Sustainability in horticulture: myth or reality?

David Hanlon and Bart Davidson
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Abstract:
Environmental issues are at the on every one minds, yet integration from of a sustainable culture form paddock to plate is extremely difficult. This article, in two parts, approaches the subject from both ends of the spectrum: growing (supply) and marketing (demand).

Last month I talked primarily about getting the business analysis side correct. This month I want to talk about sustainability or the third leg of the "pot". Environmental issues are at the forefront and for many of us yet we tend to move forward very slowly. The first step is to integrate environmental management into our business culture, just as we have integrated worker health and safety into our people side of the business: in other words we need individually and collectively have a philosophy that creates an **environmental superannuation** policy for our farms.

> "We treat nature like we treated workers a hundred years ago. We included then, no cost for the health and social security of workers in our calculations, and today, we include no cost for the health and security of nature."
>
> ***Bjorn Stigfon CEO Ab Flakt***

To do this, I want to approach the subject from both end of the spectrum: growing (supply) and marketing (demand).

In the first article Bart Davidson[1] and I will discuss some of the things that we find necessary to build a more resilient farming system and in the second article I will look at the forces at play in marketing sustainable products.

1. BUILDING A SUSTAINABLE FARM BASE

Ask a hundred people what their definition of sustainability is and you will get a hundred different answers, most of which have no measurables: that is, they are warm and fuzzy! At an industry conference recently, I tested this with a mix of growers, researchers, natural resource departmental representatives and agriculture departmental staff….none gave me a definition that was simple and measurable.

One my first rules is have sustainability definitions for your business clear and precise. My definition is simple. If your farm is sustainable, you will be able to demonstrate the following:

Increased output per hectare per:

- units of nutrient required (generally taking Nitrogen as the indicator)
- units of effective water applied (this is a wateruse efficiency measure)
- dollars spent on chemicals

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[1] Bart Davidson is a senior agronomist with RCS and is one of Australia's leading biological soil and crop nutrition consultants.

In short, this approach is firstly, output driven and secondly enables growers serious about monitoring sustainability to establish goals with subsequent strategies and monitoring practices.

The steps in establishing strategies for building a sustainable farm base are:
- establish a reliable monitoring process, and
- establish an appropriate nutrition program

Establishing a reliable monitoring process

Before embarking on strategies to improve sustainability of the business, it is essential that a reliable monitoring process be established. Often this is left to the last and only too frequently results in wasted efforts and/or poor efficiencies.

It is one of the most difficult tasks is identifying indicators that will give meaningful measures in assessing progress. I have developed a 6-step process that I use to assist in the development of indicators and monitoring methods. These are outlined below.
1. Select functional area
2. What is the issue?
3. What are our target objectives?
4. What outputs will lead to this objective?
5. What factors should be monitored?
6. What monitoring techniques will show progress?

How practical are these steps you might ask. If we take the first of my sustainable measures, nutrient use, the steps might look like the following.

Functional area

In this case, we are seeking to reduce nutrient use in our crops. We may select a single crop that we know we will be growing for the next 4-5 years within the blocks nominated.

What is the issue?

Nutrient losses are increasingly an environmental issue, in particular nitrates in the water table not to mention increasing production costs.

What are our target objectives?

To reduce nutrient inputs on a the major crop grown in the nominated blocks. For example, the objective may be to reduce the units of applied Nitrogen by 30% over 4-5 year for tomatoes. It is important that the monitoring be consistent with practices undertaken. For example, having a legume rotation will result in an increase nitrogen available to the crop. So, this needs to considered within the design of your monitoring program. Overall, I suggest that the goal should be to increase nitrogen efficiency whilst not comprising total yield over a rotation period.

What outputs will lead to this objective?

Increased nitrogen use efficiency will be demonstrated by reductions in N inputs over the nominated period. The measure is units N/kg of product.

What factors should be monitored?

In this case a number of factors should be monitored. Two are discussed here:

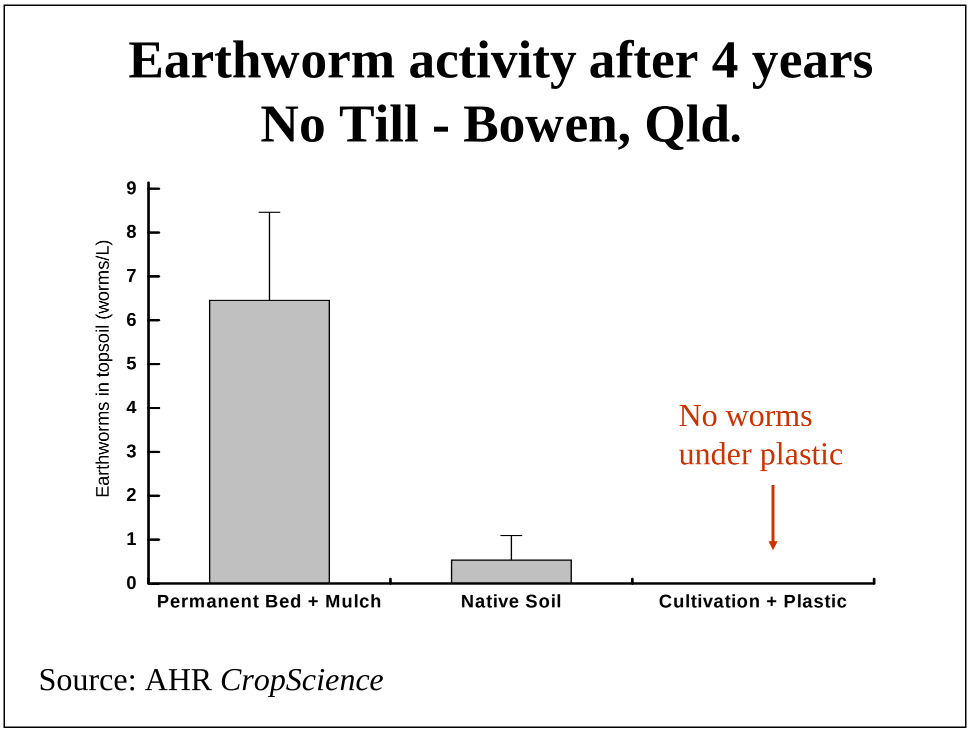
- Soil organic matter
- Soil biology

What monitoring techniques will show progress?

Soil organic matter – in this situation a soil test from the same location at the same time of the year (see further discussion on this below).

Soil biology – while a range of tests from relatively sophisticated to more simple tests. A good example of this is shown in work done by Gordon Rogers and his team in a HAL funded project[2] where the difference in earthworm populations under two different farming systems are compared to the native soil (Chart 1).

Chart 1: Earthworm activity after 4 years



[2] Rogers et al (2002), "Development of a sustainable integrated permanent bed system for vegetable crop production including sub-surface irrigation extension".

Photo 1: Earthworm activity after 1 year

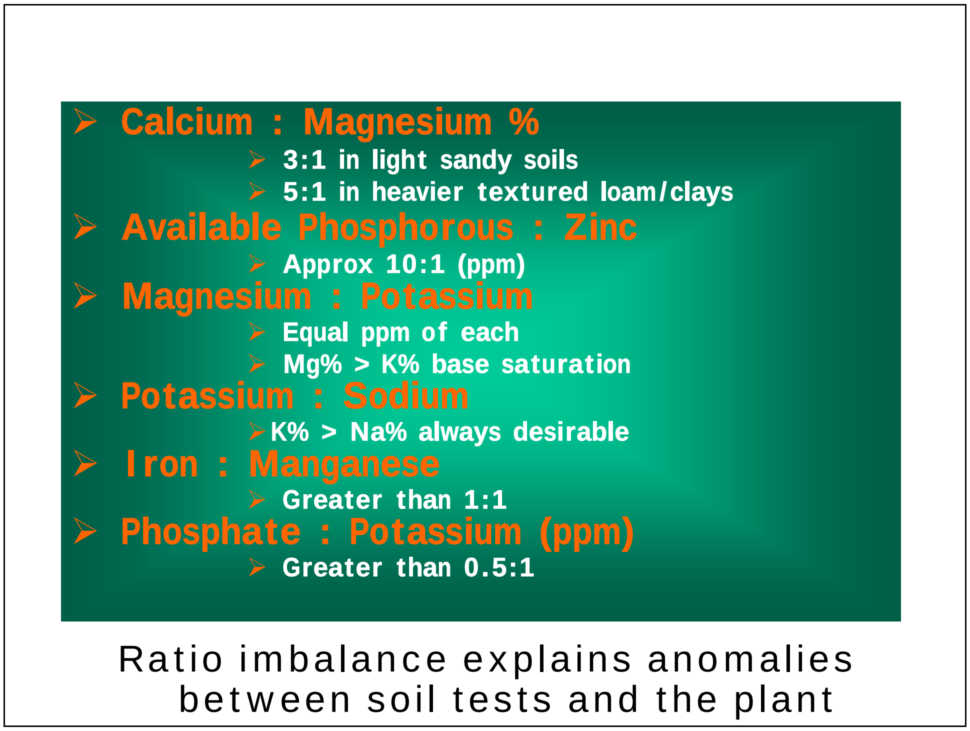
Establishing an appropriate nutrition program

In the quest for biological farming much emphasis is placed on the need for mineral balance in the soil in addition to, and many would say as a prerequisite for, biological soil fertility. Whether for plants or livestock (and humans who eat them) mineral ratios and assimilation to form proteins, amino acids and vitamins, etc., are very important.

The goal of biological soil management is to achieve adequate levels of available nitrogen, phosphorous and potassium and for the cation exchange to comprise calcium, magnesium, potassium, sodium and hydrogen in the ***desired proportions***, which in turn allow maximum nutrient availability to plants, increased plant vitality and high brix levels (sap sugar levels) with reduced susceptibility to insect attack due to lower sap nitrate levels.

There are two key points here - more than just nutrient *adequacy* is required for optimal soil fertility levels. It is important to work towards balance in the *proportion* of minerals to each other, as indicated by base saturation levels for the positively charged cations.

Chart 2: Key ratio's



NPK adequacy

A good soil test will identify exchangeable levels of the macro and micro-nutrients, which it is expected will be available to the crop in average conditions over the growing season.

The level of nitrogen, in the form of nitrate N and ammonia N combined with the nitrogen expected to be released from soil humus provide a means of estimating units available to a crop and potential deficiency. Green manure crops, prior legumes, nitrogen containing composts and cultures of nitrogen fixing biological micro-organisms can be applied to meet an identified shortfall in nitrogen so important to crop yield and protein levels. Knowing nitrogen and related yield requirements for the specific crop to be grown allows the shortfall to be identified. It also appears that the further out of balance a soils cation exchange is, the more nitrogen a crop will require to produce the same yield.

Phosphorous levels reported usually reflect exchangeable amounts. Low pH, low calcium soils with high levels of exchangeable iron and aluminium (ie. acid soils) require stable forms of phosphorous and biological activity to mineralise them. Growers can use rock phosphate with good effect in acid soils, and higher pH soils if calcium levels are not too high, assuming good levels of biological activity are present to mineralise the phosphorous. The aim is to achieve a threshold level of soil phosphate which allows sustained release over the longer term, which is why forward planning is essential in high value organic crops to avoid short term deficiency. This is particularly so as most crops require the majority of phosphorous uptake early in the season for leaf and root development.

Many soils have shown an increase in exchangeable phosphorous levels without the direct addition of phosphorous containing materials. This throws the conventional mindset off balance, yet commonly occurs when calcium to magnesium ratios are improved and a biological system is developed and balanced mineral levels are achieved. The solubilisation of iron and aluminium phosphate compounds as a result of increased pH, greater root development and more active soil microbes adept at mineralising phosphate are the primary reasons for the ‘free’ phosphate found in biologically active soils.

Soil potassium levels are quite complicated, with sufficiency of supply to plants varying significantly over the season depending on crop and clay mineralogy. Clay soils generally have adequate potassium assuming good drainage and root development of plants. Lighter textured soils growing crops with high potash requirements are more difficult. Regular small applications are preferred over single large rates to avoid loss via leaching. Composts and mulch are another source of potassium with similar attention to rates required to avoid the effect of excess potassium base saturation on the availability of other nutrients.

CEC proportions

Balancing soil cation exchange is achieved with materials that supply the appropriate quantity of elements directly via lime, dolomite, and gypsum, for example, and indirectly by avoidance of inputs that may leach cations via supply of excess nitrogen and sulphur. Cations are positively charged elements that comprise a soils cation exchange, such as calcium, magnesium and potassium. The base saturation percentage figures often found on soil analyses describe the state of the cation exchange with values for calcium, magnesium, potassium, sodium, aluminium (in acid soils) and hydrogen.

Ignoring hydrogen when evaluating the proportion of cations to each other underestimates the true soil requirement as only a portion of the potential sites available to cations is accounted for. The lower a soils pH, the more hydrogen present, and the greater the underestimation will be.

Consideration for the length of time prior to sowing is also important, as large applications of lime, for example, may dehydrate the soil temporarily and tie up copper and zinc, which in turn can cause problems for the crop such as take-all in wheat. The closer to sowing an application is the less the rate should be to minimise disruption to bio-chemical processes in the soil.

2. CAPTURING ENVIRONMENTAL SENTIMENT IN THE MARKET PLACE

Lessons for eco-agriculture from the nutraceutical industry

As producers of agricultural commodities struggle to have the cost of environmental depreciation (in layman's terms, environmental maintenance or wellness) incorporated into their product prices, it is timely to look for models in other industries that have been able to segment themselves on the basis of wellness – our wellness. The sector chosen is the nutraceutical industry. The reason for selecting this sector is because it's an industry that has very successfully responded changing health consciousness; in particular the move from conventional (reactive) cures to alternative (preventative) cures.

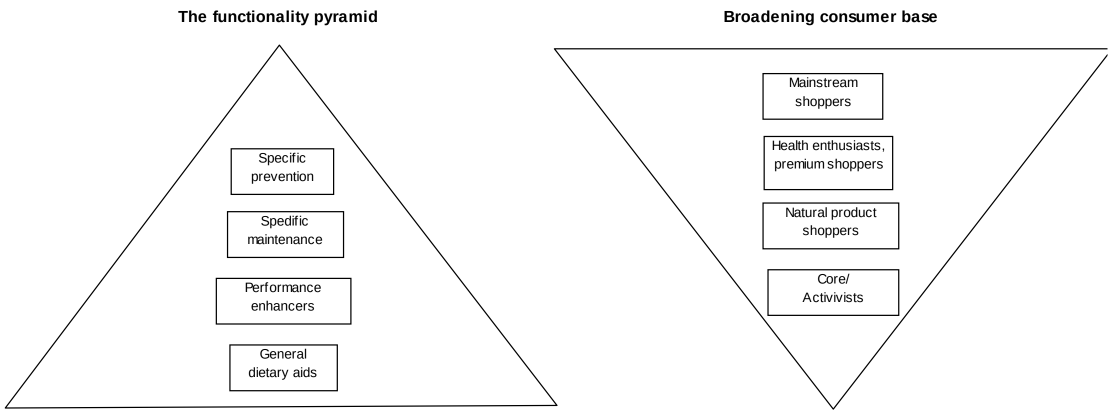
Nutraceutical is a term coined in 1984 and it has become a touchstone for innovation across the supplement and pharmaceutical industries. As Table 1 indicates, the growth in this sector far outweighs population growth (given most of the sales are in the developed world). Importantly, the newer products – herbal extracts, etc.- are the major area of growth, driven by consumers increasing desire to seek more specific solutions for maintenance of a healthy lifestyle. A lot of the fastest growing products are those directly correlated with aging baby boomer issues.

Table 1: World nutracuetical demand			
	1998	**1999**	**Change**
	US$ millions		**%**
World nutraceutical demand	**3,093**	**6,828**	**8.2%**
-Minerals & nutrients	1,327	2,314	5.7%
-Vitamins	1,003	1,628	5.0%
-Herbal extracts & other	763	2,886	14.2%
Source: The Freedonia Group (June 2000)			

What is the driving force behind the success in this sector?

There are two interrelated drivers of this growth. The first relates to progressive sophistication of products available to the consumer. Early nutraceutical products were restricted to general dietary aids (eg. vitamin C) which have expanded in range to provide a raft of specific curative supplements (eg. gingko for Alzheimer's disease). At the same time consumer demand increased from a very small base: the activists, progressing though natural products consumers and health enthusiasts and finally hitting mainstream.

Chart 1: Key drivers of nutraceutical expansion



Source: Promar International (2000)

In short, the nutracuetical market has targeted increasingly focused needs to the differing aspects of consumer needs rather than relying on general sentiment for category selling. However, by Promar International reckonings, the industry is still one tier below mainstream which is not expected until late this decade. Hence within 20 odd years this industry has moved from sideline to mainstream.

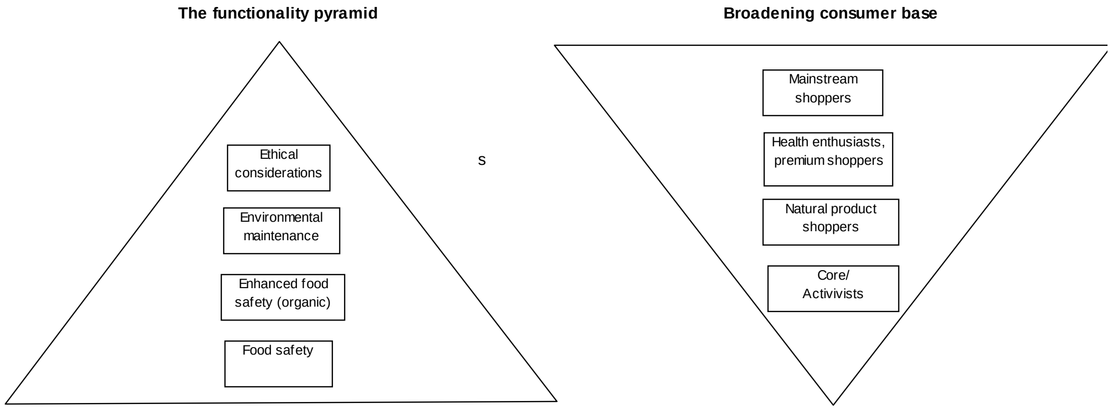
Can eco-agriculture capture the same growth?

Many critics will argue that agriculture, dominated by short-life products with little value-added or branding opportunities and many small players, is different. Whilst some of these differences do impact on the market place, I suggest the commodity focus of many in agriculture blinds them to the opportunities of product differentiation. All commodities can be differentiated, if only by their intangible benefits: our job is to identify what these are.

Eco-agriculture is simply a term coined to differentiate conventional agriculture from organic agriculture. So what makes up the difference. It all depends, but mostly it will be **demonstrated environmental care over and above regulatory compliance and this will be branded**. At present, food is largely differentiated on the basis of conventional or organic: natural or eco-food has yet to a presence in the market place.

Applying Chart 1 to eco-agriculture, the similarities are striking yet by my reckoning the industry is some 15 years behind the nutraceutical industry. Agriculture and those directly related in the food chain have, by and large, been reluctant to differentiate on the basis of refined functionality. As indicated in Chart 2, food safety dominated the debate in the early 1980s and we are only marginally advanced from this level with BSE and other issues still coming to the fore. Solely relying on organic labelling to meet sustainability expectations is, in the long term, a flawed strategy. This is relying on the general sentiment outlined above and not specifically meeting consumer needs. Whilst not against organics, it is a defensive rather than offensive way of differentiating products. The refinement of functionality in the food chain is, in my view, hindered by a lack of alternative supply chain groupings. To effectively brand any refinement based on a series of intangibles (and doing more than expected in environmental or ethical ways are intangibles in the short term), requires significant volumes of product to justify development of a specific eco-label.

Chart 2: Key drivers of eco-agriculture expansion



What is the outlook?

Both retailers and producers are missing out on capturing market sentiment that has already been identified and furthermore, has demonstrated a willingness to spend on items that contribute to wellness. Part of the problem to date has been the fragmentation of the supply chain. However, to capture this sentiment in prices reflecting true environmental depreciation, greater co-ordination in the supply chain is required and whole of chain co-operation to succeed and this will result in groupings of players under different eco-labels. Producers in particular will have to commit to label loyalty. However, capturing consumer demand in this manner is, in my view, a better way ensure sustainable practices than to progressively regulate.