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Effect of organic fertilizers on the water holding capacity of soil in different terrains of Jaffna peninsula in Sri Lanka

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ABSTRACT

Soil texture and organic matter content are the key components that determine soil water holding capacity (WHC). Management practices designed to improve soil structure are the main way to improve WHC. The object of this study was to improve the WHC of farm soils by the addition of organic fertilizers. Soil obtained from 10 different areas in Jaffna peninsula and evaluated the effect of organic fertilizers such as compost fertilizer and cow dung on the WHC of those soils. The soils from Urumpirai (0.536 ± 0.04) and Ariyali (0.535 ± 0.01) showed higher mean WHC where as soil from Iddaikaddu showed lower mean WHC than other soil samples. A significant difference ($p < 0.05$) was observed on mean WHC of each soil sample with compost fertilizer and cow dung treated separately when compared to the control. Addition of compost fertilizer and cow dung treated separately increased the mean WHC of each soil sample. Cow dung doubly increased the WHC of each soil sample. The best option for a farmer is to increase their soil organic matter to increase the WHC of their farm soil. More water in the soil could save time, money and energy spent on frequently irrigating garden plants, pot plants, glasshouse plants and general horticulture.

Keywords: Water Holding Capacity, Organic fertilizer, Compost fertilizer

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INTRODUCTION

Water holding capacity of soils is controlled primarily by: (i) the number of pores and pore-size distribution of soils; and (ii) the specific surface area soils. Because of increased aggregation, total pore space is increased [1, 2, 3, 4]. Furthermore, as a result of decreased bulk density, the pore-size distribution is altered and the relative number of small pores increases, especially for coarse textured soils [3]. Since the tension which causes a particular pore to drain is dependent on the effective diameter of the pore, greater tension is required to drain small pores, compared to large pores. The increased WHC at lower tensions such as those at field capacity is primarily the result of an increase in number of small pores. At higher tensions close to wilting range, nearly all pores are filled with air and the moisture content is determined largely by the specific surface area and the thickness of water films on these surfaces. Sandy soils have much less surface area than clayey soils and, thus, retain much less water at higher tensions. However, with the addition of organic matter, specific surface area increases resulting in increased WHC at higher tensions [3, 5]. Soil "holds" water available for crop use, retaining it against the pull of gravity. This is one of the most important physical facts for agriculture. If the soil did not hold water, if water was free to flow downward with the pull of gravity as in a river or canal, we would have to constantly irrigate, or hope that it rained every two or three days. There would be no reason to pre-irrigate. And there would be no such thing as dry-land farming. Soil texture and organic matter are the key components that determine soil water holding capacity.

Application of wastes, either for plant nutrient supply or for disposal purposes, increases the C content of the soil. An increase in C content of the soil increases aggregation, decreases bulk density, increases water holding capacity, and hydraulic conductivity [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,]. The objective of this study is to compare the water holding capacity of different soil present in Jaffna peninsula and to find out the effects of organic fertilizer applications on the water holding capacity of those soils.

MATERIALS AND METHODS

Effect of organic fertilizers on the water holding capacity of soil samples

Numbers of small holes were picked in the base of the tin box. The box was filled with 100g of air dried and sieved soil which was obtained from Thirunelvelly area. Then 30g of compost fertilizer and cow dung were mixed to that soil sample separately. Soil sample in the absence of organic fertilizers was used as control. Water was added to that soil got saturated. The tin was kept in a slanting position and hanged it to a stand with the help of string. Extra water came out of the perforation at the base. It was allowed to stand for a while. When water drops were stopped to come out, the soil was removed and weighed immediately. Afterwards the soil was kept in a hot air oven and dried at 105^{o}C for 48h [13]. Then the soil sample was cooled in a dessicator and weight was recorded. The same procedure was repeated for different soils which were obtained from various places in Jaffna peninsular such as Erlali, Urumpirai, Manthikai, Iddaikaddu, Kaithady, Chavakacheri, Ariyali, Sanguveli and Naavaly.

Calculation of Soil water holding capacity per gram of soil

Water Holding Capacity of soil (per gram of soil) = $\dfrac{\text{Weight of soil after water drained off (g)} \; - \; \text{Weight of soil after kept at } 105^{o}\text{C for (g) 48h}}{}$

Statistical Analysis

ANOVA and LSD were carried out by using SAS pakage. Weight of initial soil (100g)

Results and discussion

Water holding capacity refers to the amount of water held between field capacity and wilting point (Figure 1). Soils vary in their water holding capacity according to their structure, texture and bulk density relation ship to total pore size distribution. Soil with little water holding capacity soon dries out, reducing evaporation from its surface. In turn, the rapid decrease in soil water potential places the vegetation under greater stress, which in turn reduces transpiration as the stomatas close. Photosynthesis is accordingly reduced. The soil with small water holding capacities will require more frequent irrigation than those with large water holding capacities.

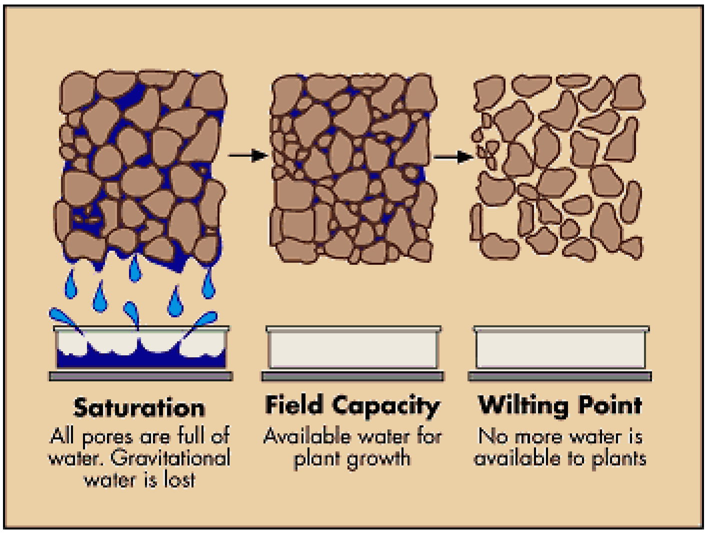

Figure 1: Stages of water holding [14].

Soil samples obtained from 10 different areas in Jaffna such as Erlali, Urumpirai, Thirunelvelly, Manthikai, Iddaikaddu, Kaithady, Chavakacheri, Ariyali, Sanguveli and Naavaly. Results were analysed statistically using ANOVA and LSD were carried out by using SAS pakage. Among these, soil samples obtained from Urumpirai and

Ariyali showed higher WHC than other soil samples (Table 1). But the soil obtained from Iddaikaddu showed less WHC compared to other soil samples. The increased WHC at lower tensions such as those at field capacity is primarily the result of an increase in number of small pores.

Organic matter and soil aggregation are inversely related to runoff volumes and sediment loss [15, 16]. The low runoff losses may be due to improved soil physical properties as a result of waste applications. Because of increased aggregation, less erosion has also been reported [1, 17, 18].

At higher tensions close to wilting range, nearly all pores are filled with air and the moisture content is determined largely by the specific surface area and the thickness of water films on these surfaces. Sandy soils have much less surface area than clayey soils and, thus, retain much less water at higher tensions. However, with the addition of organic matter, specific surface area increases resulting in increased WHC at higher tensions [3, 5].

Table 1: Water Holding Capacity of soils from different terrains in Jaffna peninsular

Terrain	WHC
Thirunelvelly	0.356 ± 0.03
Erlali	0.5 ± 0.02
Urumpirai	0.536 ± 0.04
Manthikai	0.428 ± 0.02
Iddaikaddu	0.335 ± 0.01
Kaithady	0.449 ± 0.03
Chavakacheri	0.467 ± 0.01
Ariyali	0.535 ± 0.01
Sanguveli	0.352 ± 0.005
Naavaly.	0.444 ± 0.01

Note: Values are given as Mean ± SD of six replicated experiments

Statistical analysis showed that there was a significant difference in the mean ($p< 0.05$) WHC of each soil sample with compost fertilizer and cow dung treated separately when compared to the control. Addition of compost organic fertilizer and cow dung separately increased the WHC of the each soil sample (Table 2). But the addition of cow dung increased the WHC of the each soil sample doubly than addition of compost organic fertilizer. The effect of solid wastes on soil physical properties largely depends on the rate of decomposition of wastes and its contribution to soil organic C. Factors affecting the rate of decomposition include (i) chemical composition of the waste (i.e., C content, C/N ratio); (ii) temperature, (iii) soil moisture; (iv) method of waste application, i.e., surface-applied or soil-incorporated; and (v) rate of application [19].

The water retained by the cow dung was higher than compost organic fertilizer. Therefore addition of cow dung in crop lands increases the WHC of soil this addition enhance plant growth and improve water use efficiency. Organic matter percentage influences in the water-holding capacity. As the percentage increases, the water-holding capacity increases because of the affinity organic matter has for water.

Table 2: Water Holding Capacity of soils from different terrains in Jaffna peninsular in the presence of Compost organic fertilizer and Cow dung separately.

Terrain	WHC of Soil in the presence of	
	Compost organic fertilizer	Cow dung
Thirunelvelly	0.551 ± 0.03	1.213 ± 0.04
Erlali	0.64 ± 0.02	1.415 ± 0.06
Urumpirai	0.631 ± 0.02	1.287 ± 0.03
Manthikai	0.555 ± 0.03	1.353 ± 0.01
Iddaikaddu	0.555 ± 0.02	1.144 ± 0.03
Kaithady	0.655 ± 0.02	1.374 ± 0.05
Chavakacheri	0.660 ± 0.006	1.445 ± 0.02
Ariyali	0.586 ± 0.088	1.435 ± 0.008
Sanguveli	0.473 ± 0.01	1.362 ± 0.01
Naavaly.	0.5208 ± 0.004	1.338 ± 0.01

Note: Values are given as Mean ± SD of five replicated experiments

CONCLUSION

Water holding capacity increased with addition of organic fertilizers, but increases vary with soil texture. The results from this study indicated that the addition of cow dung increased the WHC of the soils doubly than addition of compost organic fertilizer. The water retain by the cow dung is used by the plants and this addition enhances plant growth and improves water use efficiency. More water in the soil could save time, money and energy spent on frequently irrigating garden plants, pot plants, glasshouse plants and general horticulture.

REFERENCES

[1] EJ Kladiviko; DW Nelson. *J. Water Pollu. Cont. Fed.*, **1979**, 51, 325-332.
[2] AE Tiarks; AP Mazurak; Leon Chesin. *Soil Sci. Soc. Am. Proc.*, **1974**, 38, 826-830.
[3] VV, Volk; CH Ullery. Dep. of Soil Sci., Oregon state Univ., Coruallis, **1993**, 50p
[4] RTB Williams; G W Cooke. *J. Soil Sci.*, **1961**, 93, 30-39.
[5] SC Gupta; RH Dowdy; WE Larson. *Soil Sci. Soc. Am. Proc.*, **1977**, 41, 601-605.
[6] TD Biswas; BK Khosla. *In Proc. Int. Symp. on Soil Fert. Eval. India*, **1971**, 1, 831-842.
[7] A Klute; WC Jacob. *Soil Sci. Soc. Am.*, **1949**, 14, 24-28
[8] DA Mays; GL Terman; JC Duggan. *J. Envi. Qual.*, **1973**, 2, 28-91
[9] PJ Salter; F Haworth. *J. Soil Sci.*, **1961**, 12, 335-342.
[10] PW Unger; BA Stewart. *Soil Sci. Soc. Am. Proc.*, **1974**, 38, 954-957.
[11] LR Webber. *J. Envi. Qual.*, **1978**, 7, 397-400.
[12] RR Weil; W Kroontje. *J. Envi. Qual.*, **1979**, 8, 387-392.
[13] S Sundara Rajan. Practical manual of Plant Ecology and Plant Physiology, 1st Ed, Anmol Publications PVT.LTD, New Delhi-110 002 (India), **2001**, pp 10.
[14] JPB Blencowe; SD Moore; GJ Young; RC Shearer; R Hagerstrom; WM Conley; JS Potter. Soil Department of Agriculture Bulletin 462, **1960**.
[15] WH Wischmeier; JV Mannering. *J. Soil and Water Conse.*, **1965**, 20, 150-151.
[16] WH Wischmeier; JV Mannering. *Soil Sci. Soc. Am. Proc.*, **1969**, 33, 131-137.
[17] KA Kelling; AE Peterson; LM Walsh. *J. water Pollu. Cont. Fed.*, **1977**, 49, 1698-1703.
[18] RA Young. Cornell university conference on agricultural waste management, **1970**, 484-492.
[19] R Khaleel; KR Reddy; MR Overcash. *J. Envi. Qual.*, **1981**, 10, 133-141