EFFECT OF COAL REFUSE AND TOWN REFUSE ASH APPLICATIONS ON SOME SOIL PROPERTIES AND YIELD OF SESAME

SHEHATA, SH. M.

Soils, Water and Environment Res. Inst., ARC, Giza, Egypt

(Manuscript received 13 February 2006)

Abstract

A Field experiment was conducted in a sandy soil at Anshas, El-Sharkia Governorate, to investigate the effect of applying either coal refuse or town refuse ash at the rates of 0, 10, 20, 40, 60 and 80 ton/fed on some soil properties and yield of sesame. The obtained data revealed that soil bulk density, penetration resistance and hydraulic conductivity decreased with increasing application rates of either coal refuse or town refuse ash, while the maximum water holding capacity was increased. The obtained data showed that sesame seed yield increased with increasing either coal refuse or town refuse ash rates up to 80 ton/fed.

The average yields were 2.33, 3.50, 5.06, 7.26, 8.53 and 9.96 kg/plot (plot = 9 m^2) for coal refuse addition rates of 0, 10, 20, 40, 60, and 80 ton/fed, respectively, while they reached 2.33, 3.16, 4.26, 6.03, 7.36 and 8.60 kg/plot for town refuse ash additions at the same rates, respectively. Statistical analysis showed that a quadratic function fitted the relationships between either coal refuse or town refuse ash rates and sesame seed yield ($r = 0.97^{**}$). Differential's method of quadratic equation obtained was used to find the predicted values of critical level of amendments rate.

The value of the critical level was 127 ton/fed, as it represents the rate where further change in application results in a reduction in the yield.

INTRODUCTION

Sesame *(Sesamum indictum,* L) is one of the most important crops grown for oil production in Egypt. The crop is grown for its seeds, which contain more than 50 % of excellent edible semi-drying oil.

In Egypt, the production of' oil crops is insufficient for local consumption, and hardly meet about 15 % of total requirements. Intensive efforts have been devoted to improve oil yield of sesame through expansion its cultivation in the newly reclaimed sandy soil area, along with growing high yielding genotypes and adoption of cultural practices.

Town Refuse ash is the most significant by-product from municipal solid waste incineration. It accounts for 85 – 95 % of the solid product resulting from municipal solid waste incineration which reduces the volume of its mass by about 70 %. In this respect, large amounts of town refuse ash are generated reaching 21000 ton per year currently produced in Ismailia town, where their potential value is almost ignored.

In case of charcoal production, there have been some tremendous amounts of charcoal refuse and refuse ash available every day and the amount could be increased from time to time. With 150 small manual industrialization for charcoal production in Anshas, El-Sharkia governorate, the survey of standing charcoal production shows that the annual production of such residue coal ash is up to 1300 ton/year. In Anshas, wood charcoal has a low economic value as fuel. These enormous amounts of charcoal refuse and refuse ash could be sorted to amend the coarse textured soils and it could help in reducing environmental pollution.

Coal refuse is a waste material generated from the combustion of wood trees for the production of coal. It consists of inorganic matter presents in the wood that fused during the combustion process. Coal refuse may be categorized as fly ash or bottom ash. About 70 % to 80 % of coal refuse produced is fly ash; the remaining 20 – 30 % is a bottom ash (Wartman and Riemer, 2002).

Glaser *et al.* (2002) and Falcao and Van Roy (2004) mentioned that using charcoal for improving soil fertility while at the same time it increases carbon sequestration in soil. Also, they found a higher nutrient retention and availability after charcoal additions to soil; this is mainly due to the higher exchange capacity, surface area and direct nutrient additions. Moreover, charcoal may not only change soil chemical properties, but also affects soil physical properties such as soil water retention and aggregation. These effects may enhance the water availability to crops and decrease erosion.

Falcao and Van Roy (2004) found that charcoal applications directly increased nutrients availability such as P and K and increased nutrients retention such as ammonium. Preliminary results revealed that charcoal can be used as a valuable soil amendment having both liming effect and nutrient value.

continues to be practiced.

Mixing fly ash with topsoil could enhance soil physical properties either clay or sandy soils. Being a vegetative fossil, fly ash consists of mineral matter applied to soil, it can act as a secondary source of fertilizer nutrients like K, Ca, Mg, S, Cu, Fe, Mn, Mo etc. (Totawat *et al.,* 2002). Combination of both physical and chemical properties of fly ash when added to the soil, it may improve the agricultural productivity of the soil. Utilization of fly ash in agriculture would open new avenues to improve soil productivity debarring the environment from its degradation.

Land application of wood ashes has been shown to increase the growth and yield of agricultural crops in the greenhouse and field. Crops show enhanced growth and or yield from ash amendments (Vance, 1996). Ash additions equivalent to 40 ton/ha increased wheat growth by 25 to 69 %, whereas growth began to decrease relative to the control at higher rates and ceased at rate > 320 ton/ha (Etiegni *et al.,* 1991). Utilization of coal refuse and refuse ash can be considered as soil conditioner and soil improving agents.

The main objective of this study is to quantify the effects of coal refuse or town refuse ash applications on some physical properties of a sandy soil, and evaluate their effects on sesame yield.

MATERIALS AND METHODS

A field experiment was conducted in a sandy soil, at Anshas, El-Sharkia governorate. Soil analysis of the experimental site and analysis of the two materials (amendments) used, i.e. coal refuse and town refuse ash are summarized in Table 1.

Coal refuse was obtained from a small manual industrialization for charcoal production in Anshas, while town refuse ash was obtained from Ismailia town, Ismailia Governorate, Egypt.

Table1. Some chemical and physical characteristics of the studied soil and the amendments used.

Some charcteristics of the soil and the amendments	pH (1:2.5)	EC dS/m	O.M. %	Bulk Density g/cm^3	$CaCO_3$ %	Particle size distribution		
						Sand %	Silt %	Clay %
Soil depth (0-20 cm)	7.80	1.48	0.52	1.54	1.60	90.0	5.5	4.5
Coal refuse	7.54	0.53	6.66	0.78	0.50	5.0	80.8	14.2
Town Refuse ash	7.84	0.16	4.55	1.10	2.56	10.0	70.2	19.8
Total content of some elements of the amendments used								
	P %	K %	Fe ppm	Mn ppm	Zn ppm	Cu ppm		
Coal refuse	0.15	0.40	250	90	38	5		
Town refuse ash	0.09	0.12	100	20	12	1		

The field experiment comprised of two amendments with 6 rates for each amendment with 5 replicates of each rate, the plot area is 9 m^2. The experimental design was randomized complete block. Either coal ash or town refuse ash were used at rates of 0, 10, 20, 40, 60, and 80 ton/fed. Both of them were incorporated with surface soil layer (0 - 10 cm).

Sesame (Mutation 8) was planted in the mid of April where the seed rate was 15 kg/fed. All plots were fertilized as commonly practiced. Superphosphate (15.5 % P_2O_5)

was added at a rate of 140 kg/fed, it was banded adjacent to seed hills at planting, and potassium sulphate was applied after thinning at a rate of 48 kg K_2O/fed. Nitrogen fertilizer was applied as ammonium nitrate (33.5 % N) at a rate of 90 kg/fed in three equal doses, i. e. at sowing, at thinning and two weeks after thinning. Cultivation practices followed as recommended by the Ministry of Agriculture and Land Reclamation.

Sesame was harvested at the end of August. Whole plants were taken at harvest time from each plot to determine seed yield.

Undisturbed soil samples from each plot was taken from 0 – 10 cm and from 10 - 20 cm depths to determine some soil properties.

Bulk density (BD) was determined using the core methods as described by Blake (1986). For the measurement of penetration resistance (CI), a standard cone penetrometer was used. CI measurements were repeated six times in each plot from locations beside BD measurements (ASAE Standards, 1993).

Saturated hydraulic conductivity (K_{sat}) for the undisturbed soil samples was determined according to Klute (1986).

Maximum water holding capacity was determined according to the technique described by Stole *et al.* (1992).

RESULTS AND DISCUSSION

Data presented in Table 1 indicate that the silt and clay size fractions represent 80.8 % and 14.2 % of the coal refuse and 70.2 % and 19.8 % of the town refuse ash, respectively. These results are in agreement with those obtained by Chodrati *et al.* (1995) who found that ash samples were fine-textured materials, with approximately 80 and 17 % of the fly-ash in the size of silt and clay, respectively.

Soil Physical Properties:

Bulk density

Results show that soil bulk density values in the treatments of either coal refuse or town refuse ash are lower than the control treatment and the differences are statistically significant (Table 2). This could be attributed to the effect of low bulk density of both coal refuse and town refuse ash (Pathana *et al.,* 2003).

Moreover, data show that the mean bulk densities decreased with increasing application rates of either coal refuse or town refuse ash. The relative reductions in soil bulk density reach 11.06, 13.90, 18.29, 20.56 and 25.03 % on an average base due to the increase in coal refuse rates to 10, 20, 40, 60, and 80 ton/fed, respectively.

Also, the relative reductions reach 10.09, 12.74, 16.62, 18.56 and 20.82 % on an average base due to the increase in refuse ash rates applied to 10, 20, 40, 60 and 80 ton/fed, respectively. This clearly shows the adverse effect of increasing application rates of either coal refuse or town refuse ash on soil bulk density.

In this respect, Alien and Jolanta (2002) and Chirenje and Lena (2002) found that soil bulk density was reduced from 155 kg/m^3 to 120 and 130 kg/m^3 with the application of coal ash at two rates of' 80 and 160 ton/ha, respectively. Moreover, Pathana *et al.* (2003) reported that fly ash amendment addition to a variety of agricultural soils tended to decrease the bulk density. The large proportion of silt-size particles in fly ash presumably results in reducing soil bulk density.

On the other hand, the application of either coal refuse or refuse ash had no noticeable effect on soil bulk density, penetration resistance, maximum water holding capacity and saturated hydraulic conductivity in subsurface soil layer (10 - 20 cm) (Table 3). Therefore, surface applications may be a better practice because they rapidly improve surface soil conditions (0 - 10 cm) as compared to the subsurface soil layer one (10 - 20 cm).

Table 2. Effect of coal refuse and town refuse ash rates on soil bulk density, penetration resistance, maximum water holding capacity (MWHC) and saturated hydraulic conductivity (K_{sat}) (surface soil 0 - 10 cm).

Type of amendment	Rate of added amendment (ton/fed)	Bulk density (g/cm^3)	Penetration resistance ($K\ p_a$)	MWHC (%)	K_{sat} (cm/h)
control	0	1.54	13.79	19.08	19.40
Coal refuse	10	1.37	8.42	22.18	15.43
	20	1.33	7.65	28.49	12.41
	40	1.25	6.94	31.48	10.10
	60	1.22	5.83	36.23	8.74
	80	1.15	5.38	41.62	6.59
Town refuse ash	10	1.39	10.29	21.31	16.15
	20	1.34	9.14	25.71	13.54
	40	1.28	8.84	26.84	12.11
	60	1.25	8.56	28.91	10.36
	80	1.22	8.02	34.81	7.26
LSD		0.05	1.06	3.03	1.12

Table 3. Effect of coal refuse and town refuse ash rates on soil bulk density, penetration resistance, maximum water holding capacity and saturated hydraulic conductivity (subsurface soil 10 - 20 cm).

Type of amendment	Rate of added amendment (ton/fed)	Bulk density (g/cm^3)	Penetration resistance (Kp_a)	MWHC (%)	K_{sat} (cm/h)
control	0	1.56	18.63	16.20	21.20
Coal refuse	10	1.54	17.90	15.80	20.74
	20	1.52	17.50	15.77	20.82
	40	1.48	17.55	15.60	20.54
	60	1.45	17.10	15.30	19.74
	80	1.43	16.80	15.10	19.71
Town refuse ash	10	1.53	18.89	15.93	22.10
	20	1.51	18.96	15.50	20.88
	40	1.51	17.42	15.44	20.79
	60	1.48	17.18	15.30	20.12
	80	1.48	16.77	15.20	20.00

Penetration resistance

The soil penetration resistance is a good indicator for the soil physical properties; the decrease in penetration resistance allows the plant roots for easy penetration in the soil. As shown in Table 2 and Figure 1, a decrease in soil penetration resistance is accompanied by an increase in the rates of either coal refuse or town refuse ash additions. Significant differences in soil penetration resistance are obtained.

Maximum water holding capacity

Incorporating coal refuse and town refuse ash with surface soil could enhance soil physical properties. Data in Table 2 and Figure 2 illustrate that the effects of coal refuse and town refuse ash rates on maximum water holding capacity are significant as they increased with increasing either coal refuse or town refuse ash rates. Moreover, a significant difference is detected between the maximum water holding capacities in case of applying the five rates of either coal refuse or town refuse ash additions. The relative increases in the maximum water holding capacity reach 16.24, 49.31, 64.98, 89.88 and 118.13 % for coal refuse additions rates of 10, 20, 40, 60 and 80 ton/fed., respectively, while, they reached 11.68, 34.74, 40.67, 51.51 and 82.42 % for town refuse ash additions at the same rates, respectively.

In this respect, Adriano and Weber (2001) found an increase in maximum water holding capacity with increasing rates of fly ash application. The large surface of spherical-shaped silt-size of fly ash particles is associated by an increase in microporosity of soil, therefore enhancing soil water holding capacity.

Sims *et al.* (1995) show an increase in soil maximum water holding capacity from 12 to 25 % in sandy soils amended with 30 % of ash. In addition, amending of coarse textured soils with coal ash increased water holding capacity from 20 to 33 % in two California soils (Chang *et al., 1997*).

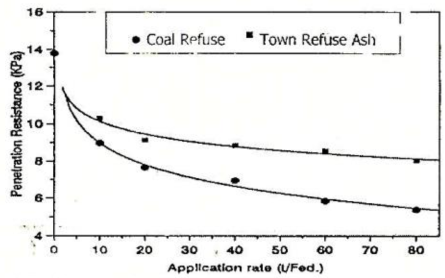

Fig. 1. Effects of coal refuse and town refuse ash applications on soil penetration resistance.

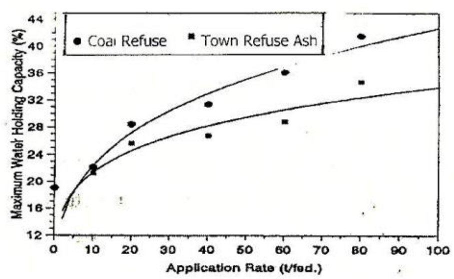

Fig. 2. Effects of coal refuse and town refuse ash applications on soil maximum water holding capacity.
(Surface soil 0-10 cm)

Hydraulic conductivity

Concerning the effect of either coal refuse or town refuse ash rates of application on soil hydraulic conductivity, data presented in Table 2 and Figure 3 show a decrease in the hydraulic conductivity with the increase of amendments application rates.

The relative decreases in hydraulic conductivity reach 20.46, 36.03, 47.95, 54.93 and 66.03 % on an average base due to the increase in coal refuse application rates from 0 to 10, 20, 40, 60 and 80 ton/fed, respectively. Also, the relative decreases in hydraulic conductivity reach 16.74, 30.19, 37.58, 46.60 and 62.50 % on an average base due to the increase in town refuse ash application rates from 0 to 10, 20, 40, 60 and 80 ton/fed, respectively.

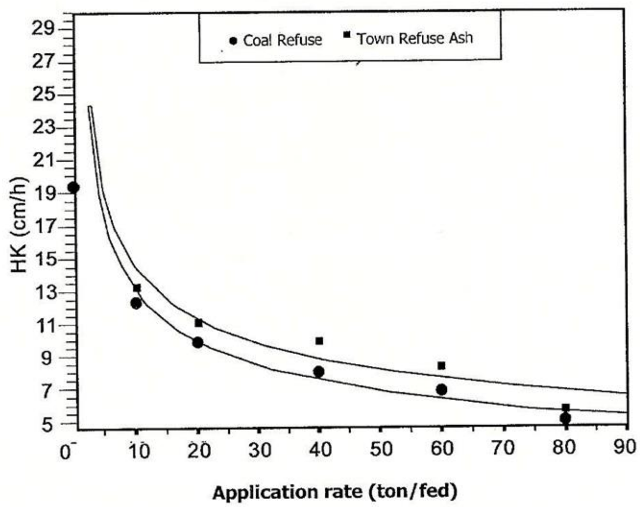

Figure 3. Effect of coal refuse and town refuse ash rates applications on soil hydraulic conductivity (Surface soil 0 - 10 cm).

In this respect, Pathana *et al.* (2003) found that incorporation of fly ash from Kwinana (West of Australia) into two sandy soils significantly reduced the hydraulic conductivity. Also, they found that the hydraulic conductivity in Kwinana (West of Australia) fly ash was 105 to 248-fold slower than in the studied soils. Earlier studies also showed that hydraulic conductivity of sandy soils decreased markedly after fly ash incorporation with soil (Campbell *et al.,* 1983).

Sesame Seed Yield:

Data in Table 4 represent the response of sesame seed yield to the coal refuse and town refuse ash applications. The applications of either coal refuse or town refuse ash at all five rates (10, 20, 40, 60 and 80 ton/fed) significantly increased the sesame seed yield. Maximum yield is achieved with the application of 80 ton/fed of coal refuse. These results are in agreement with those obtained by Chidũmayo (1994) and Glaser *et al.* (2002) who found that adding charcoal to soil can significantly increase seed germination, plant growth, and crop yield.

Table 4. Sesame seed yield (kg/plot) as affected by application rates of amendments (Plot area = 9 m^2).

Type of amendment	Rate of added amendment (ton/fed)	Seed yield (Kg/plot)
control	0	2.33
Coal refuse	10	3.50
	20	5.06
	40	7.26
	60	8.53
	80	9.96
Town refuse ash	10	3.16
	20	4.26
	40	6.03
	60	7.36
	80	8.60
LSD (0.01)	0.678	

Referring to the data presented in Table 4 and Figure 4, the difference between – sesame seed yield, when using coal refuse and town refuse ash, is significant and increases with increasing application rates. Moreover, all coal refuse treatments increases sesame seed yield by an average of 33, 53, 67, 72 and 76 % relative to control by applying coal refuse at rates of 10, 20, 40, 60 and 80 ton/fed, respectively. Also, an increase in sesame seed yield by an average of 26, 45, 56, 68, and 72 % relative to control by applying town refuse ash at rates of 10, 20, 40, 60 and 80 ton/fed, respectively. These results are in agreement with those obtained by Kreisl and Scanlon (1996) who found that the bean biomass was 49 % greater than the control for the 30 ton/ha ash application treatment, 57 % for the 40 ton/ha ash application treatment and 64 % for the 50 ton/ha ash application treatment. These results are in agreement also with Patterson *et al.* (2004) who found an increase of 72 and 50 % in barley dry matter and grain yield with the application of wood ash, while canola oilseed yield increased by 124 % due to wood ash application.

Statistical analysis of the data in Table 4 and Figure 4 shows a highly significant effect of application rates of coal refuse and town refuse ash on the sesame seed yield. Such effect is more pronounced with the coal refuse as compared to the town refuse ash at all application rates.

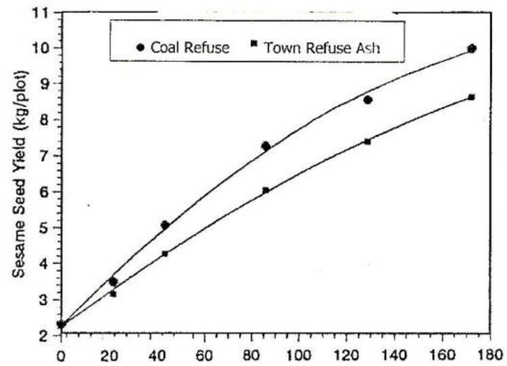

Figure 4. Effect of coal refuse and town refuse ash rates applications (Surface soil 0 - 10 cm) on sesame seed yield.

The relationships between the rates of both coal refuse and town refuse ash and sesame seed production were fitted using best fitting equation (Table 5).

Table 5. Regression equations and correlation coefficients (r*) between sesame seed yield and amendment rates.

Type	Equation	r
Quadratic	Seed = 2.24 + 0.127 amendment rat- 0.0005 amendment ratres^2	0.97**
Square- root	Seed = 0.103 + 0.669 amendment rate$^{1/2}$	0.94**
inverse	Seed = 8.82 - 61.361/ amendment rate	0.88**
Power	Seed = 0.735 * amendment rate $^{0.49}$	0.96**
Exponential	Seed = 3.00 * e $^{(0.0072x \text{ amendment rate})}$	0.93**
logarithmic	Seed = 2.82 * In (amendment rate)-5.63	0.94**
liner	Seed = 2.73 + 0.04 amendment rate	0.96**

The analysis showed that a quadratic function fitted the relationship between either coal refuse or town refuse ash rates and sesame seed yield (r = 0.97**) as compared to the other equations.

The correlation obtained for the quadratic relationship between either coal refuse or town refuse ash rates (ton/fed) and sesame seed yield (kg/fed) is as follows:

Seed=1047.48 - 59.48 amendment rate - 0.233 (amendment rate)^2 [1]

This indicates that yield increase is attributable to the additional amendment additions.

Differential's method of quadratic regression (equation 1) was used to find the predicted values of critical rate of amendment, where the critical level represents that further increase in the rate results in a reduction in the yield. In this respect, the differential quadratic regression (equation I) is as follows:

Dy/dx = 59.48 -0.467 amendment rate

The value for critical level reached 127 ton/fed, increasing to this rate of addition the yield will decline.

A highly significant correlation coefficient was found between sesame seed yield and either bulk density ($r = -0.74^{**}$), penetration resistance ($r = -0.74^{**}$), hydraulic conductivity ($r = 0.95^{**}$) or maximum water holding capacity ($r = 0.89^{**}$).

Also, the multiple regression relating the sesame seed yield to some soil physical properties to all addition rates, gives the following equation:

Seed yield = 3.662 - 0.147 Bulk density - 0.102 Penetration resistance - 0.059 Hydraulic conductivity + 0.060 Maximum water holding capacity + 0.027 Amendment rate.

The multiple correlation was highly significant ($r = 0.98^{**}$) this means that 96.04 % of the variations in sesame seed yield could be attributed to the variation in soil bulk density, penetration resistance, hydraulic conductivity, maximum water holding capacity and addition rate. Moreover, this means that 20.66 % of the variation in sesame seed yield is due to soil bulk density, 34.58 % is due to penetration resistance, 23.56 % is due to hydraulic conductivity, 60.73 % is due to maximum water holding capacity and 15.45 % is due to addition rate.

Economical Seed Yield of Sesame:

To lay out addition rate policy, the economical aspect should be considered. Due to the increase of addition rate prices, the yield per unit amendment rate should be overlooked, as the economical yield is not necessary the highest.

Data in Table 6 indicate that the yield per unit addition rate (1 ton/fed) is the highest at the rates of 20 and 40 ton/fed of amendment; as the increase for the mentioned rate ranges between 41.29 and 119.46 kg seed/ton of amendment.

The highest increase for each excess unit (one ton/fed) of amendment rate is noticed in the case of coal refuse amendment followed by town refuse ash for the two rates of 20 and 40 ton/fed of addition rates, where the yield is found to be 119.46, 51.33, 51.33 and 41.29 kg/ton amendment, respectively. However, the yield increase per excess unit of amendment rate is found to be 29.63, 31.03, and 8.85 for coal refuse additions rates of 60, 80 and 127 ton/fed, respectively, while it is 33.36, 28.93 and 21.88 for town refuse ash at the same rates, respectively.

From the environmental point of view, the problem of coal refuse and town refuse ash accumulations can be partially solved and its pollution effect will by diminished to a certain level in order to improve the surrounding environment.

Table 6. Rate of increase in sesame seed yield (Kg/fed) of sesame per unit increase of amendment rate.

Rate of added amendment ton/fed.	Type of amendment	Yield per unit of amendment	Increase of each excess unit* of amendment
0	Coal refuse	-	-
	Town refuse ash	-	-
10	Coal refuse	7.92	7.93
	Town refuse ash	38.73	38.73
20	Coal refuse	63.69	119.46
	Town refuse ash	45.03	51.33
40	Coal refuse	57.51	51.33
	Town refuse ash	43.16	41.29
60	Coal refuse	48.22	29.63
	Town refuse ash	39.12	31.03
80	Coal refuse	44.50	33.36
	Town refuse ash	36.57	28.93
127**	Coal refuse	29.97	8.85
	Town refuse ash	29.97	21.88

*:1 ton of amendment

**: critical level of amendment

REFERENCES

1. Adriano, D. C. and J. T. Weber. 2001. Influence of fly ash on soil physical properties and turfgrass establishment. J. of Environ. Quality, 30: 596 - 601.
2. Alien, M. and K. Jolanta. 2002. Usability of brown coal for improvement physical and water properties of sandy soil. 17th WCSS, 14 - 21 August 2002, Thailand. No. 1627.
3. ASAE Standards 1993. S313.2 Soil Cone Penetromater, 40th Edition. ASAE, St. Joseph, MI., USA
4. Blake, G. R. 1986. Bulk density. p. 374 - 390. In Page *et el.* (eds.). Methods of Soil Analysis Part 1. Physical and Mineralogical Methods, Am. Soc. Agron. Inc. Madison. Wis. USA.
5. Campbell, D. J., W. E. Fox, R. L. Aitken and L. C. Bell. 1983. Physical characteristics of sand amended with fly ash. Aust. J. Soil Res., 21: 147 - 154.
6. Chang, A. C., L. J. Lund, A. L. Page and J. E. Wameke. 1997. Physical properties of fly ash amended soils. J. Environ. Quality, 6: 267 - 270

7. Chidumayo, E. N. 1994. Effects of wood carbonization on soil and initial development of seedlings in miambo woodland, Zambia. For Ecol. Manage., 70: 353 - 357.
8. Etiegni, L., A. G. Campbell and R. L. Mahler. 1991. Evaluation of wood ash disposal on agricultural land: 1. Potential as a soil additive and liming, agent. Common. Soil Sc. Plant Anal., 22: 243 - 256.
9. Falcao, N. P. S. and J. E. P. Van Roy. 2004. Effect of charcoal and organic fertilizer on nutrients availability in a central Amazon Oxisol. Eng. & Agric. Carbon Utilization, Sustainable Alternatives to Sequestration. Univ. of Georgia.
10. Gangloff, W. J., M. Ghodrati, J. T. Sims and B. L. Vasilas. 2000. Impact of fly ash amendment and incorporation method on hydraulic properties of a sandy soil. Water, Air and Soil Pollution, 1 19: 213 - 245.
11. Glaser, B., J. Lehmann and W. Zech. 2002. Ameliorating physical and chemical properties of highly weatherd soils in the tropics with charcoal - a review. Biol. ferti. Soils, 35: 219 - 230.
12. Klute, A. l986. Laboratory measurement of hydraulic conductivity of saturated soil. p. 210 - 220. In Page. *et el.* (eds.). Methods of Soil Analysis, Part 1. Physical and Mineralogical Methods, Am. Soc. Agron. Inc. Medison. Wis., USA.
13. Pathana, S. M., L. A. G. Aylmoreb and T. D. Colmer. 2003. Several fly ash materials in relation to use as soil amendments. J. of Environ. Quality, 32: 687 - 693.
14. Patterson, S. J., S. N. Acharya, J. E. Thomas, A. I. B. Bertschi and R. L. Rothwell. 2004. Barley biomass and grain yield and canola seekd yield response to land application of wood ash. Argon. J., 96: 971 - 977.
15. Sims, J. T., B. L. Vasilas and M. Ghodrati. l995. Evaluation of fly ash as a soil amendment for the Atlantic coastal plain. 11. Soil chemical properties and crop growth. Water, Soil, Air Pollution, 159: 244 - 252.
16. Totawat, K. L., G. L. Nagger, S. L. Jat and R. K. Jangir. 2002. Effect of fly ash on the performance of wheat on ustochrepts of subbumid plains of India. 17^{th} WCSS, 14 - 21 August 2002, Thailand.
17. Vance, E. D. 1996. Land application of wood – fired and combination boiler ashes: An overview. J. of Environ . Quality, 25: 937 - 944.
18. Wartman, J. and M. F. Riemer 2002. The use of fly ash to alter the geotechnical properties of artifical "model" clay. Proc. To physical modeling in Geotactics, ICPMG, 02, st. John, s. Canada.

تأثير إضافات مخلفات تصنيع الفحم ورماد حرق القمامة على بعض خواص الأرض وإنتاجية محصول السمسم

شعبان محمد شحاتة

معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – جيزة

تم دراسة تأثير إضافة مخلفات تصنيع الفحم ورماد حرق القمامة بمعدلات صفر، ١٠، ٢٠، ٤٠، ٦٠، ٨٠ طن / فدان على بعض خواص الأرض وإنتاجية محصول السمسم فى الأرض الرملية بمنطقة أنشاص بمحافظة الشرقية.

أظهرت النتائج إنه بزيادة معدلات إضافة مخلفات تصنيع الفحم أو رماد حرق القمامة إنخفضت قييم كلا من الكثافة الظاهرية و مقاومة الإختراق والتوصيل الهيدروليكى للتربة بينما زادت السعة المائية العظمى للتربة.

ووجد أنه بزيادة معدلات إضافة مخلفات تصنيع الفحم أو رماد حرق القمامة زاد محصول حبوب السمسم. وتم الحصول على أعلى محصول عند إستخدام ٨٠ طن للفدان بالمقارنة بالمعاملة بدون إضافة. وكانت متوسطات قيم محصول حبوب السمسم ٢,٣٣، ٣,٥، ٥,٠٦، ٧,٢٦، ٨,٥٣ كجم /شريحة ارض (٩ متر مربع) عند إستخدام مخلفات تصنيع الفحم بمعدلات صفر، ١٠، ٢٠، ٤٠، ٦٠، ٨٠ طن / للفدان على الترتيب بينما كان متوسط قيم محصول حبوب السمسم ٢,٣٣، ٣,١٦، ٤,٢٦، ٦,٣ ، ٧,٣٦ كجم / شريحة ارض (٩ متر مربع) عند إستخدام رماد حرق القمامة بنفس المعدلات السابقة.

أظهر التحليل الإحصائى أن العلاقة بين المحصول ومعدلات إضافة مخلفات تصنيع الفحم أو رماد حرق القمامة هى معادلة من الدرجة الثانية هى (r = 0.97 **)

تم إستخدام معادلات التفاضل للحصول على المستوى الحرج لمعدلات إضافة مخلفات تصنيع الفحم أو رماد حرق القمامة التى أعلى الامثل (٨٠ طن) حين لايحدث أستجابة فى زيادة كمية المحصول ولكن بدأ فى الأنخفاض حيث اظهرت قيمة إضافة ١٢٧ طن من مخلفات تصنيع الفحم أو رماد حرق القمامة للفدان انخفاض كبير فى كمية المحصول.

وتدل النتائج انه من الممكن أستخدام مخلفات تصنيع الفحم أو رماد حرق القمامة كمصدر للمواد المحسنة لخواص التربة وإنتاجيتها.