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INTAKE, RETENTION AND DEPLETION OF WATER IN DIFFERENT RICE SOILS AS RELATED TO THEIR PHYSICO-CHEMICAL PROPERTIES

In the soil water system, water moves in response to the forces created by the physical and chemical properties. These properties may accelerate or retard the movement of water from, within and into the soil. Many reports have emphasised the important role of soil properties in influencing soil water movement (Challa and Gaikwad, 1987; Ghazy *et al.*, 1988). Hence, this study was taken up to find out the soil factors responsible for the movement of water in the rice growing soils of Kerala.

Soil samples to a depth of 0-15 cm were collected from seven typical locations representing the major rice soils of Kerala, viz., pokkali, sandy, kole, kayal, laterite, kari and karappadam (Table 1). The soils were air dried and each soil was divided into three samples thus making 21 subsamples. Standard procedures were adopted for the determination of soil pH, EC, CEC, mechanical composition, water intake, retention and depletion (Jackson, 1958 and Piper, 1942).

The rate of evaporation from soils has an inverse relation with salt content. The pokkali soil which had the highest EC showed the lowest evaporation rate. The factors which significantly influenced the rate of evaporation were particle density, coarse sand + fine sand and silt + clay. Coarse sand + fine sand and silt + clay had almost equal and opposite influences on evaporation. Fine sand fraction alone did not show any significant influence. Sandy soil, followed by laterite lost water quickly by evaporation. Their low content of silt + clay and the highest amounts of sand fractions brought about this effect. The rate of release of water by evaporation was least from pokkali soil followed by kole soil. The high salt content and abetter silt + clay fraction prevented pokkali soil from losing water by evaporation.

The data on the capillary intake by different soils indicated that karappadam soils were able to take the maximum water in shorter time. The least amount of water was taken by pokkali soil. The component of osmotic potential in pokkali soil was so predominant that the capillary potential could not influence water intake by capillarity as in other soils. Regarding the relationship between capillary intake and soil properties, it was found that bulk density was the most dominant factor influencing capillary intake. Karappadam soil had the lowest bulk density among the non-saline soils and sandy soil the highest. As the particle size determines the pore radius, the highest amount of water in karappadam soils can be explained on the basis of the capillary rise equation.

The same explanation holds good for the capillary retention of water by saturated soils. But the content of water by air dried soils showed a different picture. The highest amount of water was held by pokkali soil. Kole and kayal soils had almost the same hygroscopicity. The least hygroscopicity was shown by sandy soil followed by laterite. Baver (1956) had indicated that hygroscopicity increased with total exchange capacity of the colloids. The fact is well illustrated from the results obtained in this experiment. The highest amount of hygroscopic water in pokkali soil is due to the high cation exchange capacity coupled with high osmotic effect. Clay content had greater influence than silt content in holding hygroscopic water but silt content was more important than clay content in taking water by capillarity and holding it.

Rice fields are normally drained periodically during the course of cultivation for proper crop growth and also to facilitate harvest towards the end. The rate of drainage was highest in sandy soils followed by laterite. Kole, kayal and karappadam soils had almost the same rate of drainage. A slightly higher rate of drainage observed in pokkali soil, compared to kole, kayal and karappadam soils, was due to the washing away of salts in drainage water. Pore space and maximum water holding capacity were the most dominant factors influencing drainage. The next dominant factors influencing drainage were coarse sand + fine sand, and silt + clay, which had equal and opposite influences. These studies point to the differential water requirements by the major rice growing soils of Kerala and also point to the need for technological advancement in water management strategies of these soils.

Table 1. Physico-chemical properties of seven rice soils of Kerala

Name of Soil	pH	EC dS m^{-1}	cmol (+) kg^{-1}	Coarse sand %	Fine sand %	Silt %	Clay %	BD g cc^{-1}	PD g cc^{-1}	WHC %	Pore space %	Volume expansion %
Pokkali (Vyttila)	3.51	5.38	21.88	4.68	23.38	17.98	51.37	0.87	2.41	53.14	44.77	9.98
Sandy (Kayamkulam)	4.83	0.23	1.34	58.51	20.26	4.00	16.43	1.27	2.84	32.99	40.66	1.83
Kole (Kattukampal)	4.56	1.20	20.95	4.19	5.36	7.48	79.68	0.96	3.46	63.69	54.92	14.51
Kayal (Kainagiri)	4.19	0.68	20.76	3.37	27.24	20.05	47.57	0.97	3.32	61.26	52.53	11.98
Laterite (Pattambi)	5.18	0.15	3.35	46.61	27.84	6.47	18.08	1.18	2.71	34.81	41.32	3.31
Kari (Karumadi)	3.61	1.20	9.96	49.65	16.62	11.82	19.87	1.07	3.16	51.09	49.84	7,16
Karappadam (Moncompu)	4.36	0.50	5.68	11.83	26.22	16.03	43.69	0.89	3.13	64.46	53.25	8.39

Table 2. Water intake, retention and depletion in seven rice soils

	% increase	% water held		% loss of water		
	capillarity after 25 days	After the disappearance of gravitational water	By air dried soil (hygroscopicity)	Evaporation after 8 days	Evaporation after 5 days	Drainage after 72 hours
Pokkali	27.43	40.37	6.55	74.37	67.55	9.10
Sandy	29.62	31.09	0.54	99.06	96.00	14.44
Kole	56.47	60.13	4.82	79.18	72.08	8.42
Kayal	57.73	60.63	4.66	82.24	75.74	7.28
Laterite	34.93	36.85	1.23	95.86	90.84	12.78
Kari	47.87	50.04	2.28	88.59	83.07	10.85
Karappadam	62.48	67.48	2.58	85.95	80.08	8.09
CD(0.05)	2.995	3.487	0.670	1.249	1.472	0.862

Table 3. Coefficients of simple linear correlation of water intake, retention and depletion with soil properties in seven rice soils

X variables (soil properties)	Water intake by capillarity	Water retention		Water depletion	
		By saturated soil	By air dried soil (hygroscopicity)	By evaporation	By drainage
CEC	0.632	0..632	0.953	-0.892	-0.728
Coarse sand	-0.875	-0.878	-0.887	0,900	0.782
Fine sand	-0.118	-0.118	-0.364	0.397	0.244
Silt	0.760	0.757	0.565	-0.600	-0.632
Clay	0.716	0.719	0.863	-0.875	-0.700
Bulk density	-0.989	-0.992	-0.762	0.889	0.759
Particle density	0.802	0.800	0.911	-0.944	-0.824
Water holding capacity	0.982	0.981	0.827	-0.934	-0.819
Pore space	0.921	0.917	0.812	-0.927	-0.825
Volume expansion	0.757	0.767	0.939	-0.922	-0.749
Silt + clay	0.830	0.833	0.921	-0.940	-0.787
Coarse sand + fine sand	-0.832	-0.835	-0.920	0.942	0.787

* Correlation coefficient (r) exceeding 0.400, 0.590 and 0.468 are significant at 0.1, 1.0 and 5.0 per cent levels respectively

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REFERENCES

Baver, L.D. 1956. *Soil Physics.* 3rd ed. Asia Publishing House, Bombay, p. 40-277

Challa, O. and Gaikwad, M.S. 1987. Water retention characteristics of major soils of Dadra and Nagar Haveli. /. *Indian Soc. Sail Sci.* 35 : 118-20

Ghazy, A., Wahab, M.A. and Omar, M.S. 1988. In filtration characteristics as related to soil physico-chemical properties of Vertisol in the Nile Delta. *Egypt. J. Soil Sci.* 28 : 75- 90

Jackson, M.L. 1958. *Soil Chemical Analysis.* Prentice Hall of India (P) Ltd., New Delhi

Piper, C.S. 1942. Sort *and Plant analysis.* University Adelaide, Australia7