

Dirty Water[®]

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BACKGROUND

My nursery is situated in Amberley, 50 km from Christchurch in the South Island of New Zealand. The rainfall is about 22 in. (55 cm) per year. My water right is limited to a shallow aquifer with deep water not really an option, as the neighbors drilled down 250 m and got nothing. We are only 3 km from the sea and at an altitude of about 30 m. Originally when I set up the nursery I did it with recycling in mind. The nursery was developed with a 1 in 200 gradient. In retrospect 1 in 100 would have been a lot better. All the water ran to a central drain and out into the paddock, and boy was that green. Initially when I started on this article it was all about recycling nutrients and the practicalities I have encountered in doing it. Unfortunately any lecture preparation seemed to only point out just what you don't know. This is frustrating and seems to require an enormous effort to fix unless you just tell your story and don't pretend to be an expert. That's me, no expert.

THE BEGINNINGS OF RECYCLING

In 1984 and 1999 I had a trip to California and Monrovia Nursery. I saw the recycling and their chlorination plant and thought that was the way to go. So I dug a catch pond, rigged up a pump from the well and presto, I had recycling (Fig. 1). At the same time I constructed a computerized liquid-feed system with A and B tanks and pH adjustment. My aim was to kill all the microbes, reduce slow-release fertilizer usage, eliminate any top dressing, catch my unused water and nutrients, and chlorinate, and send it back over the nursery. The chlorine application was a little crude — 20 L in the pond every 3 days but none the less effective. The liquid-feed system was okay, but I did have trouble thoroughly mixing the chemicals. This system worked at the level where I could maintain plant vigor without topdressing.

As time went on and the amount of detritus increased in the pond, the effectiveness of the chlorine decreased. I did not realize this at the time. All of a sudden I was starting to get disease problems in the nursery, in fact more than I had ever had. A sales rep came in selling microbes — I can't even remember the product. But he suggested I throw it in my pond and irrigate it over the whole nursery. He said that would work fine. I asked about what the chlorine would do to the bugs. Kill them, was his simple answer. So after a little thought I decided to stop using the chlorine. One less job and it saved a bit of money. Instead I made it a priority to get rid of any puddles in the nursery. Almost overnight my problems seemed to disappear; "rubbish mountain" was sinking. So many of the problems with business are if you can measure it you can manage it. You don't really know what is happening. Unfortunately at that stage I could not measure it, or at least didn't work out a method of repeat application. So microbes in the pond were just airy-fairy stuff that could well be mumbo jumbo. Or was it?



Figure 1. Recycling pond at Elliott's Nursery.

A few more years down the track and the root disease problems are on the increase again, perhaps the puddles have increased and I was not measuring my recycled water — it could be anything. About 12 years ago I tested the EC conductivity factor and the pH of my water and run off. The EC conductivity factor of my runoff was 5, the water I was putting on the plants had EC conductivity factor of 0 and pH was 6.4 for runoff and 7 for the well. Yes, I have excellent water from my well, but you could argue my runoff is better water for growing plants than well water. The well water is well filtered and relatively sterile. Who knows what's in the recycled water — dirt, trimmings, dead slugs, worms, *Phytophthora*, *Pythium*, and goodness knows what else. Goodness knows what is in my potting mix. When it arrives it comes off the truck and it is about a million degrees. Sometime I can see *Mycelium* in the mix and I can always smell composting happening. Potting mixes are alive. If we used to sterilize our water some of the residual chemicals will also kill our potting mix. Do we want our potting mix sterile? For years people have used steam and methyl bromide to sterilize potting mix, but when you think about that just for a minute that is a huge contradiction — potting compost is another name for potting mix and the word compost means a living process is going on.

What is composting and what effect does it have on the plants? I read an article on the plant immune system in the journal *Nature* (Jones and Dangl, 2006). I couldn't even really understand it, as if it was in some other foreign language. It implied there were degrees of immune system, but I found it hard to understand, and then wondered what use is the research if I can't understand it.

I have come to the conclusion that it isn't even about plants and their immune system. It is about the ecosystem as a whole that the plant lives in. In fact, plants and their soil microbes have been evolving for millions of years together, one never without the other.

The plant is far from alone in its growing, and their requirements are incredibly complex in terms of nutrients and the symbiotic relationship it has with the soil. I'm sure that along with the plant the microbes in the soil will have been evolving in parallel. How many times in my life I have come into contact with pneumonia but how many times have I come down with pneumonia? Every time I come into contact with it my immune system will grow stronger. Balance is the key. Every time a plant comes into contact with *Phytophthora* fungi, if there is an area of root damage it will grow, and that in turn will supply itself as food for *Trichoderma* species, which live on those diseases. Is *Phytophthora* a bad disease or a little *Phytophthora* a good thing? Is the effective immune response from *Trichoderma* better because there are spores ready to fight the next attack or is it better to never have any there? What I do not know is whether it was a good microbe or a bad microbe that did this job or whether there are no such things as good or bad microbes; the microbes are the plant's own immune system working in a symbiotic relationship with other microbes and the plants all supplying each other with what they need to grow. Is it realistic to have no microbes in the compost mix?

Chances are as soon as you get rid of one, another microbe will grow in its place, so nuking the lot is just short term and there is more than one way to nuke.

Should I clean my water? Yes, no, or maybe?

I don't have the answers, the new silver water technology looks very interesting but it does kill things. Then I thought about the barrel with its limiting factors.

To summarize nutrients, it is all about balance. Too much and it is toxic, too little and it is deficient — either way it will not grow a plant. A plant can only grow as well as its weakest link, like the balance in the barrel.

Is it the same with certain microbes in the soil? Is there a golden balance — too little of these bacteria or too much of that bacteria and you get problems? But you can have a lot of this fungus, it just doesn't hurt. So yes I think there is a golden balance of microbes in your soil. Cultivate a good balance and watch them grow. Kill the balance and prepare to fight because things are still going to grow, but probably not as well

Do we have the right balance of nutrients in the soil? Probably not, but it is okay. Do we have the right balance of microorganisms in the soil? I wouldn't have a clue but I suppose if the plant looks alright then the balance is alright.

What if, like fertilizing, we cultivated a better balance of microflora, would our plants grow better?

I had some plants tested for plant disease. Simply, sick plants had anaerobic bacteria and well plants aerobic bacteria. Their mycorrhizal colonization was 20% and should be 90%, according to the experts.

SUMMARY

Dirty water is alive. It has nutrients and microorganisms, beneficial and otherwise, and with a bit of a hand could improve plant health and natural hygiene. By plastering our plants with our dirty water we may be holding the Holy Grail. How do you balance good microbes to bad microbes? Most bad microbes are anaerobic and

most good ones are aerobic. I went to see a septic tank specialist who makes our sewage into water. He was telling me he used to sell \$50 bags of microbes to people to get their septic tanks going and how he gave up doing that because the microbes were already there. To get them going was not so much about population as about food source, so a bag of sugar for fuel and wait 24 h and kaboom.

Compost teas are the new flavor but what are they? Soil, air, water, sugar (lots of that), brewed up together for 24 to 48 h and then lovingly watered back onto your plants.

With our dirty water we have the opportunity to collect all those microbes, alter their anaerobic/aerobic balance and spit them back onto the nursery. Every time we irrigate with clean water we have control...or at least we think we do.

LITERATURE CITED

Jones, J.D.G., and J.L. Dangel. 2006. The plant immune system. *Nature* 444:323–329.