The Andhra Agric. J 68 (4): 433-436, 2021

Determination of Water Holding Capacity of Organics and Soil

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ABSTRACT

A laboratory experiment was conducted to assess the water holding capacity of different organic materials and soil during 2014-15 at Agronomy Laboratory, Regional Agricultural Research Station, Tirupati. The treatments consisted of ten, *i.e.*, Farm Yard Manure (T_1), Pressmud cake (T_2), Vermicompost (T_3), Soil (T_4), Farm Yard Manure (15%) + Soil (T_5), Pressmud cake (15%) + Soil (T_6), Vermicompost (15%) + Soil (T_7), Farm Yard Manure (30%) + Soil (T_8), Pressmud cake (30%) + Soil (T_9) and Vermicompost (30%) + Soil (T_{10}) and replicated thrice. Results were analysed in SPSS 20 using one way Analysis Of Variance technique (ANOVA) and Duncan's Multiple Range Test (DMRT) to know the significant variations among the treatments with respect to the water holding capacity. The experimental results revealed that different organic materials tested are having significantly higher water holding capacity compared to soil alone. The highest water holding capacity (68.35%) was recorded with pressmud cake alone (T_2) followed by Vermicompost (59.21%) and FYM (57.50%). While, the lowest water holding capacity (32%) was recorded with soil alone (T_4). When all these organic materials are combined with soil @ 15 and 30% on weight-by-weight basis, the water holding capacity of soil alone was enhanced from 32- 47.87 per cent and 32-57.49 per cent respectively. It can be concluded that organic materials alone or in combination with soil would enhance the water holding capacity.

Keywords: *Water holding capacity, organic FYM, Pressmud cake and Vermicompost and Alfisols.*

Dry land agriculture depends on the management of two basic natural resources, soil and water. Soil is the supporting structure of plant and sustains its life. Judicious use of these resources requires a basic understanding of soil and water as well as the crop. The available water holding capacity and characteristics of soil are critical to water management planning for irrigation and dry land crops. The management decisions of what crops to grow, plant population, when to irrigate, how much to irrigate, when to apply nitrogen, and how much nitrogen to apply depend in part on the water holding capacity of soil.

Soil water holding capacity is the amount of water that a given soil can hold against the force of gravity. Soil texture and organic matter are the key components that determine soil water holding capacity. Soils with smaller particle sizes, such as silt and clay have larger surface area can hold more water compared to sand which has large particle sizes which results in smaller surface area. A study showed that 1% increase in soil humus will result in a 4% increase in stored soil water (Morris, 2004) and 1 part humus holds 4 parts of water (Wheeler and Ward, 1998). Therefore, the more humus that can be added to the soil, the greater the water holding capacity of the soil.

MATERIAL AND METHODS

A laboratory experiment was conducted to assess the water holding capacity of different organic materials and soil during 2014-15 at Agronomy Laboratory, Regional Agricultural Research Station, Tirupati. The collected soil samples and organic materials were air-dried and passed through a 2 mm mesh sieve for determining water holding capacity (WHC). The treatments consisted of ten, *i.e*., Farm Yard Manure (T_1), Pressmud cake (T_2), Vermicompost (T_3), Soil (T_4), Farm Yard Manure (15%) + Soil (T_5), Pressmud cake (15%) + Soil (T_6), Vermicompost (15%) + Soil (T_7), Farm Yard Manure (30%) + Soil (T_8), Pressmud cake (30%) + Soil (T_9) and Vermicompost (30%) + Soil alone (T_{10}) and replicated thrice (Table 1). Water holding capacity of soil was determined by the Keen-Raczkowski Box Method (Keen & Raczkowski, 1921).

The radius and depth of keen box was measured with a vernier calipers. The dish of the keen box was cleaned and dried and it is weighed. Whatman No.1 and 44 filter paper is cut and placed at the bottom of the keen box. The air-dried soil was passed through a 2mm sieve. Then the box is filled with soil with repeated tapings (20-30 timing) on the top of the table for complete and uniform packing. The surface is leveled with the spatula. The keen box with air-dry soil is weighed. The box is placed in the soaking tray and gradually filled with water from the side till the water level was about 1 cm above the base of the box. The tray is covered to prevent evaporation from soil surface and it is kept for 12 hours or more for equilibrium. A continuous and shining film of water at the soil surface confirms this. The box is carefully removed from the water and wiped dry from outside and weighed quickly. The expanded soil (above dish's rim) is cut off with spatula and it is transformed to previously weighed watch glass. The watch glass is weighed with expanded out wet soil. The soil of watch glass and keen box is dried in the oven at 105^0C and constant weight is recorded. A blank test (only with keen box and filter paper) was also run simultaneously to find the weight of the water absorbed by the filter paper alone.

$$\text{Water Hilding Capacity (WHC)} = \frac{\text{Total quantity of water present in the wet soil}}{\text{Oven dry weight of total soil}} \times 100$$

Results were analysed in SPSS 20 using one way Analysis of Variance technique (ANOVA) and Duncan's Multiple Range Test (DMRT) to know the significant variations among the treatments with respect to the water holding capacity of different treatments.

RESULT AND DISCUSSION

Water holding capacity refers to the amount of water held between field capacity and wilting point (Fig.1). Soils vary in their water holding capacity according to their structure, texture and bulk density relationship to total pore size distribution. (Reichert *et al.*, 2009) 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 stomata close. Accordingly, photosynthesis is reduced. The soil with small water holding capacities will require more frequent irrigation than those with large water holding capacities**.**

The experimental results revealed that different organic materials tested are having significantly higher water holding capacity compared to soil alone. The highest water holding capacity (68.35%) was recorded with pressmud cake alone (T_2) followed by

Table 1. Effect of various organic materials and soil alone on water holding capacity

S.No	Treatments	Water holding capacity (WHC)	Per cent increase in WHC
T_1	Farm Yard Manure	$57.50 \pm 1.44^{(c)}$	44.35
T_2	Pressmud cake	$68.35 \pm 1.09^{(a)}$	53.18
T_3	Vermicompost	$59.21 \pm 1.30^{(b)}$	45.96
T_4	Soil	$32.00 \pm 1.04^{(h)}$	-
T_5	Farm Yard Manure (15%) + Soil	$38.82 \pm 0.44^{(g)}$	17.57
T_6	Pressmud cake (15%) + Soil	$47.87 \pm 0.18^{(d)}$	33.15
T_7	Vermicompost (15%) + Soil	$40.59 \pm 0.53^{(f)}$	21.16
T_8	Farm Yard Manure (30%) + Soil	$46.54 \pm 0.48^{(e)}$	31.24
T_9	Pressmud cake (30%) + Soil	$57.49 \pm 0.54^{(c)}$	44.34
T_{10}	Vermicompost (30%) + Soil	$45.85 \pm 0.86^{(e)}$	30.21

** Significant at 1% level same alphabet beside Means indicates insignificant difference (DMRT).

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

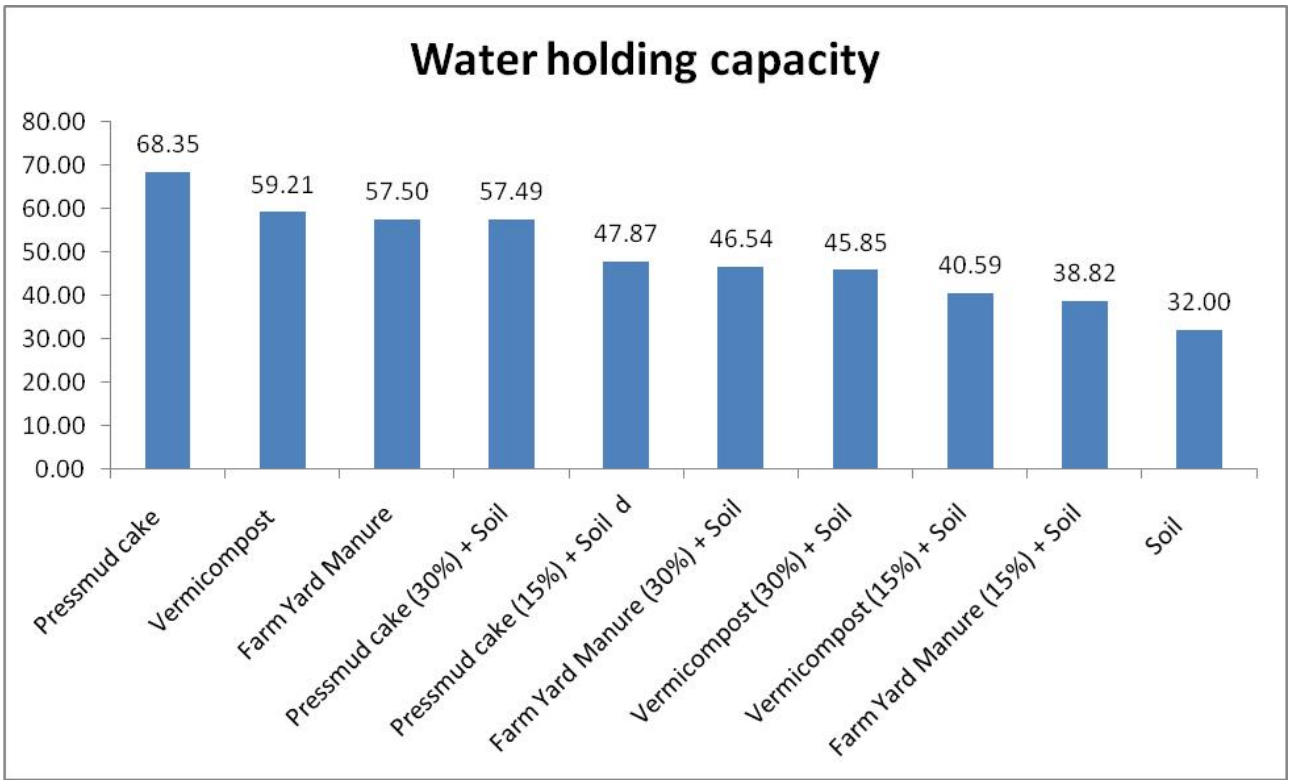

Figure 1. Effect of various organic materials and soil on water holding capacity

vermicompost (59.21%) and FYM (57.50%). While, the lowest water holding capacity (32%) was recorded with soil alone (T_4). When all these organic materials are combined with soil @ 15% and 30% on weight-by-weight basis, the water holding capacity of soil alone was enhanced from 32 to 47.87% and 32 to 57.49%, respectively (Table. 1). It can be concluded that organic materials alone or in combination with soil would enhance the water holding capacity (Fig.2). The water holding capacity of the soil which may depends on micro porosity of soil, varied significantly with application of organic nutrients. Furthermore, the high humus content along with increased surface area and favourable aggregates might had resulted in increased water holding capacity in those treatments. These results are in the conformity with the results of earlier worker Maheswarappa *et al.,* (1999) that FYM and vermicompost application increased soil porosity and water holding capacity to a greater extent after growing of East Indian Galangal.

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Received on 19.10.2021 and Accepted on 23.12.2021