The Clay Research Group

RESEARCH AREAS

Climate Change ◆ Data Analysis ◆ Electrical Resistivity Tomography
Time Domain Reflectometry ◆ BioSciences ◆ Ground Movement
Soil Testing Techniques ◆ Telemetry ◆ Numerical Modelling
Ground Remediation Techniques ◆ Risk Analysis
Mapping ◆ Software Analysis Tools

The Clay Research Group
www.theclayresearchgroup.org

October 2008

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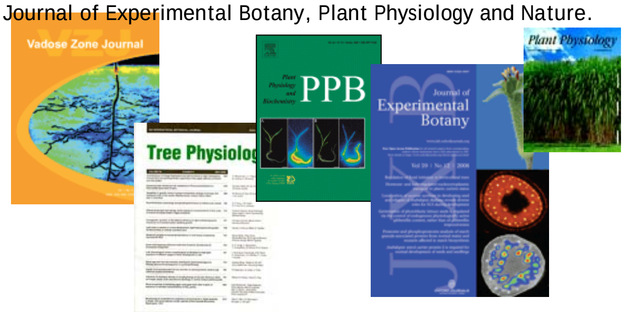
We rely heavily on the published works of others, and in particular in the field of plant physiology. Open access is provided to many of the journals on the web and we make use of The Vadose Zone Journal, Tree Physiology, Plant Physiology and BioChemistry, Journal of Experimental Botany, Plant Physiology and Nature.



EPSL have agreed to work closely with the CRG to produce a publication looking at the impact of trees on buildings. Paul Thompson of Marishal Thompson, the owner of EPSL, added that "this was a long overdue publication and we have agreed to work closely with the Clay Research Group to whom all revenue streams will be dedicated to help support CRG and its creditable aims." The work is to be undertaken by Laboratory Head Mark Mitchell, working with Dr.Pat Denne, Dr. Sian Thomas and **Paul Thompson.** The laboratory would be undertaking their analysis based largely upon the Marishal Thompson data set.

Peter Osborne hasn't been at all well, but tells us he is recovering following surgery. Best wishes for a speedy recovery and with luck we may see Peter at Aston next year, at the annual subsidence conference. His views may be misplaced, but we are sure he means well!

Andy Tipping of the London Tree Officers Association (LTOA) is forging links between the various parties involved with the investigation and resolution of root induced subsidence claims via the Joint Mitigation Protocol. Hopefully there will be an opportunity for the LTOA and CRG to work together at sometime in the near future.

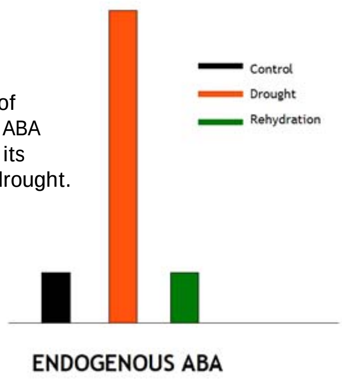
If you have come across something you feel would benefit our community, and would like to share it with others, we would like to hear from you.

Visit our web site at www.theclayresearchgroup.org. If you have any queries contact Stephen Plante on … splante@hotmail.co.uk

ABA & Drought Stress

Last month we reported the work of Huang et al., reported in The Journal of Experimental Biology (Vol 59) revealing the link between ABA and drought stress in an article entitled "The Relationship of Drought-Expression in Arabidopsis to Hormonal and Environmental Factors".

Presence of endogenous ABA confirming its relationship to drought.



They also report how effective the ABA analogue PBI425 is in plants that were not watered.

At day 10 without water, both the control and the ABA treated plants had died, whereas the analogue treated plants remained healthy. The treated plants wilted at 14 days but recovered on watering.

Obviously this work cannot be extrapolated to differing species due to wide genetic variation but nonetheless, a very useful study throwing light on a complex topic.

What is interesting is the ability to "hyper-induce" ABA regulated genes, which results in a substantial increase in drought tolerance. The analogue accumulates and becomes more efficient.

Why the genetic complexity? Stress response takes place in a wide variety of circumstances. Following injury for example, in darkness and light, salt stress, changes in the circadian rhythm and at various stages of growth - all permutations are possible and a genetic response is required for all.

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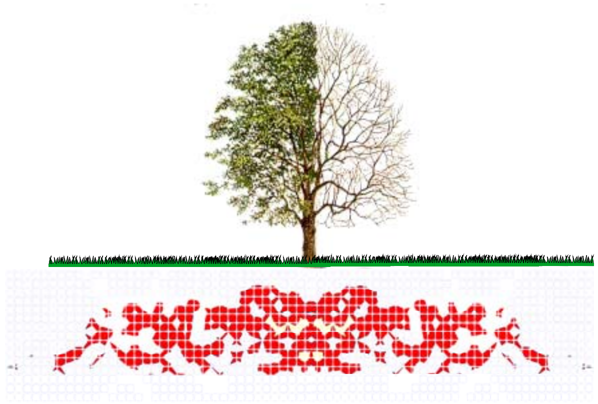
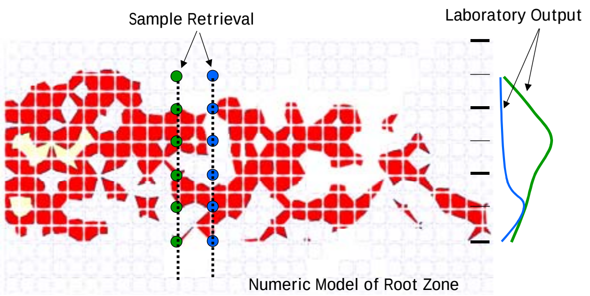
Numeric Modelling of Root Induced Soil Stress

Our numeric model – see below - suggests that soil stress beneath mature trees may not be uniform as previously thought. Instead, there may be significant variability across the root zone.



This may be a function of how roots grow in a competitive environment – there is no advantage in them competing for the same zone of moisture as the upper limit of suctions they can exert will be limited – combined with variability in the soil mineralogy.

A more advanced mapping technique is required, possibly involving MRI scanning but the practical problems across a large footprint would make this difficult.

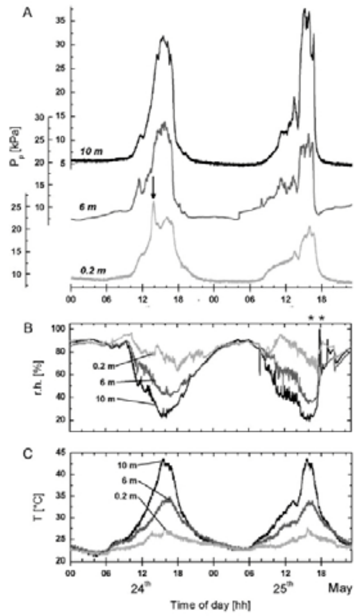


The relevance (and this is an example from the numerical model) is an explanation for the considerable variation when testing soils, even when bores are sunk close to one another – see above. Two bores sunk within 1mtr can deliver very different results.

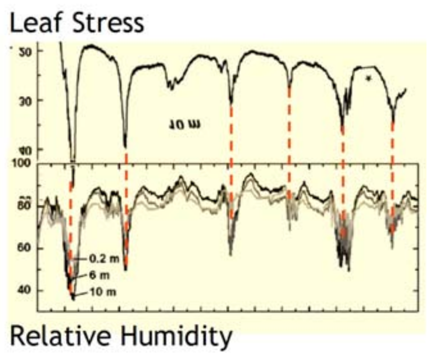
Stomal Aperture and Relative Humidity

We mentioned in last months edition how relative humidity is a driver of transpiration, and that it will be playing a larger part in our predictive model in the future.

Below is an extract from a paper in the Journal of Experimental Botany, Vol 59, entitled "A Novel, Non-Invasive, Online Monitoring, Versatile and Easy Plant Based probe for Measuring Leaf Water Status" by Zimmerman et al., which relates the two.



Inverting the leaf stress image (below) and using the humidity sequence from the paper reveals the following relationship over a 7 day period.



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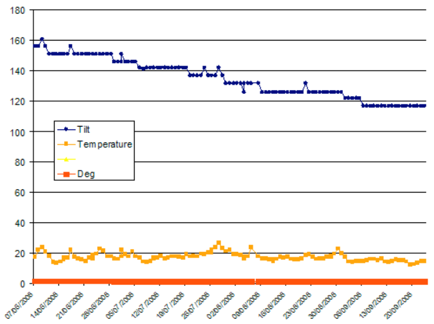
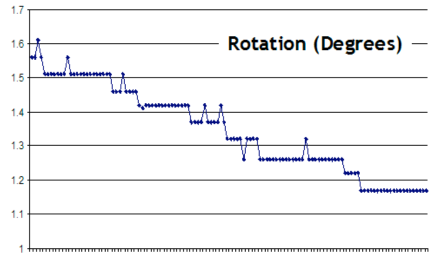
Electrolevels

Because subsidence involves rotational movement engineers understand the benefit of measuring it direct by using electrolevels but costs have – until recently – been prohibitive. The latest sensors offer solid state circuitry and are far more robust than earlier models. Jonathan Gray from Crawford & Company has provided an example from one of the installations used as part of our calibration exercise.





By plotting temperature alongside movement, we can discount it as a cause. Second, because we are measuring fine movement we can detect it much quicker than say, crack or level monitoring.

The fact that we are gathering data every day, from our desk, rather than once every few months, from site, helps.

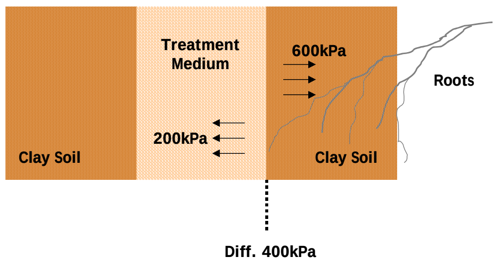
The readings above cover the period 7th June through to the 23rd September. We see movement of 0.34 degrees over the 4 month term and a clear pattern of root induced clay shrinkage emerging when we compare the output with that from the datum, which shows no movement.

Electrolevels provide accurate information, more often, allowing us to settle claims quicker. Telemetry saves time and reduces site visits.

Rehydration

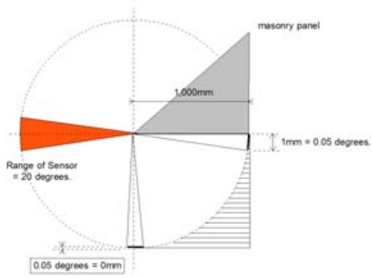
Rehydration can work very well. In simple cases – young, shallow rooting trees and shrubs – watering the garden with a hosepipe may be sufficient.

However, there are drawbacks. Watering mustn't attract roots to areas where they might cause problems in the future. It isn't a permanent solution. Hosepipe bans at times of peak demand, and water metering present problems in clay shrinkage areas. Selling your home on the understanding that a purchaser will have to apply water in the summer isn't a sensible solution.



The CRG proposal extends the availability of harvested water and balances suctions in the ground sufficient to induce controlled release, avoiding saturation. In short, it is particularly efficient and designed to deliver moderate water retention properties, allowing water to reach the zone where it is needed to abate or reduce the nuisance.

It doesn't rely on any mechanical devices or appliances and is self-regulating, delivering moisture at a depth, and over a period of time, that is relevant to root induced clay shrinkage.



Calibration between vertical and rotational movement is complex as we see, left, but our study suggests that we use a value of 0.2 degrees of rotation as the onset of movement sufficient to cause cracking in a domestic structure.

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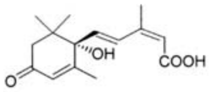
ABA Analogues

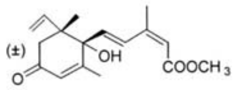
We see below the close relationship between ABA and the analogues referred to in the previous newsletter. The action of natural ABA is short-lived whereas analogues have been proven to accumulate , acting over longer periods, and with greater effect.

ABA

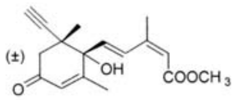


Abscisic acid

ANALOGUES



8'-methylene ABA methyl ester
PBI-365



8'-acetylene ABA methyl ester
PBI-429

"No Subsidence" Policy

Measuring rotation (as opposed to crack monitoring) takes account of building flexure. Burland, Wroth and others have demonstrated that buildings flex prior to the onset of cracking, and typically the foundations will have dropped 10mm or so prior to damage appearing.

The resolution of the electrolevel (EL) sensors combined with the mode of failure (i.e. rotational) means that EL's are best suited to detecting fine movement, and much earlier than any other technique.

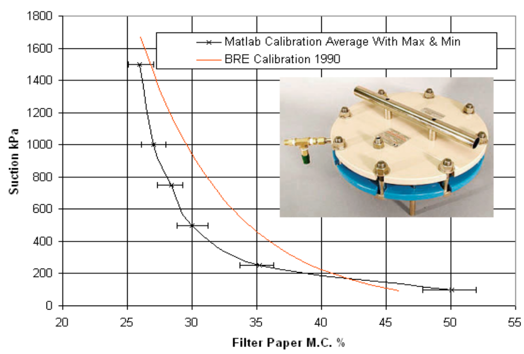
For this reason, EL's can detect movement prior to cracks appearing. They can be fixed to a building and take readings 24 hours a day, with no (or very little) manual intervention. Using this technology in combination with the intervention technique would make it possible for an insurer to offer a 'no subsidence protection policy'.

Filter Paper Test

Problems with the filter paper test are widely recognised and several papers over the last few years refer to anomalous results, which MatLab suspect may be due to the manufacturing process.

They have undertaken their own calibration using six batches of 12 No. 50mm diameter x 10mm high clay samples placed in the pressure membrane extractor and taken to suctions of 100, 250, 500, 750, 1,000 and1,500 kPa.

Six filter paper 'burgers' were then made from the twelve samples at each pressure, one filter paper in each, and sealed and left for seven days. The average and range of the filter paper moisture contents from each set of six burgers at the six different suctions are shown below.



Clearly there are variations and it would appear they are associated with possible changes in the chemical composition of the filter papers. MatLab will provide an update shortly.

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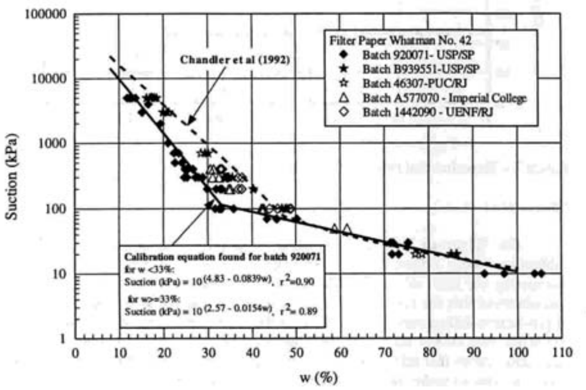
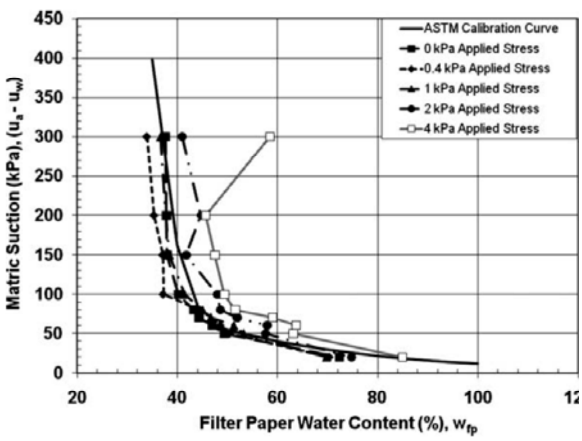
Filter Paper Test - 2

The pressure plate calibration results – previous page – reflect those obtained by others and published at the 2006 Saturated Soils Conference where papers entitled *"Evaluation Of Filter Paper Calibration"* by Fernando A. M. Marinho and *"The Filter Paper Method Revisited"*, Orlando M. Oliveira were delivered.



Kenton C Power et al ("A Revised Contact Filter Paper Method", Geotechnical Testing Journal, Vol 31) investigated the application of a load to the filter paper to increases its accuracy as we see below. They applied loads of 0, 1, 2 and 4kPa, still using the Whatman Grade 42 filter paper.



The findings confirm the importance of using the correct calibration curve – the one that matches what actually happens in the laboratory. The authors suggested using a 1kPa loading to ensure the correct contact is made between the sample and the paper.

ROOT STRESS