البتموس) تميزت بارتفاع محتواها من المادة العضوية والكاربون العضوي والهيومين عن بقية المخلفات حيث بلغت تراكيزها 479.4 و 206.54 و 312.0 غم كغم$^{-1}$ على التوالي في حين وجد اعلى تركيز لحامض الهيومك 17.52 غم كغم$^{-1}$ و اوطأ C:N وهي 8.96 في مخلفات الدواجن مقارنة ببقية المخلفات. لقد ازداد حاصل الباذنجان بزيادة اضافة المخلفات العضوية نسبة الى معاملة المقارنة. لقد اعطت مخلفات الدواجن اعلى حاصل للباذنجان (100.00 طن هكتار$^{-1}$) (178 طن هكتار$^{-1}$) للمستويين 20 و 40 طن هكتار$^{-1}$ على التوالي.

الكلمات المفتاحية: حامض هيومك, المخلفات العضوية.Solanum melogeua

1. INTRODUCTION

Organic matter is one of the basic components for the soil and forms with the mineral part of the soil which called a solid phase. The organic matter is composed of plant and animal residues and the residues of biology as the main source for soil and plant fertilization. The resulting yield was with high quality and nutritional value (Al-Fadhli, 2011). Organic fertilization with animal manures can exhibit the behavior of slow decomposing fertilizers that contribute to the equilibrium in supplying various elements for the plant and adding it to the soil continuously after its decomposition with the action of soil microorganisms (Al-Qaisi, 2017). Barker and Pibeam (2007) indicated that organic wastes are complex compounds in different decomposition and stability resulting from animal and plant residues that contain many nutrients in different forms and varying degrees of validity, when adding it to the soil, the microorganisms will attack them, which work on initially analyzing them by easily degradable substances and the degradation products disappear as a result of feeding microorganisms on them. Shaaban, (2009) indicated that humic acid, fulvic acid, and humin are the main components of organic matter and It positively affects plant growth such as increasing the permeability of cell membranes, stimulating enzymatic reactions, improving cell division and cell elongation, increasing plant enzyme production and stimulating intracellular vitamins and giving a promising future for increasing crop production as a source of low-cost natural fertilizers. Al-Fadhli, (2011) showed that humic and some intermediate materials improve the physical, chemical and biological properties of the soil and secreting growth catalysts such as cytokines, gibberellins, and Auxins.

2. MATERIALS AND METHODS

The experiment was conducted in one of the greenhouses for the autumn season (2018 - 2017) belonging to the Department of Horticulture, College of Agriculture, Al-Qasim Green University. The soil of the plastic house was plowed and then leveled and three terraces were made with a width of (80 cm) for the terrace along the greenhouse, with leaving a distance of (1 m) between the terrace and another. The experimental unit included five eggplant plants, the distance between one plant and another is 40 cm, with leaving a distance of 1 m between the experimental units using the randomized complete block design (RCBD). Table (1) shows some of the chemical and physical traits for the soil used in agriculture. The main treatments included the drainage wastes which is symbolized by (M), poultry wastes which is symbolized by (D), cow manure which is symbolized by (A), and peat moss which is symbolized by (P), with a rate of (20, 40 tons.ha^{-1}) for each of them ($3 \times 9 = 27$) in addition to the control treatment (without any adding). The electrical conductivity of irrigation water and soil extract (1: 1) was estimated according to (page et al., 1982) method, the nitrogen availability in the soil was estimated using Micro Kjeldahl device according to (page et al., 1982) method. The phosphorus availability in soil was extracted using a solution of 0.5 molar sodium bicarbonate according to (Olsen and Sommers, 1982) method. The dissolved potassium was estimated using a flame photometer according to the (Page et al., 1982) method. The organic matter was divided into its components (humic acid, fulvic acid, and humin) according to (Aiken et al., 1985), Humin was estimated as follows:

Humin (g.kg^{-1}) = organic matter (g.kg^{-1}) - (Humic + fulvic) (g.kg^{-1}).

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Table 1: Some chemical and physical traits for the soil before cultivating.

Traits	Units	Value	
Electrical Conductivity (ECe)	$dS.m^{-1}$	4.32	
Degree of soil reaction (PH)		8.22	
Lime	$g.kg^{-1}$	220	
Gypsum		1.50	
Calcium	$mmol.L^{-1}$	4.00	
magnesium		3.40	
Sodium		5.52	
Potassium		0.17	
Chloride		2.60	
Sulfates		6.69	
Bicarbonate		3.80	
Carbonates		0.00	
Organic matter	$g.kg^{-1}$	4.18	
Cation exchange capacity (CEC)	$meq.kg^{-1}$	15.05	
Bulk density	$\mu g.m^{-3}$	1.33	
porosity	%	31.00	
Sand	$g.kg^{-1}$	937.50	
Clay		47.50	
silt		15	
Texture	**Sandy**		
Humic acid	$g.kg^{-1}$	0.41	
Fulvic acid		0.17	
Humen		3.60	
Nitrogen	$mg.kg^{-1}$	Total = 15.00	availability = 8.99
Phosphorus		Total = 7.11	availability =0.13
Potassium		Total = 5.00	availability =2.20
Lead		Total = 3.64	availability =0.13
Cadmium		Total = 0.19	availability = 0.05

3. RESULTS AND DISCUSSION

1- Segmentation of organic wastes into its components

Table (2) shows that the organic wastes from plant origin (peat moss) were characterized by raising their content of organic matter, organic carbon and humin than the rest of the wastes, where their concentrations amounted to (479.4, 206.54, 312.0 $g.kg^{-1}$), respectively. while the highest concentration of humic acid amounted to (17.52 $g.kg^{-1}$) and the lowest C: N ratio amounted to (8.96) in poultry wastes compared to other wastes. The high concentrations of total nitrogen, total phosphorus and total potassium in poultry wastes compared with other wastes may be attributed to the fact that the urinary and excretory system is uniform in poultry, which means an increase in the concentration of urea (Uremia) in poultry wastes followed by increasing concentrations of nitrogen, phosphorus, and potassium in these wastes. The table also shows that the lead and cadmium concentrations in drainage wastes amounted to (107.02, 6.04 $mg.kg^{-1}$), respectively, which means adding significant amounts of these two elements to the soil, thus increasing the amounts absorbed by the plant. Figures (1,2) show the concentrations of organic matter and humic acids in the soil after cutting plant at the end of

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the season resulting from the decomposition of the added wastes and at the levels of (20, 40 tons.ha-1), respectively, where the concentrations of humic, fulvic and humin increased from (0.41, 0.17, 3.60 g.kg^{-1}) for the control treatment to (1.17, 0.51, 2.59 g kg^{-1}, and 4.097, 1.20, 5.50 g.kg^{-1}, and 2.54, 1.28, 2.97 g, kg^{-1}, and 2.20, 1.32, 6.57 g.kg^{-1}) for drainage, poultry, cows and peat moss, respectively at the level of (20 tons.ha^{-1}), While the concentrations of these acids increased to (2.35, 1.03, 5.21 g.kg^{-1}, and 5.99, 1.76, 8.05 g.kg^{-1}, and 3.33, 1.39, 3.89 g.kg^{-1}, and 2.20, 1.32, 6.57 g.kg^{-1}) for drainage, poultry, cows and peat moss, respectively, when increasing the adding level of waste to (40 tons.ha^{-1}). Poultry and peat moss wastes gave the highest concentrations of organic matter and its components from humic acids in the soil. This may be attributed to the rapid degradation of these wastes in the soil, poultry waste is characterized by low C: N, which increased the rate of decomposition and production of organic matter and humic acids. Also, the peat is originally degraded before being added to the soil as shown in Table (2).

Table 2: Concentrations of Some Compounds and elements forming the added Organic Wastes.

Traits	Units	Type of Organic wastes			
		Drainage wastes	Poultry wastes	Cows manures	Peat moss wastes
Organic matter	g.kg^{-1}	353.6	461.8	397.4	479.4
Organic carbon		153.4	150.2	178.3	206.5
Humic acid		96.8	175.2	148.7	104.8
Fulvic acid		42.4	51.4	75.2	62.6
Humin		214.4	235.2	173.5	312.0
Total nitrogen		14.3	16.7	14.4	12.3
Total phosphorus		7.1	14.7	5.1	3.0
Total potassium		2.2	5.4	4.6	4.2
C: N		10.7	8.9	12.36	16.7
Lead	mg.kg^{-1}	107.0			
Cadmium		6.04			

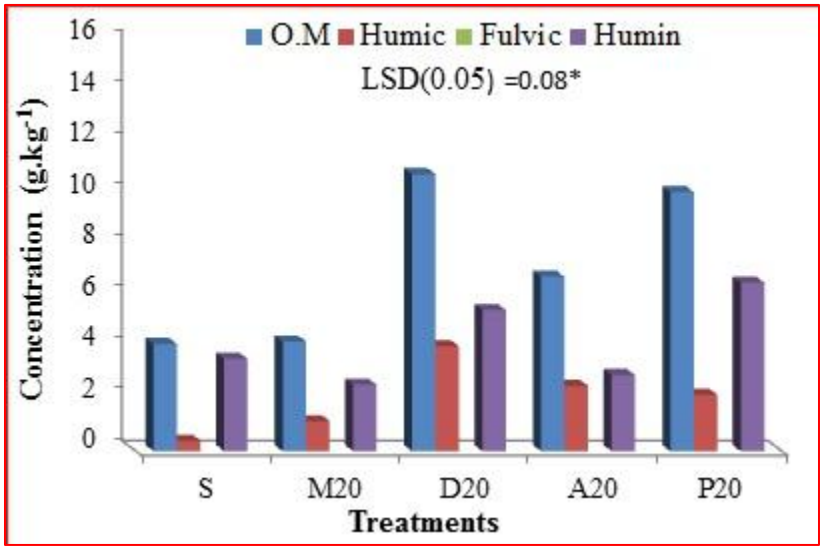

Figure 1: Concentrations of organic matter and humic acids in soil (g.kg^{-1}) at the level of (20 tons.ha^{-1}) after harvest.

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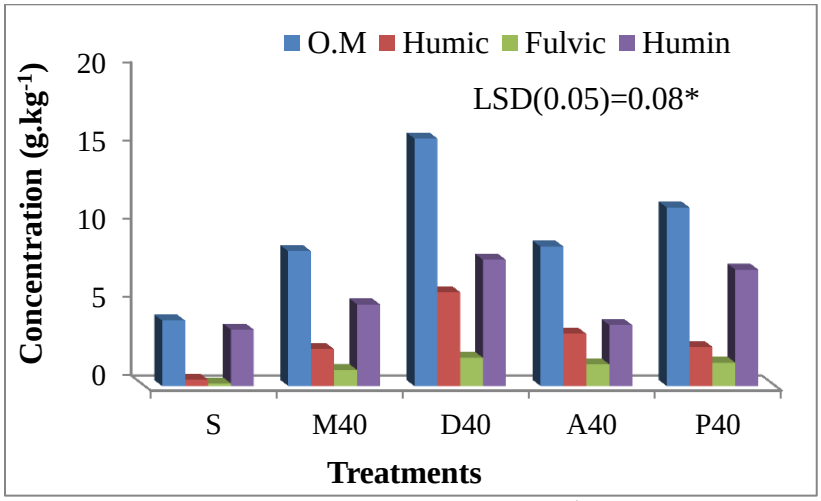

Figure 2: Concentrations of organic matter and humic acids in soil (g.kg^{-1}) at the level of (40 tons.ha^{-1}) after harvest.

2- Effect of organic wastes on some soil traits and growth and yield of eggplant

Table (3) shows that adding organic wastes at the level of (20 tons.ha^{-1}) led to increasing the yield from 13.18 kg/experimental units (65.90 tons.ha^{-1}) for the control treatment to 14.71 kg/experimental units (73.55 tons.ha^{-1}) and 20 kg/experimental units (100.00 tons.ha^{-1}) and 14.36 kg/experimental units (71.80 tons.ha^{-1}) and 16.88 kg/experimental units (84.40 tons.ha^{-1}), While the increase in addition to (40 tons.ha^{-1}) led to increasing the yield to 27.50 kg/experimental units (137.50 tons.ha^{-1}), 35.61 kg/experimental units (178.05 tons.ha^{-1}) and 24.04 kg/experimental units (120.20 tons.ha^{-1}) and 32.31 kg/experimental units (161.55 tons.ha^{-1}) for drainage wastes, poultry wastes, cow wastes and peat moss wastes, respectively. This may be attributed to the role of these wastes in improving the physical properties of soil like the apparent density, porosity and stability of soil aggregates, as well as its role in increasing the availability of nutrients in addition to their biological effects in terms of increasing the number and activity of microorganisms analyzing these wastes as well as chemical effects for containing it on humic acids (Humic, Fulvic, humin) as shown in table (2), which works to chelate ions and form more soluble compounds, which facilitates their movement and absorption by the plant. The decomposition of these wastes results in some growth catalysts, such as cytokines, gibberellins, and auxins, which increase the availability of nutrients, thus increasing the yield. These results agree with (Mikkelsen and Leytem, 2005).

Table 3: Effect of adding organic wastes on eggplant yield

Treatments	Yield	
	kg/experimental units	tons.ha^{-1}
S	13.18	65.90
M20	14.71	73.55
M40	27.50	137.50
D20	20.00	100.00
D40	35.61	178.05
A20	14.36	71.80
A40	24.04	120.20
P20	16.88	84.40
P40	32.31	161.55
LSD(0.05)	**1.703***	**4.966***

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The addition of wastes improves soil fertility by adding nutrients such as nitrogen, phosphorus and potassium after decomposition in the soil which works to increase the availability of other elements through reducing the degree of soil reaction with action of organic acids resulting from decomposition and the release of CO_2 from decomposing organisms and respiration of roots, which when combined with water forming a Carbonic acid, which is reflected positively in increasing the yield. Poultry wastes gave the highest yield of eggplant amounted to 20.00 kg/experimental units (100.00 tons.ha^{-1}), 35.61 kg/experimental units (178.05 tons.ha^{-1}) and at the two levels (20, 40 tons.ha^{-1}), respectively. This may be attributed to the high concentration of humic acid resulting from the decomposition of poultry wastes, which amounted to (175.2 g.kg^{-1} wastes) as shown in Table (2) because of its effective role in increasing cell division and elongation of cells, increasing the production of plant enzymes and stimulating vitamins within cells. Humic acid plays a major role in increasing the production of various crops. It is clear from the results that humic acid has physiologically affected in the eggplant yield, where It stimulated cellular activity and enhanced the plasma membrane structure of the plant cell. It also contains carbon compounds that build the plant tissues and the association of these compounds with auxins led to induce the root emissions of secondary roots and absorbent capillaries, which facilitated the absorption of nutrients from the soil. This was positively reflected in the growth of eggplant yields (Garcia et al, 2010; Al-Shammari, 2017). Figure (3) shows the relationship between the concentrations of organic matter in the added wastes and the eggplant yield (Kg/experimental unit). The eggplant yield increased significantly with increasing the concentrations of organic matter resulting from the decomposition of various organic wastes. This reflects the significant effect of organic matter in improving the physical, chemical and biological traits of soil, which was effectively reflected in the improvement of plant growth traits and subsequent increase in eggplant yield and for all types of added organic waste. The figure also indicates that the slope of the line at the level of (40 tons.ha^{-1}) was greater (0.0664) than at the level of (20 tons.ha^{-1}) (0.0331), which means increased response to the addition of organic wastes, which significantly increased the yield relative to the control treatment. Figure (4) shows the relationship between the concentrations of humic acid resulting from the decomposition of different organic wastes and the eggplant yield (Kg/experimental unit). where the yield increased significantly with the increase in acid concentrations resulting from decomposition, The increase in yield was greater at the level of (40 tons ha^{-1}) than at (20 tons.ha^{-1}) to increase the concentrations of acid produced from the decomposition of these added wastes to the soil. These results agree with several studies that indicate the significant role that humic acid plays in improving plant growth and increasing root activity, which is reflected in increased eggplant yield as shown in Table (3). It is clear from Figure (5) that the poultry waste has excelled on the remaining types of added wastes in increasing the yield of eggplant and for both levels (20, 40 tons.ha^{-1}), with a significant difference from the other types of wastes. The lowest yield was (13.18 kg/experimental units) at the control treatment, while the yield increased significantly for all types of added wastes. This increase in yield increased when the level of the addition was increased to (40 tons.ha^{-1} wastes).

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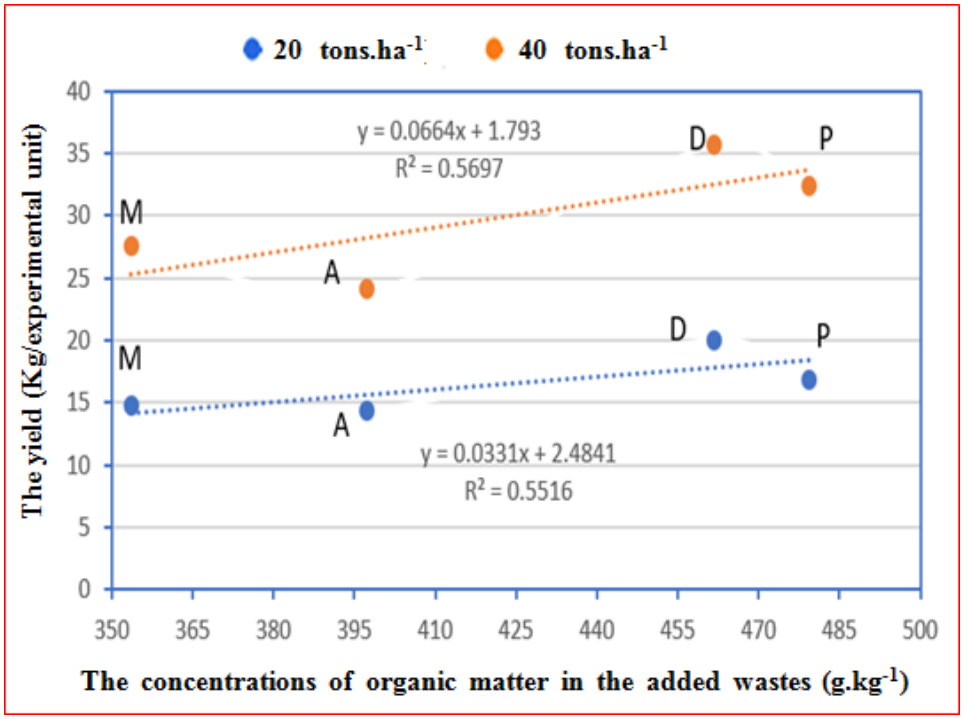

Figure 3: The relationship between the concentrations of organic matter in the added wastes and the eggplant yield (Kg/experimental unit).

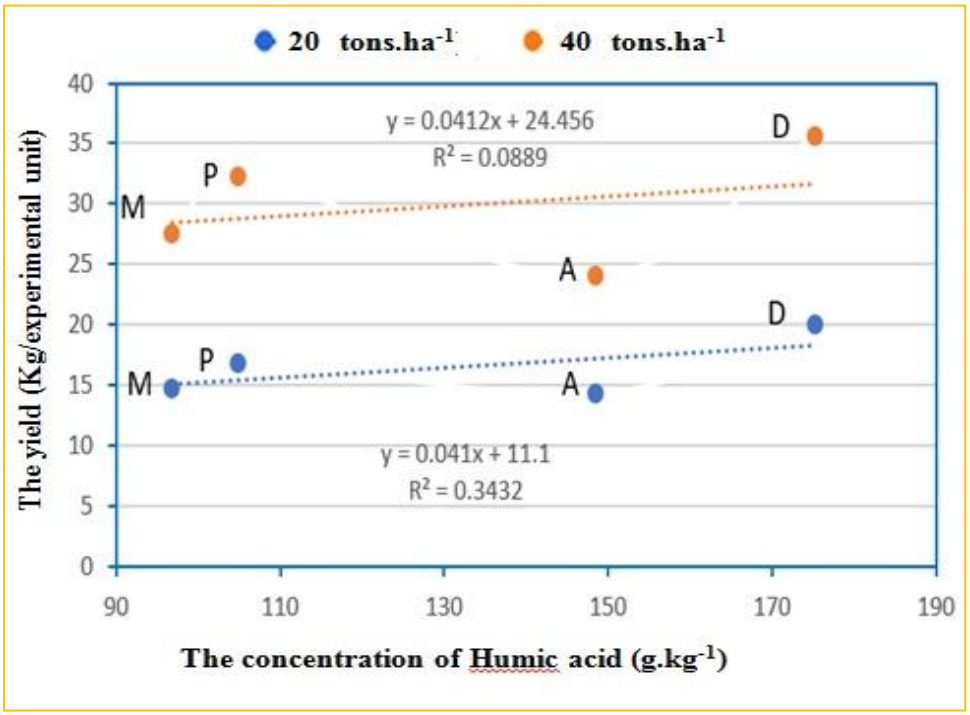

Figure 4: The relationship between the concentrations of Humic acid in the added wastes and the eggplant yield (Kg/experimental unit).

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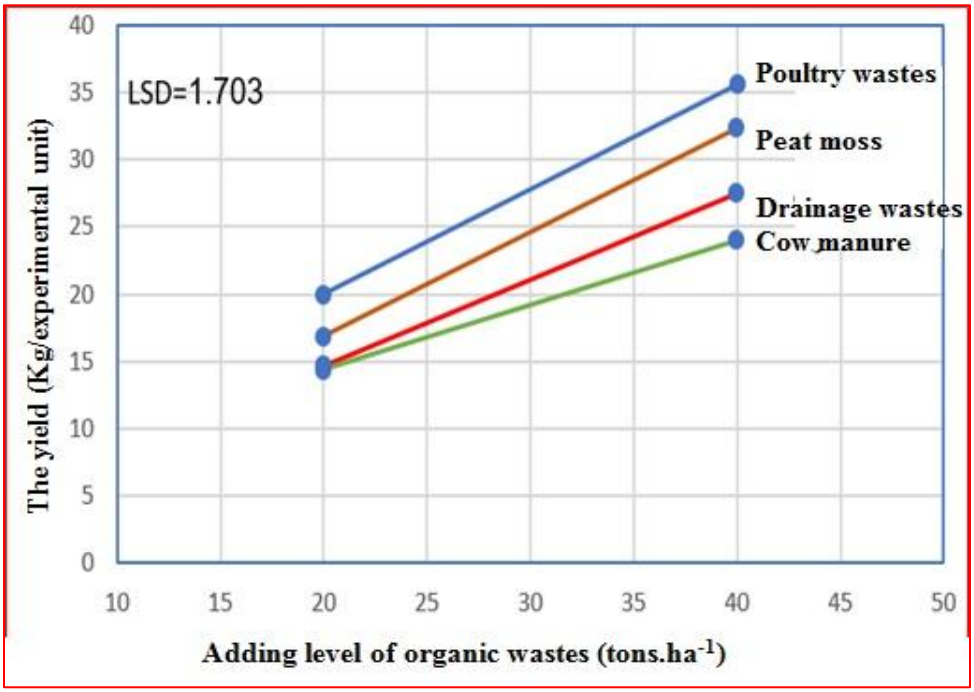

Figure 5: The relationship between the type and adding a level for organic wastes and the eggplant yield (Kg/experimental unit).

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