FACT SHEET

SOIL BIOLOGY MANAGEMENT FOR VITICULTURE

BRETT IRVINE : CARBON CHASERS AGRICULTURE

The Soil Foodweb is a complex system of micro-organisms. The organisms include bacteria, algae, fungi, protozoa to the more complex nematodes and micro-arthropods and up to visible earthworms, insects, small vertebrates, and plants. The numbers of each group are regulated by their available food sources and environmental conditions. They consume one another according to the figure below and in doing so regulate soil nutrient availability, control disease, change soil physical and chemical properties and alter soil moisture retention and availability.

These organisms exist in a symbiotic relationship with the plant in the soil and on the plant surface although most activity is in the rhizosphere (area around the roots). In this way the plant can actually manipulate the make-up of organisms around them for their own benefit.

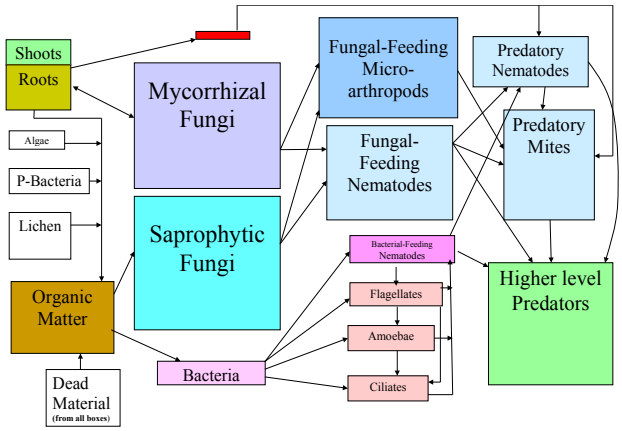

Fig.1 *– The Soil Foodweb in Healthy Orchard and Forest Systems* (Diagram courtesy of SFI Lismore)

The Plants are an Important Part of the Foodweb Cycle

Plants produce exudates (sugars) on all their surfaces to attract microbiology. These exudates encourage the biology the plant requires to proliferate on their leaf and root surfaces. The organisms will then supply the plant with the necessary nutrients or provide disease suppression in exchange for the exudates. Vineyards with a history of chemical and fertiliser applications have inadvertently changed the diversity of organisms present through creating a different environment; often toxic to many organisms. Beneficial micro-organisms applied to the plant surfaces start the symbiotic relationship where these organisms are missing. Replacing missing microbiology can be achieved through applying compost teas or compost.

Plants will require different micro organisms in varying quantities depending upon their species and their specific environmental conditions. If the beneficial organisms are not present to use the exudates and proliferate, disease causing organisms may use these exudates themselves leading to problems for the plant. It is important to ensure a broad diversity of all organisms are present and create the right environment for the beneficial ones, as selected by the crop, to thrive in the correct ratio to one another.

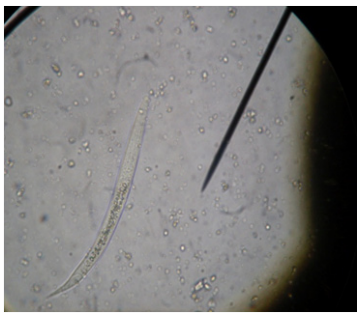

Fig.2 *– Bacterial Feeding Nematode (x400)*

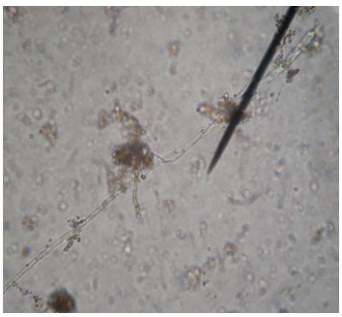

Fig. 3 – Beneficial Fungal Hyphae (x400)

Disease Suppression Mechanisms of Beneficial Biology

Beneficial biology will use the exudates so no food is left for the proliferation of pathogenic species. They also produce antibiotics, inhibitory compounds and toxins to prevent pathogen or pest growth. As the below diagram illustrates they should also occupy infection sites on leaf surfaces so pathogens cannot breach the cell wall and infect cells. This is the main way foliar applied compost teas inhibit the development of diseases such as powdery and downy mildew.

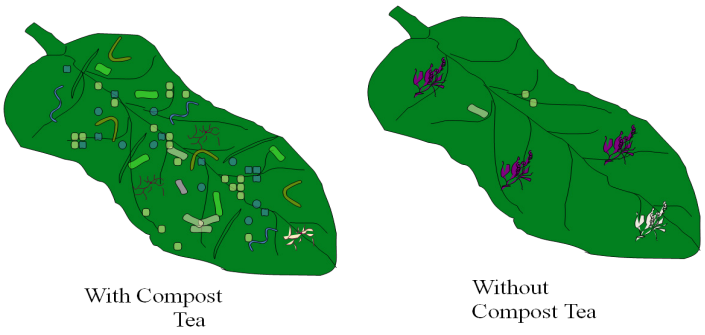

***Fig.4** – Representation of Desired Biology Result on Leaf Surface Through Use of Compost Tea.*
(Diagram courtesy of SFI Lismore)

Good Soil Biological Diversity Will Achieve the Following

1. Nutrients consumed by biology become tied up within organisms and eventually excreted in organically bound forms. This will stop them solubilising into leachable or gaseous forms.
2. Nutrients become available at rates a plant requires. This is due to plants releasing exudates to increase or decrease the numbers of the corresponding nutrient producing organisms.
3. Soil bacteria, fungi, protozoa, beneficial nematodes and arthropods will
   i) maximise nutrient cycling through weathering of soils and better utilisation of applied fertilisers,
   ii) compete for resources and space, inhibit and consume diseases and pests
4. Aerating and building soil structure for the root system to penetrate by breaking down compaction layers, consuming toxic materials and increasing incorporated organic matter levels
5. Change plant unavailable nutrients into available forms

Compost & Compost Tea are Soil and Foliar Sources of Biological Inoculum

Compost can provide a diversity of bacteria, fungi, protozoa, nematodes and nutrients. Compost Tea's can be used to provide a diversity of bacteria, fungi and protozoa only. It is important that they are made and applied correctly to give the organisms the best chance of establishing and thriving in their environment. Additives such as molasses, fish hydrolysate, amino acids and kelp are foods that can help boost biological activity and increase their survival rates. The most important factors for healthy soils anywhere are keeping soils aerobic and suitably moist all year round (remember they are alive so keep organisms active and in a suitable environment).

The Process to Improve Viticultural Soil Through Biological Principles

1. Determine the missing biology and chemistry
2. Add organisms and food at appropriate times for maximum success – compost, compost tea and minerals
3. Soil – initially bacterial biology then highly fungal aerated compost tea and additives
4. Roots – add biology including mycorrhizal fungi and additives
5. Foliar – add biology via fungal dominated compost tea and additives including nutrients

My Observations So Far....

Many farms in Australia and overseas are now implementing part or full biological farming programs to successfully produce winegrapes and tablegrapes. The following observations have been quickly and relatively easily achieved:

1. 70% reductions in commercial fertiliser additions without crop reduction or quality compromise
2. Chemical cover spray programs successfully replaced by high quality compost tea applications
3. Highly visible increases in root depth and density
4. Earlier fruit colour development and harvest dates
5. Low nitrate nitrogen levels in crops with often similar total nitrogen levels (low nitrates should result in reduced disease pressure, better fruit storage, less low quality foliage, bud fertility increase)
6. Plant nutrient improvements only came with good biology and not with increased organic matter or humics alone
7. Significant savings in time and costs particularly due to decreasing the use of foliar chemicals

The biggest barrier to successful implementation for some managers has been the mindset change to a more holistic approach and the need for high quality compost at all stages of the operation. It can also be difficult to know whether sufficient nutrient cycling is occurring without lab testing. Access to large volumes of high grade commercial products is an emerging problem.

Overall, rapid (two month) change can and is occurring but the implementation phase is usually slower due to the time taken for owners and managers to develop their confidence in the biological farming approach.

Carbon Chasers Agriculture

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Murray Valley Winegrowers' Inc