Healthy soils

Drought: myth and reality

Soils that can deliver moisture and nutrients in even the toughest conditions are the best antidote to the long dry spells that are a feature of the Australian climate, says GREG PAYNTER

Drought instils fear into the hearts of many agriculturists. For organic farmers, the best way to cope with the ever-present threat of drought is to be proactive – to design a farming system based on diversity of flora and fauna above and below the ground. The greater the diversity, the more resilient and stable the farm.

Organic farmers need to intimately understand the environment of their farm. They need to know how to match their business to the productive capacity of the ecosystem. And they need to know what ecological processes are taking place on their land and in their air and water.

With this knowledge they can adopt farming strategies that work within the constraints of drought.

A fundamental principle of organics is the need to build and feed the soil. Organic farmers manage the interactions between the organic components of soil so that humus is developed. Humus has a great capacity to store nutrients and moisture; it is the key to stable and resilient farms that can survive drought.

Active and diverse soil biota in the rhizosphere of plant roots extends the capacity of the plant to seek nutrients. In effect organic farmers foster the beneficial and co-operative relationship between the soil biota and the plant host. When the soil has a great diversity of plant material – that is, roots and root exudates – that diversity increases the capacity for the exchange of nutrients and soil moisture. It boosts productive capacity in drought because the plant has more access to these resources. But it doesn't happen overnight: it can take three to five years to reach balance within the soil.

GROUNDCOVER MANAGEMENT

Organic farmers foster these interactions between soil and plants and manage drought primarily by managing and maintaining groundcover. Managing groundcover involves returning organic matter to the soil via cover crops, green manure crops, crop sequencing, poly-culture systems, diverse pasture mixes and grazing management. Compost is used to chelate minerals and provide humic and fulvic acids and the use of crusher dust to add diverse amounts of trace elements. Note Fulvic acid also aids root extension, which further aids the capacity of plants to obtain nutrients and water.

Bare soil loses up to 80% of available water during a season – a considerable loss of productive capacity.

DROUGHT MYTH – NOT JUST A LACK OF WATER

It is quite often said that drought is a function of the lack of available water. Others would argue that the problem is the lack of nutrients available to use what water is present. With proper nutrients, plants that might have produced only, say, 2.5 tonnes of biomass can produce as much as 4t. That's a major difference in productivity in either livestock or crop production. That's why organic farmers place such importance on creating stable humus by increasing soil organic matter and biological diversity.

Below are some practices that integrate much of the above theory, practice, philosophy and principles to achieve sustainable and viable enterprises in drought situations.

What is humus?

Humus is the end product of the decomposition and re-composition of organic matter by microorganisms. When fresh organic matter is placed in a compost pile, rapid multiplication of micro-organisms takes place. Certain microbes (bacteria, fungi, and actinomycetes) break this raw organic matter down into smaller particles (gums, waxes, lignins) that are resistant to further decomposition, and simple organic compounds (sugars, amino acids) that are water soluble. Following the breakdown phase, a second group of microbes bind together these particles and compounds, especially lignins and microbial biomass, into more stable humic substances (fulvic acid, humic acid, humins).

Microbes attach these long-chain humic compounds to the clay particles in soil, resulting in a clay-humus crumb. The bound humus is not water soluble in the soil or compost but can become soluble through root secretions from plants only. In a healthy soil system, a natural feedback loop exists whereby plants secrete root exudates telling microbes what they need, and in response, soil microbes regulate mineralisation of the clay-humus crumb and feeding of the plants. The objective of humus management is to produce an active, quality humus in both soils and compost, thus providing a stable bank of nutrients available to be taken up by the crop as and when needed.

– *Why Compost*, Spring 2004 ed.
Organic Farmer, UK Soil Association

GRAZING MANAGEMENT

Good grazing management allows high stock densities over a short time followed by sufficient rest periods before grazing again. This creates greater pasture species diversity and development, greater soil biota diversity. When a plant loses biomass above ground it sheds its root biomass to equalize energy requirements. Short, intensive grazing encourages sloughing of root material. It builds more soil carbon/organic matter and promotes humus development. Other benefits of greater biomass production include more nutrient-dense fodder for the livestock, more resilience to drought, greater water use efficiency and nutrient recycling and regeneration. These all help mitigate the affects of drought. Holistic grazing management practices are a good example of these strategies.

Our aim is 100% groundcover, 100% of the time …. This year has been one of the toughest years on record, but we still have plenty of good feed compared to what we've had in previous droughts. By increasing the organic matter in the soil, we are improving the water holding capacity of the soil and reducing leakage to the groundwater system. We have little surface run-off and virtually no erosion

– Bruce Maynard (www.lwa.gov.au)

ORGANIC ZERO-TILL

From a cropping perspective, zero-till organic methods – which involve cover crops, crop rolling, direct drilling of seedlings and using cover crop residues to control weeds – create a more stable soil environment. Soil temperatue is more constant and the soil more permeable. Water holding capacity is increased, evaporation reduced and stable humus is developed.

The main outcome is that optimum yields are obtainable over a wide variety of climatic conditions, due to the capacity of the soil to provide nutrients and water to the plant under more extreme conditions.

A RECENT TRIAL

I was involved in a field trial at the Dalby Agricultural College through a grant from DAFFA Farm Innovation Program during the worst drought in a 100 years. In that trial, organic wheat yielded 3.22t a hectare while the control method of conventional minimum-till practice yielded 2.2t/ha. The organic wheat was worth $450/t and the conventional wheat $340/t – a sizeable difference in gross returns.

The Rodale Institute in the United States has been running trials on organic farming for 25 years. In extremely dry years the organic trials out-yielded the conventional practice by 38-137% for maize.

In soybeans the organic trials out-yielded conventional practice by 152-196% using legume cover crops and composted manure treatments respectively. Similar results were also achieved in extremely wet years.

INTEGRATION OF CROPPING AND LIVESTOCK

Other innovative strategies that integrate cropping and livestock enterprises are pasture cropping and advanced sowing developed and refined by Colin Seis and Bruce Maynard respectively. Pasture cropping uses C4 and some C3 summer dominant perennial pastures which are cell grazed through summer. A cereal grain or fodder crop is direct drilled into the pasture over winter and is grazed or harvested.

Advanced sowing follows similar principles to pasture cropping but introduces alley farming using Old Man saltbush (or other fodder tree crops could be used), cell gazing, perennial pasture species (both winter and summer dominant) and dry sowing of cereal or fodder crops.

These practices are used by both conventional and organic farmers and are often called regenerative farming because this approach addresses the maintenance and improvement of soil carbon, which leads to continuous improvement of productive capacity.

SUMMARY

In the 1919 NSW Department of Agriculture *Farmer's Handbook* more than 70 pages is devoted to why soil humus is important and how growers can protect it.

Building soil humus is the key to minimising our exposure to drought because it holds up to 20 times its weight in water and increases nutrient availability by up to 70%.

The main lesson for organic farmers to consider is how they manage the soil environment so that stable humus is produced. ■

RESOURCES

- www.attra.org search 'drought'
- www.managingwholes.com
- www.acresusa.com toolbox/archives/Drought myth
- www.newfarm.org/depts/ NFfield_trials/1103/ notillroller.shtml – see slide show
- do a web search on 'Bruce Maynard advanced sowing' and 'Colin Sies pasture cropping'
- www.lwa.gov.au/downloads/publications_pdf/ PN030586_p10-15.pdf
- www.amazingcarbon.com.au regenerative agriculture – Dr Christine Jones
- DW Lotter, R Seidel, W Liebhardt, *The performance of organic and conventional cropping systems in an extreme climate year.* CAB International, 2003. Might be available through Newfarm site.
- Queensland DPI, *Organic Farming: Is it for you?* 2004.

Crop rolling and planting simultaneously at the Rodale Institute, United States.

Organic soybean direct drilled into rye cover crop.