J. Agric. Sci. Mansoura Univ., 29 (12): 7617 - 7623, 2004

AN EXPERIMENTAL TEST OF A NONIONIC SURFACTANT (DLBA)* AS A SOIL CONDITIONER

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ABSTRACT

This work was carried out to study the effect of DLBA additions in improving physical properties of sandy and calcareous soils. Surface Soil samples were collected for research purpose from Ismalia and Nubaria regions, respectively.

Soil conditioner was added at rates of 0.0, 0.1, 0.2 and 0.5% and thoroughly mixed with the investigated soil portions. Then the soil were subjected to wetting and drying cycles for five weeks, whereas the lower soil moisture content, were in the range of 3-5%, while the upper values were in the range of 9-15%.

The results revealed that the tested conditioner improved soil properties as well as its ratio increased. Total porosity, available water and aggregates percentage were increased, while bulk density values were decreased in both soils. The hydraulic conductivity values were decreased in the sandy soil. While its values slightly increased in calcareous soil, due to re-distribution of soil pores.

Finally, application of DLBA had improved physical properties of the tested soils, consequently it is suitable for conditioning soils. DLBA efficiency was 10% from agrosoke efficiency, for the same rate of addition on similar soils.

INTRODUCTION

Nonionic surfactants are widely used in the pharmaceutical, cosmetic and food industries. Nowadays, there are some trails to their use in the agricultural purposes at a commercial scale. Their attractive properties referring to their physical adsorption on soil particles presumably prolonging their activity as wetting agents and maintaining their presence in the surface soil. They are not insolublized by Ca^{2+} and Mg^{2+}, also they exhibit low phytotoxicity when used as soil conditioners, Stewart (1975), Micich and Linfield (1986).

The improvement effect of soil conditioner on soil properties became an approved knowledge; Azzam (1983), El-Amir *et al.* (1993), and Abdulrasol and Abdulaziz (1998).

The present investigation aims to study the effect of DLBA as a new soil conditioner on some soil physical properties.

MATERIALS AND METHODS

Surface disturbed (0-30 cm depth) soil samples were collected from Ismailia and Nubaria regions, respectively. The samples were prepared for the research purposes and analysis. Soil portions from each sample were

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* DLBA : nonionic surfactant, granules hydrophilic, yellowish white, Ph : 5.3 density : 5.54 gm/cm³ Micich and Linfield (1986)

conditioned with 0.0, 0.1, 0.2 and 0.5% of DLBA. After mixing the soils were subjected to 12 wetting and drying cycles for five weeks, whereas the lower soil moisture contents were in the range of 3-5%. While the upper values were in the range of 9-15%. Then, the treated soil materials were left to air dryness.

The estimated soil properties according to the general methods of **Black (1965)** are listed in Table (1).

RESULTS AND DISCUSSION

I: Effect of "DLBA" on soil aggregates percentage and their mean weight diameters .

Data in Table (2) showed that the values of mean weight diameter and total aggregate percentages increased by adding nonionic surfactant DLBA to Table (1)both soils compared with the control. Moreover, the values increased by increasing the addition rates of soil conditioner to the two soils.

In the sandy soil, data showed that the values of mean weight diameter increased from 0.21 mm for control treatment to 0.47, 0.48 and 0.54 mm for the treatment of 0.1, 0.2 and 0.5% addition rate, respectively. The same trend was obtained for the aggregation values whereas for control it was 22.20% and for the treatments they were 35.51, 36.43 and 41.19%, respectively.

Concerning the calcareous soil the data of Table (2) showed that, the values of mean weight diameter increased from 0.27 mm for control treatment to 0.30, 0.35 and 0.44 mm for the investigated treatments, respectively. The aggregation percentage increased from 27.80% to 32.01, 36.80 and 44.39%, due to the treatments, respectively.

These increases may be attributed to the effect of nonionic surfactant (DLBA) on the co-agulation of soil particles.

The aggregation percentages due to the 0.5% DLBA treatment were 41.19 and 44.39% for the sandy and sandy loam soils, respectively. Mohamed (1990) in a previous similar study found that the addition of agrosoke by the rate of 0.4% led to 40.20 and 38.11% aggregation for sandy and sandy loam soils, respectively. This comparison shows that DLBA efficiency is about 10% from agrosoke efficiency in forming soil aggregation.

II- Effect of DLBA additions on the soils bulk density (gm/cm^3), total porosity % and pore size distribution.

Data in Table (3) show that, as the application rate of DLBA increased, the bulk density values for the two soils decreased. The decrease in sandy soil was 8%, while in sandy loam was 7.3% from the control treatment. This finding can be attributed to the soil aggregation due to the treatments and the followed re-distribution of soil pores. Similar data were obtained by Abdullah (2004), who found 6.3 and 7.9% decrease in bulk density after acryhop treatment with sandy and sandy clay loam soils, respectively.

Table (1): The investigated soil analysis

Soil location	Particle size distribution %				Textural class	O.M%	$CaCO_3$	EC mmohs/ cm 25°C 1-5 soil water extract	PH	Soluble ions meq/100 gm soil							
										Cations				Anions			
	Coarse sand	Fine sand	Silt	Clay						Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
Ismalia	56.68	31.81	5.51	6.00	sandy	0.30	1.23	0.31	7.1	1.55	1.09	2.10	0.22	--	0.35	2.96	1.95
Nubaria	39.95	34.97	10.89	14.19	Sandy loam	0.51	17.44	0.83	7.8	3.08	1.25	2.40	0.45	--	0.99	3.55	3.05

Table (2): Effect of DLBA on the aggregation percentage, distribution and mean weight diameter for the investigated soil samples.

Treatment	Aggregate size distribution %				*T.A %	*M.W.D mm
	5.0-2.0 mm	2.0-0.84 mm	0.84-0.42 mm	0.42-0.25 mm		
Sandy soil						
Control	2.24	4.22	7.12	8.62	22.20	0.21
0.1%	8.15	7.01	9.15	11.20	35.51	0.47
0.2%	8.13	7.00	9.29	12.01	36.43	0.48
0.5%	9.04	8.11	10.05	14.00	41.19	0.54
Calcareous soil						
Control	3.30	4.15	8.15	12.20	27.80	0.27
0.1%	3.40	4.30	11.21	13.10	32.01	0.30
0.2%	4.12	5.22	12.35	15.11	36.80	0.35
0.5%	6.06	6.20	13.03	19.10	44.39	0.44

*** T.A.: Total aggregates** *** M.W.D. : Mean weight diameter**

The values of total porosity reveal that soils were highly affected by DLBA additions. Concerning the sandy soil; total porosity values increased from 38.33% for the control treatment to 39.46, 40.60 and 43.25% for the treatments of applications rates (0.1, 0.2, 0.5% of DLBA), respectively. While for the calcareous soil the similar.

Table (3): Effect of DLBA on soil bulk density, total porosity and pore size distribution of the treated soils.

Treatment	B.D. gm/cm^3	T.P %	Pore size distribution		
			Micropores	Mesopores	Macropores
Sandy soil					
Control	1.63	38.33	12.44	4.01	21.88
0.1%	1.60	39.46	14.35	5.90	19.21
0.2%	1.57	40.60	14.99	6.80	18.81
0.5%	1.50	43.25	17.69	7.79	17.77
Calcareous soil					
Control	1.50	40.73	19.82	5.01	16.40
0.1%	1.47	41.92	19.98	7.85	16.09
0.2%	1.40	44.69	21.13	7.97	15.59
0.5%	1.39	46.38	21.58	9.58	15.22

B.D. : Bulk density
T.P. : Total porosity

Micropores : < 30µ
Mesopores : 30-100µ
Macropores : > 100µ

Value changed from 40.73% to 41.92, 44.69 and 46.38% for the same addition rates, respectively.

Similar results were obtained by El-Hady (1979) and Mohamed (1990) who found that total porosity values were increased by using synthetic conditioners in sandy and calcareous soils in Egypt.

Concerning pore size distribution which is a good mean for representing water and air movements in soils, the values in table (3) show that the application of DLBA in both soils led to re-distribution of soil pores. Micropores and mesopores were increased at the expense of macropores in both sandy and sandy loam soils. Data in Table (3) indicate that the highest values of pore size distribution were observed with the mesopores in calcareous soil, whereas, the values changed from 5.01% to 9.58 for control and 0.5% treatments, respectively. While the highest values in the sandy soil were observed with the micropores whereas, the values changes from 12.44% to 17.69% for the some treatments, respectively.

Awad (1989) found that the micropores of the sandy soil increased more than the other types of pores while, the mesopores increased more than the other pores in the calcareous.

IV- Effect of DLBA on soil hydraulic conductivity :

Data in table (4) showed that the values of hydraulic conductivity coefficient of sandy soil were decreased from 15.23 cm/h for control treatment to 13.89, 13.11 and 12.18 cm/h for the treatments of 0.1, 0.2 and 0.5% addition rates, respectively. This decrease could be attributed to the decrease in drainable pores percentage in sandy soil.

Regarding the effect of DLBA on the calcareous soil, the values changed from 10.11 cm/h for the control treatment to 12.15 cm/h for the 0.5% treatment, due to the pore size re-distribution and the increasing of mesopores percentage. The obtained data are in good agreement with those obtained by Awad (1989) and Mohamed (1990).

III Effect of DLBA additions on moisture retention of sandy and calcareous soils.

Data in table (5) show the effect of the investigated conditioner on soil moisture characteristics, (water holding capacity, field capacity, wilting point and available water) in sandy and calcareous soils.

Table (4): Effect of DLBA on hydraulic conductivity of the investigated soils.

Treatment	Hydraulic conductivity cm/h	
	Sandy soil	Sandy loam soil
Control	15.23	10.11
0.1 %	13.89	10.80
0.2 %	13.11	10.96
0.5%	12.18	12.15

The moisture constants values of both sandy and calcareous soils treatments increased by increasing the added doses of DLBA used.

The values of water holding capacity in sandy soil increased from 20.08% for control to 22.11, 23.05 and 25.21%, while in calcareous soil the values were 28.11% for control treatment and 29.00, 29.39, 31.28%, respectively for 0.1, 0.2 and 0.5% of soil conditioner used.

The same trends were observed to the values of field capacity and wilting point, but the rate of increasing in witting point was less than in field capacity.

The increasing rate of available water percentages due to the 0.5% DLBA treatment compared to the control were 14.68% and 17.09% for sandy and calcareous soils respectively, while Mohamed (1990) found 6% and 13% in similar soils with 0.4% agrosoke. Azzam (1983) reported that the available water for plant increased eight times than the control by using 0.5% P.A.M.G. 2 in Inshas sandy soil.

These results could be explained on the basis of the effect of the DLBA on increasing micropores, mesopores and to aggregates formation.

Comparison between the two soils used indicated that DLBA was more efficient in increasing amount of available water in calcareous soil than in sandy soil especially in 0.5% addition rate of conditioner used.

These results are in good agreement with those obtained by De-Boodt (1990), and Abdulrasol abd Abdulaziz (1998) who reported that the use of soil conditioners increased field capacity, wilting point and available water in soils with increasing the rate of application.

Table (5) Effect of DLBA additions on soil moisture retention.

Treatment	W.H.C %	F.C. %	W.P. %	A.W. %
Sandy soil				
Control	20.08	8.77	2.30	6.47
0.1 %	22.11	9.11	2.41	6.70
0.2%	23.05	9.87	2.69	7.18
0.5%	25.21	10.71	2.88	7.42
Calcareous soil				
Control	28.11	14.55	5.35	9.95
0.1 %	29.00	15.13	5.60	10.33
0.2	29.39	16.50	5.86	11.02
0.5%	31.28	17.63	5.94	11.65

*** W.H.C : Water holding capacity** *** F.C. : Field capacity**
*** W.P : Wilting point** *** A.W. : Available water**

Generally, DLBA compound enhanced soil physical properties in both sandy and calcareous soils. Its effect increased as the addition rates increased. Also, its efficiency was about 10% of agrosoke efficiency.

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اختبار تجريبى لمركب DLBA كمحسن للتربة

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أجريت هذه الدراسة لبحث تأثير استخدام مركب DLBA على تحسين الخواص الطبيعية للأراضى الرملية والجيرية. وتمت الدراسة بأخذ عينات من مناطق الإسماعيلية والنوبارية وتم معاملتها بإضافة ٠,١ ، ٠,٢ ، ٠,٥ % حيث خلطت هذه الكميات بالأراض تحت الدراسة وتم توصيل المحتوى الرطوبى بعد الخلط إلى السعة الحقلية فى كلا الأرضين ثم عرضت لسلسلة من عمليات الإبتلال والجفاف.

أظهرت النتائج المتحصل عليها كفاءة استعمال هذا المركب فى الأرضى المستخدمة حيث قلت قيم الكثافة الظاهرية لكلا الأرضين كما قلت قيم التوصل الهيدروليكى للأراضى الرملية عن المعاملة الكنترول فى حين زاد التوصيل الهيدروليكى للأراضى الجيرية وذلك لإعادة توزيع مسام التربة نتيجة المعاملات كما زادت قيم السعة الحقلية ونقطة الذبول والماء الميسر فى كلا الأرضيين وكانت معدلات الزيادة فى النسبة المئوية للماء الميسر فى الأراضى الجيرية مقارنة بالكنترول أعلى منها فى الأراضى الرملية، كما زادت قيم التجمعات الأرضية وبالتالى متوسط وزن القطر (M.W.D) فى كلا الأرضين. وكانت قيم التحسن فى خواص الأرض تزداد بزيادة معدلات الإضافة من هذا المركب الجديد وبمقارنة هذا المركب مع فاعلية مركب الأجروسوك لنفس الأغراض فى أراضى مشابهة تبين أن فاعليته تساوى ١٠% من فاعلية الأجروسوك.

وعموماً يمكن القول بأن هذا المحسن مناسب لتحسين خواص التربة خصوصا أنه يمكن تحضيره من مواد تجارية إقصادية.