MYCORRHIZA …… important for sustaining the earth.

Increasing World Food Demand and **Industrialisation of Food -**

It's estimated that by 2030 the earth will need to support 8.3 billion people. The UN Food and Agriculture Organisation has stated that by then, farmers will have to produce 30% more grain than they do now to keep pace with hunger. The fact is that there is enough arable land available to produce the food required for the growing population. The more uncertain question is, are farmers able to continue to sustain agricultural production while fossil fuels decline and phosphate resources become depleted? The demands of a more globalized and industrialized food culture have taken the greater proportion of farming to monoculture cropping. Large areas of land are continually cropped year after year with the addition of chemical fertilizer, at increasing volume and cost, to achieve the same yields.

The introduction of chemicals to fertilize crops which simplified the process and the chemistry of the soil is taking a toll, not only on the ability of the soil to produce food, but also on our health. The relationship between the health of the soil, the health of plants and animals, and human health has not been considered holistically for a long time. Nutrition has been analysed, segregated into components and industrialized back into a so called nutritious products. The same has happened with farming practices, where the process is broken down to a series of chemical fixes for both growth and pest control. The important synergies contained in doing both farming and nutrition in a more holistic way have been overlooked, while narrowly focused scientific research, industrial food manufacturing,

commodity pricing and farm efficiencies have led the way. In a bid to grow more quantities of food, its quality, diversity and value have been sacrificed. As well, the food, now mass produced and capable of feeding an increasing population, is inequitably distributed, deconstructed to products of less nutritional value and it's estimated that in Western countries up to 30% of food ends up as garbage.

The State of the Topsoil -

Loss of organic matter and nutrient balance in soils means the earths' most critical resource, the thin fragile layer of living topsoil, may not meet the upcoming and unprecedented demands on it. Degradation, desertification, soil erosion, and expansion of agriculture into marginal areas, rainforests and wetlands, further influence the ability to produce more food without adverse impacts on the natural resource base and biodiversity.

Worn out soils are more susceptible to drought, flooding, disease and pests and become dependent on high levels of chemicals, both for production and for protection from diseases. Use of chemical fertilizers, weed control chemicals and pesticides results in increasing levels of toxicity in the environment and impacts on water resources. Add to this erosion, land clearing and compaction and the damage starts to destroy the possibility of future generations being able to produce enough food for survival.

Agricultural practices -

Clearly the agricultural practices that dominate world production are due for an overhaul if food production is to increase and environmental considerations to improve. A biological, organic approach to managing the worlds' soil could provide the major shift needed to create changes in the way we grow, buy and eat food.

It has been reported by UNEP that organic and biological practices in Africa outperformed industrial, chemical intensive conventional farming while also improving soil fertility, water retention and drought resistance. The analysis of 114 farming projects in 24 African countries found that organic or near-organic practices resulted in significant yield increases.

The Change to Biological or Organic -

Composts, compost tea, fish fertilizer, seaweed products, worm juice, blood and bone, humates, mineral fertilizers, manures and other biological fertilizer inputs are a move towards more natural and sustainable nutrition for crops and plants. They are an improvement from the urea/NPK chemical regime where the plants are provided with a fix which will be needed again for the next crop sometimes in increased volume. The organic nutrition is an improvement for the long term health of the soil but it is still only nutrition.

Introducing Mycorrhiza -

In past decades natural environs were full of mycorrhiza, beneficial symbiotic fungi that form an association on the roots of about 90% of the world's plants. Over time, due to chemicals, desertification, erosion, drought, compaction, loss of organic matter and other degradation, these symbiotic fungi have become less prevalent in soils and the continual tilling of land for crops has reduced the benefit of these fungi completely.

Good topsoil is not just dirt, it is a microcosm of life. Healthy soil contains billions of beneficial microorganisms which play a role in nutrition and nutrient recycling. Mycorrhizae are extremely important to the health of soil and in turn to the health of plants.

Farming widespread areas affects the plant/mycorrhizal relationship in two fundamental ways, first it isolates the plant from beneficial mycorrhizal fungi available in natural settings and secondly it increases the crops need for water, nutrients and soil structure. Once lost from a farm the mycorrhizal populations are hard to recolonize.

Introducing MAI Australia Pty Ltd -

MAI produce MycoApply, a commercially and organically produced mycorrhiza product, for application to farm crops through seed coating at the time of sowing. It can also be used for vegetable growing, horticulture, pasture growing, turf growing and gardens. This is a powder or granular product supplying millions of beneficial fungal spores ready to attach themselves to the germinating seed or the seedling roots producing a symbiotic state between the resulting mycorrhizal fungal filaments and the plants new roots. As the plants roots grow so does the fungal association providing many benefits to the plant and the soil.

The fungal threads penetrate into the root and secure sugars provided by the plant to fuel their growth. In exchange these fungal filaments radiate out from the root into the surrounding soil where they capture nutrients and water and transport these back to the plant. It is estimated that mycorrhizal fungal filaments explore hundreds to thousands more soil volume compared to roots alone.

Endomycorrhiza (including Glomus species) are able to form a beneficial association with most grains, pastures, vegetables, fruit and nut trees, vines and grasses. MycoApply can be used to improve crop production, existing horticultural growing, pasture production, vegetable growing and when establishing new vines. Seed coating, root dipping, fertigation or watering- in being the usual methods of application to get MycoApply to the root zone.

Mycorrhizal Benefits –

Drought Tolerance – Crops with mycorrhizal seed coating will have a better success rate when being established in low rainfall zones and will survive longer once they are grown and drought ensues. This is an important advantage when faced with the unreliability of rainfall due to climate change and reduces the impact of cropping on water resources or irrigation.

Improvement in Soil Condition – Exudates formed by the mycorrhiza provide the glue between soil particles so the soil has better structure. When frequent tillage is practiced the long chains of carbon that are the essence of humus are converted to carbon dioxide and released into the atmosphere. Soil depleted of its humic fraction is more prone to erosion and loses microbial diversity. In 1996 it was discovered that a substance called Glomalin was produced by the Glomus species mycorrhiza. Glomalin is made up of 30-40% carbon and represents 30% of the carbon in soil. It is the super glue that binds organic matter to particles in the soil. It also forms soil clumps that improve the soil structure and prevent other soil carbon from escaping. It is glomalin that gives the soil its tilth, a subtle texture that can be identified by experienced farmers by feeling for the smooth granules as they flow through their fingers. Glomalin is relatively stable in soils, lasting for 7-42 years.

Carbon Storage – Using mycorrhiza provides a carbon sink as plants with mycorrhiza will capture about 10% more carbon and once it is captured it remains in the soil. It is estimated that a 100 hectare crop with mycorrhiza would fix 1 million kgs of carbon out of the atmosphere, the equivalent of 150 mid sized cars driving 30,000 kms in a year would produce in emissions. Multiply this by the many

thousands of hectares under cultivation and a significant solution to carbon sequestration emerges.

Plant Stability – The larger root mass secures the plant to the ground firmly preventing soil erosion and dislodgement by animals or grazing. As it is less susceptible to drought and the plant has created a better soil structure it can remain secured and prevent wind erosion. After 2-3 additions of MycoApply and if there is minimum tilling before planting the next crop, the benefits of mycorrhiza spores remaining in the soil will pass on advantages to the next crop of plants grown. Over time, with the right conditions, the populations of mycorrhizae will increase and make the soil more fertile, so continued additional applications of mycorrhiza product become unnecessary.

Protection from Disease – Mycorrhizal fungi protect roots against disease organisms that enter the root zone in several ways. Some disease is discouraged because physically they can't invade the space where mycorrhiza exists. Some produce antibiotics that attack diseases or produce structures that prevent diseases from entering roots. Other, more active, mechanisms are used as in the case of the 'hangman's noose' used by mycorrhizal fungi to trap and strangle root-feeding nematodes.

Increase in Yields – 1000's of published studies have shown the improvement of crop yields following the use of mycorrhiza, Between 10 and 50% increase in yield ,depending on the crop and the growing conditions, has been reported. Add to this the 20-30% reduction in fertilizer and pesticide requirements when using mycorrhiza and the crop revenue is more than covering the investment in mycorrhizal additions.

Less input of chemical fertilizer – as the mycorrhiza have increased the root mass it enables the plant to seek out nutrients from a larger surface area than untreated plants and also the microscopic filaments can seek out nutrients and water from spaces between soil particles where normal sized roots couldn't.

The mycorrhiza do their best work when the phosphate/nitrogen input is decreased as they are an adjunct to the plant system, designed by nature, to increase the scavenging of P & N and other nutrients. If too much P & N is added to the system, in the form of chemical fertilizer, no real difference can be detected, as the mycorrhizae are prevented from working effectively. One of the real benefits of adding mycorrhizae is to allow lesser chemical inputs and still gain an increase in yield. BUT it is hard to convince someone growing crops to hold back on chemical input. This has been done for generations and this works so why change. Farmers are reluctant to change as they fear inferior crop production and less income, they are thinking that already there are many risks with farming… why add another one?

So change to a biological and sustainable approach will not happen overnight but it will happen, this is why……

Industrial fertilisers – World phosphate fertilizers are a diminishing finite resource, and peak phosphate is spoken of in a similar way to peak oil. The manufacture of chemical input fertilizers based on petroleum will become increasingly costly and difficult as oil production diminishes, even if gas is used the resulting emissions will have to curbed or paid for.

Pollution – increasingly there are areas of toxicity through the continued use of chemical fertilizers and the resultant leaching into water systems and even in some cases out to sea. This has caused

huge destruction of marine life where the environment is nothing but a toxic waste zone. Soil degradation is occurring at an alarming rate and topsoil must be seen as a living part of the system and not just as dirt with chemicals, as this abuse of the soil will lead to an unsustainable future in agriculture. Rejuvenating soils with mycorrhiza where chemicals and cropping have diminished their natural occurrence is proving an environmentally friendly alternative to improve crop production.

Organics – Organic inputs are generally more sustainable and create less adverse environmental impact at the user end. More biological fertilizers are all an improvement on continued chemical input but they are still only nutrition. Mycorrhiza actually changes the root physiology of the plant to give benefits which are conferred for the life of the plant. Making a more biological system will help to ensure the survival of mycorrhiza but if no mycorrhiza is in the system to start with, no amount of organic nutrient input will produce mycorrhiza or make as much effect as when mycorrhiza are present.

Margins – farmers are struggling with costs and margins are small. If the amount and costs of chemical inputs can decrease over time and, at the same time, the condition of the soil can improve through the use of mycorrhiza, that's a double win situation. It's easier to make soil amendments to prevent further degradation than it is to rectify major problems such as soil toxicity, erosion, salinity and water pollution.

Carbon Credits – farmers will need to be part of the carbon emissions trading scheme. The addition of mycorrhiza to the crops will bind more carbon into the soil than plants without mycorrhiza. This will offer a major carbon store in addition to areas of tree plantings.

Healthy Environment- farmers want to pass on a healthy productive farm to future generations. Younger generations of farmers will not necessarily accept that things can't be done differently. They will be willing to try new or different strategies which in some cases may be the old ways come full circle. Cover crops, no till, cycling of crops, mixed farming, more organic nutrition and use of mycorrhizal inputs.

Before the push with chemical fertilizer farmers would use cover crops, organic fertilizers, crop rotation and incorporate nitrogen fixing legumes into management practices to add fertility to the soil. A good cover crop added 50 – 100 kgs of nitrogen per acre and protected against erosion. Oversimplifying growing practices with chemical inputs has created a downside for soil condition and the environment.

Most food today comes from legumes, oilseed crops and cereal grains. These crops are estimated to take up 80% of agricultural land. These staples are relatively high in protein and calories and easy to store and transport thus making them attractive to the current industrial process of making food.

However being annual crops they must be grown from seed every year using fossil- fuel intensive cultivation and fertilization methods. To maintain annual yields farmers are faced with growing input costs and use of intensive practices releasing large amounts of carbon dioxide in to the air. As well, there are the fallout effects of run-off pollution, soil erosion and degraded soil.

Agriculture needs to review its practices and take a broader view on the consequences that follow if it continues without making changes. **One of the easiest changes to improve the growing system of agricultural products is to add mycorrhiza**.

MycoApply is organically produced in Western Australia by

MAI Australia Pty Ltd.

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Further information and **online purchasing**
www.maiaustralia.com.au

Articles and Research Documents, Michael Amaranthus MA Inc.
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