

# Measurement of the open porosity of agricultural soils with acoustic waves

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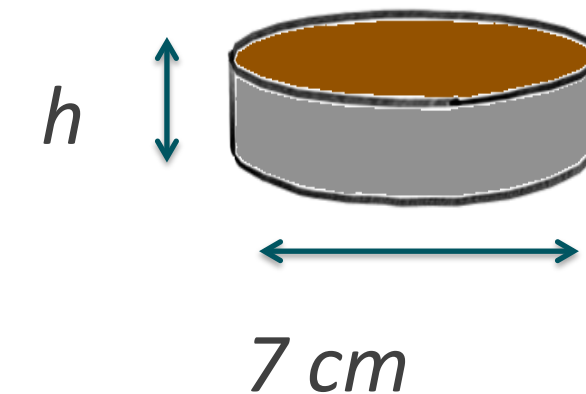
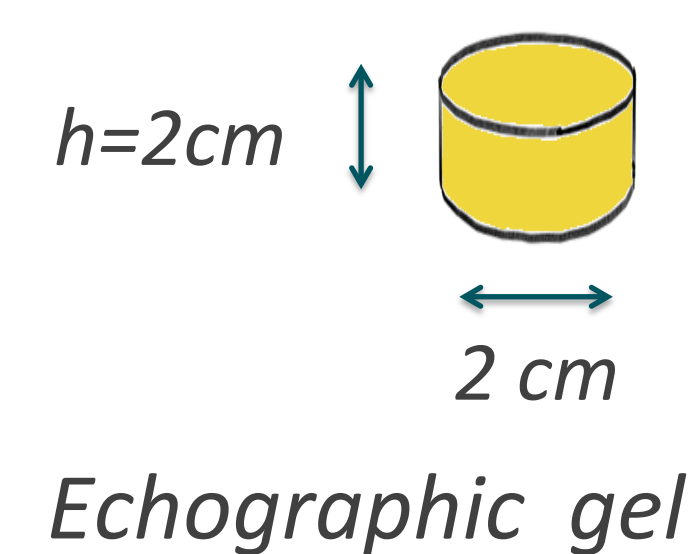
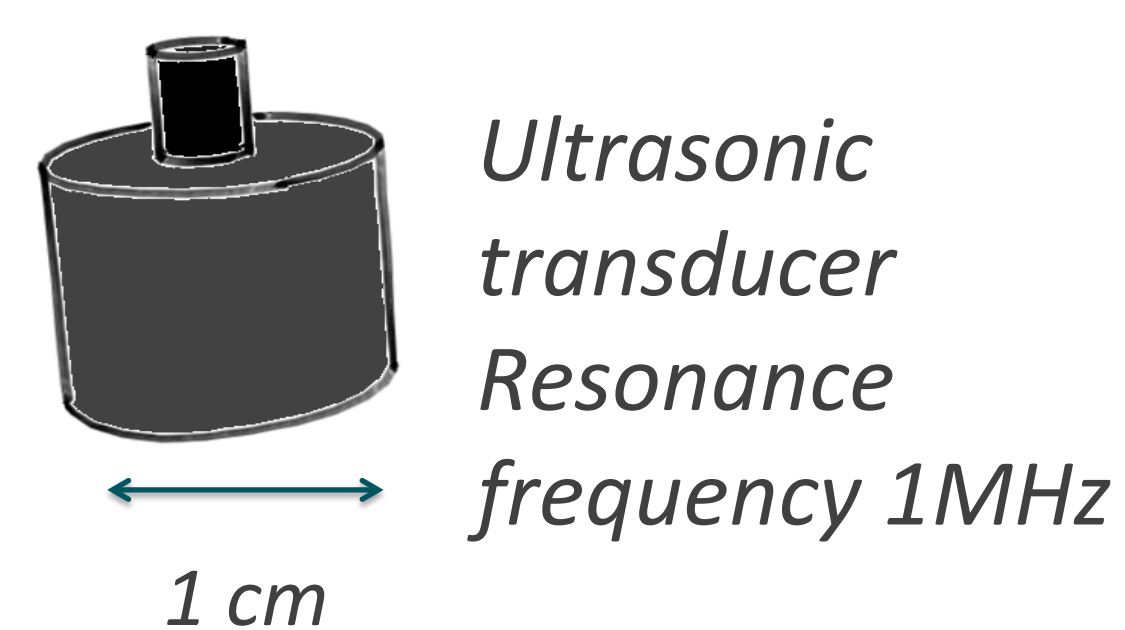
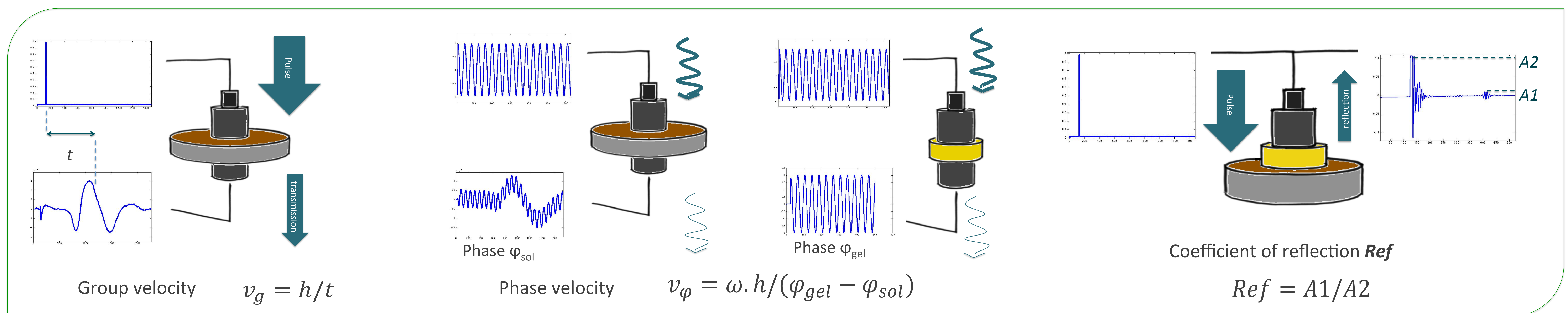
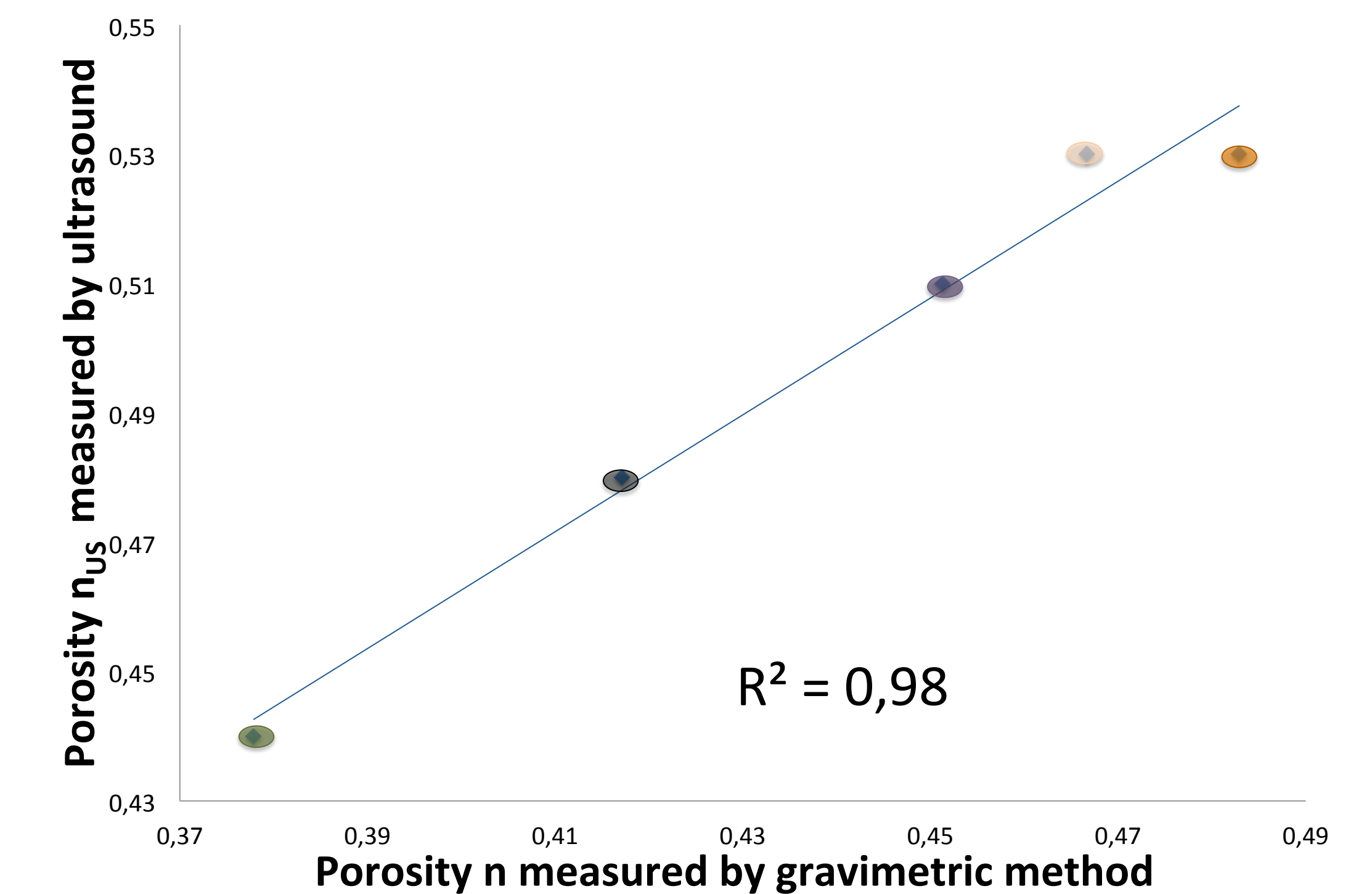
**Context.** Soil compaction by agricultural engine degrades soil porosity. It increases bulk density. Water flows are increased, erosion is facilitated and crop production decreased. Determining soil porosity, giving insight on the soil compaction, with the aim to provide advices to farmers in their soil optimization towards crop production, is thus an important challenge. Porosity is one of the soil properties that affect plant growth along with soil texture, aggregate size, aeration and water holding capacity.

**Objectif.** Develop a rapid and non destructive method to measure soil porosity.

**Theory.** The compression wave is influenced partly by open porosity. For a normal incident wave, the open porosity is defined by the equation (Fellah et al., 2003):

$$n_{US} = \sqrt{\frac{v_g}{v_\phi} \frac{1 - Ref}{1 + Ref}}$$

**Material and methods.** A high voltage amplifier multiplies by 50 the incoming signal from an Arbitrary Wave Generator. On the other side of the soil sample, the receiver is connected to a preamplifier that adds 34 dB to the output signal. Finally, the received signal is digitized.



Soil sample with  
10% water content  
14.6% clay  
78% silt  
7.4% sand

*Group velocity: speed with which the envelop of the wave propagates through space.*  
*Phase velocity: speed at which the phase of any frequency of the wave travels.*  
*Phase: a point in time during a waveform cycle, 360° being a complete cycle.*  
*ω angular frequency*

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