Herbi-Safe™ Sustainable Herbiciding Made Simple

By Graeme Sait

The greatest barrier preventing conventional growers from switching to organics is **weed management.** How does a grower change to hand weeding or mechanical methods when financial viability seems linked to the labour-saving aspect of chemical control? The grower may feel shackled to the spray rig but the supposed benefits of this approach need more evaluation.

The definition of **financial viability** must be linked to **sustainability** if we are to consider the longer term profitability of our farming soils. The fact is that many of the most popular herbicides are anything but sustainable and if they are not impacting upon overall profitability now then they most certainly will be in the future!

A major problem with herbicides relates to their effect upon **beneficial soil life**. The original registration of these chemicals required little, if any, research into their impact upon soil biology. It was almost as if this army of organisms did not play a role in crop production or plant health! However, the conventional ag science community is slowly awakening to the realisation that sustainable agriculture is not possible if we disregard **soil biology**.

Assessing the Collateral Damage

At a recent seminar in NSW I was fascinated to hear details of research conducted by **Dr Margaret Roper** of the Western Australia **CSIRO**. She is one of a handful of researchers looking at the impact of herbicides on soil life. She suggests that the triazines, which include **atrazine** and **simazine** are doing irreparable damage to soil biology.

Certainly the latest research into softer options like **glyphosate**, in terms of unwanted side effects, is no less disturbing. **Professor Don Huber** from Purdue University in the US is taking a closer look at the world's largest selling herbicide. He states "glyphosate is an economic and effective herbicide but it can have extensive non-target effects on nutrient availability, the soil environment and agricultural sustainability." There are two factors that appear to be involved. Glyphosate was originally patented as a **chelating agent** and it can wrap around cations and make them unavailable. On soy beans, for example, an application of glyphosate can temporarily 'tie up' manganese and cause the 'yellow flash' symptoms that are often reported by producers. Huber adds that problems related to glyphosate are also linked to its **toxicity to soil microbes**. In his research he has shown that glyphosate reduces the population of organisms needed to make **manganese** and **iron** available for plant uptake. In one study there was a **90% reduction** in manganese-reducing organisms in the treated soil and in another where only 2.5% of the recommended application rate of glyphosate made its way into the soil, manganese uptake was cut by **80%** and iron uptake by **50%**.

It was previously understood that glyphosate kills a beneficial bacteria called *Pseudomonas fluorescens* (that protects against take-all and a host of other diseases) but now the **collateral damage** appears more substantial. That damage may also extend to user's families and to nearby residents unlucky enough to suffer overspray. A long held suspicion that glyphosate may promote **spontaneous abortion** in humans has recently been confirmed and that effect is both profound and frightening.

Many growers do not understand the **toxicity** of glyphosate when it is inhaled. Experimentally induced inhalation of Roundup by rats produced **100% mortality** in 24 hours. Humans ingesting as little as 100 mL of Roundup have died (suicide attempts using Roundup have a 10-20% success rate.[1,2])

Something is missing on this grower's face and it is not his smile. Breathing equipment is essential when spraying glyphosate.

Researchers confirmed that glyphosate is toxic to many soil microbes including nitrogen-fixing bacteria, mycorrhizae, actinomycete, and yeast isolates. One study found that glyphosate inhibited the growth of **59%** of selected naturally occurring soil microbes[3].

Glyphosate, by inhibiting the growth of some microbes allows the overgrowth of others. This includes microbial plant pathogens. **Fusarium**, for example, is a naturally occurring soil fungus that is a destructive plant pathogen. Fusarium invades the roots of plants and either kills the plant outright or prevents normal growth. Subsistence farmers in Colombia have noted that fields accidently sprayed with herbicides in attempts to destroy Coca do not produce at the same level as they did prior to being sprayed, and in some cases produce no crops at all[4,5].

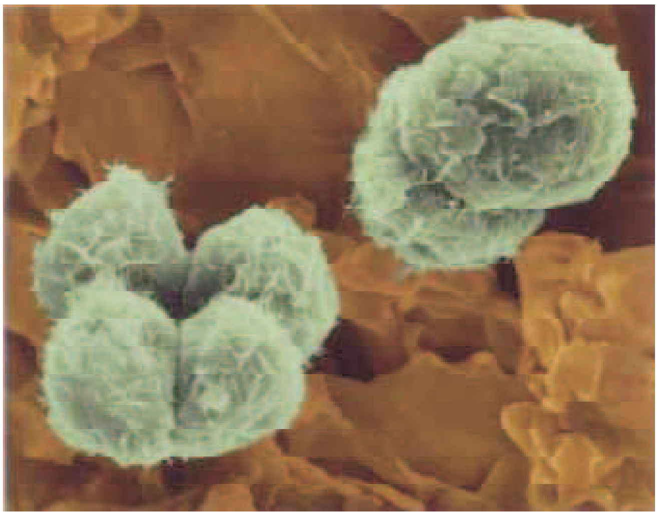
Mycorrhizae are soil fungus that function to increase nutrient uptake by plants through a symbiotic association with the roots. Mycorrhizae have been implicated in the improved resistance to stress, and are necessary for the proper growth and development of most vascular plants. Studies have shown that glyphosate inhibits the growth of mycorrhizae. Killing of beneficial mycorrhizae can result in overgrowth of toxic or pathogenic fungus, such as Fusarium.[6,7]

Glyphosate also destroys **nitrogen-fixing bacteria**. These creatures are incredibly important and will become more so as oil prices increase due to peak oil. It is fair to evoke the Churchill quote that; "never before have so many owed so much to so few" in relation to the relatively small number of species that convert atmospheric nitrogen into all-important, plant-available nitrogen.[8]

Stealing Food from Your Workforce

Glyphosate, and other herbicides, can also indirectly compromise protective and plant-supporting organisms that are so critically important if we are to produce nutrient dense, disease resistant crops. This indirect assault involves a major species in the soil food web called **algae**. Algae are plant-like creatures which contain chlorophyll and photosynthesise to produce a glucose-based food source for **fungi** and **bacteria** – the major players in this subterranean workforce. Single-celled algae drop like flies in response to herbicide applications, as large numbers are positioned on the surface chasing sunlight for photosynthesis. This initial casualty rate is unavoidable but can be compensated for to some degree with the addition of 5 litres of molasses per hectare with each herbicide application. Algae live down to depths of 15 cm so the community not on the surface at the time can bounce back to eventually compensate for the losses. However, if the **herbicide** remains in the soil, after killing the plant, then it can continue to **compromise algae populations**. When the rest of the soil food web is deprived of a major food source (derived from algae) then their performance will suffer and we can expect reduced protection from pathogens, less nitrogen fixation, decreased humus formation, problems with nutrient delivery and a reduction in growth-promoting, microbe exudates.

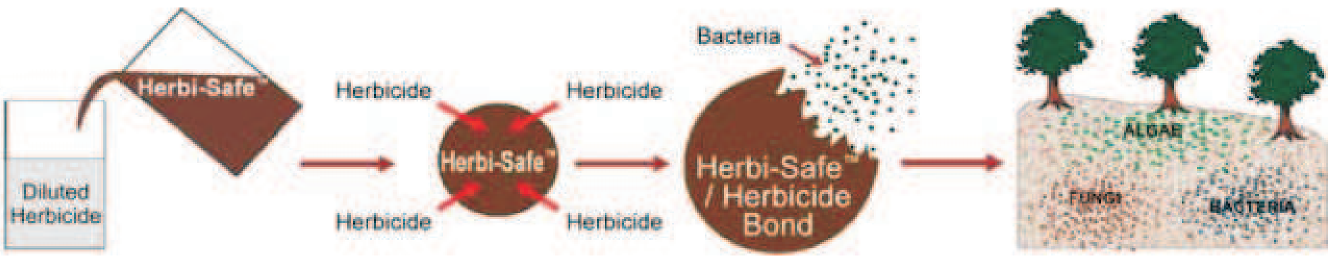
At this point you may be thinking how lucky it is that **glyphosate** is **biodegradable** and therefore will not sponsor ongoing destruction of algae. Unfortunately, research does not support this suggestion. While bacteria can biodegrade glyphosate, they must be present in sufficient numbers to achieve this task. **Humus levels** have dropped from **5%** to **1.5%** in Australia and humus is the home base for these biodegrading organisms. Research suggests that glyphosate can now remain in the soil for up to **six months**. That is six months of chipping away at algae populations, locking up trace minerals, and killing key beneficials and that is simply not sustainable.



Single-celled algae drop like flies in response to herbicide. The key is to remove herbicide from the soil the moment it has done its job. Any residues will continue killing algae.

Increasing Herbicide Sustainability

For several years NTS has recommended the use of **fulvic acid** in conjunction with glyphosate and other contact herbicides. Fulvic acid has a phenomenal C.E.C of 1400 and this tremendously absorbent natural acid can bond to glyphosate if the two materials are combined. The fulvic/glyphosate bond is welcomed by the plant and when herbicide residues end up in the soil they are still tied to fulvic acid. Fulvic acid is amongst the most powerful known **bacterial stimulants** and this is one key to **increasing the biodegradability** of the herbicide. There may only be 10% of the bacteria required to biodegrade glyphosate, remaining in the soil, but these creatures are drawn to the fulvic acid like bees to a honey pot. **Glyphosate** is eaten along with the fulvic acid and a biological bomb is defused in the process. During the past 18 months NTS has been researching a variety of other additives to further enhance this **detox process**.



DPI Research Collaboration Spawns New Product

NTS is involved in an ongoing research collaboration with the **QLD DPI** Forestry department now known as **Forestry Plantations QLD**. Research projects to this point have included an evaluation of guano granules and boron humates in comparison to the standard MAP planting fertiliser. There have been planting trials with a new potassium-based polymer, which holds 160 times its own weight in water, in an attempt to reduce tree losses in dry conditions. There have also been a variety of **herbicide trials** looking at more ecologically acceptable strategies. Forestry Plantations QLD is a trail-blazer in sustainable forestry management and they are dedicated to reducing their ecological footprint wherever possible in their large scale operations. Initial trial work confirmed the potential of the NTS approach. In our own research with glyphosate we had found that a particular formulation of ingredients tended to outperform all others in terms of detox potential. The DPI research involved a combination of glyphosate, Starane and 2,4-D which are used to control blady grass, bracken fern and other woody weeds in their plantations. This research confirmed our earlier findings and spawned the release of a new herbicide detox agent, called **Herbi-Safe™**.

Herbi-Safe™ - Softening the Blow

Herbi-Safe™ is a very acidic, herbicide-friendly formulation which catalyses rapid biodegradation of herbicide residues in the soil. It represents a remarkably inexpensive strategy to increase the **sustainability** of herbiciding.

Herbi-Safe™ is added to herbicides at the rate of 1 Litre per hectare for broad acre spraying. For spot spraying it is recommended that Herbi-Safe™ be included in equal amounts with the herbicide involved.

Herbi-Safe™ should not be combined with residual herbicides as there is an obvious danger that they will rapidly biodegrade and therefore not serve their purpose.

There is also an issue with **selective herbicides** as it is possible that Herbi-Safe™ could make them less selective.

Footnotes:

1) Martinez, T.T. and Brown, K. (1991) "Oral and pulmonary toxicology of the surfactant used in Roundup herbicide." Proceedings of the Western Pharmacology Society, v. 34, 43-46.

2) Adam, A., et al (1997) "The oral and intratracheal toxicities of Roundup and its components on rats." Veterinary and Human Toxicology, Jun 39(3):147-51.

3) Carlisle, S.M. and Trevors, J.T. (1988), "Glyphosate in the environment." Water, Air, and Soil Pollution 39:409-420.

4) Levesque, C.A. (1987), "Effects of glyphosate on Fusarium spp.: its influence on root colonization of weeds, propagule density in the soil, and crop emergence." Can. J Microbiol. Vol 33, pp354-360.

5) Sanogo, S., et al,(2000) "Effects of herbicides on Fusarium solani f. sp glycines and development of sudden death syndrome in glyphosate-tolerant soybean." Phytopathology, v. 90 (N1): 57-66.

6) Estok, D. et al (1989) , "Effects of the herbicides 2,4-D, glyphosate, hexazinone, and trichopyr on the growth of three species of ectomycorrhizal fungi." Bulletin of Environmental Contamination and Toxicology v 42, pp 835-839.

7) Levesque, C.A. and Rahe, J.E. (1992), "Herbicidal interactions with fungal root pathogens, with special reference to glyphosate." Annual Review of Phytopathology v.30, 572-602.

8) Hendricks, C.W. (1992), "Effects of glyphosate and nitapyrin on selected bacterial populations in continuous-flow culture." Bulletin of Environmental Contamination and Toxicology v. 49, 417-424.