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EFFECT OF SOME AMENDMENTS ON SOME PHYSICAL AND HYDROPHYSICAL SOIL PROPERTIES.

El-Maddah, E. I.
Soil, Water and Environ. Res. Instit. Agric. Res. Center, Giza, Egypt.

ABSTRACT

A field experiment was carried out on clayey soil during seasons 1996/1997 and 1997 at El-Gemmeiza Agricultural Research station, El-Gharbia Governorate to find out the effect of some natural soil amendments saw-dust (S.D), Wheat straw (W.S), shell of peanut (S.P), plant residual (P.R), and farmyard manure (FYM) on some physical and hydrophysical soil properties.

Bulk density tended to a significant decrease while total porosity tended to a significant increase with application of the studied amendments as the amendment level in the soil increased. On the other hand, hydraulic conductivity and infiltration rate were significant increased compared with the control treatment. The best treatment was FYM at the application rate of 30 m^3/fed.

Application of these amendments caused an increase in moisture content at the different suctions, where the highest values were recorded for the FYM treatment and the lowest ones were obtained with saw-dust application. The higher the amendment content is the greater the water content at any particular suction. The increase in water content was greater at lower suctions than at the higher suctions. The available water storage capacity increased with increasing the added amount of amendment.

The results suggest that these amendments may increase the ability of clayey soil to store water for plant use.

Key words: Amendments, saw-dust, wheat straw, shell of peanut, farmyard manure.

INTRODUCTION

Rule of thumb calculation indicate that 7.5 million feddans under cultivation in Egypt would require 170 million tons of farmyard manure annually, much more than is available; other sources of organic matter must be identified and exploited.

The importance of organic matter to agriculture on arid and semi-arid soils is second only to that of water. Organic materials can increase soil productivity by improving physical properties. However, the organic matter content in Egyptian soils gradually decreased and in order to increase it, the use of different sources of organic residues became necessary. Saw-dust is an important wood industry-residue which can be used as an amendment in soils, where its application in a rate of 112 ton ha^{-1} enhanced water availability after 3 years of application and caused changes in chemical and physical properties of amended soil (Roberts et al., 1988).

Negm *et al.* (1996) found that water holding capacity tended to increase proportionally by increasing the quantity of saw-dust mixed with soil. They concluded also that saw-dust is a benefical amendment to improve the physical properties of soils.

Albinet (1971) found that the structural stability and porosity of alluvial soils were improved by application of straw. Miller and Aursted (1971) found that straw incorporation of the furrow bottom increased furrow infiltration into a sandy loam soil during 3 years study period. Straw incorporation became less effective as the season progressed. The annual addition of 13.4 tons of straw/ha. Increased infiltration over the control about 90% during the first irrigation, 65% during the second and 35% during the third irrigation.

In Egypt, Talha *et al.* (1979a) studied the effect of different rates of clover and wheat straw and decomposition rate on physical properties of alluvial soil. They found that the values of hydraulic conductivity, infiltration rate and total porosity increased as the added organic material increased, while the value of bulk density decreased.

Talha *et al.* (1979b) studied the effect of different rates of clover and wheat straw on water movement in calcareous soils under saturated flow. They found that the correlation coefficient between hydraulic conductivity and total porosity and quick drainable pores are positive and highly significant. However, the simple correlation coefficient between hydraulic conductivity and bulk density and slow drainable pores are negative but highly significant.

Russell *et al.* (1952) found that there was a significant positive correlation between the organic matter content and moisture retention. Hortenstine and Rothwell (1968) indicated that compost and other organic materials tend to increase the water holding capacity and improve the physical condition of most soils.

Morachan *et al*. (1972) reported that water retention were increased slightly but significant with increasing organic residues. The increases at low suction are evidently due to greater surface area and to greater number of large pores accompanying increased soil organic matter. The increase in high suction must be due to greater surface area. The bulk density was significantly decreased with increasing organic residues.

Salter and Williams (1963) reported that annual application of farmyard manure resulted in a significant increase not only in available water capacity of sandy loam soil, but also in volume of water released at low tensions. Biswas and Khosla (1971) observed an increase in soil water retention characteristics and hydraulic conductivity from applying organic matter (farmyard manure) to soils over a 20 year period. Mays et al (1973) found an increase from 11.1 to 15.3% in water content corresponding to the- 0.33 bar matric potential of a silt loam after an application of 327 metric ton/ha of municipal compost for 2 years in a pot study. Hamdi *et al.* (1979) found that the different levels of organic manures led to an increase in the maximum water holding capacity and a marked increase in the moisture equivalent. Im (1982) mentioned that the beneficial effects of organic matter addition on soil physical conditions included better aeration and increased infiltration for silty and clayey soils and increased water holding capacity and moisture availability for sandy soils. El-Awag *et al.* (1992) reported that farmyard manure (FYM) is one of the natural soil amendments which correcting and improving physical properties of soil especially, the heavy texture one.

The objective of the present work was to study the effect of some natural soil amendments on some physical and hydrophysical soil properties which reflect on soil productivity and plant health, in clayey soils.

MATERIALS AND METHODS

Two successive field experiments were carried out at El-Gemmeiza Agricultural Research Station (El-Gharbia Governorate) for two seasons, winter season 1996/1997 using wheat (Triticum aestivum) plants and summer season 1997 using maize plants (zea mays) to study the effect of soil amendments on some soil physical and hydro-physical properties. Soil properties of the experimental soil are presented in Table (1a) and analysis results of the used natural amendments are shown in Table (1b).

Table (1a): Some physical and chemical properties of the used soil.

Properties	**Values**	
Soil depth, cm	0 – 20	20 – 40
PH, 1= 2.5 (suspention)	7.98	8.10
Ece, dSm^{-1}	1.12	1.23
Soluble cations, meq L^{-1}		
Ca^{2+}	2.83	3.10
Mg^{2+}	3.18	3.28
Na^{+}	4.84	5.59
K^{+}	0.35	0.33
Soluble anions, meq L^{-1}		
CO_3^{2-}	---	---
HCO_3^{-}	3.14	2.99
CL^{-}	5.78	5.90
SO_4^{2-}	2.28	3.41
Sand, %	26.31	24.22
Silt, %	30.16	29.66
Clay, %	43.53	46.12
Texture class	Clayey	Clayey
Field capacity (F.C.), %	42.82	38.33
Wilting Point (W.P.), %	23.51	21.38
Available water (A.W.), %	19.31	16.95
Bulk density (Db) gm cm^{-3}	1.36	1.38
Total porosity (E), %	48.68	47.92
$CaCO_3$, %	1.98	2.13
O.M., %	2.28	1.46

Table (1b): Some chemical properties of the used amendments.

Amendments	**O.M., %**	**O.C., %**	**Total N., %**	**C/ N ratio**
Saw-dust (S-D.)	95.75	56.89	0.19	299.42
Wheat-straw (W-S)	84.15	48.81	0.27	180.78
Shell of Peanut (S.P.)	80.95	46.95	0.53	88.59
Plant residual (P.R)	76.58	44.42	1.08	41.13
Farmyard manure (FYM)	32.18	19.31	0.64	30.17

The area of the experiment was devided into 60 plots using a randomized complete block design with three replicates. The tested amendments are as follow:

1- Saw-dust. 2- Wheat straw. 3- Shell of peanut.
4- Plant residual 5- Farmyard manure.

The rates of all amendments were 0, 10, 20 and 30 m3/fed. The amendment amounts were homogenously mixed to 30 cm depth. Wheat (Sakha 1969) was planted in the first season (1996/1997) while zea mays (three-way cross-321) was planted in the second one (1997) without no application of any amendment to study the residual effect of applied amendments in the first season. The basel doses of N, P and K were applied according to the recommendations.

Soil samples (0-20 cm) and (20-40 cm) were collected from each plot at the end of each growing season to determine some physical and hydrophysical properties of soil. Soil bulk density (Db) was determined using the core method (Vomocil, 1986). Total porosity (E, %) were calculated according to the equation: E = (1- Db/Dr) X 100, where; Dr: is the real density.

Three replicates of both hydraulic conductivity and infiltration rate were determined (cm/hr.) using a constant water head for hydraulic conductivity and double ring infiltrometer for infiltration rate (Richards, 1954).

The moisture tension characteristic relationships were determined at suction of 0.001, 0.1, 0.33, 0.66, 1.0, 5 and 15 bars using pressure plate and pressure membrane apparatus. The field capacity (F.C.) at a tension of 0.33 bar and the wilting point (W.P.) at 15 bars (Richards, 1954).

Statistical analysis was done according to procedure out-lined by Snedecor and Cochran (1967). The mean values were compared at 0.05 level using L.S.D.

RESULTS AND DISCUSSION

Effect of added amendments on bulk density and total porosity:

Soil bulk density is one of the useful values which used as an indication for soil structure. This property was mainly affected by macro pore spaces. Data in Tables (2 and 3) showed that application of the studied amendments led to a significant decrease in bulk density of the two soil depths at the end of the two seasons compared with the control. The lowest values of the bulk density and the highest ones of the total porosity were associated with the treatment of FYM and the contrary were obtained with the saw-dust application. This decrease may be attributed to the high content of organic matter in these amendments which refers to formation of the soil aggregates. Such results agree with that obtained by El-Awage *et al.* (1992) and El-Naggar *et al.* (1996). Another explanation for the decrease in bulk density as a result of these applications is due to a dilution effect resulting from the mixing of the added organic matter with the more dense mineral fraction of the soil (Powers et al. 1975).

Table (2): Some physical properties of the studied soil as affected by the applied amendments at the first season (1996/1997).

Amendment application	Rate m^3/fed.	BuLK density (gm/cm^3)		Total Porosity, %		Hydraulic conductivity (cm/hr)		Infiltrat-ion rate (cm/hr.)
		0 – 20	20 – 40	0 – 20	20 – 40	0 – 20	20 – 40	
Saw-dust (S.D.)	0	1.36	1.38	48.68	47.93	0.79	0.74	0.96
	10	1.33	1.36	49.81	48.68	0.82	0.76	0.99
	20	1.30	1.35	50.94	49.06	0.84	0.78	1.06
	30	1.28	1.33	51.70	49.81	0.87	0.79	1.12
	Mean	1.32	1.36	50.28	48.87	0.83	0.77	1.03
Wheat straw (W.S.)	0	1.36	1.38	48.68	47.93	0.80	0.74	0.97
	10	1.31	1.36	50.57	48.68	0.84	0.77	1.04
	20	1.28	1.34	51.70	49.43	0.87	0.79	1.11
	30	1.26	1.33	52.45	49.81	0.89	0.82	1.15
	Mean	1.30	1.35	50.85	48.96	0.85	0.78	1.07
Shell of Peanut (S.P.)	0	1.36	1.38	48.68	47.93	0.80	0.75	0.96
	10	1.32	1.37	50.19	48.30	0.85	0.78	1.05
	20	1.29	1.35	51.32	49.06	0.87	0.80	1.12
	30	1.27	1.33	52.08	49.81	0.90	0.83	1.16
	Mean	1.31	1.36	50.57	48.78	0.86	0.79	1.07
Plant residual (P.R.)	0	1.36	1.38	48.68	47.93	0.80	0.73	0.97
	10	1.30	1.35	50.94	49.06	0.86	0.79	1.13
	20	1.26	1.33	52.45	49.81	0.88	0.81	1.18
	30	1.24	1.30	53.21	50.94	0.91	0.84	1.21
	Mean	1.29	1.34	51.32	49.44	0.86	0.79	1.12
Farmyard manure (FYM)	0	1.36	1.38	48.68	47.93	0.79	0.74	0.97
	10	1.28	1.31	51.70	50.57	0.91	0.86	1.20
	20	1.23	1.29	53.58	51.53	0.94	0.89	1.27
	30	1.21	1.25	54.34	52.83	0.97	0.91	1.32
	Mean	1.27	1.31	52.08	50.71	0.90	0.85	1.19
L.S.D. (P = 0.05)		0.02	0.03	0.88	1.23	0.03	0.05	0.06

With regard to effect of the application rates of amendments on bulk density and total porosity, data in Tables (2 and 3) revealed that bulk density tended to decrease as the amendment level in the soil increases. Total porosity take the opposite. The lowest values of bulk density and the highest ones of the total porosity were obtained by addition of 30 m3/fed. of any amendments and the highest values of bulk density and lowest ones of total porosity were obtained by control (Without amendments).

The previous tables showed that slight decrease in values of bulk density for saw-dust, wheat straw and shell of peanut. The values were slight decrease after wheat and corn but the values of all treatments were lower in the upper soil layer than in the deeper one due to the turning under of amendments which did not reach to the deeper depth with the same quantities of their arrangement in the upper layer.

The lower bulk density of the treated soil with amendments at the end of the first season compared with the second season may be due to the depression in the residual effect of these amendments in the second season as a result of its decomposition.

Table (3): Some physical properties of the studied soil as affected by the applied amendments at the second season (1997).

Amendment application	Rate m^3/fed.	BuLK density (gm/cm^3)		Total Porosity, %		Hydraulic conductivity (cm/hr)		Infiltration rate (cm/hr.)
		0 – 20	20 – 40	0 – 20	20 – 40	0 – 20	20 – 40	
Saw-dust (S.D.)	0	1.36	1.38	48.68	47.93	0.80	0.75	0.97
	10	1.34	1.37	49.43	48.30	0.81	0.78	1.03
	20	1.31	1.36	50.57	48.68	0.82	0.79	1.09
	30	1.29	1.34	51.32	49.68	0.84	0.80	1.14
	Mean	1.33	1.36	50.00	48.59	0.82	0.78	1.06
Wheat straw (W.S.)	0	1.36	1.38	48.68	47.93	0.79	0.74	0.96
	10	1.32	1.37	50.19	48.30	0.83	0.79	1.07
	20	1.29	1.35	51.32	49.06	0.85	0.80	1.13
	30	1.28	1.34	51.70	49.43	0.86	0.83	1.16
	Mean	1.31	1.36	50.47	48.68	0.83	0.79	1.08
Shell of Peanut (S.P.)	0	1.36	1.38	48.68	47.93	0.78	0.74	0.98
	10	1.33	1.37	49.81	48.30	0.84	0.78	1.09
	20	1.30	1.36	50.94	48.68	0.86	0.81	1.15
	30	1.29	1.34	51.32	49.43	0.88	0.84	1.17
	Mean	1.32	1.36	50.19	48.59	0.84	0.79	1.10
Plant residual (P.R.)	0	1.36	1.38	48.68	47.93	0.79	0.75	0.97
	10	1.32	1.36	50.19	48.68	0.82	0.78	1.14
	20	1.28	1.34	51.70	49.43	0.87	0.82	1.19
	30	1.26	1.32	52.45	50.19	0.89	0.84	1.22
	Mean	1.31	1.35	50.76	49.06	0.84	0.80	1.13
Farmyard manure (FYM)	0	1.36	1.38	48.68	47.93	0.79	0.75	0.97
	10	1.30	1.32	50.94	50.19	0.85	0.79	1.15
	20	1.26	1.30	52.45	50.94	0.87	0.81	1.20
	30	1.23	1.27	53.59	52.08	0.91	0.83	1.23
	Mean	1.29	1.32	51.42	50.28	0.86	0.80	1.14
L.S.D. (P = 0.05)		0.05	0.06	1.73	2.21	0.06	0.06	0.07

Effect of added amendments on hydraulic conductivity and infiltration rate:

The hydraulic conductivity and infiltration rate are a function of the pore size distribution, and are affected by geometry of the pores especially the macro pores which are the main contributors to the passage of water. Data in Tables (2 and 3) revealed that application of the studied amendments led to a significant increase in both hydraulic conductivity and infiltration rate. Generally, hydraulic conductivity decreases as soil depth increases. The highest values of the hydraulic conductivity and infiltration rate were recorded for the treatment of FYM, and the lowest ones were obtained with the saw-dust application. These increments may be due to the role of organic materials on formation of water stable aggregates and hence increasing in total porosity. Similar results had been obtained by EL-Naggar *et al*. (1996). Hardan and AL-Ani (1978) stated that the addition of date and sugar beet waste improved the infiltration rate and hydraulic conductivity of the soils.

Concerning the effect of the application rate of amendments on the hydraulic conductivity and infiltration rate, data in Tables (2 and 3) showed that hydraulic conductivity and infiltration rate tended to increase as the amendment level in the soil increases. The highest values of both hydraulic conductivity and infiltration rate were obtained by adding $30m^3$/fed of any amendments and the lowest ones were obtained by control (Without amendments).

The increasing values of infiltration rate of the treated soil with some amendments such as saw-dust, wheat straw and shell of peanut at the end of the second season compared with the first one may be due to the slight decomposition of these materials after the first season, while the contrary were obtained with farmyard manure which may be due to the depression in its residual effect in the second season.

Effect of added amendments on soil moisture properties:

Soil moisture retention is one of the limiting factor on agriculture development, particularly in arid and semi-arid zones where the amount of water is very limited. The capacity of soils to receive or store water which is available to the growing plants is a great importance to agriculture production. soil moisture content at different tensions ranging from 0.0 to 15 bars tension for amended soil with different rates of amendments are given in Tables (4 and 5). Data obtained indicated that all amendments caused an increase in moisture content at the end of the two seasons compared with the control. The highest values of moisture content were recorded for the treatment of FYM, and the lowest ones were obtained with saw-dust application. The increase in water content was greater at lower suctions than the higher suctions. This increase at low suctions are evidently due to greater surface area and to greater number of large pores accompanying increasing soil organic matter, whereas the increase at high suction must be due to a greater surface area. These results are in line with that obtained by Negm *et al.,* (1996) who reported that water holding capacity was markedly raised by any of addation especially in case of saw-dust present alone. Similar results were obtained by Roberts *et al*., (1988).

Concerning the effect of the application rates of the amendments on soil moisture content data revealed that the higher the amendment content is the greater the water content at any particular suction. Thus water holding capacity at any tension increased with increasing the rate of amendment application.

The relationship between the rate of amendments and soil moisture percentage at field capacity (0-33 bar), wilting point (15 bars) and available water percentage in soils were positive in both seasons. The available water storage capacity increased with increasing the added amount of amendment. Salter *et al.* (1966) found that the available water storage of a soil was negatively correlated with coarse sand percentage and positively with fine sand and organic matter content. Since organic matter has high water holding capacity, its addition to soil should increase the amount water available to plants.

Table (4): Retained soil moisture percentage (on weight basis) at different tensions of the studied soil as affected by applied amendments at the first season (1996/1997).

Treatment	Rate m^3 /fed.	First season (1996/1997)							
		Tension bar							Available water (A.W)
		0.001	0.1	0.33	0.66	1	5	15	
Saw-dust (S.D.)	0	75.64	61.02	46.39	41.55	37.29	31.41	25.53	20.86
	10	86.49	67.82	48.04	42.27	37.91	31.90	25.89	22.15
	20	87.51	68.40	48.79	43.12	39.02	33.25	26.43	22.36
	30	88.13	70.15	49.87	44.18	39.93	33.43	26.94	22.93
Wheat straw (W.S.)	0	74.42	60.59	46.16	41.22	37.28	31.35	25.59	20.57
	10	87.56	68.57	48.47	42.71	38.02	32.04	26.05	22.42
	20	88.32	69.15	49.50	43.26	39.34	33.42	26.85	22.65
	30	89.20	71.21	50.11	44.43	39.65	33.51	26.96	23.15
Shell of Peanut (S.P.)	0	75.52	60.83	46.13	40.85	37.35	31.14	25.36	20.77
	10	88.13	69.12	48.68	42.92	38.57	32.12	25.95	22.73
	20	89.73	69.95	49.81	43.86	39.72	33.54	26.87	22.94
	30	90.71	71.82	50.22	44.73	39.95	33.72	26.99	23.23
Plant residual (P.R.)	0	75.43	60.86	46.28	40.82	37.24	31.38	25.51	20.77
	10	89.12	69.96	48.95	43.93	38.78	32.87	25.84	23.11
	20	90.32	70.17	49.98	43.97	39.85	33.65	26.25	23.73
	30	93.12	71.93	50.74	44.92	39.98	33.92	26.51	24.23
Farmyard manure (FYM)	0	75.55	61.05	46.26	41.34	37.30	31.15	25.61	20.65
	10	91.25	70.22	50.95	43.82	38.29	32.95	27.02	23.93
	20	92.32	71.81	52.72	44.04	40.10	33.82	28.47	24.25
	30	94.84	73.99	53.99	45.25	40.15	34.10	28.86	25.13

This could be attributed to increasing organic matter content in the soil with increasing amendment application to soil, which has an important role in producing greater number of larger size pores. However, the values of field capacity, wilting point and available water in the second season were lower than those obtained in the first one. This indicates a lower residual effect of added amendments in the second season.

These results of increasing water holding and available water storage capacities, and decrease bulk density are important in assessment of water requirements and planning of irrigation schedule.

Thus application of these amendments to soil increase the carbon content of the soil. An increase in carbon content of the soil increases aggregation, decreases bulk density, increases water holding capacity and hydraulic conductivity (Biswas and Khosla 1971, Kladivok and Nelson 1979).

Table (5): Retained soil moisture percentage (on weight basis) at different tensions of the studied soil as affected by applied amendments at the second season (1997).

Treatment	Rate m^3/fed.	Second season (1997)							
		Tension bar							Available water (A.W)
		0.001	0.1	0.33	0.66	1	5	15	
Saw-dust (S.D.)	0	70.35	56.75	43.71	38.64	34.70	29.21	23.74	19.97
	10	83.12	64.52	44.93	40.16	36.01	29.93	24.60	20.33
	20	85.03	65.93	46.72	41.66	37.07	31.59	25.10	21.62
	30	85.90	66.64	47.38	42.58	37.93	31.76	25.60	21.78
Wheat straw (W.S.)	0	70.21	56.07	43.79	38.34	34.67	29.16	23.80	19.99
	10	80.13	62.47	45.49	39.72	35.36	29.80	24.64	20.85
	20	82.14	64.10	47.10	40.98	36.40	30.68	25.35	21.75
	30	85.82	66.23	47.54	41.32	36.74	30.82	25.72	21.82
Shell of Peanut (S.P.)	0	70.23	56.57	43.72	37.99	33.79	29.38	23.74	19.98
	10	76.42	60.60	45.78	38.82	33.84	29.67	24.87	20.91
	20	78.32	61.89	47.27	39.52	34.17	29.92	25.46	21.81
	30	82.60	64.28	47.78	40.20	34.94	30.12	25.84	21.94
Plant residual (P.R.)	0	70.15	55.99	43.69	37.55	33.70	28.25	23.72	19.97
	10	78.13	61.34	46.08	39.25	33.86	28.31	24.95	21.13
	20	80.44	62.96	47.44	39.37	34.46	28.59	25.52	21.92
	30	84.74	65.46	48.07	39.56	34.56	28.96	25.92	22.15
Farmyard manure (FYM)	0	70.32	56.78	43.87	39.00	34.92	29.50	23.82	20.05
	10	76.97	60.72	44.46	39.55	35.29	29.93	24.05	20.41
	20	79.43	62.52	45.61	39.86	35.45	29.99	24.45	21.16
	30	84.41	65.85	47.31	40.27	35.70	30.12	25.69	21.62

From aforementioned discussion it could be concluded that these amendments are beneficial to improve the physical and hydrophysical properties of clayey soils.

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تأثير بعض مصلحات التربة على بعض خواص الأرض الطبيعية والهيدروفيزيائية.

الحسينى إبراهيم المداح
معهد بحوث الأراضى والمياه والبيئة - مركز البحوث الزراعية - الجيزة - مصر.

أجريت تجربة حقلية فى أرض طينية بمحطة البحوث الزراعية بالجميزة محافظة الغربية خلال موسمى ١٩٩٦ /١٩٩٧ ، ١٩٩٧م لدراسة تأثير إضافة بعض مصلحات التربة (نشارة الخشب — تبن القمح — قشر الفول السودانى — مخلفات نباتية —وسماد بلدى) على بعض الخواص الطبيعية والهيدروفيزيائية للأرض.

أوضحت النتائج أن إضافة المصلحات أدى إلى نقص الكثافة الظاهرية وزيادة المسامية للتربة بزيادة معدل إضافة المصلحات. كما إزداد كلا من التوصيل الهيدروليكى ومعدل رشح المياه فى التربة فى نهاية موسمى النمو بالمقارنة بالكونترول، وكانت أحسن معاملة فى تحسين خواص التربة الطبيعية هى معاملة السماد البلدى، وأحسن معدل للإضافة هو ٣٠م٣/ فدان.

ووجد أيضاً أن إضافة هذه المصلحات أدت إلى زيادة المحتوى الرطوبى عند الضغوط المختلفة، وكانت أعلى القيم لمعاملة السماد البلدى وأقلها لمعاملة نشارة الخشب، وأن هذه القيم تزداد بزيادة معدلات الإضافة عند أى من الضغوط. كما أن الزيادة فى المحتوى الرطوبى تكون أكبر عند الضغوط المنخفضة وأقل عند الضغوط المرتفعة. وبذلك تزداد كمية الماء الصالحة للنبات. وقد اقترحت الدراسة أن هذه المصلحات يمكنها أن تزيد من قدرة الأرض الطينية على تخزين الماء من أجل استعمال النبات.