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

May 2008

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Newsletters

Some excellent newsletters are being produced by colleagues in the industry.

Legal updates are available from Anna Pickles at Plexus Law. E-mail address is anna.pickles@plexus-law.co.uk. See Page 4 in particular where they include a review of the Perrin Case. It highlights the need for good evidence when felling a tree and has wider ramifications.


Legal Matters
Personal Injury and Insurance
plexus


OCA

OCA's newsletter provides updates relating to arboricultural matters as well as climate change. Contact …
lindsey.button@landscapeplanning.co.uk

It is interesting to see some insurers embracing remote sensing and telemetry. Good news. Gathering data from site without having to make regular visits.

The Post also contained an article describing how knowing more about the site, from your desk, will help deal with surge.

See the example on Pages 3 & 4.

NEXT MONTH

Richard Rollit prepares his prediction for 2008 at the end of May as part of our own weather profiling. It appears that more experts are coming to the view that weather patterns early in the year set the scene for the summer, which is good news.

This Edition

Once again we look at modelling – what can be achieved from our desk-top prior to making the visit. How reliable are the various models? See Page 4 for Case Study 2.

This approach offers some significant advantages. Visiting the site with details of the likely soil conditions, tree height and distance and an estimate of the root zone has to be beneficial when arriving at a diagnosis.

We try to look into the future and wonder how claims might be handled in 2015. Will Black Box technology be used to prevent claims, using an early warning system?

Could we reach a stage where we anticipate when damage might occur rather than respond when it does. Will the role of the insurer change? Instead of being seen as an industry that responds poorly at point of claim, will insurers be offering comfort and protection before the event?

How would they fund it? Claims savings. Not having claims in the first place – or reducing their frequency significantly – means that insurers make money to invest in customer care before the event.

We have the models, we have the technology. All that is missing is the confidence and will to drive through change. Savings of £100m are achievable. Safer homes. Protecting the homeowner and keeping the trees. Not all of them of course, but where we can. See Page 2.

We examine which trees are riskier than others. Can we really say the Ash is 20% riskier than the norm with any degree of confidence? Anyway, what is the norm and why is the Oak top of the league? Who says it is? Page 2 provides some answers.

Carbon Footprint

Going to site, instructing an arborist who travels to the same site, instructing monitoring (four visits?), instructing investigations and then repairs?

Are we serious about climate change? Serious enough to do something?

We could reduce our carbon footprint by 75% on 50% of the claims we deal with – and for relatively little effort.

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Risky Trees

If we standardise the average tree and give it a value of '1', the Ash would have a value of 1.2, the Willow and Plane even more, and the Oak would be head and shoulders above, topping the league with a value of 2.

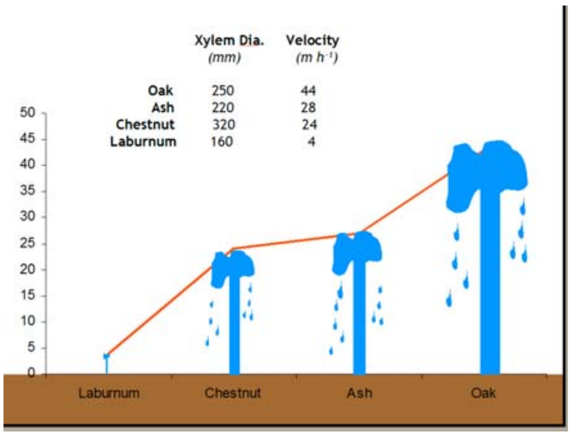
The value takes into account the suctions it exerts, the distance its roots grow and the amount of ground movement it can produce. It is also the riskiest tree in terms of frequency of damage to count of trees planted.

The conifer is risky for a different reason – because it is often planted too close to houses, acting as a screen.

The methodology of building the risk table has been outlined before. Taking a large sample of claims we list the species, height, distance, soil PI, movement in the monitoring term and so forth.

The risk values are the numbers we have to multiply the standard tree value by to achieve the ground movement, soils suctions etc.

So, in a hot, dry summer, the amplitude of soil suctions and ground movement for the Ash tree was 20% higher than our normalised value. Some trees were less aggressive than the norm as we would expect.



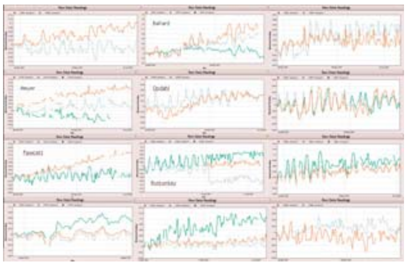
There is also physiological evidence (see table above) in support of the theory. If the Chestnut was '1', we see the Ash is a more effective water pump, and the Oak even better. 24 x 1.2 = 28.8 (28 for Ash) and 24 x 2 = 48 (44 for Oak).

Predicting the Future

Imagine applying for home insurance in 2015. The risk to your home will have been calculated already. If you live in a risky North London postcode and have a tree nearby whose roots extend beneath your home , built on clay, you will be issued with a 'black box' movement sensor with instructions on where and how to fit it for a low premium.

Not quite as far-fetched as it sounds. Some insurers already install them in cars.

The black box will send signals to a huge data warehouse somewhere in the world – it doesn't matter where because they are linked using telemetry. It is a 'fit and forget' technology.



The data warehouse will report on statistical exceptions – houses that are moving more than others. It won't have to know anything about subsidence.

Picking up movement early in the year means the insurer could instruct a suitable expert quickly. Possibly before the homeowner reports any damage.

The implications are huge. Imagine insuring with someone who monitors your home 24 hours a day to help you avoid subsidence.

Imagine claim numbers reducing from 30,000 p.a. to 15,000 claim p.a. Imagine reducing the total industry spend by say £100m p.a. and investing in preventative work and service delivery instead.

Customer satisfaction would ensure growth. Reduction in spend would ensure profit.

How do we prevent claims from happening? With some help we might be closer to a solution than we realise. Most of the pieces are already in place.

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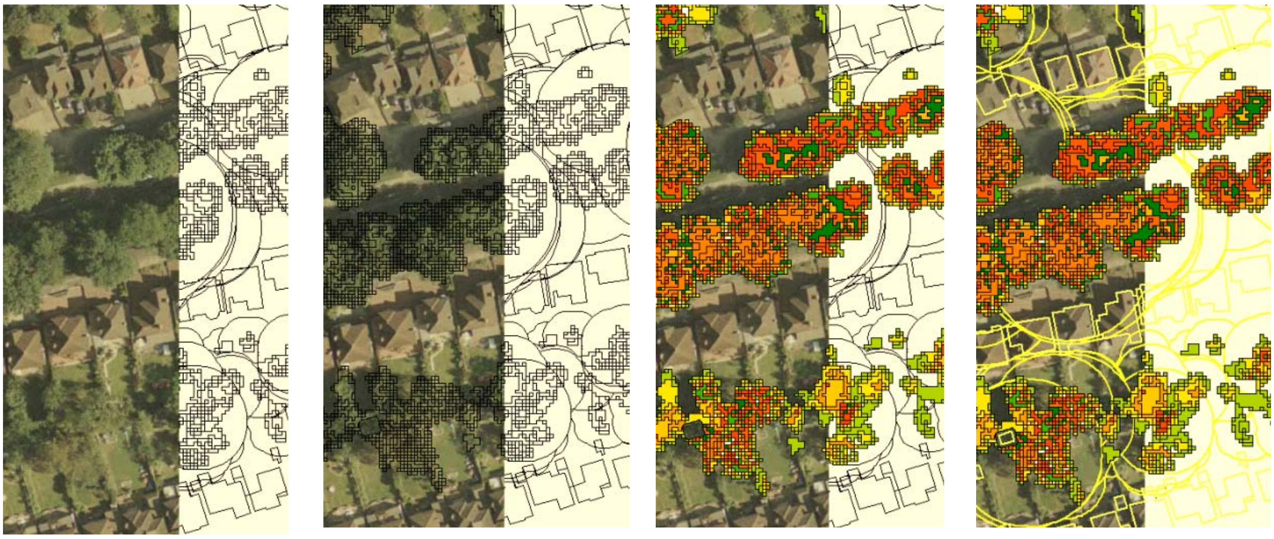
SUBSIDENCE RISK MODEL EXPLAINED

Below we see how the subsidence model is built and how we use LiDAR imagery. Aerial photographs are excellent but they have no 'location intelligence'. We might see a tree by a house, but how tall is the tree, how far away from the building and anyway, how do we know the address of the property even if we think there is a risk?

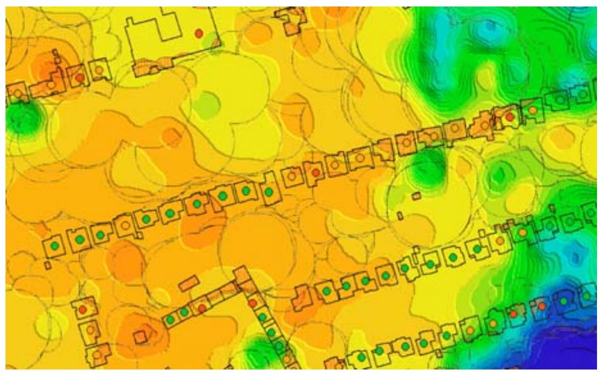
Superimposing the LiDAR onto the aerial image reveals just how good the fit is. The grid of digital data described the tree canopy exactly, and maps it's height accurately. More accurately than we can from ground level. Then we build a thematic map to illustrate the tree heights, and distinguish large ones from hedges and shrubs.



Aerial Image LiDAR *Comparing Canopy* *Plotting Tree Heights* *Root Zones and Buildings*

The next stage is describing the likely root zone using an algorithm validated using claims data. Superimpose onto our unique geology – a shrink/swell value on a 250m tiled grid – to complete the risk assessment.

Finally, locating the building. Using OS MasterMap we define the building footprint, perimeter and floor area. OS AddressPoint locates the address.



Right is the combined image. Geology, root zones, buildings and AddressPoint, each with a risk attribute.

We explored how the model is used in the claims environment last month. On the following page we publish another example.

The technology to change the way claims are handled – the way insurance is conducted – are already available. The only thing lacking is the will.

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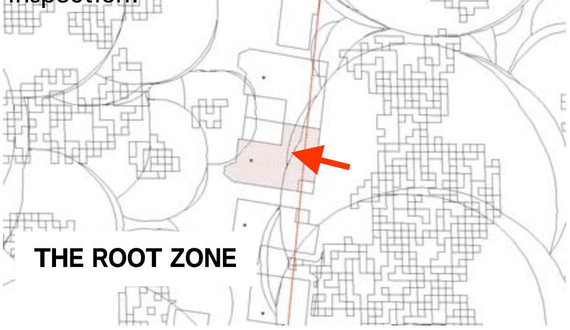
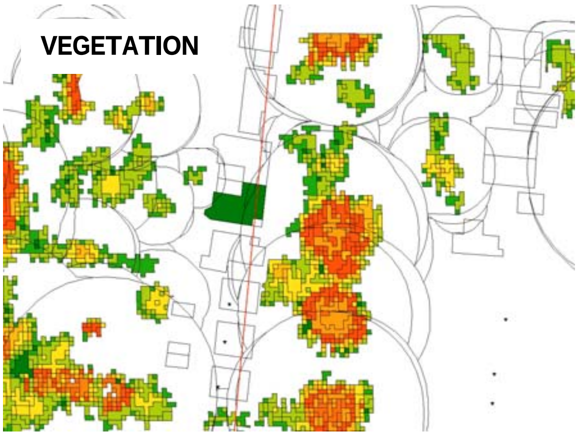
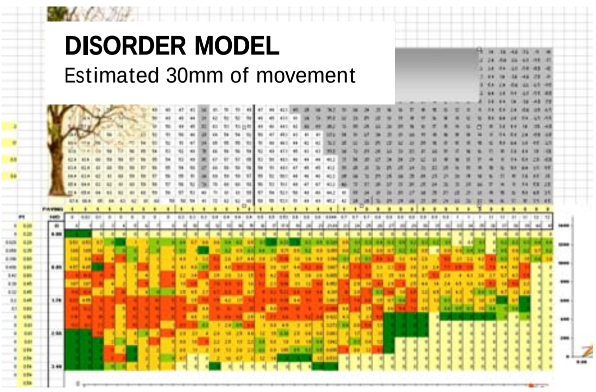
CASE STUDY - 2

Property in North London with damage to the internal walls. The investigations reveal a soil with a high Plasticity Index – variable between 30 – 50%. A mature Oak in the front garden, 17mtrs tall and 15mtrs distant. Cracks open and close seasonally.

Below are the screen prints from our model to see what conclusions we would have drawn from our desk top – before making an inspection.

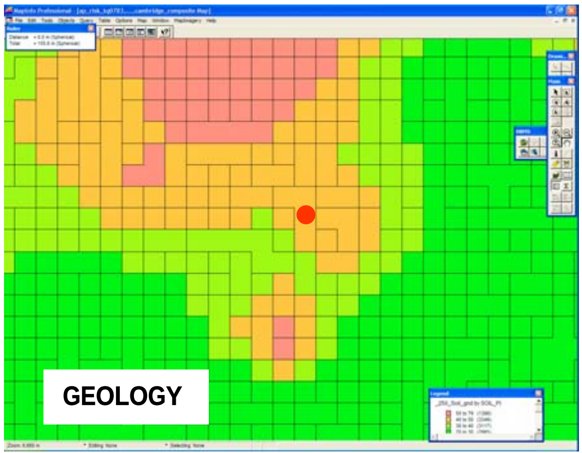






GEOLOGY

The 250m tiled grid returns a Plasticity Index of 41%. The average of the values retrieved from the site samples. The site (red dot, screen centre) is on the periphery of the outcropping London Clay.



VEGETATION

Using LiDAR data, the tree is 15.5mtrs from the front house wall and the canopy is 17mtrs high.

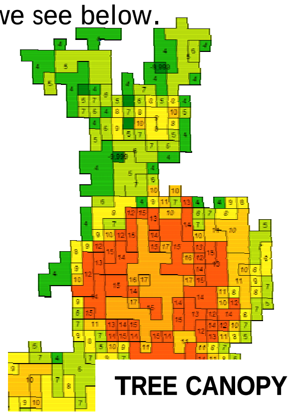
ROOT ZONE

Using the numeric disorder model we plot the root zone extending beneath the building. It extends to the centre of building.

TREE CANOPY

LiDAR provides a topographic outline of the tree canopy with every 'tile' measured against the ground profile as we see below.

Looking at the variability we see just how difficult it is to make an accurate assessment by simply looking at the tree from ground level, and particularly so when they are in groups. Best done from the desk-top.



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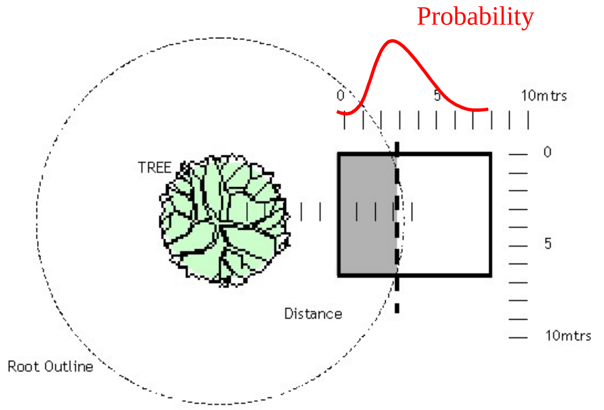
RISK – THE ROOT ZONE OVERLAP

To further refine the estimate of risk we consider the modelled root zone – the amount we estimate roots extend beneath the building, or 'percentage overlap'.

To clarify, this has very little to do with where the roots are, but rather the statistical analysis of where ground movement sufficient to cause damage occurs.

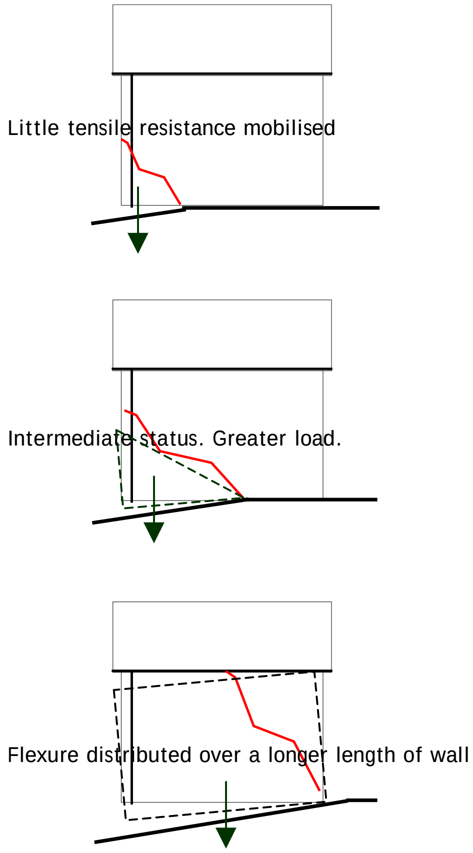


Structural engineers will look at stress distribution in the masonry and the association looking for flexure sufficient to overcome any tensile resistance in the masonry.

The masonry may well be able to withstand loss of support directly beneath the wall for a while and as the root zone covers the entire footprint, we assume tilt will replace cracking in an idealised model.

If we wanted to break the house – produce cracking – we would hold it at each end and flex it. The cracks might follow openings and lines of weakness, but the openings don't cause it.

This understanding tells us that not all trees near to buildings cause damage. It is a refinement of the other factors we describe on Pages 3 & 4.



Cantilevers and building failure. Top we have relatively little weight overhanging a short distance. The bending moment is less than the case below it.

Here (centre) the weight of the unsupported masonry if greater, and the bending moment increases proportionately.

Any limiting tensile stress in masonry is at best notional, and the point of maximum weakness is a combination of ground movement and the bending moment in the structure.

Flexure adds a dimension to the estimate of failure, which is why the 'percentage overlap' calculation has an empirical base.

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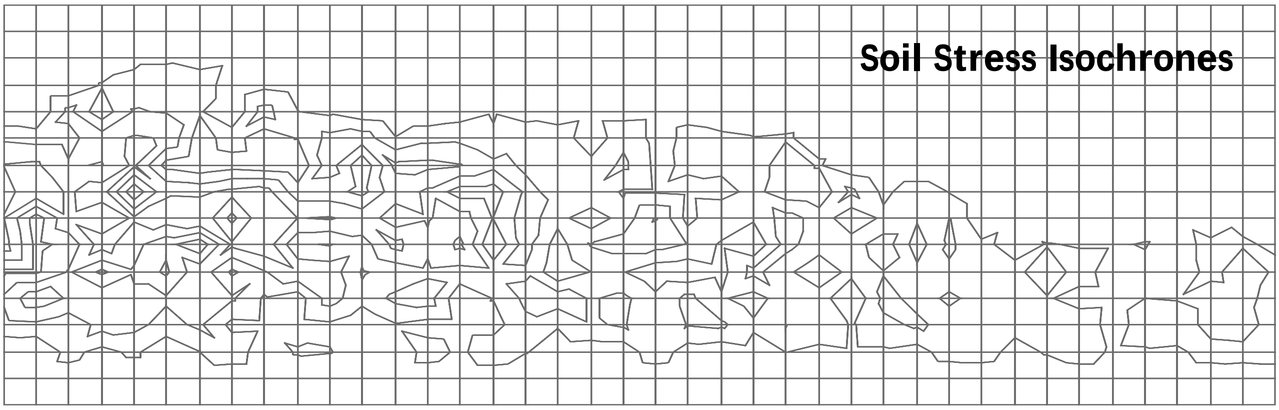


MODELLING SOIL STRESS

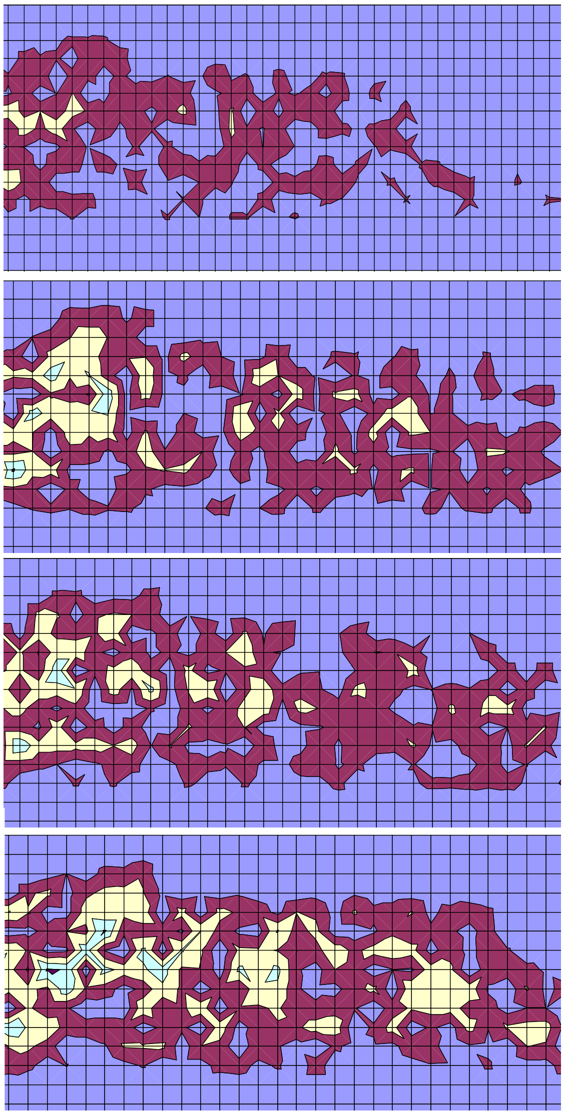
The likely pattern of soil stress produced by the root zone of a mature tree early in the year are shown, right – perhaps between June and August.

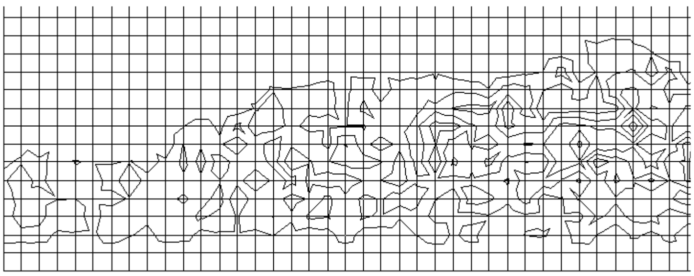
Soil mineralogy changes with depth across the footprint and the model reflects the results of the soils investigations at Aldenham.

The cells will merge eventually as the soil dryness equilibrates but preferential moisture abstraction by roots in areas where the moisture retention properties are less will produce an initial imbalance across the root footprint.

This coarse graph highlights significant stress changes and at a higher resolution the gradations would merge. This is one of the building blocks behind the Disorder model.

As ever we would be interested to hear from anyone who has a view on this topic.





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Long-distance signals regulating stomatal conductance and leaf growth in tomato (*Lycopersicon esculentum*) plants subjected to partial root-zone drying

Authors: Wagdy Y. Sobeih[1]; Ian C. Dodd[1]; Mark A. Bacon[1]; Donald Grierson[2]; William J. Davies[1]

Journal of Experimental Biology
Volume 55, Number 407, November 2004 , pp. 2353-2363(11).
Oxford University Press

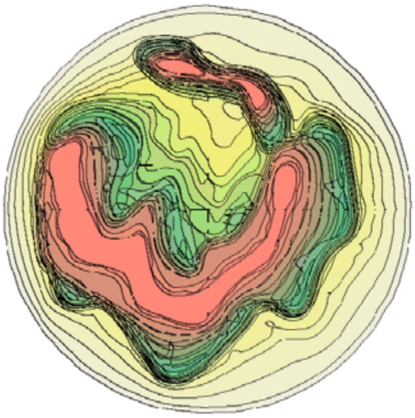
We have reported before on the work of Professor William Davies and Dr Ian Dodd from Lancaster University. Below we reproduce an extract taken from the web site of Ingenta. The full article can be purchased for $42.96.

"Tomato plants were grown with roots split between two soil columns. After plant establishment, water was applied daily to one (partial root-zone drying—PRD) or both (well-watered control—WW) columns.

Water was withheld from the other column in the PRD treatment, to expose some roots to drying soil. Soil and plant water status were monitored daily and throughout diurnal courses. Over 8 day there were no treatment differences in leaf water potential (inf>leaf</inf>) even though soil moisture content of the upper 6 cm of the dry column in the PRD treatment decreased by up to 70%.

Stomatal conductance (g<inf>s</inf>) of PRD plants decreased (relative to WW plants) when the potential of the dry column decreased by 45%. Such closure coincided with increased xylem sap pH and did not require increased xylem sap abscisic acid (ABA) concentration ([X-ABA])"

In summary plants – and trees – can live comfortably even under conditions of stress, surviving on less water and this is well recognised in dry countries (Australia is an example – *"Regulated deficit irrigation and partial rootzone drying as irrigation management techniques for grapevines"M.G. McCarthy,).* In these countries, PRD actually has a beneficial effect, increasing fruit production.



PRD Root Zone on Plan with variable soil stress related to moisture content.