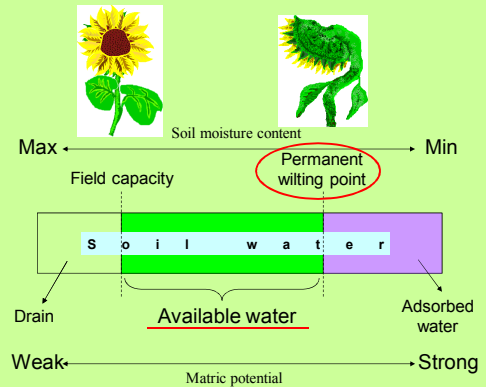


## Measurement of soil water potential associated with thermodynamics.

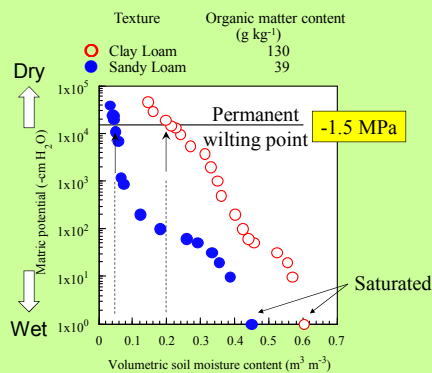


Shinji SUZUKI  
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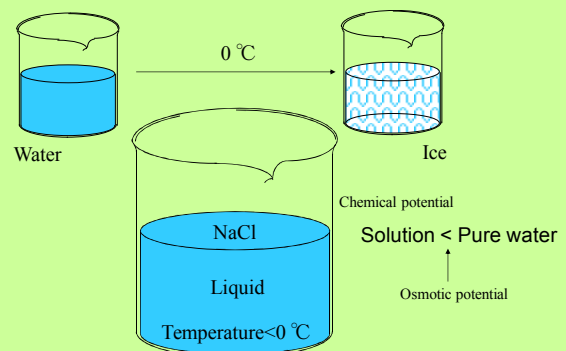
What is water retention (water holding capacity)?



Soil Water Characteristic Curve



## Freezing Point Depression Method



## Freezing Point Depression Method



## Freezing Point Depression Method

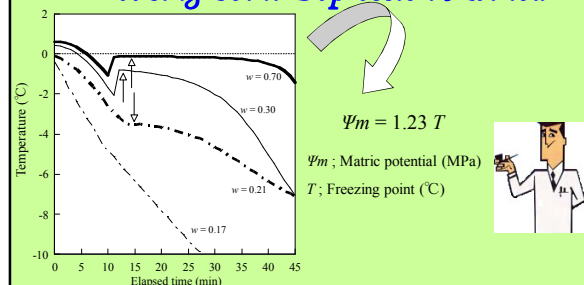
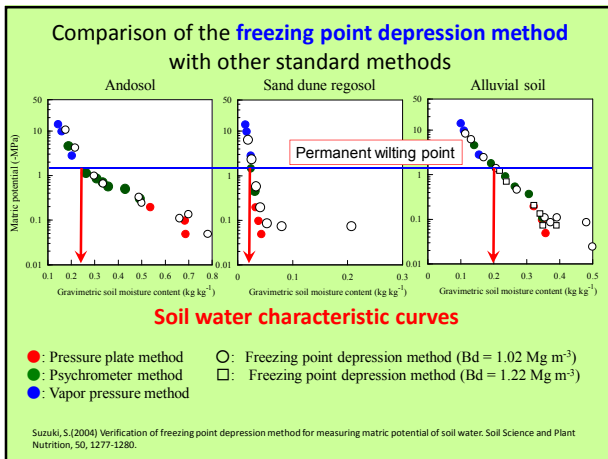
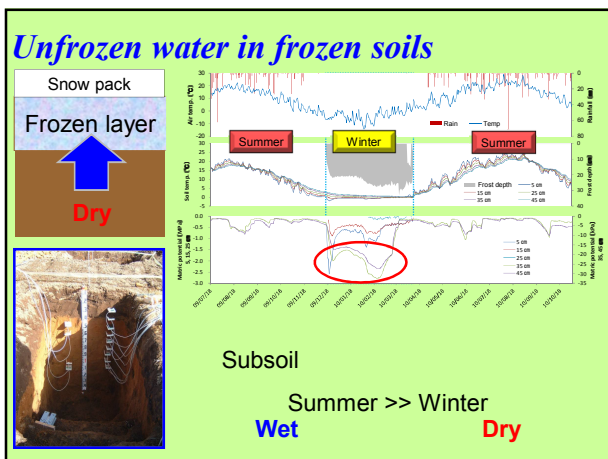
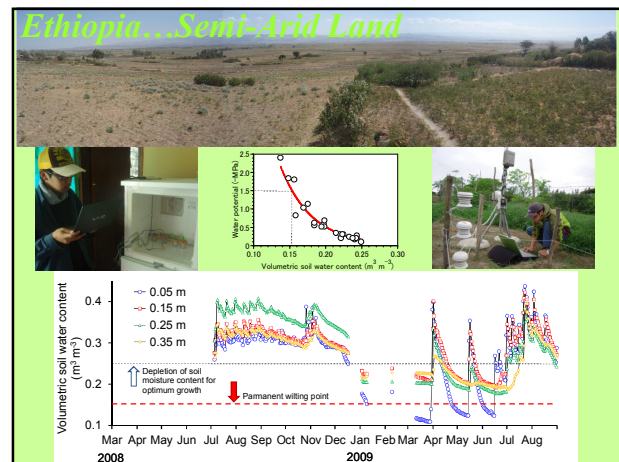
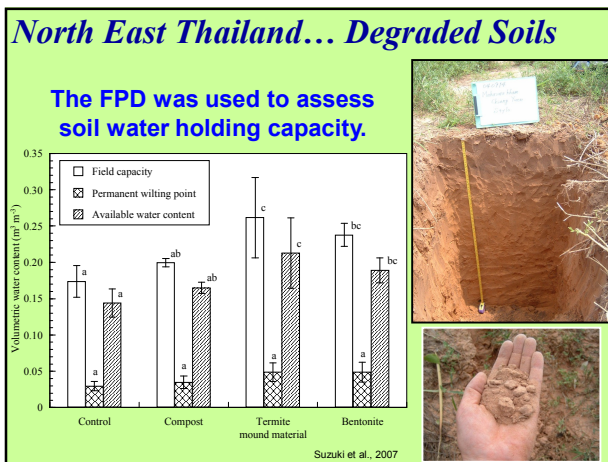


Fig. Freezing point of an Andosol having different soil moisture content. w: gravimetric soil moisture content (kg kg<sup>-1</sup>). Arrows indicate freezing point.



Pressure plate / Pressure extractor	Potentiometer	Freezing point depression method
Sample preparation 1 - 3 days	1 - 3 days	3 - 7 days
Measurement 2 weeks - 1 month	1 - 10 minutes	1 - 2 hours
Price 11,000 GBP	13,000 GBP	270 GBP



## Unfrozen water in frozen soils



### Permafrost

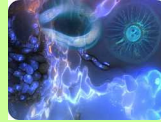
20%-25% of the world's land surface  
Russia, Canada, Alaska, China, Japan,  
and Antarctica



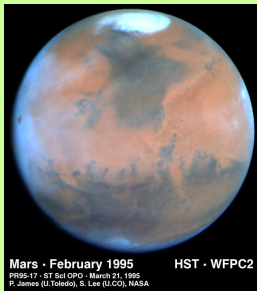
## Unfrozen water in frozen soils

"Unfrozen water supports metabolic activity of microorganisms survived in frozen soil." (Yanai and Toyota, 2006)

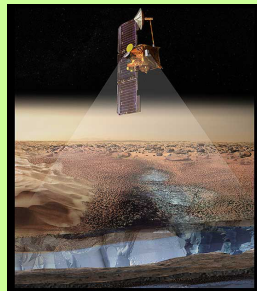
"60 to 94% of the soil microorganisms might survive following the successive freeze-thaw cycles." (Yanai et al., 2004)



## Unfrozen water in frozen soils ???



Mars - February 1995  
PR95-17 - ST Sci OPO - March 21, 1995  
P. James (U. Toronto), S. Lee (U. CO, NUSA)



It is estimated that as much as 60,000 km<sup>3</sup> of water may be frozen in the Martian soil.

## Freezing Point Depression Method

Learn a lesson from the past

R. K. Schofield

(1935, Rothamsted)



### THE MEASUREMENT OF pF IN SOIL BY FREEZING-POINT

By R. K. SCHOFIELD, M.A., Ph.D.  
AND J. V. ROTELHO DA COSTA, Ph.D.  
Soil Physics Department, Rothamsted Experimental  
Station, Harpenden, Herts

(With One Text Figure)

BOYCEVICH & MCCOY (1913) undertook freezing-point determinations as a means of measuring the actual concentration of the soil solution directly in the soil at different moisture contents. Only with said, however, did they find the depression of the freezing-point to be nearly inversely proportional to the moisture content. In general the freezing-point depression increases more nearly in geometrical progression as the water content decreases in arithmetical progression. They nevertheless adhered to the view that the depression was a reflection of the salt concentration, and advanced the hypothesis that part of the water that is driven off when the soil is oven-dried is "unfree", i.e. not available for the solution of salts. KENN (1919) criticised their interpretation, showing that, according to their definition, the amount of "unfree" water must vary with the total moisture content. This theory did not enable them to account for a close similarity which they observed between the lowest moisture content at which they were able to induce freezing (depression just over 1° C) and the "willing coefficient" of Briggs & Shantz, and they at first thought it a coincidence. Subsequently (1919) they concluded that there must be some fundamental connexion here, a view that BOYCEVICH has recently (1926) reaffirmed.

PACHER (1921a, 1921b, 1922) later showed that large depressions can be obtained in soils and other granular materials washed free of all soluble materials, and that the effect of dissolved material when present is superimposed on that of the finely divided insoluble material, the two effects being very nearly additive. When both are present, the characteristic of the contribution of the solid matter is, in general, a change from a very small depression, say 0.01° C, to a relatively large one, say 1° C, for perhaps a threefold reduction in moisture content which might change

Schofield and Rotello da Costa (1938)

*Thank you very much for your attention.*



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