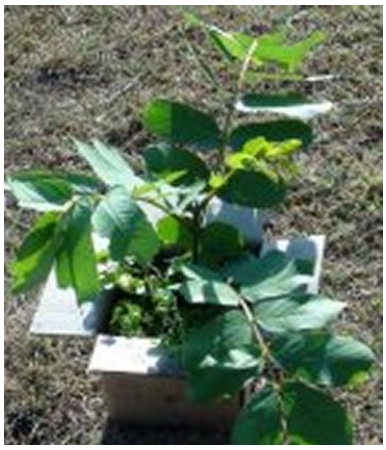
Newsletter 8th October

The Soil BioPack story – a behind the scene look at their development

At long last Soil BioPacks are available. We now have a product which looks really good, or as good as what looks at first sight to be nothing more than a box of soil can look.



Now with the delays in getting the Soil BioPacks into production many of you may have guessed developing these Soil BioPacks has not been as straight forward as may have appeared at first. It has certainly been a challenge, but an educational one, so I thought for this newsletter I would tell the story – warts and all.

Warning

But before I start a warning. Before you even think about buying a Soil BioPack you need to think about whether adopting a system of growing using soil biology is really for you.

Most food in the world is produced by a system of chemically based mono-culture. Let us face facts this is the most efficient and economical way of producing food in bulk. The negatives are that the food is often lacking in trace mineral which are important for health and often the produce is picked before it is ripe so the plants do not have a chance to produce the phytochemicals which are important for health.

Organic farming recognised the dangers of excessive use of chemicals but the emphasis has been on avoiding toxic chemicals rather than the positive benefits of improving health.

Growing based on soil biology has the aim of increasing the mineral content and the important phytochemicals need for health by relying on the soil biology to release minerals otherwise locked up in the soil and allowing plants to ripen naturally and be eaten quickly after harvesting. The principles are good but there are some serious practical issues that need to be explained upfront.

First soil biology, particularly the critical mycorrhizal fungi are delicate and easily damaged by working the soil, they are living creatures that need looking after, it is not a simple question of sprinkling a little powder on the soil and hey presto all the problem are solved. A certain area of land must be sacrificed to provide a permanent refuge for the critical soil biology and the working of the soil must be minimised.

Secondly soil biology is a working eco-system. This means abandoning the nice neat clean soil and organised vegetable beds that many growers take great pride in. It means a system of interacting plants and biology, this inevitably means the soil is no longer nice, neat and tidy but can honestly look a bit of a mess. Crops are often grown alongside plants which are host for the soil biology. The right hosts should not compete with the crops and often will assist in their growth. But if you are a tidiness freak then growing using soil biology is definitely not for you.

Thirdly a multi culture system with highly fertile soil is a natural magnet for weeds. The customary herbicides used to control weeds can quickly destroy the soil biology. Growing using soil biology does not lend itself to mechanisation so it means substituting the energy saved from no-till growing with hand weeding.

If these have not put you of let's get to the story of the Soil BioPacks.

Story time

Once upon a time (in reality about forty years ago) I had watched the red clouds of soil spreading across the sky - millions of tonnes of top soil were lost in these dust storms. Realising that soil is the basis of all life on earth I decided that I would take up the challenge of learning how to regenerate soil. This is the story of that challenge.

Now all good stories should have a beautiful heroine and some baddies or monsters. Unfortunately for this story beautiful heroines are a bit light on, but we certainly have lots of monsters, may be a little on the small side but certainly not lacking in evil intents or ferocity.

Old time farmers

Now I said the story started forty years ago, that's not quite true, it really started 4,000 years ago when the Chinese developed a system of agriculture (see Farmers of Forty Centuries www.gutenberg.org) which sustainably fed a population at least double the population of current USA. Nature was partly on their side with massive mountains which resulted in flooding which killed large numbers of people but covered the land in mineral rich soil. Drought also killed many people with no side benefits. Nature is never totally benevolent.

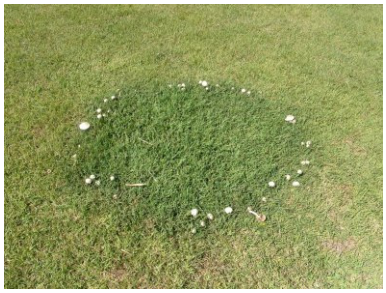
Now contrast this with the USA where the pioneers found some of the richest soils in the world which could grow hungry crops like tobacco. This made some farmers very rich, for a time at least, but within a couple of generations the soil was so badly depleted it was barren - but no problems - just abandon it and move a bit further West, chop down the native forests and hey presto more beautiful farmland (at least for a while). If you want to see the modern version - take a holiday to Brazil.

These early pioneers had little understanding of soil chemistry but science did eventually come to the rescue producing powerful chemical fertilisers to provide the plants with the main nutrients they need. If you want to see how effective these chemicals can be come back from your Brazilian holiday via Israel where they are growing fine looking fruit and vegetables in nothing more that desert sand.

Dust storms

When my story started some forty years ago I was pretty ignorant about what makes soils soil (like many people at that time). But I could see that there was more to soil than just its chemistry, there is the soil structure, without structure you can have a soil which is like concrete when dry and soup when wet - not good for growing.

So I started to experiment with additives to improve structure. I quickly learned that just adding 'magic powders' is just a waste of time. The only thing that worked was to keep the soil moist and grow something - anything but I had no idea about the mechanism of how it was working. Now I know it is the soil biology, particularly fungi that gives it the structure.



I did learn about the benefits of adding mushroom compost and much later saw the benefits of fungi from the fairy rings on a bit of waste land on my block. The growth inside the ring was far more luxuriant than elsewhere. It was only when I attended a lecture by John Crawford of Sydney University that I began to understand how fungi fundamentally change the soil by making myriad fine passages throughout the soil all bound together by sticky exudates. Exudates, probably the most valuable but underrated material on earth.

I learned about the synergistic relations between plants and mycorrhizal fungi and became fungiphilic. As I studied deeper I learned just how complex fungi and their relationships with plants really are, with a bewildering number of fungi and an even more complex coupling of types of specific types of fungi and their chosen host plants.

A while later I began to learn about trace elements, mineral and phytochemicals which play a profound effect on human health. The nearest character in this story to a beautiful heroine is my wife Xiulan who contracted diabetes, which forced me to study the effect of diet on health.

Food food everywhere

The story of soil is not a happy story; we now have the most efficient agricultural system the world has ever seen. We have a world surplus of food - it is so cheap and plentiful that we waste some 30%. I know that there are some billion people that are undernourished but that is not because there is no food, it is the results of an intrinsic failure in human nature which prevents us reaching sensible and practical political solutions. (See tonight's news, whether it is the USA Congress holding the world to ransom or some terrorist group).

Now maybe I suffer a bit from delusions but I am realistic enough to recognise that neither he USA Congress nor Al-Shabaab are going to take any notice of an old fogey from Gin Gin Queensland.

However I do have a lot of land, and live in a good climate with an adequate supply of water from a system of dams so at least I can attack the problem of how I can grow quality food to help Xiulan with her diabetes.

Theory and practise

Now thanks to my good friend Mr Google and Mr Kindle of Amazon fame, and my odd habit of waking up at 5 in the morning and reading for a couple of hours I do have access to a wealth of information.

I can read all about the theoretical information on mycorrhizal fungi with their almost infinite number of unpronounceable names. I can find an equally almost infinite number of practical 'how to books' on gardening, composting, permaculture etc., but I just cannot find that magic practical book on 'how to grow and care for mycorrhizal fungi'.

I had access to a lot of good scientific information, but it was not helping my specific problem of cultivation the fungi.

But sometimes in life it pays to go out and do things even if you are not sure what you are doing - so I purchased a variety of fungi, read the instruction manual which made it all seem so easy, and tried inoculating the plants I wanted to grow.

It was not a great success. True it sometimes did work sometimes, and I could see the fungi attaching to the roots of the plants but it was not a reliable process, nothing like sprinkling a few radish seed onto the soil and coming back a week later to see all the shoots. Radish seeds cost me $2 and always worked, fungal spores cost me $200 and sometimes worked and sometimes not.

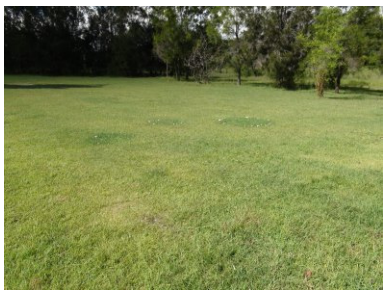
I learned that plants actually have to invite the fungi to bond by exuding chemical triggers into the soil which attract the fungi. If the soil is too rich, as in a heavily fertilised vegetable patch, the plants will simply not bother to put out the triggers so the fungi does not attach.

Again if there is not enough calcium in the soil they don't attach.

Without the fungi it is easy enough to feed the plants the primary chemicals (N,P,K) needed for their growth but may they miss out on the critical trace elements and minerals which really need the enzymes and intense pressure of the fungal hyphae to release and make available to the plants.

So here I was, paying $200 a kilograms for special fungi imported from the US and most was just going to waste - I needed a new approach.

Missing the obvious



Now sometimes I get a bit cross with myself when I am being stupid and not seeing the obvious. I live in an eco-village on a bush block. On three sides there is bushland, on the forth there is an abandoned house which has gone feral. The picture shows the fungal rings which just appear, as if by magic, on my block. Every time I dig in my garden I see the evidence of fungi.

What had I done to create the little fairy fungal rings that improved growth on my block? Absolutely nothing - nature had done it all. Rather than stay in bed reading all those high powered articles on mycorrhizal fungi what I really needed to do was get out of bed and see how nature does it.

In the dry like now you could walk around my block and not see one sign of fungi - that is until you get to the areas I irrigate where there is plenty to see. But wait until the rainy season comes. There is literally fungi everywhere - every conceivable shape and colour, the bright red ones with the spots look particularly ferocious but I have a rule - I leave them alone and hope they leave me alone - and I can run faster than a mushroom. So far that rule seems to have worked even with the snakes that visit us in the wet.

Obviously the fungal spores are being blown onto my block (together with weed and other seeds) but any one spore probably has a one in a million chance of mating up with a suitable host to create a new mycorrhizal fungal colony. But that is not really a true picture of what is happening. Once a fungus has attached to a plant is stays there living in this symbiotic relationship - every year it grows and extends it web to other suitable plants nearby. It does this year after year - fungi are very long lived so it does not really matter if the majority or even all of its spores are lost in any one year - there is always next year.

Host plants

So the answer seemed pretty clear - just get a living plant which is already inoculated with fungi and this can then be transplanted somewhere else to recreate a new colony. Sounds simple and it is - but this is when the problems start.

The first question is what plants to select as the host, knowing that there are specific fungi for specific host plants. If there was only one fungus for each specific type of plant this would completely ruin this approach but this is not the way nature works.

First any one type of plants may support a whole range of different fungal species, it may have preferred fungi but it will host many types, secondly plants in nature do not generally grow in a mono-culture, they seem to benefit from having a whole range of other species around.

I am not sure I understand how these symbiotic relationships between plants work but neither is it necessary to understand everything. It is really nice to understand the scientific mechanism, but it you cannot just observe how it works as a system.

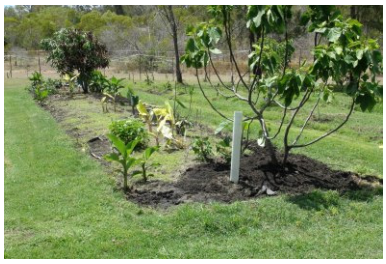
If this argument seems a bit of a cop out, an excuse for ignorance - think about sex, people have been having sex and reproducing for hundreds of thousands of years probably with very little understanding of how it works or what it is all about - but we are here so it has worked fine.

Eco systems – natures war zone

So my aim became to create a balanced eco-system of plants and soil biology with the plants providing the energy and the biology providing the plants with nutrients and a beneficial soil structure.

I live in an eco-village which is supposed to have a natural balance, but there are very few spots left in the world with a purely natural eco system. In our village we have inevitably modified the environment; the most obvious impact is the water in our dams which has led to the mass breading of kangaroos, duck, water hens etc.

Natural eco-systems are not all creatures and plants living in a perfect natural harmony, its competition for survival as were just shown to me. A kookaburra was sitting on my veranda railing while I was eating my lunch, I threw him a piece of my lunch but he never got it, from nowhere a butcher bird flew in catching the food in mid-flight. If our cricketers could catch like that we would rule the cricket world.



I spend a lot of my time fighting the effects of living in an eco-system. There are the kangaroos. Many people think kangaroos are so cute and cuddly, they may well be but they are highly destructive, when they get into my block they will simply tear down the plants and trees for no apparent reason (I think with the males it is some form of sexual frustration). I have been building a fence around my place which gets higher and higher as they learn to jump over it; you need at least two metres to keep a kangaroo out.

I thought I was winning but now am plagued with rabbits that go under or through my fence. That's my next challenge, but after that there is the ducks and the swamp hens who just love my wicking beds.

Then there are the weeds, so many seeds just blown in on the wind waiting for a bit of water so they can take over. But it is not all bad news, the wind and the animals and birds are the very carriers of the soil biology onto my block. It is a question of learning to manage an eco-system for mutual benefit.

Save the bush

It would be theoretically possible to go out to the virgin bush and simply collect BioPacks already loaded with a balanced eco-system. It would also be illegal and totally destructive, that is exactly what the early Americans did.

They would also be so full of pests and weeds that there would be a lot of very angry customers. We need a controlled eco-system.

Grandmothers, mothers and daughters

The way I see it is that we must dedicate a certain area of land to soil regeneration. The native bush is like a grandmother providing the basic life for soil regeneration. We need to take the benefits of this natural bush to create a controlled daughter eco system, this is the BioPacks. When these BioPacks mature in customers gardens they become mothers providing the benefits of soil biology to a wider area which continuously expands.

However we should not dig or work this biology reservoir, working the soil kills the fungi. The reservoir or refuge has in turn has to be left undisturbed so the biology can go about its business of mothering the next generation of soil biology. It may seem wasteful to set aside a certain area simply for soil regeneration but this is currently the only way I can see a sustainable system working.

My soil is naturally full of biology but I want to allow easy access to biology from the surrounding environment. This sounds good but has one major snag, weeds and pests also want to join the party. I do not want to use herbicides or pesticides to control these; the result is an awful lot of hand weeding to keep them in control. In fact hand weeding is the biggest single expense in producing the BioPacks and cannot be guaranteed 100%.

Plants provide the energy and carbon

So to summarise with my Soil BioPacks I aiming for a controlled eco system in which the plants and biology work together but competition from the baddies is minimised.

Plants are critical, their energy from photosynthesis provide the energy and carbon, in the form of sugars which powers the entire eco system. You cannot have an eco-system without plants - they provide the energy from sunlight and the carbon from the atmosphere.

At one time I thought all I needed to do was to select just one plant as a host. I wanted a plant that would act as a host for the fungi (and other soil biology) and grow alongside crops without being too invasive but would spread in a manageable way.

Gota Kola

I thought I had hit the jack pot with Gota Kola which seemed to fit all these requirements. This was my Mark 1 BioPack.

This is a medicinal herb but what I really like about Gota is that is makes a really good ground cover around vegetables. I know many people like to have a nice clean soil around their plants but I just don't like to see bare soil, even if covered with mulch, I just like green mulch which is making use of all the sunshine that would otherwise go to waste on bare soil. Soil biology needs feeding and the energy come from the photosynthesis of the plants.

The great thing about Gota is it is not too aggressive so can give a green mulch without outcompeting other plants. Sounds fine in theory but what about practise? I had real problems growing Gota in isolation (as was my original plans for the BioPacks). I don't quite understand the mechanism but is just seems to need other plants nearby to grow well. This picture shows a tomato plant growing quite happily in a clump of Gota Kola.

I was lucky because I failed. Gota Kola may be very difficult to grow in isolation, but in the natural state it grows exceptionally well but in combination with other plants like grasses and weeds. I went to all the trouble of carefully preparing 'pure' plants and tried to propagate them - I may have failed but in a perverse way this was a major success - a learning experience.

Combination of plants

My 'lucky' failure with Gota Kola in isolation has made me realise the benefits of having a combination of plants.

It made me realise that I should not be looking for that one magic plant which is a perfect mother for the biology - that is just not the way nature works. I have always been an advocate for the synergistic benefits of companion planting without really knowing why.

I should be looking of a combination of plants which work synergistically together.

The challenge is to select the right combination of plants.

Tap roots and fibrous roots

Now this may be such a simplification that it may not meet the approval of horticulturists but I think of plants as either having tap roots, or mat roots (often called fibrous roots).

If there are any other root enthusiasts out there that think roots are more exciting than what grows above ground then 'Roots Denystified' by Robert Kourik is a good read (as usual available from Amazon).

Gota Kola is a tap root plant and my hunch is that it needs a fibrous or mat root plant as a companion. It is well known that plants transfer water between themselves, particularly when mycorrhizal fungi is present, so may be this is the mechanism.

I decided to choose two types of plants, those that form a deep tap root and those that form a mat root.

Tap roots are highly beneficial for extracting nutrients from deep in the soil, fibrous roots are better able to extract moisture from the soil and readily link to fungi. Together they work better in combination.

Tap rooted plants

For the tap rooted plants after much experimenting I am sticking with Gota Kola but have gone to my old friend Senna Alata.

The Senna is the best soil regeneration plant I know, (Arrow Root is the second) it is a legume with a strong root system which is extremely effective at extracting minerals, particular phosphorous from deep in the soil. The leaves are rich and luxuriant and make an excellent mulch or compost. It is a desert plant with very deep roots which compliments the Gota which is a swamp plant with shallower roots.

I had almost decided against Senna as I thought it may be just too aggressive for a small wicking bed but I changed my mind as it is coppices so well. You can cut it right down to ground level and it will simply spring back up again with what appears to be a new tree. The roots may be a bit aggressive but I am finding I can grow vegetables right alongside and as far as I can see they grew as well if not better than vegetables growing in isolation. This is understandable as they will bring up water and nutrients from deep in the soil and through the mycorrhizal fungi share with other plants that are part of the fungal web.These pictures show Kang Kong and lettuce growing quite happily in combination with Gota Kola and Senna Alata.

The only snag I can see with Senna is that is sensitive to frost, however frost may kill all the above ground foliage but they just pop back up again when the warmer weather arrives. Another snag is that it does tend to attract cabbage whites which lay their eggs in the seeds pods. That does not seem to damage the plant much but I like to grow Chinese vegetables like BokChoi etc. which the cabbage whites just love.

Mat or fibrous rooted plants

I have experimented with a range of the mat root plants.

Some grasses, like Couch, formed an excellent mat, they are great for the soil biology and are so dense that the help supress the weeds so in many ways they are the ideal fibrous rooted plants for BioPack.

The negative is that they are very aggressive for the BioPacks. I don't want customers complaining the BioPacks had taken over their garden. For the time being I am just going to let the customers decide whether they want the benefits of the of using grasses and will put up with the extra work of controlled the spread of the grass.

Clover seems a natural second choice, particularly as the rhizobium bacteria are readily available, but the last thing I want is a monoculture so I have been evaluating a range of herbs.

Mint and Lemon Balm looked a little aggressive while Oregano and Dill seemed a little delicate however the parsleys, Italian and Curled seemed a good balance and so have been selected as the primary herb but I am making up a herbal mix to add to the BioPacks.

The primary criterion is the ability of the root structure to support the soil biology but obviously it is nice to have useful plants which have health benefits.

It has also been suggested that plants like the marigolds may be useful for controlling nematodes. Experimentation never seems to stop.

Adding the biology

I may be fortunate in having a biologically active soil to start with but that is not enough so I am buying in the critical components like mycorrhizal fungi, rhizobium bacteria, compost activators and worms from the specialist suppliers and using these to help build up a working ecosystem.

Mycorrhizal fungi

Mycorrhizal fungi are the most likely to be deficient in worked soils as they are easily damaged and the most difficult component of the soil biology to build up yet they play one of the most crucial roles in the soil. They therefore form a key plank of the BioPacks.

While I have worked to improve the natural mycorrhizal fungi in my soil I am combining these with commercially available spores. These I add to the beds, initially by dosing the roots with the fungal spores, then reinforcing by pouring water containing spores into holes leading to the root zone. I keep on doing this until the fungi have clearly taken.

Individual BioPacks are then cut from the bed ensuring that only a small proportion of the bed is disturbed and the plants and fungi can readily regenerate to make the next batch of BioPacks.

At the moment, while the system matures, I am also adding extra spores to individual BioPacks as they are prepared for distribution - a bit of a belt and braces approach.

Minerals

There is a basic law in plant nutrition called the law of minimum, which basically says that the plant growth is restricted by the component in shortest supply regardless of how much other nutrients are in excess.

In the time of the American farmers destruction of the Eastern farmland nitrogen was the limiting nutrient, there was simply not enough manure available, the only readily available source of external nitrogen. The development of the Haber Bosch process in the Second World War removed that limitation and replaced it with the limitation of the size of the wallet.

Our increasing understanding of the technology of fertilisers has meant that now plants are rarely restricted by a lack of the N,P,K nutrients. This has led to a greater

focus on the secondary nutrients. However the reality is that we humans need a much wider range of nutrients, particularly the trace elements, than plants. The commercial reality is that it is perfectly possible to produce great looking produce which sell well in the stores but which fail to provide us with the minerals and the complex chemicals, like the vitamins and the phytochemicals needed for human health.

I am therefore adding these trace elements and minerals to the BioPacks.

Two choices were open for the supply of minerals, rock dust from a quarry or custom blended minerals packs. The mineral packs were selected despite the much higher price as they had a much better structure and a defined content.

Customers may be happy adding additional minerals in the form of the very cheap quarry dust or the higher prices trace element packs into the body of their beds.

Compost

Properly prepared compost is the most practical method of increasing the microbial action of the soil. I am purchasing compost from Wide Bay Composts with the excellent advice of Mike Harrison. They take great care in managing the biology and make use of seaweeds products which are excellent for encouraging biological action.

I have experimented with commercial compost accelerators which are source of concentrated bacteria. My current view is that as I am using high quality commercial compost in which the bacteria is very carefully controlled that additional accelerators are not needed.

Worms

Worms play a critical role both improving soil texture but particularly distributing the soil biology. Bacteria may breed very fast but don't have legs so without the larger, mobile components of soil biology will stay in one spot.

Fungi grow at a much slower rate but will slowly expand into adjacent soil.

The worm eggs are supplied by Kookaburra Worm Farms where George Mingin has been extensively involved in the wicking bed development. He is producing a special blend of worms, the traditional composting worms which tend to remain in one area and the much large Amynthus worms which are highly mobile so make excellent carriers of soil biology.

Eggs are much more reliable during transport than live worms although it takes a few months before they are mature enough to start breeding.

Packaging and distribution

One of the issues in developing the BioPack is postage. My original plan was to use relatively small packs which would be cheap to post. Obviously I wanted to keep the cost of the BioPacks and postage as low as possible, after all they are just an inoculant. However there was a learning experience here too, there is simply a

minimum size for a viable ecosystem. I have now upgraded the size of the pack to a 152mm cube which using some vermiculite can be kept within the 3 Kg limit.

I have tried posting grown plants with foliage but it is really not all that practical. The soil and foliage were mixed together. I sometimes wonder if Australia Post has a special vibrating machine to mix up the contents of the packages.

I have therefore adopted the practise of trimming all plants to the top of the box and packing the remaining foliage in vermiculite so the box is packed tightly.

After looking at pictures of the Soil BioPacks in full foliage this may lead to a bit of disappointment in opening the box to find no visible plants - but with a bit of water and sun the plants soon refoliate.

Distribution

At the moment I am shipping the Soil BioPacks directly to customers. The cost of a Soil BioPack is $28 each and $15 for postage plus an extra $3 for each additional Biopack.

You can pay by direct transfer (A/c details with confirmation of order) or PayPal.

If I can persuade he coaches to distribute the Soil BioPacks then the final customers can see the ecosystem at work. Obviously the ideal solution would be for coaches to incorporate the Soil BioPack into their completed wicking beds offered for sale.

I am attaching a flier for the Soil BioPacks and have stocked up on supplies so let us hope they take off.

Colin