Effect of Incorporation of Animal Manure Compost on Capillary Rise and Distribution of Cations in Reclaimed Tidal Flat Soils

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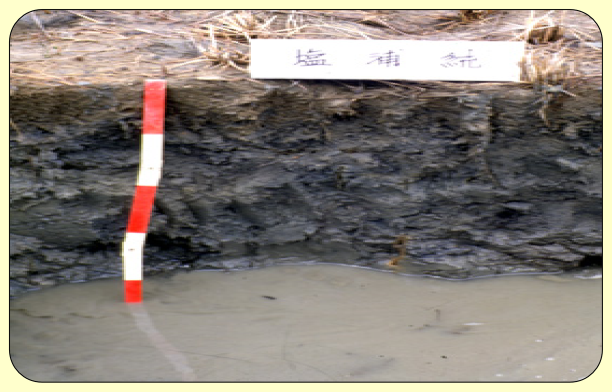
ABSTRACT

In this study, we investigated the proper application rates of organic matter controlling capillary rise and leaching patterns of cations in soil Columns packed with reclaimed tidal f`lat soils. The results showed that the capillary rise height was increased with increasing amount of animal manure compost and also the time to reach the maximum height was faster in a soil column packed with loamy sand than that of sandy loam, indicating the clay content and organic matter content can strongly influence the capillary rise. On the other hand, capillary rise was faster at reclaimed flat tidal soil faced with larger pore size of coal bottom ash than reclaimed tidal flats soils faced with smaller size of coal bottom ash.

Backgrounds

- The term "reclaimed flat tidal land" means artificially created land through several construction processes such as construct e`mbankment as the sea dike to block w`ater flow and removal of surface water from the inland tidal flat land. But there are so many problems in agriculture uses.
- Therefore, salt exclusion and improvement of physical and chemical properties of soil are needed. Application of organic matter and coal bottom ash to the soil, `enhancing granulation and aggregate stability, can improve drainage, hydraulic conductivity and aeration.



High groundwater table

Poor drainage

Salt accumulation

Materials & Methods

Table 1. Characteristics of soils and organic matter used in experiment

Sorts	pH (1:5)	EC[1] (dS m^{-1})	CEC[2] ($cmol_c$ kg^{-1})	OM[3] (%)	SAR[4]	ESP[5] (%)	Exchangeable ($cmol_c$ kg^{-1})				Soluble ($cmol_c$ kg^{-1})				Total ($cmol_c$ kg^{-1})			
							Ca^{2+}	K^+	Mg^{2+}	Na^+	Ca^{2+}	K^+	Mg^{2+}	Na^+	Ca^{2+}	K^+	Mg^{2+}	Na^+
Loamy sand	6.56	5.23	1.26	1.02	0.63	79.3	1.89	0.02	3.13	1.00	0.59	0.99	0.73	3.65	2.48	1.01	3.86	4.65
Sandy Loam	7.25	0.58	2.44	1.62	0.51	44.6	2.64	0.89	6.28	1.09	0.15	0.88	0.35	0.71	2.79	1.77	6.63	1.80
Organic matter	8.52	11.25	8.50	-	-	-	14.11	67.05	3.37	5.39	3.01	49.26	3.03	22.61	17.13	116.31	6.40	28.00

[1]EC : Electrical conductivity; [2]CEC : Cation Exchange Capacy; [3]OM : Organic matter; [4]SAR : Sodium Adsorption ratio; [5]ESP : Exchangeable Sodium Ratio

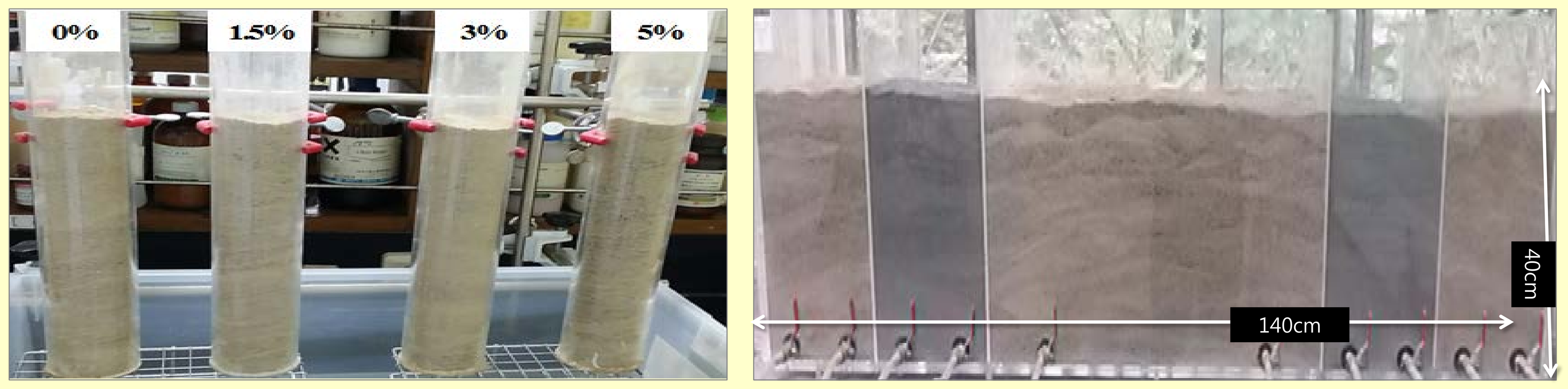


Fig. 1. Picture of apparatus of capillary rise experiment (left) and soil block to observe capillary rise pattern (right).

Results

Table 2. Cations of soils with different Organic matter contents

	Amended OM (%)	Exchangeable cations ($cmol_c$ kg^{-1})				Soluble cations ($cmol_c$ kg^{-1})			
		Ca^{2+}	K^+	Mg^{2+}	Na^+	Ca^{2+}	K^+	Mg^{2+}	Na^+
Loamy sand	+ 0	1.89	0.02	3.13	1.00	0.59	0.99	0.73	3.65
	+ 1.5	3.18	1.03	3.30	1.15	0.43	1.29	0.82	4.18
	+ 3	3.68	1.32	3.38	0.46	0.49	1.94	0.97	4.77
	+ 5	4.50	2.32	3.48	0.69	0.63	2.46	1.08	5.08
Sandy Loam	+ 0	2.64	0.89	6.28	1.09	0.15	0.88	0.35	0.71
	+ 1.5	3.54	1.04	5.01	0.38	0.29	1.80	1.62	1.65
	+ 3	4.14	2.41	5.65	0.48	0.31	1.79	1.12	2.05
	+ 5	5.09	1.33	2.51	0.07	0.82	4.85	4.51	3.19

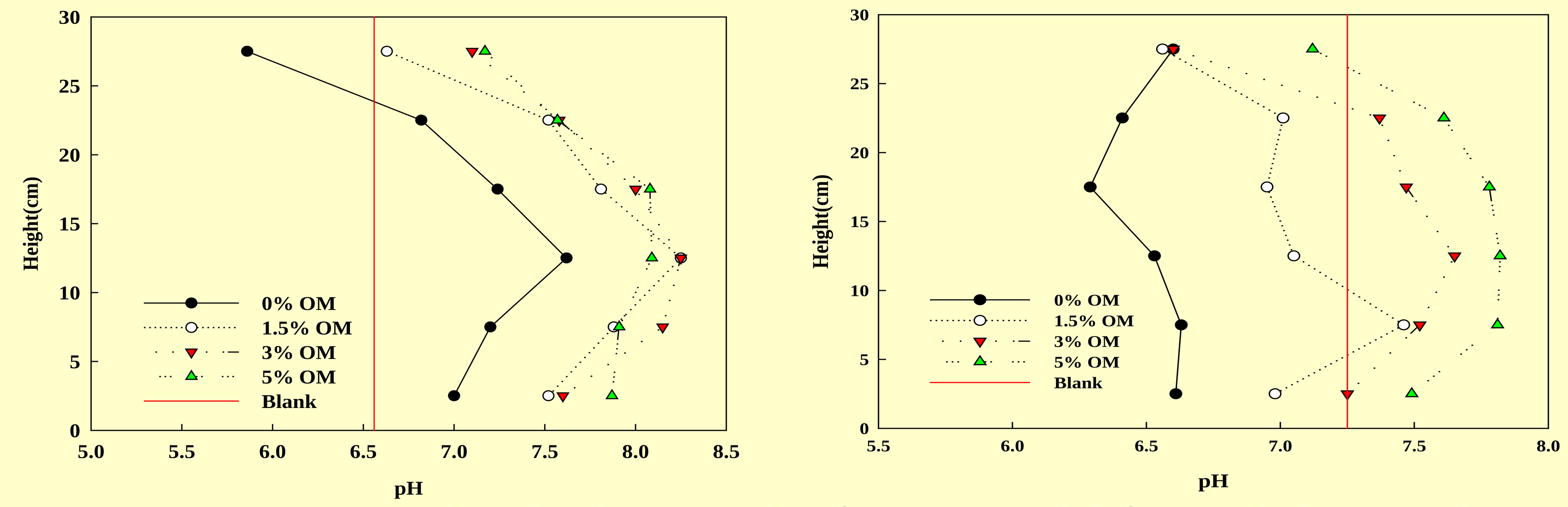


Fig. 4. pH transition with soil column height of Loamy sand (left), Sandy loam (right).

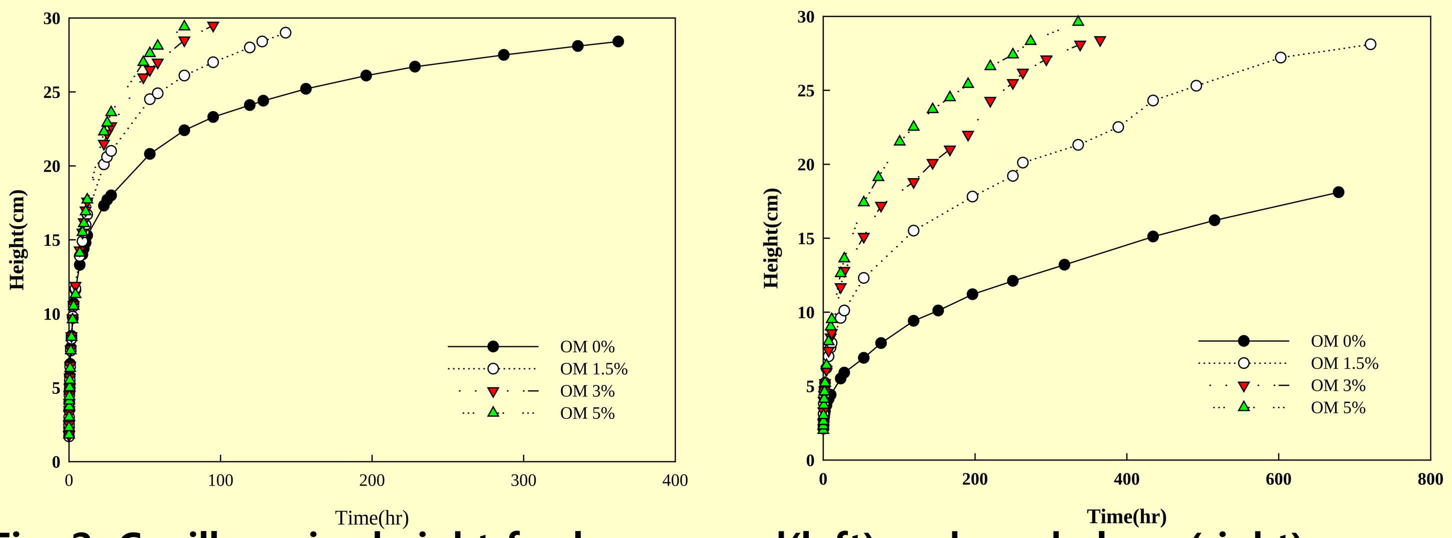


Fig. 2. Capillary rise height for loamy sand(left) and sandy loam(right).

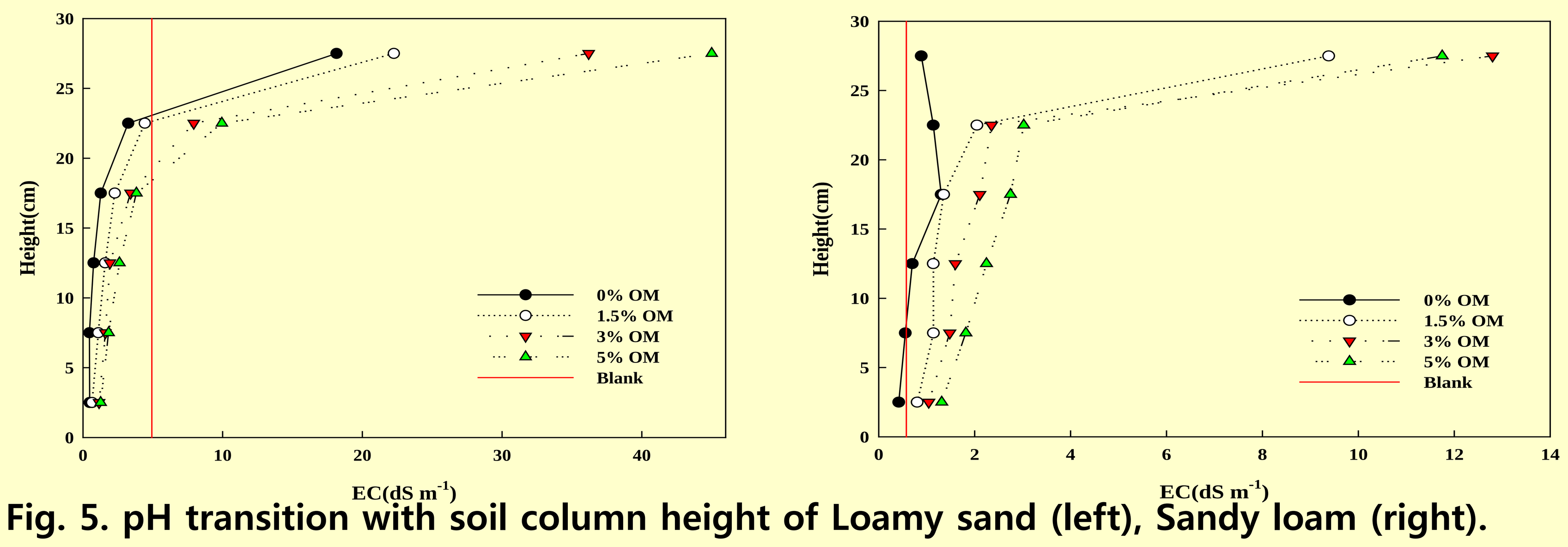


Fig. 5. pH transition with soil column height of Loamy sand (left), Sandy loam (right).

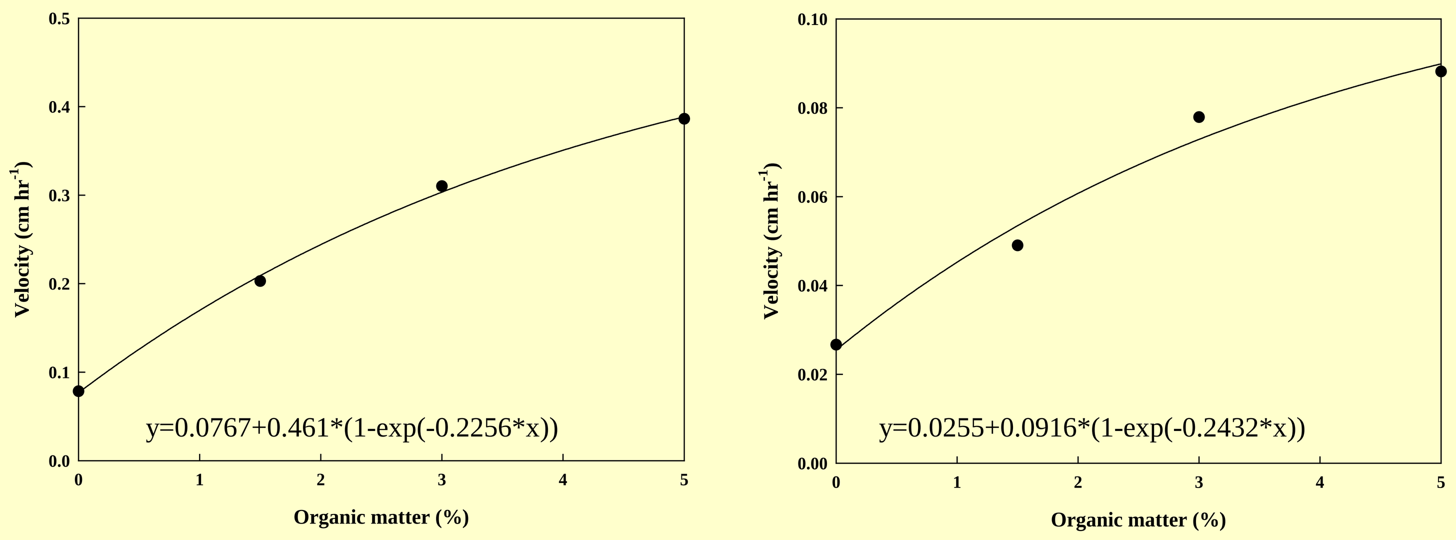


Fig. 3. Velocity of capillary rise height for loamy sand (left) and sandy loam (right).

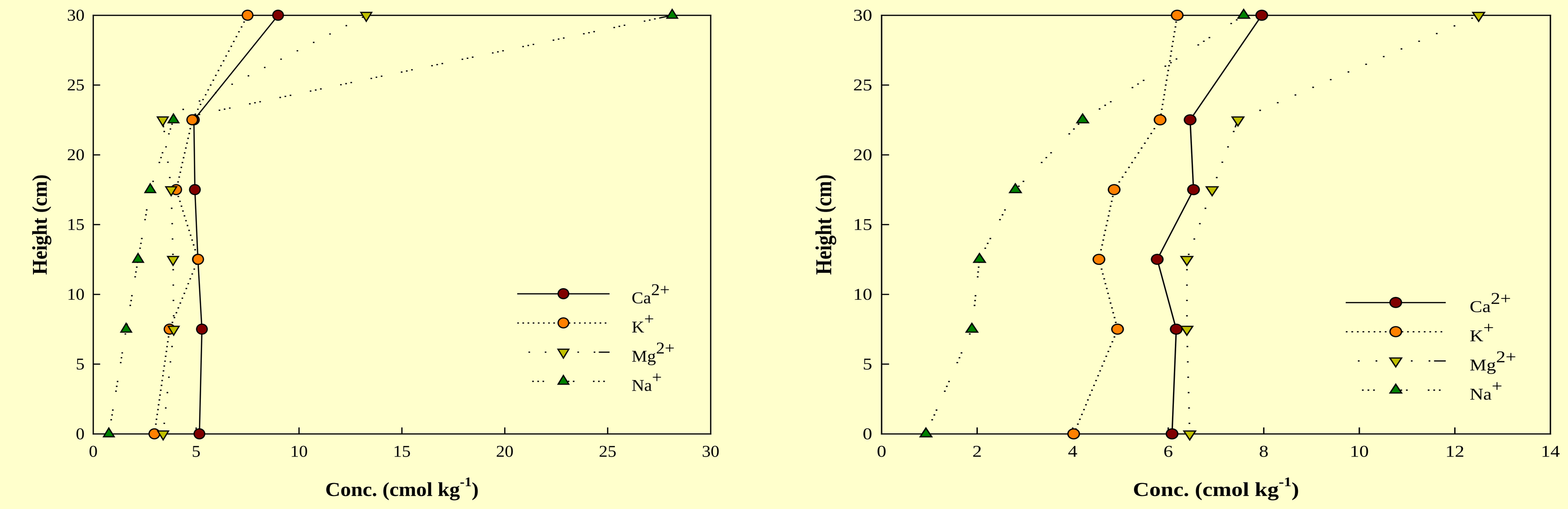


Fig. 6. Cation distribution patterns for loamy sand (left) and sandy loam (right).

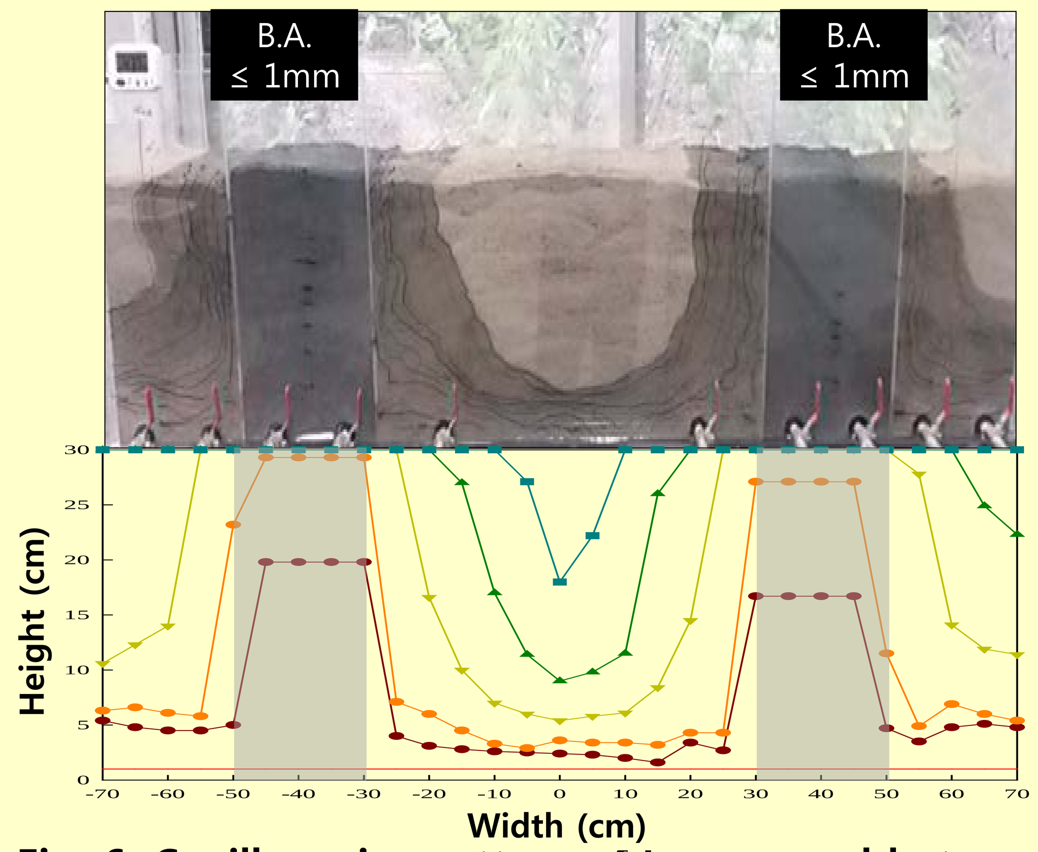


Fig. 6. Capillary rise pattern of loamy sand between the drainage channels packed with the same particle size of macro porous media.

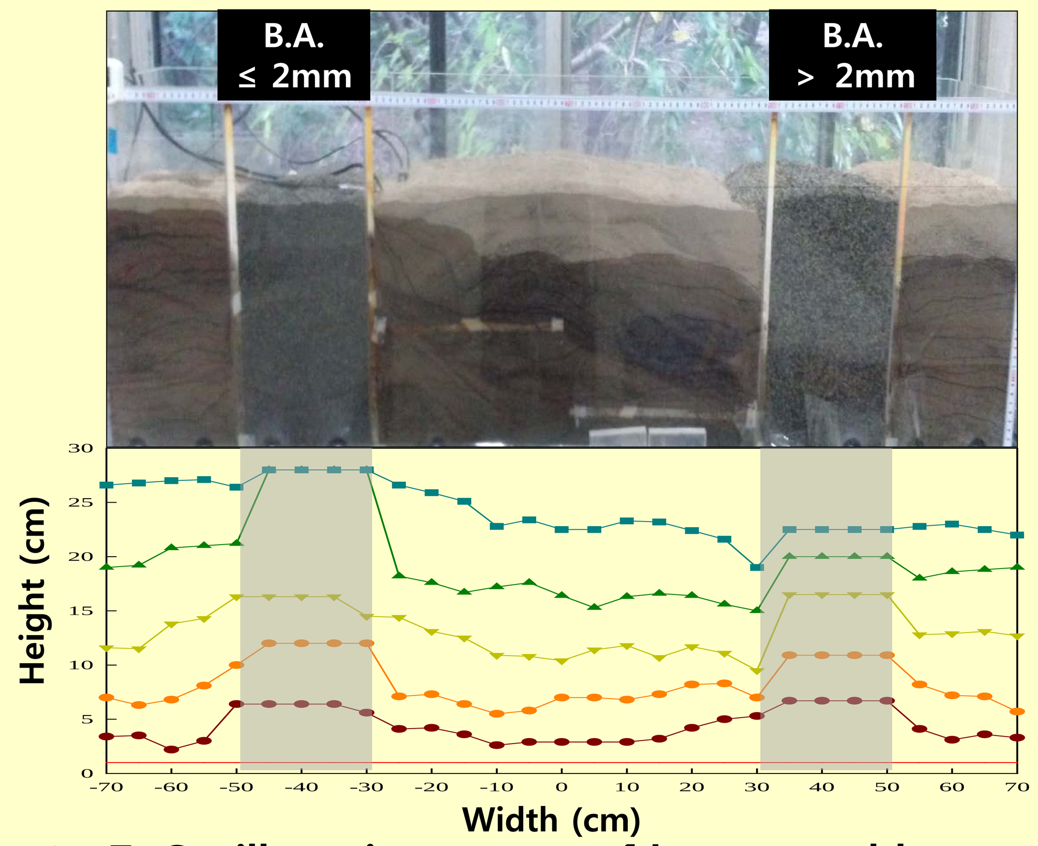


Fig. 7. Capillary rise pattern of loamy sand between the drainage channel packed with the different particle size of macro porous media

◆ Conclusions

1. The amendment of organic matter may enhance the upward movement of salts to the surface.
2. That may also enhance the reduction of salinity by immobilizing the soluble salts within saline sodic soil system.
3. To enhance removal of salts from the top soil the drainage channel packed with macro porous media should be placed in reclaimed flat tidal soil.

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