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Soil water holding and related properties suited to aquaculture pond in coastal saline belt

Selection of site is one of the most important factors for success of coastal aquacultural farm. A suitable site is the one that provides optimum conditions for the growth of the species cultured at the targeted production level. Soils with high water holding capacity to make feasible earthen pond construction and to prevent losses due to seepage in the ponds are desirable. Texture, bulk density, organic matter and specific gravity determine to a large extent the water retention by soil. The retention and release of water by soil is a direct functional arrangement of soil aggregates and their porosity (Nagar *et al.*, 1995). The present study was undertaken to assess the water holding capacity of coastal soils in relation to different properties of soil.

Six soil samples were collected from each of three coastal areas, viz., Muttukadu (Chengai M. G. R. district, Tamil Nadu), Nellore (Pattapalem and Chemarayanapalem villages of Bogulu *mandal*) and Kakinada (Bhairavipalem village) of Andhra Pradesh. The composite soil samples collected from each area were air-dried, powdered and then sieved for further analysis at the laboratory. The bulk density, specific gravity, porosity, void and water holding capacity ratio of the soil samples were analyzed by the methods described by Richards (1960). The liquid limit of soil was determined with the help of standard liquid limit apparatus designed by Casagrande (Punmia, 1990). The soil passed through 420 micron sieve was used for the determination of liquid limit and the ASTM tool was used for making grooves for sandy nature of soils. Soil textural analysis was done following the method described by Piper (1966). The organic carbon was determined by Walkley and Black (1934) rapid titration method.

The physicochemical characteristics of soil (range and average) are presented in Table 1. The average bulk density of 1.38 Mg m^{-3} was observed in Kakinada, 1.62 Mg m^{-3} in Nellore and 1.91 Mg m^{-3} in Muttukadu soils. Low bulk density of Kakinada soils was associated with relatively high organic carbon content (r=-0.85). These results are in confirmation with the findings of Walia and Rao (1996). The bulk density was proportional to the sand content of the soil (r=0.90). Similar results have also been reported by Kaushal *et al.* (1996). The values of specific gravity did not vary much and ranged from 2.16 to 2.37 Mg m^{-3}.

Kakinada soil had the maximum porosity of 36.0 percent, whereas Nellore and Muttukadu had porosity of 20.2 and 19.8 percent, respectively. The difference in porosity may be due to sand content in the soil. The high value of porosity in Kakinada soil was due to high void ratio corroborating the findings of Painuli and Pagliai (1996).

The high sand content (81.0%) was observed in Muttukadu soil and low (46.75%) in Kakinada soil. Clay content was high in Kakinada soil (35.5%) as compared to Nellore (11.25%) and Muttukadu (11.0%) soils. The silt content was less in Muttukadu soil (8.25%) as compared to the values observed in Nellore (15.5%) and Kakinada (17.5%) soils. Soil samples from Kakinada retained more water than Nellore and Muttukadu. The highest water holding capacity of 46.0 percent was registered in Kakinada soil and

Table 1. *Physicochemical characteristics of different coastal soils*

Soil property	Nellore	Muttukadu	Kakinada
Bulk density (Mg m^{-3})	1.58-1.74 (1.62)	1.60-1.98 (1.91)	1.30-1.42 (1.38)
Specific gravity (Mg m^{-3})	2.20-2.22 (2.25)	2.30-2.42 (2.37)	2.10-2.25 (2.16)
Porosity (%)	19.8-22.2 (20.2)	19-20.2 (19.8)	34.5-36.2 (36.0)
Voids ratio	0.26-0.31 (0.29)	0.22-0.26 (0.24)	0.55-0.57 (0.56)
Water holding capacity (%)	38.2-41.5 (40.0)	35.0-37.5 (36.0)	45.0-47.5 (46.0)
Liquid limit (%)	23.2-25.8 (24.3)	21.2-21.6 (21.4)	38.8-40.2 (39)
pH (1:2.5)	7.42-7.34 (7.40)	7.30-7.33 (7.32)	7.44-7.60 (7.50)
Electrical conductivity (dS m^{-1})	4.06-4.41 (4.28)	7.02-7.33 (7.03)	9.44-9.46 (9.45)
Organic carbon (%)	0.11-0.13 (0.12)	0.10-0.12 (0.11)	0.50-0.52 (0.51)
Sand (%)	74.5-77.5 (76.0)	80.5-81.75 (81.0)	45.5-50.25 (46.75)
Silt (%)	14.0-16.5 (15.5)	8.0-8.5 (8.25)	12.5-25.25 (17.5)
Clay (%)	10.0-12.5 (11.25)	10.5-11.0 (11.0)	36.75-37.5 (35.5)
Textural class	Loamy sand	Loamy sand	Sandy clay

Note : Values in parantheses are values of six soil samples

low in Nellore (40.0%) and Muttukadu (36.0%) soils. The decrease in water holding capacity of soils was paralleled by increase in bulk density (r=-0.98). Munsiri *et al.* (1995) observed similar results in pond soils at Auburn.

The highest liquid limit of 39.0 percent was observed in Kakinada soil, whereas Nellore and Muttukadu soils have low values of 24.3 and 21.4 percent, respectively. The water holding capacity and liquid limit were directly related for all soils (r=0.968).

The organic carbon content was high in Kakinada (0.51%) soil and low in Nellore (0.12%) and Muttukadu (0.11%)

Correlation coefficient and regression equation between water holding capacity and some soil properties

Soil property	Correlation coefficient	Regression equation
Bulk density	-0.986	Y = -18.69x + 71.26
Specific gravity	-0.981	Y = -46.85x + 146.54
Liquid limit	0.968	Y = 0.52x + 26.09
Void ratio	0.966	Y = 28.23x + 30.41
Organic carbon	0.926	Y = 20.44x + 35.63
Clay	0.921	Y = 0.33x + 34.32
Sand	-0.963	Y = -0.26x + 58.46

electrical conductivity was low (4.28 dSm^{-1}) for Nellore soil and high in Kakinada soil (9.45 dSm^{-1}) with more clay content. Higher electrical conductivity values in coastal soils are mainly due to saline water inundation (Maji and Bandopadhyay, 1996).

The water holding capacity as affected by soil characteristics and the correlation coefficient values are given in Table 2. The water holding capacity was negatively correlated with sand content, bulk density and specific gravity and positively correlated with all other parameters. The simple regression equations for selected soil characteristics in relation to water holding capacity are also presented in Table 2.

Comparing all soil properties, it can be concluded that Kakinada soil is characterised by highest water holding capacity, associated with the higher values of liquid limit, porosity and clay content. The Nellore and Muttukadu soils had less water holding capacity because of their sandy nature. The Kakinada soil may have less seepage compared to other soils because of higher water holding capacity, which reduces the water infiltration into the soil. By going through the above investigations, it can be concluded that soils of Kakinada are best suited for the construction of aquaculture ponds.

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