Back to soil biology basics

Background

Healthy soils are the foundation for growing a good Tea Tree crop. Undertaking management practices that create the right environment for biological beneficials to thrive is a way of proactively mitigating against pest and disease occurrence and improving plant access to soil nutrients for improved tree development and health.

There has been limited specific research undertaken for Tea Tree on the impact of fertiliser application, soil ameliorants or plantation floor management on soil health indicators such as physical structure, biology, chemistry, and consequences for tree health, growth, and productivity. It is hoped the industry will develop improved knowledge in the near future but for now general rules of thumb researched and recommended for other industries of the region can certainly be applied to Tea Tree.

Why is good soil biology beneficial?

There is a growing appreciation of the integral importance of soil life and plant-symbiotic interactions for improved plantation and soil health. Soil biology ranges from invisible bacteria to earthworms you can see (Figure 1). Soil microbes are responsible for converting organic material, such as composts, mulches and crop residues into nutrients that are available to the crop. They also aerate the soil through their activities providing better soil structure for tree root development, and an aerobic living environment for beneficial fungi that process carbon that is retained in the soil longer-term.

Mycorrhizal fungi associations have been observed in Tea Tree. These help in Phosphorus, Molybdenum, Copper and Zinc nutrition and are improved with the addition of organic matter to the soil. Fungi form complex hyphal networks through the soil, spanning large distances to access different resources. Having readily available nutrients in the soil better aligns nutrient availability with tree demand.

Key points

- Good soil biology has a diversity of species and abundant populations.
- Growers can undertake management practices that build optimal conditions for improved soil biology.
- Cycling and availability of nutrients at the right time to meet tree uptake demand during development and growth is increased by an active soil biology.
- Pest and disease occurrence is improved by a well-balanced soil biology population, reducing the need for herbicides, insecticides and pesticides.

We need to be careful to manage soils to promote species diversity of soil biology as well as overall population sizes. Soil disturbance through frequent deep tillage quickly alters soil structure and soil microbial, fungi and beneficial bacteria communities. Plant pathogens can more easily dominate in anaerobic environments effecting tree development, vigour and ultimately yield. By increasing the size and diversity of microbial communities, plant pathogens are suppressed and beneficial organisms are more easily able to thrive. The application of rotations improves the soil biology and reduces reliance upon herbicides and pesticides.

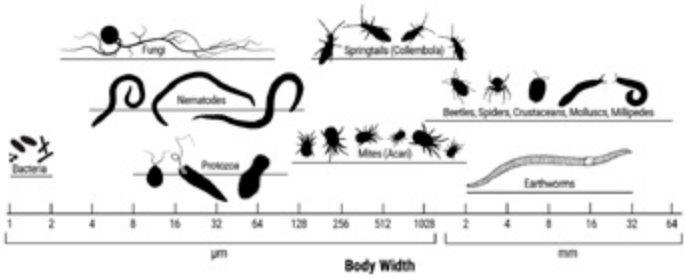

Figure 1. Biology in your soil, from invisible bacteria to visible earthworms (Source: Brackin et al., 2017)

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What are management practices known now to encourage improved soil biology?

These general rules of thumb can be used now as a guide to improving soil biology:

- Manage fertiliser nutrients and ameliorant inputs to maintain soil pH and nutrients within optimal recommended ranges throughout active growing periods. Over-supply of nutrient, especially nitrogen (N), can be easily lost via run-off, drainage and atmospheric pathways as well as cause toxicity to certain beneficial soil biology.
- Consider N supplied by mineralised soil sources in nutrient budgets- N stored in soil types of the Tweed, Clarence and Richmond River to 40cm, taking into account of mineral N and 14-day potentially mineralised n (PMN), have been determined to range from 75- 175kg N/ha (CRDC, 2020). Soil microbes are needed to convert soil N into a form available for plant uptake.
- Grow a cover/green manure or grazing crop in the season or seasons leading up to establishing a new crop to break the monoculture. For example, legume break crops in local sugarcane research resulted in increased labile carbon, microbial biomass, fungal biomass, and microbial enzyme activity which are all important for soil health (SRA, 2020). The boost in soil biology after a legume rotation is likely to be short lived (3-5 months) but it occurs during the crucial window of initial seedling establishment and will reduce pathogen populations in the soil .
- Add organic matter to the soil- the slow break-down and release by soil biology activity extends nutrient release to the plant over a period of time. It is recommended that this practice is undertaken to support fertiliser inputs (not as a replacement) until an adopted annual soil/biomass testing regime indicates rates of fertiliser, including N, can be reduced.
- Minimise tillage during planting- Fungi are particularly sensitive to disturbance because the hyphal networks can only regenerate slowly after any disturbance.
- Control traffic in the inter-row to prevent soil compaction- well-aerated soils have a better water infiltration rate and holding capacity to ensure moisture levels are optimal for developing root systems. Increasing soil water infiltration will also reduce the amount of water moving off the soil surface.
- Schedule irrigation to optimise soil moisture to meet crop demand. Water-logging or over-drying of the soil will see soil biology activity decline and impact production potential.

Monitoring soil health for improved soil biology management

The best way to evaluate the health of soil is to monitor and measure changes over time. Monitoring can also help to identify factors that are constraining soil biology diversity, population size and overall soil health outcomes. Knowing the current status can help inform decisions on pre-plant and in-crop soil management practices such as tillage, nutrient requirements (nutrient budgeting including available soil sources) and soil amendments.

There are a range of monitoring protocols available but one of the most user-friendly methods has been developed on the North Coast (North Coast LLS, 2020) and is freely available from SoilCare (https://www.soilcare.org/soil-health-card.html).

The Soil Health Card is a 10-point checklist that covers all easily measured aspects of soil health. It includes methods to measure:

- Groundcover
- Diversity of soil life
- Soil strength – penetrometer
- Soil water infiltration
- Root development
- Soil structure
- Aggregate stability
- Earthworm numbers
- Soil pH
- Diversity of plant species

References

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Contact Northern NSW

Alice Moore (Warner)
Farmacist Pty. Ltd.

0402 924 955
alicew@farmacist.com.au

Contact Far North Queensland

Belinda Billing
Farmacist Pty. Ltd.

0476 583 137
belindab@farmacist.com.au

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