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Impact of Some Organic Residues on Some Properties of Calcareous Soils and Tomato Germination

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A POT EXPERIMENT was conducted to investigate the effect of three organic residues on some properties of a saline calcareous soil and seedlings germination of tomato plants in the green house at National Research Centre. The obtained results indicate that the dry matter and germination of tomate plant increased by using the organic residues. The maximum percentage of tomato germination was obtained from peanut and/or coffee residues + calcareous soil + sand (1:5:1) treatments. Using the calcareous soil as a control treatment gave no plantation due to its high salinity as well as the crust formation.

Application of composted materials to the saline calcareous soil decreased both EC and pH values and increased C/N ratios of the calcareous soil.

Keywords: Sandy and saline calcareous soils, peanut, coffee and guava residues, tomato plants.

Nowadays the extension of desert reclamation and cultivation in Egypt, has become urgent and essential due to the tremendous increase in population. Attention should be taken to reclamation of calcareous soil, since the great area and reclaimed soils are mostly calcareous. Most of the calcareous soil problems are due to high percentage of $CaCO_3$ which cause the high EC and/or pH values, micronutrents fixation and/or precipitation as well as crust formation. The organic matter content of Egyptian soils, generally not exceed 2% due to the high temperature, and arid climate, in addition to the shortage of organic manure addition to these soils.

On the other hand, the intensive use of inorganic fertilizers caused the pollution of soils, water and plant. Thus the utilization of organic fertilizers in the calcareous soil may decrease soil pollution and improves its physical and chemical properties. Ibrahim (1989), Abdel Moez, *et al.* (1995) and Abdel Moez and Saleh (1999) found that the organic materials have a different effect in modifications of the physical and chemical properties of soils as well as their influence of their nutrition status and soil fertility.

Moreover, organic residues are used in peatmoss preparation which is considered one of the most suitable media for production of plant seedlings. The preparation of peatmoss needs individual organic material or mixed with some other materials such as bentonite and/or sand in different ratios. The importation of peatmoss from other countries needs high costs, while its locally manufacturing will (limit), economize its importation from abroad and in the sametime, decreases environmental pollution through using the organic wastes in peatmoss preparation.

In this investigation, a trial was carried out to improve some properties of saline calcareous soil as well as preparing peatmoss by utilizing some organic residues as individual and/or mixed with the calcareous soil and pure sand in different ratios.

A pot experiment was conducted to test the germination percentage of tomato seeds in different preparation media. The percentage of germentation and the dry weight of tomato plant seedlings were estimated. Also, the effect of organic wastes addition to the saline calcareous soil on some properties of this soil were included.

Material and Methods

Soil

A sandy calcareous soil sample was collected from El Ameria province, Alex. governorate. Table 1 shows some properties of the collected soil sample.

TABLE 1. Some chemical properties of the calcareous soil.

pH	EC, 1:5	Total %		C/N	Soluble Cations				Soluble Anions		
1:25	m.mohs/cm	O.C.	N	ratio	meq/100g						
					Na^+	K^+	Ca^{++}	Mg^{++}	Cl^-	HCO^-	$SO_4^=$
7.73	5.47	0.45	0.09	5.0	23.17	35.5	10.5	3.0	65.62	2.75	7.81

Organic residues

Three organic residues, namely, peanut, coffee and guava residues were prepared. The organic residues were incubated individually for 3 weeks under laboratory conditions and distilled water was added daily to be about 60% of water holding capacity in order to decrease C/N ratios. Some properties of the organic residues before and after incubation are shown in Table 2.

TABLE 2. Properties of calcareous soil and organic residues before and after incubation period.

S.N.	Material	pH, 1:5		EC, 1:5 m.moh/cm		O.C%		Total N %		C/N ratio	
		1	2	1	2	1	2	1	2	1	2
1	Calcareous soil	7.73	7.70	5.47	5.40	0.45	0.40	0.09	0.08	5.00	5.00
2	Peanut residue	7.03	7.03	2.23	2.00	31.70	28.50	1.20	1.34	26.4	21.00
3	Coffee residue	6.00	5.45	1.40	1.00	35.4	30.00	1.90	1.90	22.8	15.70
4	Guava residue	7.30	7.30	2.40	2.40	34.2	21.2	1.23	1.30	27.7	16.30

1. Before incubation
2. After incubation

Different ratios from organic residues, calcareous soil and/or sand (Table 3) were incubated for 3 weeks under laboratory conditions in the same manner previously mentioned in incubation of the organic residues. As well as a control, each treatment were carried out in randomized block design with 4 replicates treatment. After incubation period, 10 seeds of tomato (Cassel Rock) were germinated in the different treatments and the growth of seedlings of every treatment was continued for 3 weeks. Thereafter, seedlings of every treatment were harvested, dried at 70° and weighted. The percentage of seedlings grown in each treatment was calculated. Also, EC, total O.C, total N, and C/N ratio of different soil samples, treatments were estimated according to methods described by Cottenie *et al.* (1982). pH was determined in soil water extract (1:5) using pH meter (Jackson,1967), $CaCO_3$ by calcimeter according to Piper (1995). The germination percentage were recorded according to Bartlett (1937).

Results and Discussion

Effect of organic materials incubated with calcareous soil on some properties of different treatments

Twenty four treatments with four replicates for each treatment in randomized block design were carried out to investigate the effect of incubation of three organic residues with calcareous soil and/or sand in different ratios on EC, total organic carbon, total N and C/N ratios. It is believed that the enrichment of saline

TABLE 3. Different treatments of pot experiment.

	Amounts (g)	Treatments
1	50 (soil),	Control
2	50 (peanut residue)	
3	50 (coffee residue)	
4	50 (guava residue)	
5	25 (soil) + 25 (sand), 1:1	soil + sand
6	16.6(soil) + 33.2 (sand), 1:2	
7	8.35 (soil) + 41.8 (sand), 1:5	
8	33.2(soil) +16.6 (sand), 2:1	
9	41.8 (soil) + 8.35 (sand), 5:1	
10	25 (soil) + 25 (peanut residue), 1:1	soil + peanut residue
11	16.6 (6soil) + 33.2 (peanut residue), 1:2	
12	8.35 (soil + 41.8 (peanut residue), 1:5	
13	33.2 (soil) + 16.6 (peanut residue), 2:1	
14	41.8 (soil) + 8.35 (peanut residue), 5:1	
15	16.6(soil)+16.6 sand+16.6 (peanut residue), 1:1:1	soil+sand peanut residue
16	12.5(soil)+25(sand)12.5(peanut residue), 1:2:1	
17	7.13(soil)+14.26(sand)7.13 (peanut residue), 1:2:1	
18	12.5(soil)+12.5(sand)+25 (peanut residue), 1:1:2	
19	7.13(soil)+78.13 (sand) +35.65(peanut residue), 1:1:5	
20	25(soil) +25(coffee residue), 1:1	Soil + coffee residue
21	16.6(soil)+ 33.2(coffee residue), 1:2	
22	8.35(soil) + 41.65(coffee residue), 1:5	
23	33.2 (soil) + 16.6 (coffee residue), 2:1	
24	41.65(soil) +8.35 (coffee residue), 5:1	
25	16.6 (soil) +16.6 (sand)) + 16.6 (coffee residue), 1:1:1	soil + sand + coffee residue
26	12.5(soil) +25 (sand)12.5+ (coffee residue), 1:2:1	
27	7.13 (soil) + 35.65(sand) + 7.13 (coffee residue), 1:5:1	
28	12.5 (soil)+ 12.5 (sand) + 25 (coffee residue), 1:1:2	
29	7.13 (soil) +7.13 (sand) + 35.65 (coffee residue), 1:1:5	
30	25 (soil) +25 (guava residue), 1:1	soil + guava residue
31	16.6(soil) + 33.2 (guava residue), 1:2	
32	8.35 (soil + 41.65 (guava residue), 1:5	
33	33.2(soil) + 16.6 (guava residue), 2:1	
34	41.65 (soil) + 8.35 (guava residue), 5:1	
35	16.6(soil)+ 16.6 (sand)+16.6 (guava residue), 1:1:1	soil + sand + guava residue
36	12.5(soil)+25(sand)+ 12.5(guava residue), 1:2:1	
37	7.13 (soil)+35.65(sand)+ 7.13(guava residue), 1:5:1	
38	12.5(soil)+ 12.5(sand)+ 25 (guava residue), 1:1:2	
39	7.13 (soil)+ 7.13(sand) + 35.65(guava residue), 1:1:5	

calcareous soil (EC, 5.43 m.moh/cm) with organic materials may produce a suitable media for plant growth.

EC values

Data reported in Table 4 show that EC values of different treatments ranged between 1.00 and 5.40 m.moh/cm. The maximum and minimum EC values of

different treatments were obtained from calcareous soil and coffee residues, respectively. It appears that addition of organic residues mostly, decreased soil salinity with more than 50%. The efficiency of coffee and/or guava residues for decreasing EC values of calcareous soil was greater than that of peanut residue. The previous result may be attributed to the initial EC values of the organic materials as this is clear from Table 2. Generally, such results are in accordance with the findings of Ismail *et al.* (1996).

TABLE 4. Effect of organic residues incubated with calcareous soil and /or sand on properties of incubated materials.

S. No.	Material	EC, 1:5 (m.moh/cm^3)	Total %		C/N ratio
			O.C.	N	
1	Calcareous soil	5.40	0.45	0.09	5.00
2	Peanut residue	2.23	28.50	1.50	18.00
3	Coffee residue	1.00	30.00	1.90	15.70
4	Guava residue	2.00	21.20	1.30	16.30
5	Soil + peanut residue (1:1)	2.77	11.20	0.93	12.00
6	Soil + peanut residue(1:2)	2.22	19.12	0.96	19.90
7	Soil + peanut residue(5:1)	2.25	8.36	0.30	27.80
8	Soil + sand (1:1)	2.15	0.38	0.05	7.60
9	Soil+sand+peanut residue(1:1:1)	2.46	7.68	0.38	20.20
10	Soil+sand+peanut residue(1:1:2)	2.14	7.46	0.49	15.20
11	Soil+coffee residue 1:1:	2.14	15.30	1.09	14.00
12	Soil+Coffee residue 2:1	2.46	7.24	0.82	8.80
13	Soil+soil+coffee residue 1:1:1	1.49	12.52	0.61	20.50
14	Soil+soil+coffee residue 1:2:1	2.12	12.28	0.60	20.50
15	Soil+soil+coffee residue 1:5:1	1.87	11.50	0.50	23.00
16	Soil+soil+coffee residue 1:1:2	1.32	10.26	0.65	15.80
17	Soil+soil+coffee residue 1:1:5	2.18	14.16	0.70	20.20
18	Soil + guava residue 1:1	2.66	13.56	0.65	20.80
19	Soil + guava residue 1:5	2.16	15.82	0.84	18.80
20	Soil + guava residue 2:1	2.37	13.34	0.70	19.06
21	Soil+sand+guava residue 1:1:1	1.91	6.76	0.29	23.30
22	Soil+sand+guava residue 1:2:1	1.88	6.56	0.49	13.40
23	Soil+sand+guava residue 1:1:2	2.50	14.48	0.77	18.80
24	Soil+sand+guava residue 1:1:5	2.23	16.98	0.90	18.90

C/N ratio

C/N ratios fluctuated between 5 and 27.8; the maximum and minimimum C/N values were obtained from calcareous soil + peanut residues (5:1) and calcareous soil, respectively.

Data, also, show that C/N ratios of different treatments decline during the compost process. Mostly C/N ratios of different treatments decline with about

20:1. The exceptions were in cases of larger amount of soil and /or sand than that of organic residues. The 20:1 ratio is a critical ratio in terms of crop production. If the C/N ratio is higher than about 20:1, a strong possibility of a nitrogen shortage arises for the plants growth due to the competition between the metabolic and synthetic activities of the microflora and the nutritional requirements of the plants growth. On the other hand, if the C/N ratio is too less than 10:1 a deterioration of plant growth will be arise, due to the burning of plants at the previous ratio. Similar findings were obtained by Thakur *et al.* (1995), Kaloosh (1994) and Sakar (1985).

Percentage of germination and dry weight of tomato plants

Biological methods such as a germination and initial growth tests may be used as good alternatives or a complementary to chemical tests as indicators of biomaturity by using compost as a source of nutrients for plants and as a soil conditioner (Zucconi *et al.* 1981).

Data in Table 5 and Fig. 1,2 reveal that % of germination of tomatoes plants ranged between 20 to 90%. The maximum germination magnitude was obtained from organic media prepared from peanut residue and/or from calcareous soil + sand + coffee residues treatment (1:5:1 by weight), compared to the minimum one which was obtained from soil + sand + guava residues treatments (1:2:1 by weight). It is interesting to mention that the treatment of calcareous soil (control treatment) prevent the germination of tomato seedlings. Such result may be due to high soil salinity as well as crust formation of calcareous soil. Data also, show that mixing the organic residues with calcareous soil and sand in different ratios, attained different values for both tomatoes germination percantage and dry weight. It appears that the type of organic residues has the greater effect on germination percentage and dry weight of tomato seedlings, compared with calcareous soil and pure sand. However, the previous parameters decline with increasing the compost portion than to 1:1 or more.

TABLE 5. Percentage of tomato seedlings grown in some treatments.

S. No.	Treatment	% of tomato seedlings growth
1	Soil (Control)	0.0
2	Soil + Peanut residue (1:1)	85
3	Soil + peanut residue (1:2)	60
4	Soil + sand + coffee residue (1:1:1)	60
5	Soil + sand + coffee residue (1:2:1)	60
6	Soil + sand + coffee residue (1:5:1)	90
7	Soil + sand + coffee residue (1:1:2)	70
8	Soil + guava residue (1:5)	40
9	Soil + sand + guava residue (1:1:1)	40
10	Soil + sand + guava residue (1:2:1)	20
11	Soil + sand + guava residue (1:1:2)	80
12	Peanut residue	90
13	Coffee residue	70

On the other hand, Fig.2 shows that mostly, the maximum tomato seedlings germination produced the maximum dry weight of tomato seedlings. Dry weight of tomato seedlings resulted from peanut residues treatment reached more than 10 times of that resulted from calcareous soil + sand + guava residues (1:2:1 by weight).

Generally, the previous results indicated that peanut residues, peanut+ calcareous soil (1:1 by weight) and coffee residues +sand +calcareous soil (1:5:1) by weight) treatments resulted in the maximum values of both % of tomato seedlings germination and dry weight. The previous results agree with the findings of Abdel Malek *et al.* (1978), and Pare *et al.*(1997).

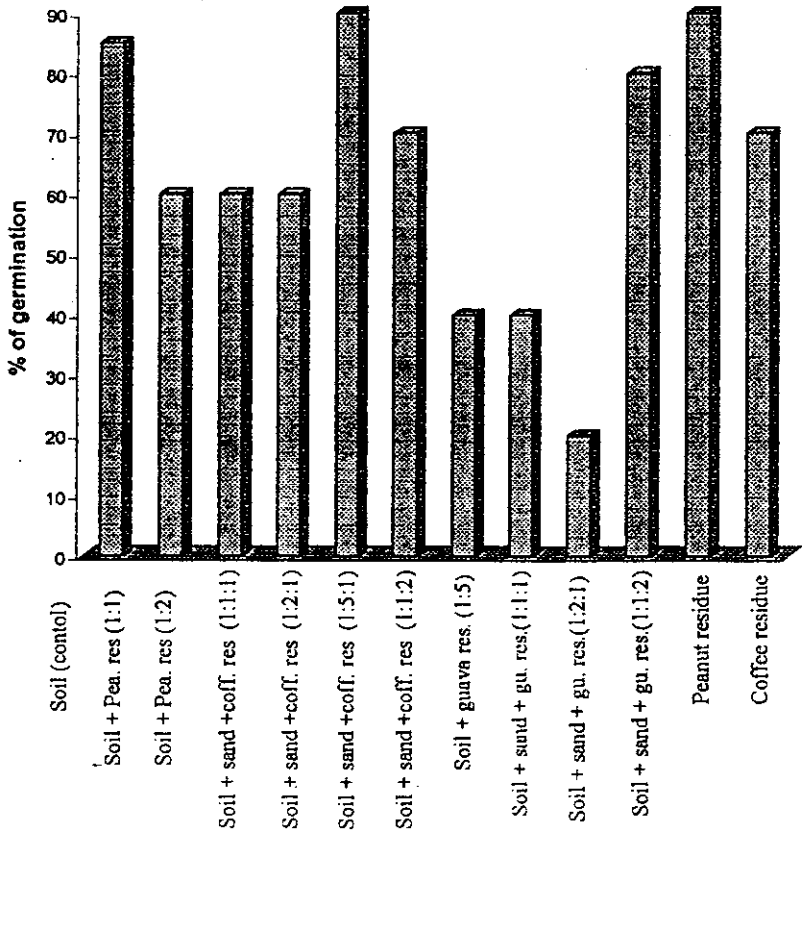

Fig. 1. Percentage of tomato seedlings grown on some treatments.

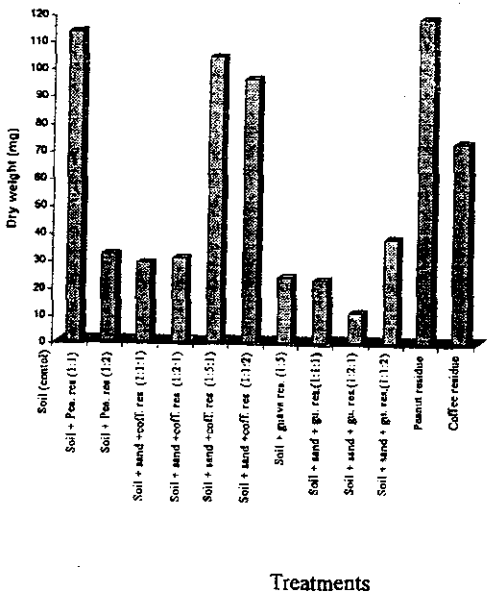

Fig. 2. Dry weight of tomato seedlings.

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أثر استخدام بعض البقايا العضوية على بعض صفات التربة الجيرية وانبات الطماطم

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قسم الأراضى والمياه بالمركز القومى للبحوث – الدقى – مصر.

استخدمت ثلاثة أنواع من البقايا العضوية المكمورة من كل من قشر الفول السودانى ، الجوافة ، البن والتى تم اختيارها كبيئة عضوية لإنتاج شتلات الطماطم وذلك بتجربة أصص بصوبة المركز القومى للبحوث بخلطهم برمل نقى وأرض جيرية بنسب مختلفة لمدة ثلاثة أسابيع والحفاظ على الرطوبة عند ٦٠٪ من السعة الحقلية .

تم زراعة عشرة بذور من الطماطم فى كل معاملة وكانت النتائج المتحصل عليها كما يلى :

نسبة الإنبات والوزن الجاف كانت أفضل ما يمكن تحت ظروف التربة الجيرية مع المخلفات تحت الدراسة وباستخدام مخلفات الفول السودانى المخضن بمفرده أدى ذلك إلى إنبات ٩٠٪ من بذور الطماطم المستخدمة – كما أمكن الحصول على نفس النسبة بتخضين التربة الجيرية مع الرمل ومخلفات البن بنسبة ١:٥:١ على التوالى بتطبيق تلك المخلفات المكمورة مع التربة الجيرية أدت إلى خفض الأملاح الكلية وزيادة الكربون العضوى والنيتروجين الكلى ونسبة ك :ن للتربة الجيرية بينما أدت إلى انخفاض طفيف فى حموضة التربة المستخدمة بعد الزراعة مقارنة بمعاملة المقارنة .