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Effect of Black Tea Wastes on some of soil Properties and Barley *(Hordium vulgar* L.) Growth and Yield

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Abstract

The pots experiment carried out in the Saqlawiyah institute during the spring season 2008-2009 using sandy loam soil from Saddat Al-Falluja region. The soil was treated with black tea wastes (locally called "Bithil") with four treatments BT0 (control), TW1, TW2, TW3 with applications of 0%, 2%, 4%, and 6% respectively. Barley was planted for 65 days as a test crop. At the end of growth season, some of soil and plant properties had been measured. Generally, the treatments had a high significant effect in decreasing bulk density from 1.51 $Mg.m^{-3}$ in TW0 to 1.27 $Mg.m^{-3}$ in TW3 and a significant effect in increasing porosity from 41% to 50% for the TW0 and TW3 respectively. The treatments had also high significant effect in decreasing both the soil EC from 7.3 to 2.8 $dS.m^{-1}$ for TW0 and TW3 respectively with negative correlation factor of – 0.98 and pH from 8.53 for TW0 to 7.59 for the treatment TW3. Tea wastes showed a high significant effect in increasing dry weight as average from 7.93 to 9.51 $g.plant^{-1}$ for treatments TW0 and TW3 respectively with increasing ratio of 83%. The tillers number and the weight of 1000 seeds of the plant increased due to tea wastes application from 4 to 8 TPP (Tiller per Plant) and from 44.3g to 57.6 g for the treatments TW0 and TW3. The third treatment TW3 was the best in affecting soil properties and plant components.

تاثير فضلات الشاي الاسود على بعض خواص التربة ونمو وحاصل الشعير *Hordium vulgar* L.

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الخلاصة

نفذت تجربة مختبرية في سنادين في معهد الصقلاوية خلال الموسم الربيعي 2008–2009 في تربة مزيجة رملية من منطقة سدة الفلوجة . عوملت التربة بمخلفات الشاي الاسود المنزلي (المسمى محلياً بالبثل) باربع معاملات TW0 (مقارنة)،TW1،TW2،TW3 حسب المستويات 0% ، 2% ، 4% ، 6% من وزن التربة خلطاً مع التربة. زرعت التربة بالشعير في 15–12–2008 وحصد المحصول في 20–4–2009 . في نهاية موسم النمو تم تقدير صفات التربة والنبات. اظهرت النتائج ان لمخلفات الشاي تاثيراً معنوياً جداً في خفض الكثافة الظاهرية للتربة من 1.51 ميكاغرام . $م^{-3}$ في المعاملة TW0 الى 1.27 ميكاغرام. $م^{-3}$ في المعاملة TW3 وتاثيراً معنوياً في زيادة مساميتها من 41% الى 50% في المعاملات TW0 و TW3 على التوالي. وكان للمعاملات بشكل عام تاثير معنوي جداً في خفض ملوحة التربة من 7.3 الى 2.8 ديسيسمنز.$م^{-1}$ في المعاملات TW0 و TW3 على التوالي وبمعامل ارتباط سالب 0.98– وكذلك خفض درجة تفاعلها من 8.53 للمعاملة TW0 الى 7.59 للمعاملة TW3 . كان لمخلفات الشاي المنزلي تاثيراً عالي المعنوية في زيادة الوزن الجاف للمجموع الخضري كمعدل من 7.93 الى 9.51 غم. نبات$^{-1}$ للمعاملات TW0 و TW3 على التوالي وعدد التفرعات ووزن 1000 حبة لمحصول الشعير زاد نتيجة لاضافة مخلفات الشاي من 4 الى 8 فرع. نبات$^{-1}$ ومن 44.3 غم الى 57.6 غم للمعاملات TW0 و TW3. كانت المعاملة الثالثة TW3 هي الافضل في تاثيرها على خواص التربة ومكونات النبات.

الكلمات الدالة :
مخلفات الشاي الاسود، خواص التربة، نمو الشعير، الحاصل

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Introduction

The use of organic conditioners and urban wastes has many beneficial effects on chemical properties for the degraded soils and plants growth. Albaladejo et al. (1994) indicated that the application of 6.5 to 26 kg/m^2 of urban solid wastes which were full of organic materials had a significant effect in rapid leaching of salts and saving essential nutrients for plant uptake, he also stated that that the urban wastes increased total nitrogen and carbon, available phosphorus and exchangeable sodium and potassium in soil and these effects remains for three years after application. Sheta et al (2005) stated that the application of natural amendments like bentonite, river deposits (Rawadat) and organic matter as a thin subsurface layer of 15 cm depth to calcareous sandy soil increased yield average of squash (ton/ ha) between 122-187%, he also pointed to the decrease of soluble salts percentage in the subsurface soil. Kizilkaya and Ekberli (2007) studied the effects of 5% treatment of hazelnut husk (HH) and tea production waste (TEW) to clay loam soil on urease enzyme activity and its kinetics, they stated that the treatments of soil with hazelnut husk and tea waste increased urease activity in soil, the reaction velocity increased as substrate concentration increased, however this increase continued up to 8% substrate concentration level in control soil and 10% substrate concentration level in organic waste amendment soil concentration level, it became constant at 12% substrate concentration level in organic waste amendment soil. Adija et al. (2008) assigned that the municipal solid waste untreated used as amendment may have caused variation in the concentrations of heavy metals in treated soils and ranged from 0.48 to 7.64 mg / kg of a cadmium and 23.6 to 38.3 mg / kg of copper. Nikolic (2003) stated in the treatment of soil with three dilutions of water and compost (agricultural and trade) in ratios 1:5, 1:10, 1:20 during the growing season of potatoes resulted in the highest sum of the tubers in the ratio 1:20 as agricultural compost which was attributed to the effect on the content of soil carbon, potassium, and organic phosphorus. Albaladejo et al. (2000) mentioned that organic conditioners are applicable and effective way to improve soil physical properties affected by erosion and is an important source of organic matter, and the use of organic waste has become a traditional way to increase the organic content of the soil where the addition of waste at rates 65, 130, 195, 260 tons / ha increased the soil organic carbon as municipal solid waste to reduce runoff and soil loss. Ozdemir et al. (2009) pointed out that they added bio-solids (BS) at vital rates 0%, 2%, 4%, 6% and found that these materials have increased the total nitrogen, available phosphorus and exchangeable potassium when added to soils subjected to erosion, while the impact of tea waste (TW) was very little in the levels of erosion, and also that both materials (BS and TW) increased the content of potassium in the soil. Due to lack of local studies on the use of the remains of domestic tea as a conditioner of the soil and its effects on soil properties and plant, the current study aims to the following:

1. Assessing the impact of using the remnants of domestic organic tea as a conditioner on some soil properties.
2. Assessing the impact of applying remains of domestic tea to the soil on barley growth and yield components.

Materials and methods

Sandy loam soil was selected from the city of Fallujah (Saqlawiya institute) which was classified under the Great group Typic torrifluvent. Samples of the soil surface horizon (0-30 cm) have been taken and divided into two parts, the first was air dried and sieved with (2 mm) diameter sieve in which some physical and chemical properties were estimated (Table 1) according to the procedures set out in Pansu and Gautheyrou (2006). The other part of the soil was sieved with (4 mm) diameter sieve and placed in plastic pots having 6200 g capacity of soil and drilled from the lower base for the purpose of excess water drainage. Soil treated with four different levels of domestic tea wastes (locally called "Bithil") (Table 2) TW0, TW1, TW2, TW3 at rates 0%, 2%, 4% and 6% respectively of the soil weight in the pots and mixed with soil. Test of germination rate for the barley seeds (local variety "Mariot cultivar") was carried out and the germination rate was 90%. Pots were planted with seeds on 15/10/2008 at 10 seeds per pot by drilling a small depth of 3 - 4 cm and a triple format (3 rows of 3 seed holes for each one), and at equal distances, and then irrigated with water. When germination was obtained, the plants were reduced to 5 per pot. Fertilization was achieved according to the recommendations of the Ministry of Agriculture (40 kg urea / donum, triple superphosphate 60 kg / donum) with two rounds, the first round was at planting and the second was after 25 days of the first batch. The plants were irrigated regularly according to the weighted method after exhausting 50% of field capacity. Weeding and crop service have been conducted regularly as needed. Experiment carried out according to Completely Randomized Design CRD with three replicates. After 65 days of cultivation dry weight of shoots, the number of tillers was calculated and after the completion of maturity and harvest at 20/ 4 / 2009, the weight of 1000 grains was calculated. The other soil characteristics have been estimated after the end of the experiment. Results were analyzed statistically by using the electronic computer program GenStat 2008[1].

[1] www.vsni.co.uk

Table 1, Some of Soil Physical and Chemical Properties

Sand	Silt	Clay	Texture	Bulk density Mg/m^3	O.M.	Calcite	Gypsum	CEC $cmol.kg^{-1}$ soil	EC $dS.m^{-1}$	pH
	g. kg^{-1}					$g.kg^{-1}$				
759.6	64.7	175.7	SL	1.52	9.2	373	21.3	11.8	7.4	7.59

Anions $mmole.liter^{-1}$			Cations $mmole.liter^{-1}$				
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$SO_4^{=}$	$CO_3^{=}$	HCO^{-}_3	Cl^{-}
11.23	5.52	21.77	0.38	1.92	nil	30.21	3.3

Table 2, Some of Tea Wastes Chemical properties

property		Value
C:N ratio		31
N	g. kg^{-1}	13
P		1.0
K		9.0
EC		0.41 $dS.m^{-1}$
pH		5.4

Results and Discussion

Table 3 shows the effect of different tea waste treatments on some of the chemical and physical characteristics of soil, it is clear from the table that there was a high significant influence of black tea waste in reducing the electrical conductivity of the soil with negative correlation coefficients - 0.98, where salinity decreased from 7.3 dS . m^{-1} in the treatment of TW0 comparison to 2.8 dS. m^{-1} in TW3 treatment, a decline of 38%, and this may be due to the role of solid tea waste in increasing soil porosity and thus the speed of washing salts from the soil and this is consistent with Albaladejo et al. (1994), who pointed out that municipal solid waste containing tea waste contribute in leaching salts quickly from the soil. Table 3 refers to the impact of the tea wastes of higher significance in reducing the pH of soil from 8.53 in treatment TW0 to 7.59 on the treatment TW3, a decline of 88% and this may be due to the role of tea wastes as an organic material in the composition of some acidic compounds resulting from the simple decomposition of tea and the existence of adequate moisture, reducing slightly the pH of soil and this is what referred to by Albaladejo et al. (1994). Table also shows a very significant effect of tea waste in reducing soil bulk density from 1.51 Mg /m^3 in the treatment TW0 to 1.27 Mg / m^3 in the treatment TW3 while the difference between the treatments TW2 and TW3 was non-significant as well as treatments TW0 and TW1. There was a significant effect of tea wastes in increasing the average porosity of 41% in the treatment TW0 to 50% in the treatment TW3 because increasing porosity is a function of low bulk density because of the increased volume of soil resulting from the addition of organic waste and this is consistent with what was referred by Albaladejo et al. (2000) that the organic conditioners improve soil physical properties such as porosity and bulk density. While the differences between the treatments TW2 and TW1 were non-significant compared with control treatment.

Table 3, Effect of Black Tea Wastes on Some of Soil Properties

Treatments \ property	EC $dS.m^{-1}$	pH	Bulk density $Mg.m^{-3}$	Porosity %
TW0	7.3	8.53	1.51	41
TW1	6.0	8.13	1.43	44
TW2	4.8	7.90	1.33	48
TW3	2.8	7.59	1.27	50

property	EC	pH	Bulk density	Porosity
$LSD_{0.05}$	0.575	0.147	0.107	0.0465

Table 4 shows the effect of various tea treatments in some growth characteristics of barley crop. It is clear from the table there was a very significant effect of black tea waste in increasing the dry weight of shoots from 7.93 g .$plant^{-1}$ in the treatment of control to 9.51 g .$plant^{-1}$ in the third treatment TW3 and increase of 83%. The table also shows a high significant difference between the control and TW3treatment in the number of tillers in the plant where it was 8 branch .$plant^{-1}$ in the third treatment while it was 4 branch.$plant^{-1}$ in the control, while the differences between the TW2 and TW1 treatments were not significant and between the TW1 treatment compared with control TW0 was also non-significant. The table also indicates that there are differences of high significance between treatments in the weight of 1000-grains reaching 57.6g in TW3 treatment compared with 44.3 g in the control TW0. This

increase in dry weight per plant and number of tillers and the grains weight is due to the role of organic matter in increasing the proportion of total nitrogen, potassium and available phosphorus in the soil, which is reflected on plant growth and this is consistent with Ozdemir et al. (2009).

Table 4, Effect of Black Tea Wastes on Some of barley growth and yield components

Treatments \ property	Dry weight of total vegetal g.plant^{-1}	Tillers number branch.plant^{-1}	1000 grains weight gm
TW0	7.93	4	44.3
TW1	8.43	6	46.3
TW2	8.87	7	51.3
TW3	9.51	8	57.6

property	Dry weight	Tillers number	1000 grains weight
$LSD_{0.05}$	0.369	2.02	1.29

Conclusion and recommendations

1. The tea wastes have an important effect in decreasing soil salinity and pH.
2. The tea wastes play a major influence in reducing bulk density and increasing porosity for the same soil.
3. The black tea wastes have a very significant effect in increasing dry weight and tillers number of barely crop.
4. The tea wastes have a high significant role in increasing the weight of 1000 grains barley plants.
5. It is recommended to expand research trials about the positive effects of tea wastes on soil properties in various soil textures, and on horticultural plants.
6. We suggest investigating the effects of brewed black tea on the microbial life of soil especially in the poor fertility soils.

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