Radio frequency water treatment.

Phenomenon and explanation of enhanced water transport in a plant

"The Dandilion Experiment"

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RF Water Treatment: Phenomenon and Explanation

- Part 1. Discuss experiment I did in 2014/15 investigating effect of RF treatment on water transport in a plant.
  - *"Effects of Radio Frequency Water Treatment on Revival of Wilted Flowers"* (*Water Journal*; Feb 2017.)
  - Effect was confirmed: *RF treatment can strongly enhance water transport in a plant system*.
- Part 2. Mystery remains: *What is the explanation?*

Radio Frequency Water Treatment.

- 10-50 MHz radiation - with high-amplitude pulses – applied for short period (seconds), e.g. to water flowing through pipes.
- Commercial products were developed in the 1990's – *Vi-Aqua* (Ireland), *E.S.P.* (US).
- Today there are multiple products for:
  - Ag-Hort: plant growth, health, germination
  - Drinking: animal & human health
  - Water pathogen treatment
  - Industry: scale reduction, cement hydration

Vi-Aqua Plantmate
used in the experiment

Vi-Aqua Plantmate for home gardeners.

- Applies RF AM waves at 27.2 MHz into a bucket of water – with high amplitude pulses.
- Applied for just 15-20 secs.
- Claim: water enhances plant growth (30%+), health, seed germination, slows wilting of picked flowers.
- Water retains property for 1-2 days.

Controversy!

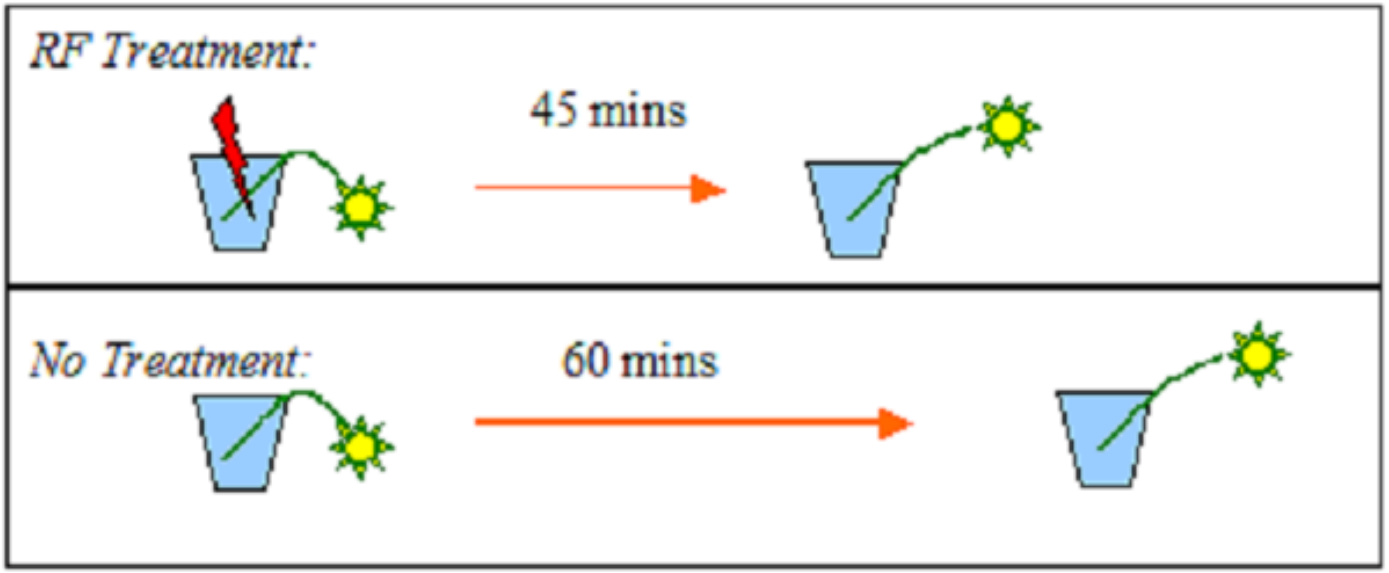
- Lots of debunker attacks on RF water treatments – many academic chemists and physicists claim effects are theoretically impossible.
- But many commercial users and scientists who have researched it are adamant about effects.
  - RF treatment is now accepted in two areas: widespread industrial use for reducing scale deposits in pipes/infrastructure, and in concrete hydration –
  - Debunkers have largely stopped attacking these –
  - But this is distinct from effects on organic systems – in farming-agriculture-horticulture.

Evidence for effects is strong but unpublished

- Lots of formally recorded observations, from farm managers, farmers, etc.
  - On multiple crops and veges, pasture, tomatoes, etc
  - On animal health and growth (pigs, chickens, cattle)
  - Golf courses, lawn establishment, floriculture, etc
- Some formal field trials with controlled experiments have been done.
  - In ag-hort sector - one ag-hort research institute (Ireland)
  - Private research trials on as NZ farm (Scott Biotechnology)
- Real evidence for effects is very positive – but hard to find reports, no formal publications.
  - Practically no studies appear to be published in scientific peer-reviewed journals.

Wilted Flowers Experiment (1)

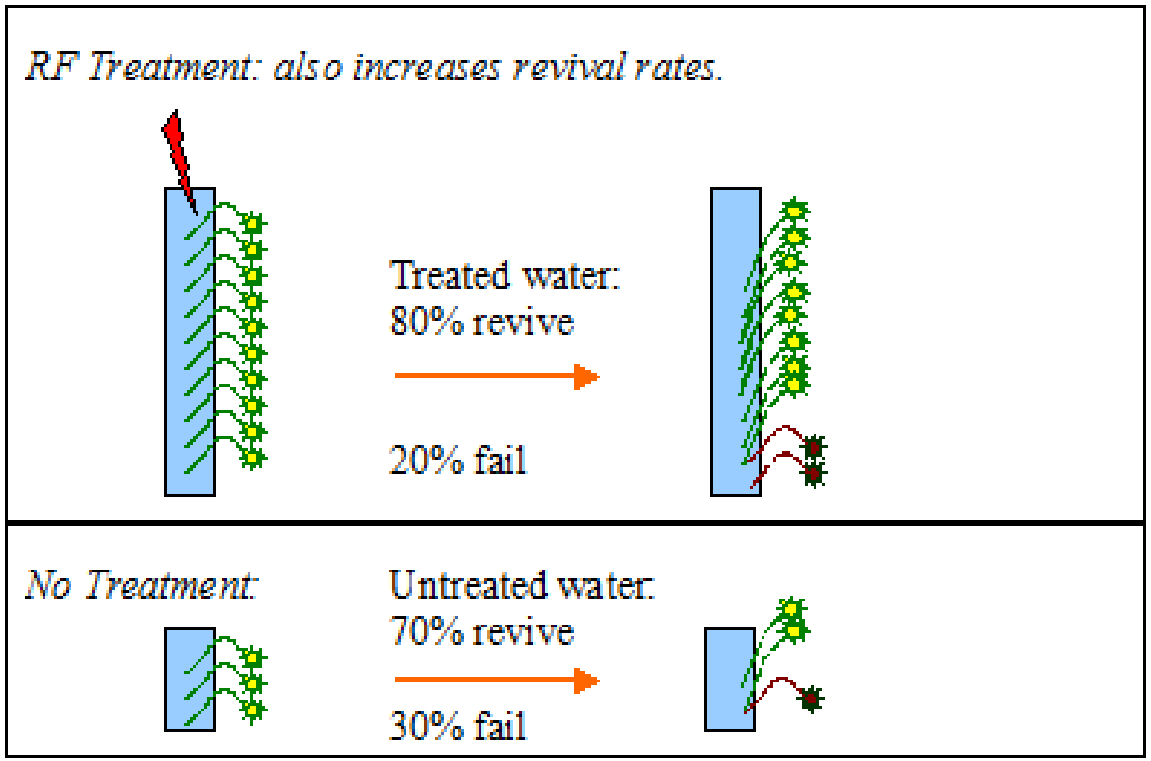
- Compare revival times of wilted flowers – ‘catsear dandilions’ *(Hypochoeris radicata)* used.



Note: this represents the typical scale of effect found – but there is no ‘average time’ in general because it depends on severity of wilting.

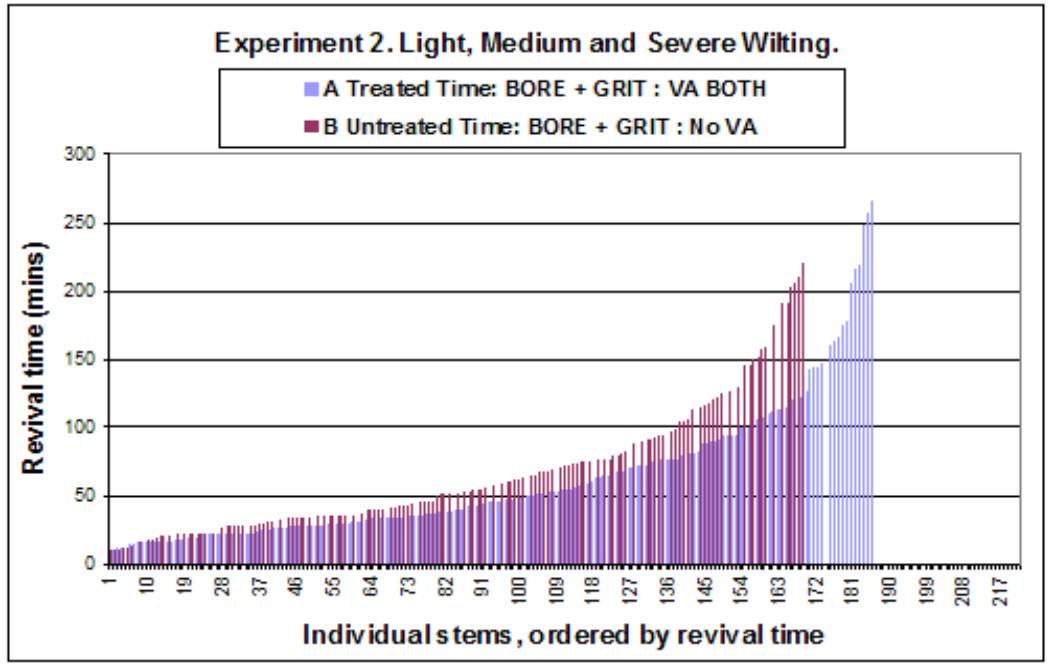
Wilted Flowers Experiment (2)

- Compare revival rates.



Note: this represents the typical scale of effect found – but there is no ‘average revival rate’ in general because it depends on severity of wilting.

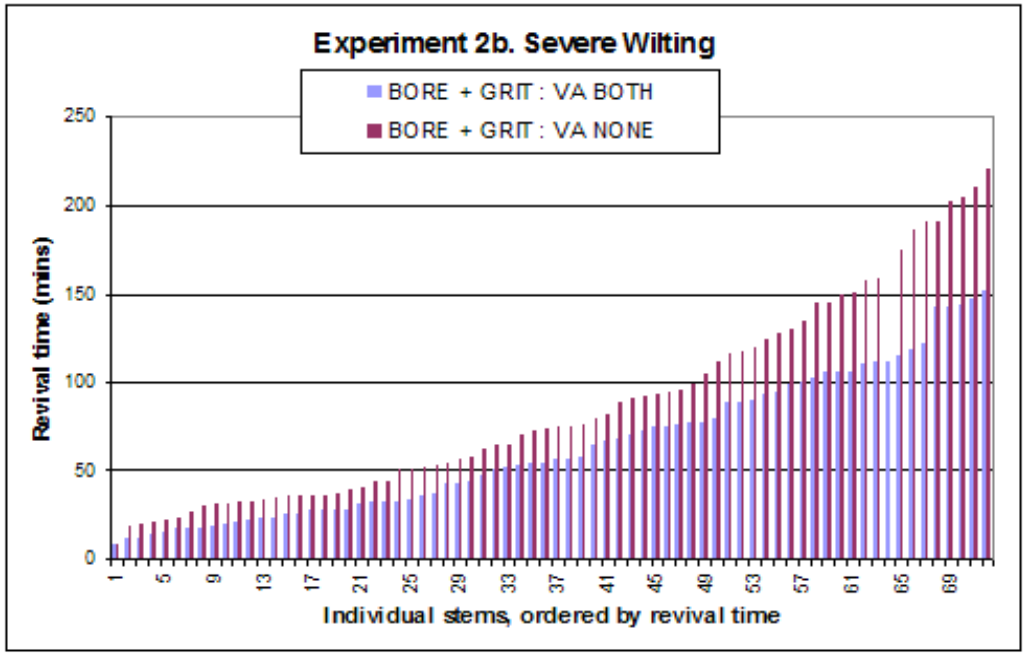
Main Result: Strong Effects.



- Revival speed increased by 28% avg for treated sample (blue).
- Proportion failing to revive decreased: 24% (for untreated) to 16% (treated).

- Using *grit water* and *treating water and stems together* gives large effects.
- Revival speed increases 19%-32% (increasing with wilting severity).
- Statistical significance is conclusive ($p<0.01$)
- Total proportion reviving increases for treated sample.

Results 2. Wilting Severity.



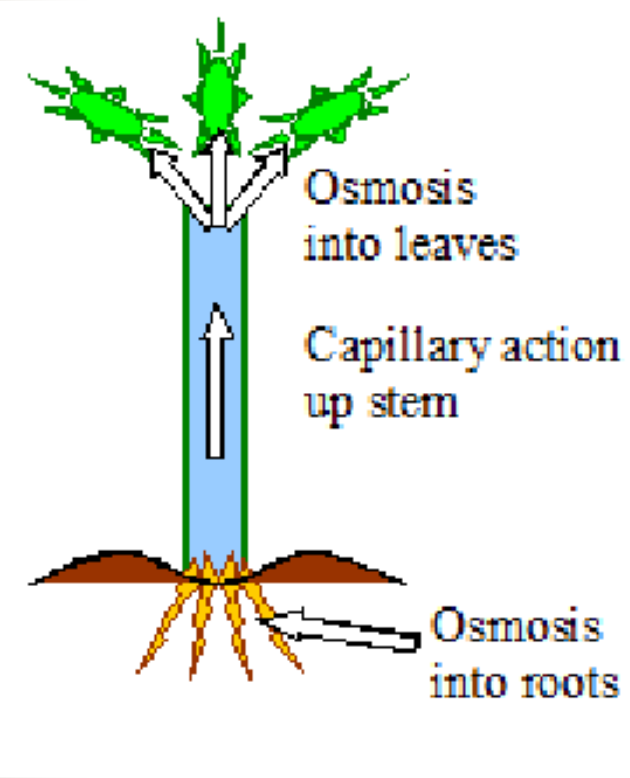
- Breaking down by *light*, *medium*, *severe* and *very severe wilting*:
- Treatment differences increase with severe wilting.
- Statistical significance is conclusive ($p < .01$)

Severely wilted subsample:

Revival speed increased by 32% avg (blue).

Proportion failing to revive decreased from 33% (untreated) to 22% (treated).

Water Transport Effect

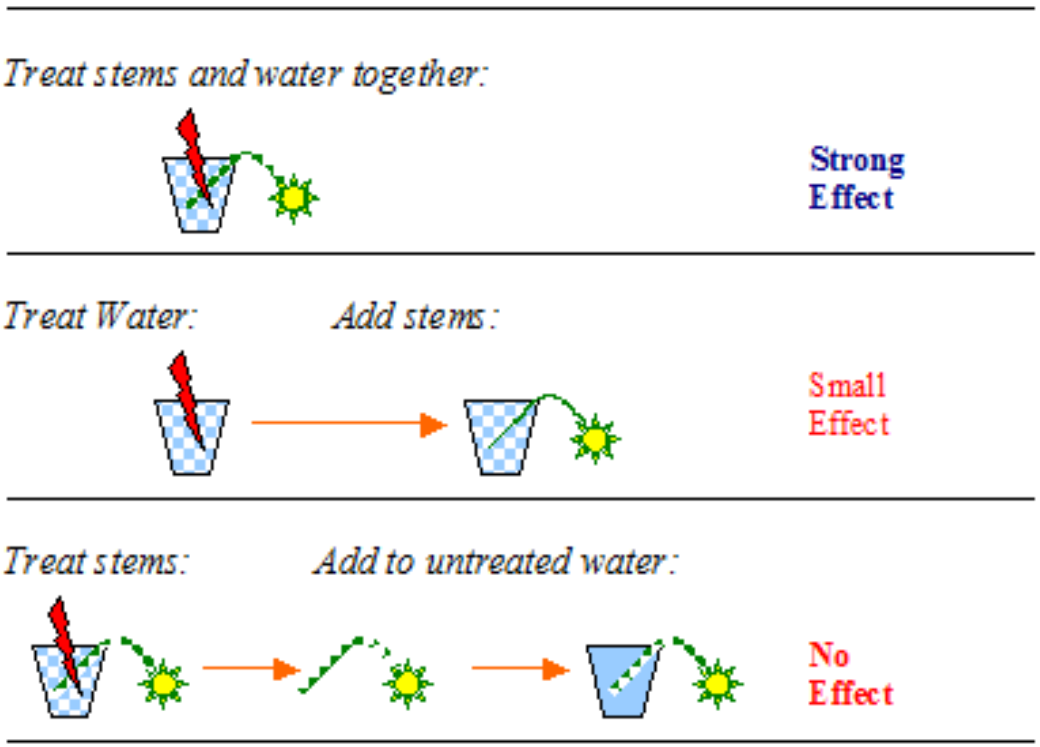


- Water transport in plants is enhanced by RF treatment
- This is a physical (EM-driven) process – osmosis and capilliary action

Basic Clues to the Process

- 1. Does the RF treatment affect *water properties* or *plant material* or *both together?*
  - (Called: *treatment target variations*)
- 2. Does the RF treatment require impurities in water to interact with?
  - (Pure/Salt/Grit *water type variations*)
- 3. Does the RF treatment require time for the effect to develop?
  - (Water develops property *after* treatment)

1. Treatment Target.



- Varying the treatment target shows effect is on water + stem *not* on stem alone

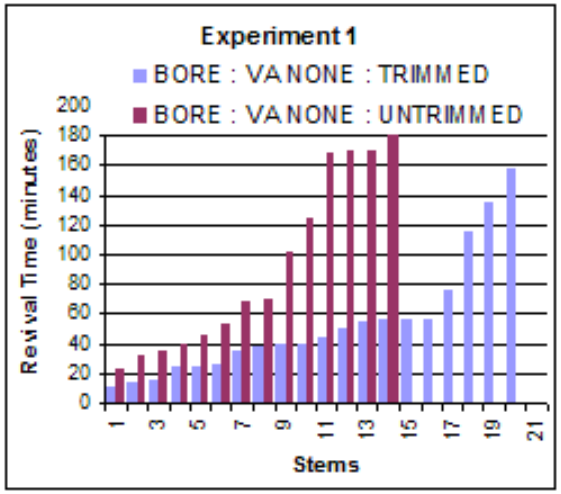
2. Water Impurities

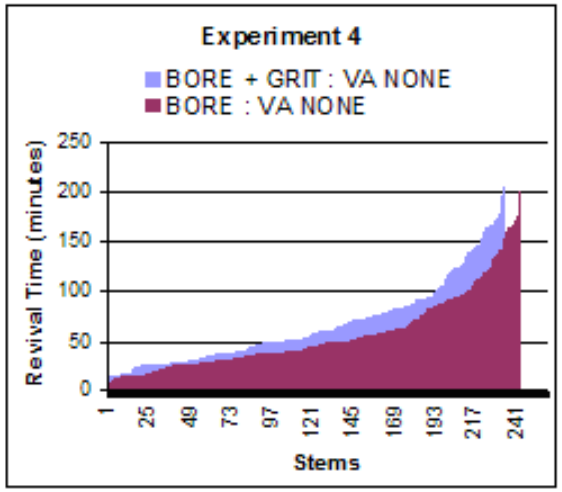
- Pure water – no effect found
- Salt 1% solution – weaker effect (12%)
- Grit 1% solution – strong effect (20-30%)
  - Added impurities are electrically active – also may be critical that there are micro-bubbles in water.
  - Grit was a sandy-clay earth - provides mass of dissolved minerals, colloids.
  - Note: using strong grit or salt solutions (>2%) *slow* flower revival so much that experiments take too long – so 1% solutions used in main experiments.

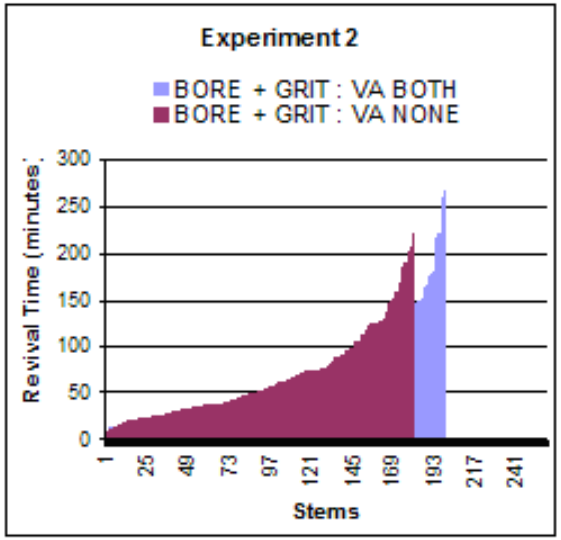
3. Water Property Develops

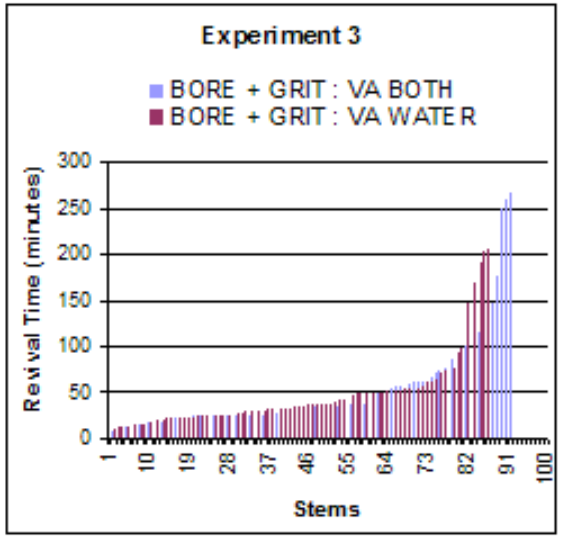
- Treatment appeared to take effect only after about 20 minutes – before that no difference in revival speeds is apparent.
- So: *treated water + stem* appears to develop property over 20+ minutes –
- Not as an immediate effect of the RF.
  - Not totally sure about this – but strong indication.
- This supports the *EZ interpretation* and *External Energy interpretation*, later.

More Experimental Variations.









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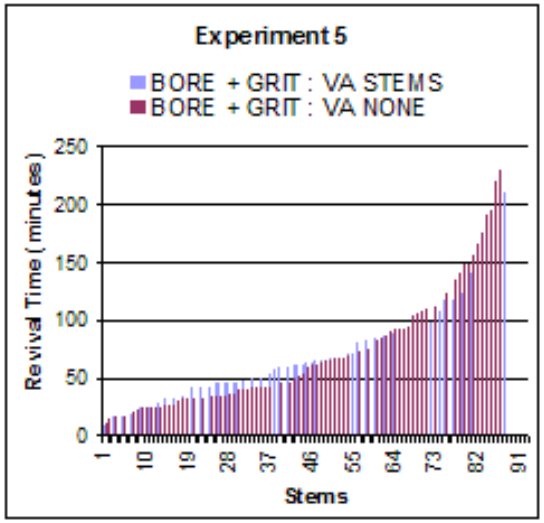

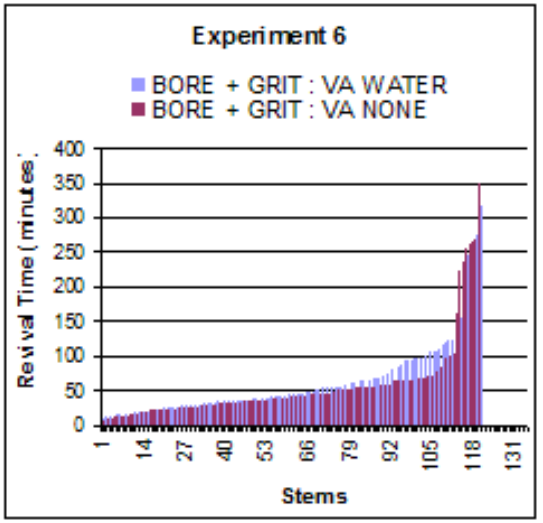

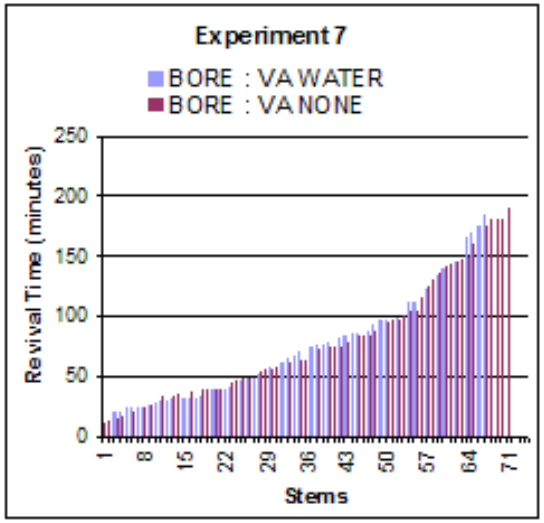

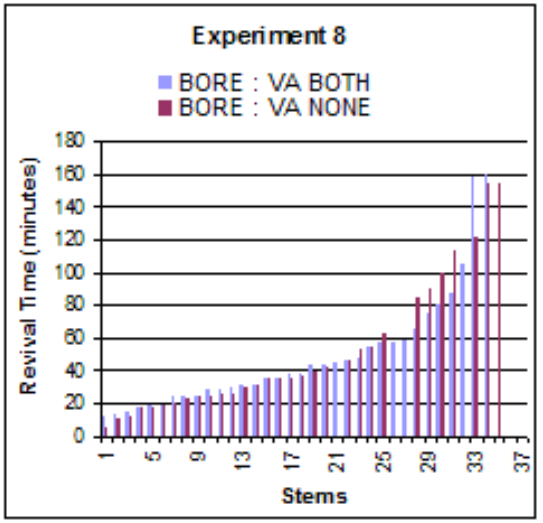

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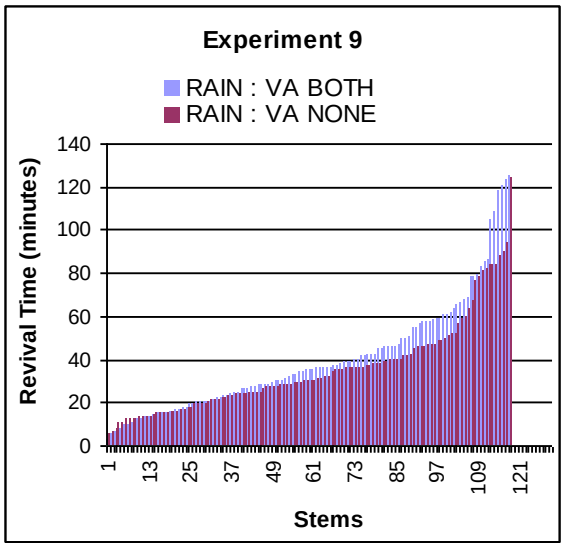
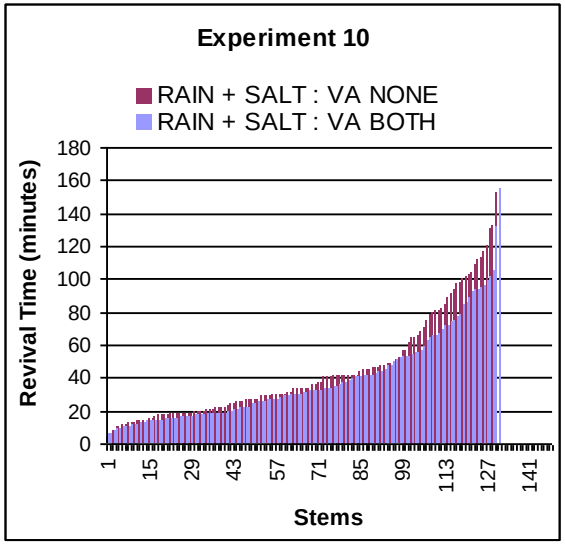
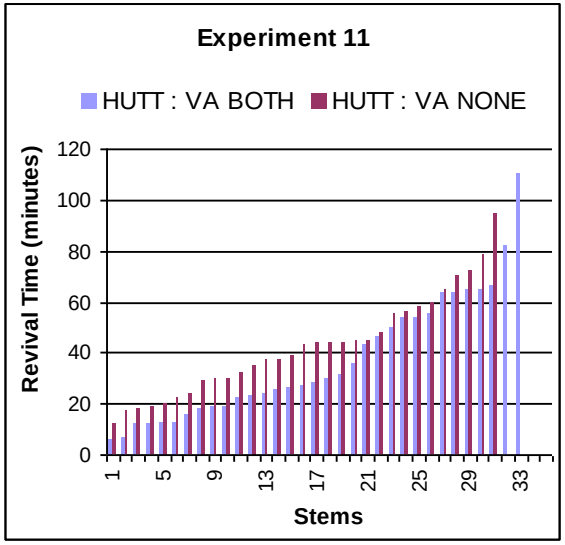
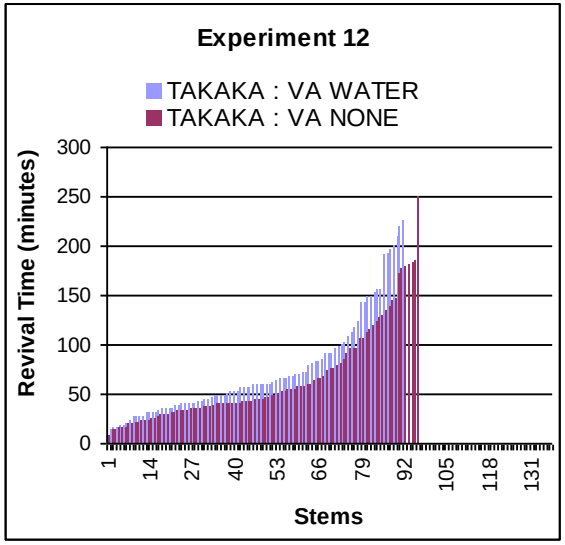








Key features of interpretation

- No effect from treating stems only → effect is not on the stem material: it is *carried by properties of the water*.
  - Revival seems initially *delayed* by treating water only → untreated stem water blocks effect of treated water?
- No effect from clean water → effect depends on *electrically active particles* present (and micro-bubbles?)
  - Colloids/mineral help the effect – but just NaCl is sufficient
- Treated system *develops* the property (20 minutes), does not take it on immediately → something dynamic is happening in the water, *catalysed by the RF radiation*.

- Resulting effect is on *water transport* –
  - Process of *capilliary action* + *osmosis* → physical EM-driven process, not a chemical reaction, not a metabolic process.

Part 2. What is the explanation?

- This leaves us with a mystery.
  - Orthodox water science denies the effects are even possible, and has no explanation.
- I will argue that EZ theory is the critical ingredient to explain the processes.
  - I think EZ theory can explain it –
  - But it has not yet been applied to this phenomenon in specific detail.
- But first a quick review of earlier research:
  - Colloid research in the 1990's – 2000's

Colloid Research in 1990s

- RF water treatment originated from research on colloids: more than a dozen research groups – e.g.
  - Chibowski-Holysz-Busch-Wojcik *et alia* (Poland)
  - Higashitani-Oshitani-Hatade-Okuhara-Kage-Kotamura *et alia* (Japan)
  - Colic and Morse (US) → (Vi-Aqua)
  - → Morse-Leahy-Macken-Ryan-Darragh (Ireland)
- More than 50 original physical-chemistry research papers in 1990's.

Orthodox Physics Questions:

- What is the locus of the RF interaction?
  - Is it a process happening throughout the water – or at the air surface – or plant surface – or around impurities or ions or colloids or bubbles?
- What is the importance of the frequency?
  - Is it a special effect that just works at 27.2 MHz?
- What is the importance of the amplitude?
  - Why pulsed high-amplitude waves required?
- What effects are there on physical properties?
  - Conductivity, ph, surface tension, chemical species?
- What is the time dependance?
  - Evidence of ongoing dynamic processes?

1990s studies found many details:

- The effective RF range is about 10-50 MHz – but effects claimed to stop at about 50 MHz (Colic and Morse). Requires high-amplitude RF pulses – not steady RF field.
- Requires micro-bubbles(?) – hypothesis that interaction is perturbation of bubble-water interface(?) – it creates plasma zones around micro-bubbles(?) – it breaks up H-bonded water networks.
- Studies investigated lots of physical variables – conductivity, ph, surface tension, temperature, zeta potentials, reactive chemical species, etc. Many subtle but definite effects – but some problems with replication.

"Magnetic Water Memory" Mystery:

- Referred to as "Magnetic water memory". E.g.
  - Colic and Morse, 1997."The *magnetic water memory effect is probably one of the most challenging problems of modern physical chemistry*… The existence of the *magnetic memory of water was a rather anecdotal phenomenon until recently* when the members of several laboratories reported sophisticated physicochemical measurements which quantified this exciting process."
  - Different to Jacques Beneviste's concept of *water memory* – but no doubt connected at a deeper level.
  - (Did this connection lead scientists to stop research?)
- This line of colloid research into RF treatment largely stops after 2000 – leaving the subject in a state of mystery over fundamental interactions.

Physical research lacked knowledge of water structure (EZ) theories.

Researchers were not aware of EZ processes:

- Colloid studies failed to identify EZ phenomenon – that we now know are probably central to the mechanism.
- Failed to determine micro-effects on biological systems - practically no peer reviewed publications about this.

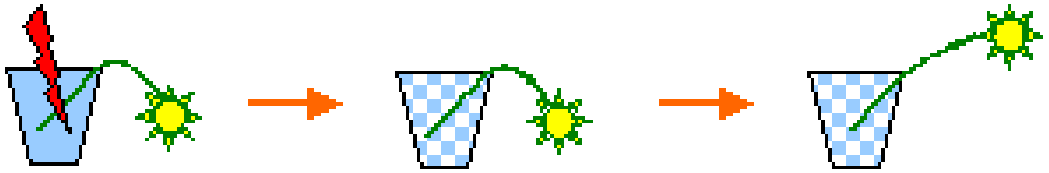
And questions remain unanswered:

- What is the effect of RF treatment on exclusion zones?
- What kinds of exclusion zones are formed?
- Without understanding this dimension I think the phenomenon will always remain mysterious.

Broader Explanatory Scheme

Explanatory Scheme: Three Stages.

1 .RF interaction → 2. Water property develops → 3. Processes affected



RF waves interact with water…

New property of the water develops…

Water property affects osmosis | capillarity…

Where does the energy come from?

What water property is created?

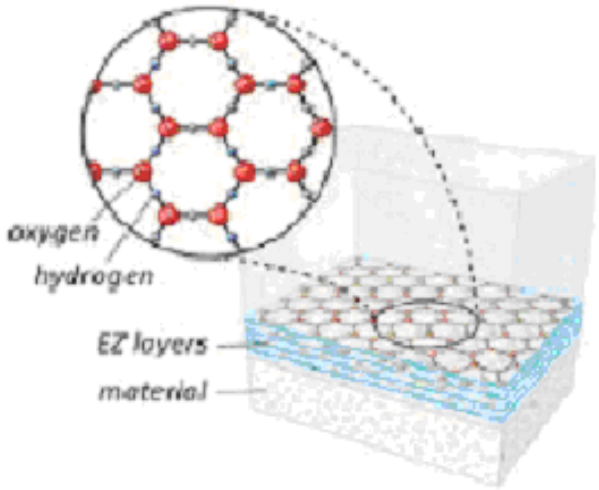
The two objections by sceptics:

- 1. Water cannot carry structural properties required to produce such effects.
- 2. RF radiation is too low-energy to cause significant effects.

- Taken as conclusive, but both are wrong:
  - 1. Water develops EZ structures.
  - 2. Other energy sources are available.
- Hypothesis: RF *catalyses* absorption of external radiation (into EZ structures…)

First point: EZ Structures

- Water takes on long-lasting properties through EM structures – EZ structures.
- EZ structures are central to many water processes.
- Including osmosis and capillary action.



Pollack: EZ Water Structure

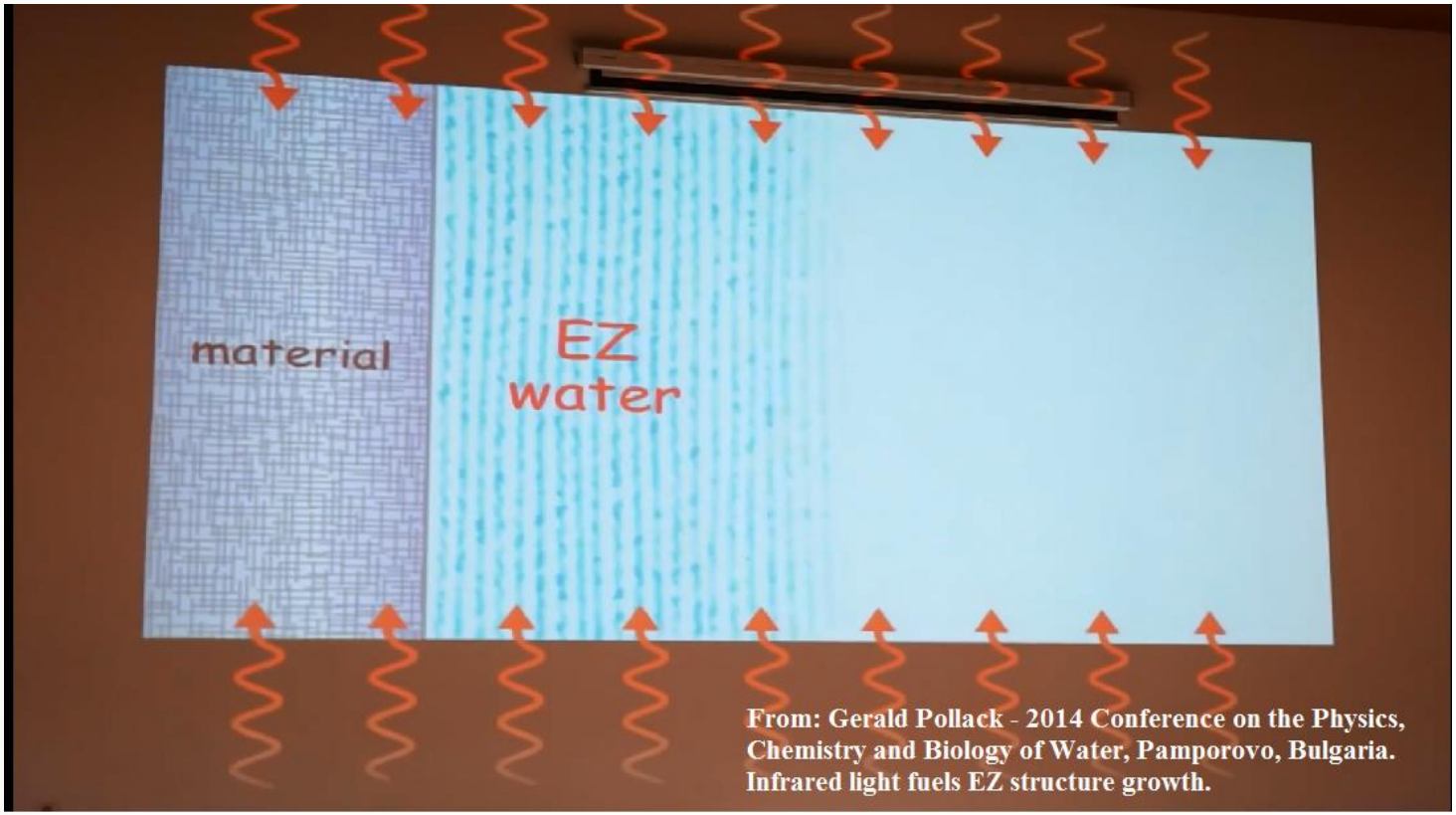
The EZ theory is *ideal* to explain phenomenon of enhanced water transport *if we can confirm the RF treatment causes the formation of EZ structures.*

Second point: Energy

- EZ structures take energy to build.
- The energy provided directly by the Vi-Aqua RF treatment is not enough.
  - Comparable to shining a small flashlight into the water for several seconds.
- RF energy supplied is tiny compared to normal thermal energy exchanges, through air and bucket surfaces, and through heat radiation.

IR radiation is the normal energy source for building EZ layers

- Pollack (2013): substantial evidence EZ structures build using infra-red radiation as energy source.



Hypothesis: The energy source is free radiation – IR (or MV?)

- Conclusion: the energy to build EZ structures is *not* provided by the RF EMF.
- Hypothesis: the energy is provided by free infra-red heat radiation (or other light).
  - This is the normal energy source to build EZ structures.
- RF treatment *catalyses* a reaction:
  - The EZ structures build over 20+ minutes – after RF EMF is switched off.
  - Development of EZ structures are *typically catalysed* at hydophilic interfaces – "self-assembling" structures.

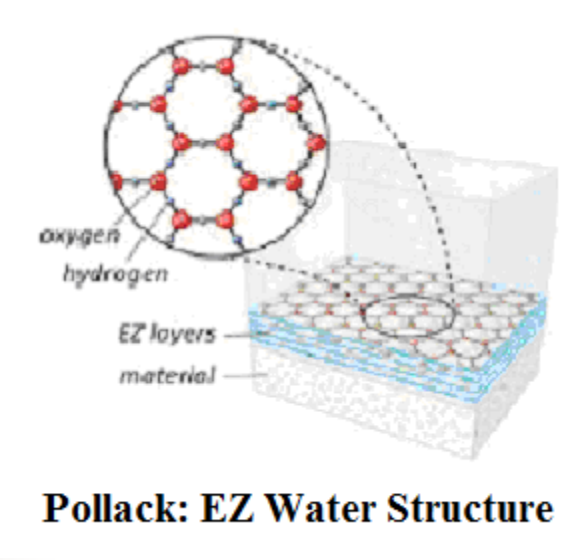
Catalysed RF heat transfer is consistent with normal physics.

- There is nothing in physics or thermodynamics to rule out this kind of process –
  - The system of water + bucket + air + heat and light radiation is not in thermal equilibrium. Our environment is a *far-from-equilibrium* state.
- To absorb radiation only requires structures that *resonate* with light frequencies.
  - Water resonates strongly at special IR and MV wavelengths and extracts this energy from spectrum.
  - But lots of unused energy left in the spectrum!

Summary.

- RF water treatments have real effects including enhanced water transport.
  - RF technology can have BIG benefits in Ag-Hort – and subsequently for the environment.
- Water transport is propagated in organic systems through EZ structures and processes.
  - Water transport in plant biology should be studied from this point of view.
- The RF interaction with water is not understood in conventional science – still open in EZ science.
  - Further studies required to find mechanisms for catalysing absorption of IR radiation by water.

(Extra A) The Water Property

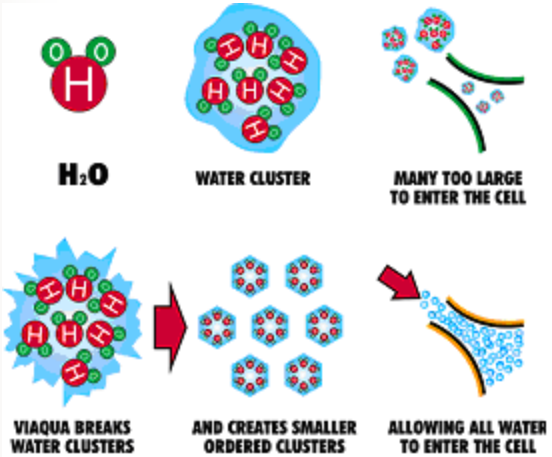


Pollack: EZ Water Structure

- Gerald Pollack (2013) in *The Fourth Phase of Water* puts forward a broad theory of EZ water structure.
- Proposes that osmosis and capilliary action are driven by electrical energy stored in EZ water structure.
- This promises to explain the basis of the changed water state, and its effect on water transport.

(Extra B) The Water Property

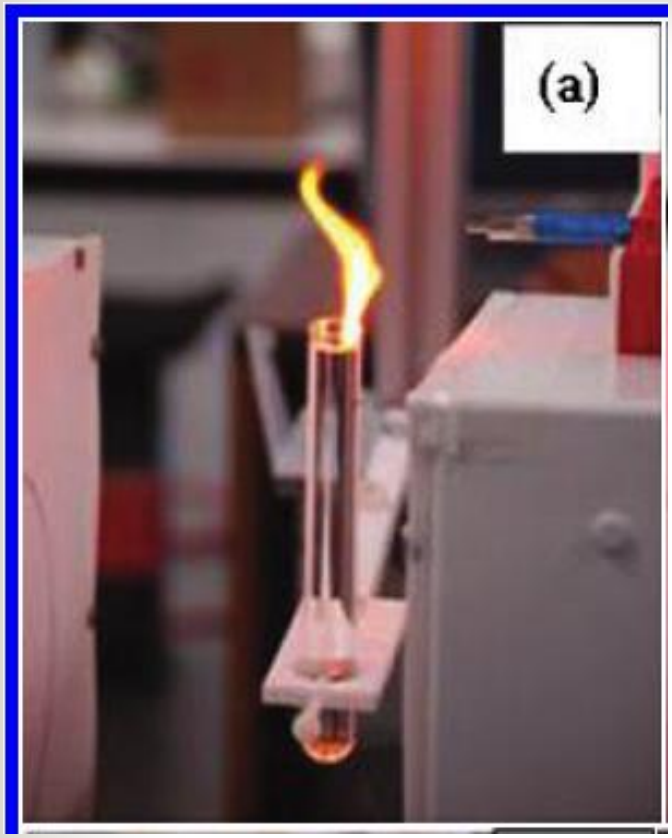
- EZ theory was not widely known until about 2013 (Pollack) – earlier researchers (Colic and Morse, Leahy, Darragh, etc) did not know to look for this structure.



Darragh *et alia*:
Vi-Aqua Explanation:
breaking up water clusters

Vi-Aqua researchers offered another explanation: *the RF treatment breaks up water clusters.* This may also be part of the explanation - it also represents a long-lasting change of structural properties of bulk water. But EZ theory is more comprehensive.

(Extra C) Kanzius: Burning Water 2007



Kansius 2007 discovered RF treatment allows salt water to burn!

- "$NaCl–H_2O$ solutions of concentrations ranging from 1 to 30%, when exposed to a polarised radiofrequency beam at 13.56 MHz at room temperature, generate an intimate mixture of hydrogen and oxygen which can be ignited and burned with a steady flame." R. Roy, M. L. Rao and J. Kanzius. *Materials Research Innovations 2008 VOL 12 NO 1.*
- But production stops immediately the RF source is switched off.
- High-power RF source – 400 watts

Survey Article Leahy *et alia* (2000)

- Leahy, J.J., Macken, C. and Ryan, M., *Journal of Colloid and Interface Science* 225, 209–213 (2000). "The Effects of Radiofrequency Electromagnetic Radiation on the Adhesion Behavior of Aqueous Suspensions."

range when the colloidal particles and metallic surface were oppositely charged and enhanced attachment between similarly charged particles. It is proposed that this observation is due to a reduction in the surface potential of the charged particles due to thickening of the adsorbed layer.

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Summary: Colic and Morse (1999)

- "The elusive mechanism of the magnetic 'memory' of water." 56 research refs – 1990s Colloids and Surfaces A: Physicochemical and Engineering

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