AOA SOIL FIELD DAYS TALKING POINTS – Peter Briscoe

Q. How do you maintain productive groves while streamlining nutrient requirements?

A. Olive trees take the bulk of their nutritional requirements through the roots, so ensuring maximum soil health and structure is the most important aspect of any nutrition program. Certain biology is responsible for improving nutrient uptake through the root structures and the soil health will determine the effectiveness of these microbes

There are a number of different nutrition experts with differing opinions regarding olive tree nutrition and as the grower, you need to work out the best and most effective method based on your own individual circumstances. In this document, my opinions are from the perspective of improving the biological content and species of the soil and creating an environment that allows those microbes to flourish.

Every year a large portion of the farmers' revenue is spent on agrochemicals to promote olive trees' growth, to control plant pathogens, and to increase the nutritional value and quality of the olive products.

The public concern on the use of agrochemicals (i.e., chemically based fertilizers, fungicides, insecticides, etc.) has increased in recent years, due to the negative effects on the environment (e.g., soil and groundwater pollution), the ecosystem's biodiversity, and human and animal health

Several researchers have focused their efforts on the development of alternative, eco-friendly practices aiming to increase olive crop yield, to control biotic threats, and to ameliorate olive tree's health

An essential aspect of sustainable agricultural management is the development and implementation of eco-friendly methods and strategies that promote a soil's biological processes, decrease agricultural inputs, and improve soil structure and fertility

The olive plant forms a strong relationship with beneficial soil microbes such as Bacillus spp. and certain fungi, which enables the plant to grow, not only in limiting nutrient soils, but also under various abiotic stresses, such as water scarcity

Q. How do you manage applications of fertilisers to optimise plant uptake and minimise losses to run-off, leaching or gas emissions?

A. Your soil health and biological content in the soil determines how the tree takes up nutrients through the roots. A decline in soil quality and key biological species has a profound effect on tree growth and performance. Applications at key times during the year coupled with a good quality soil structure and biological content will ensure the tree takes up the nutrients required throughout the season and avoid nutrient lock up in the soils and deficiencies within the tree.

Over fertilising olive trees can adversely affect the trees production and creates vigorous growth while inhibiting fruit production.

A common mistake is over fertilising when the trees aren't growing adequately. Over fertilising can also lead to poor oil quality.

Q. When should I take soil and leaf tests?

When starting your journey into understanding and improving the soil health and biological content of your soil, leaf and soil testing should be conducted every year until you get a better understanding of how the soil structure and biology are affecting your trees performance.

Leaf analysis should be completed in January every year. In the first year of leaf sampling, if possible and affordable, take a fresh sample for analysis every 4 weeks to get a better understanding of how your trees are taking up nutrients.

Soil samples should be collected every year at first to measure the soil structure, nutrient availability and soil health and marry those results against the leaf samples to measure the nutrients actually getting into the tree. The more informed you are as to what is available in the soil and how the tree is taking up those nutrients will streamline your fertiliser program. This will ensure more environmentally beneficial practices, reduce costs and drive better tree performance leading to better cropping outcomes.

Biological testing is also critical to understand the level of microbes in the soil and the split between bacteria and fungi. Prior to the addition of any microbial products or bio-stimulants, you need to understand the biological make-up of the soil first. The bacteria and fungi are the engine room of your tree and drive tree health, immune health, nutrient uptake and will

'switch on' the trees natural defence systems to better mitigate biotic and abiotic stresses.

Any biological additions to the soil must be assessed prior to application to determine what microbes are in the mix, what colony rate is in the mix per ml or gram (minimum of 10^7 per microbe per ml/gram is required), how will the microbes be fed, how often is the product required to be applied (products that are applied every 1-2 months are required to do so due to the bacteria or fungi not persisting in the soil and surviving) and how are the benefits assessed and measured.

Q. What fertiliser methods should I use?

A. Olive trees take the bulk of their nutrient requirements through the root structure.

The main nutrients to analyse are nitrogen, potassium, phosphorous, calcium, magnesium, manganese, zinc and sodium with the other 8 required nutrients less important as long they aren't seriously deficient or in toxic levels.

The use of P and Ca in the soil can be economically prohibitive. Bioremediation of the soil is the most effective method in ensuring these and all elements are available for the tree as certain microbes will unbind these nutrients from the soil structure (especially P) and convert them to a plant available source. Others will fix nitrogen from the atmosphere providing part of your nitrogen requirements for no extra cost

Potassium and nitrogen are the 2 most critical elements to keep within the desired range

There is much conjecture around the use of foliar fertilisers as part of an olive nutrition program, with some believing they offer no value for the expense and others believing that in certain circumstances, they are required to ensure the tree has sufficient specific nutrients to function at the highest level. In my opinion, a well-structured soil and leaf testing program will give you the data to make informed decisions on whether to use foliar fertilisers as part of your overall nutritional program.

Q. How do I improve soil biology and carbon in my soils?

A. Not enough attention is given to soil quality, but it has a profound effect on growth and performance of your trees. Think of the soil as the equivalent to your stomach. The biological content in your stomach drives immune health and is now being targeted as a catalysts in the medical profession for treating a range of issues. It is believed that up to 80% of your immune health is driven by your gut microbes. The soil is exactly the same. The plant has a symbiotic relationship with certain microbes that drive their immune health, determine nutrient availability and uptake and affect the overall performance of your tree

The effect of land management practices and the condition of your soil will determine your productivity

It is key to remember, just like 'oils ain't oils', 'Any microbes won't do.' Biological science has now advance enough for us to pick and choose which species to use, how to feed them and keep them multiplying at the desired level and the effect the lack of these microbes has on plant health and production. The use of particular microbes, particularly Bacillus, can have a profound effect on the soil and the plant in as little as 6-12 months. Certain Bacillus species are antagonistic in nature towards any undesirable microbe that is trying to enter the root zone. They work hand in hand with the plant to protect it and provide exactly what the plant is requiring while building the plants immune structure and suppressing pathogens. Part of the IP of Bactivate is to genetically manipulate (not modify) the selected Bacillus species to remain in an antagonistic state prior to entering the soil and root zone. The effectively has them on guard from the minute they enter the root zone.

Studies have shown

Soil carbon can be built through a number of avenues but there is growing evidence to show that certain Bacillus species will capture atmospheric carbon, use part of it for their body function and fix the remainder in the soil (Bacillus mucilaginous has been scientifically proven to achieve this).

Soil carbon can also be increased through the use of composting, but it is important to use a high-grade compost that is fully composted and free of pathogens. The addition of bacteria to the compost prior to applying will unlock nutrients in the compost and break down into the soil more effectively. Chicken manure compost that isn't fully composted down is not recommended and neither is compost containing high amounts of woody

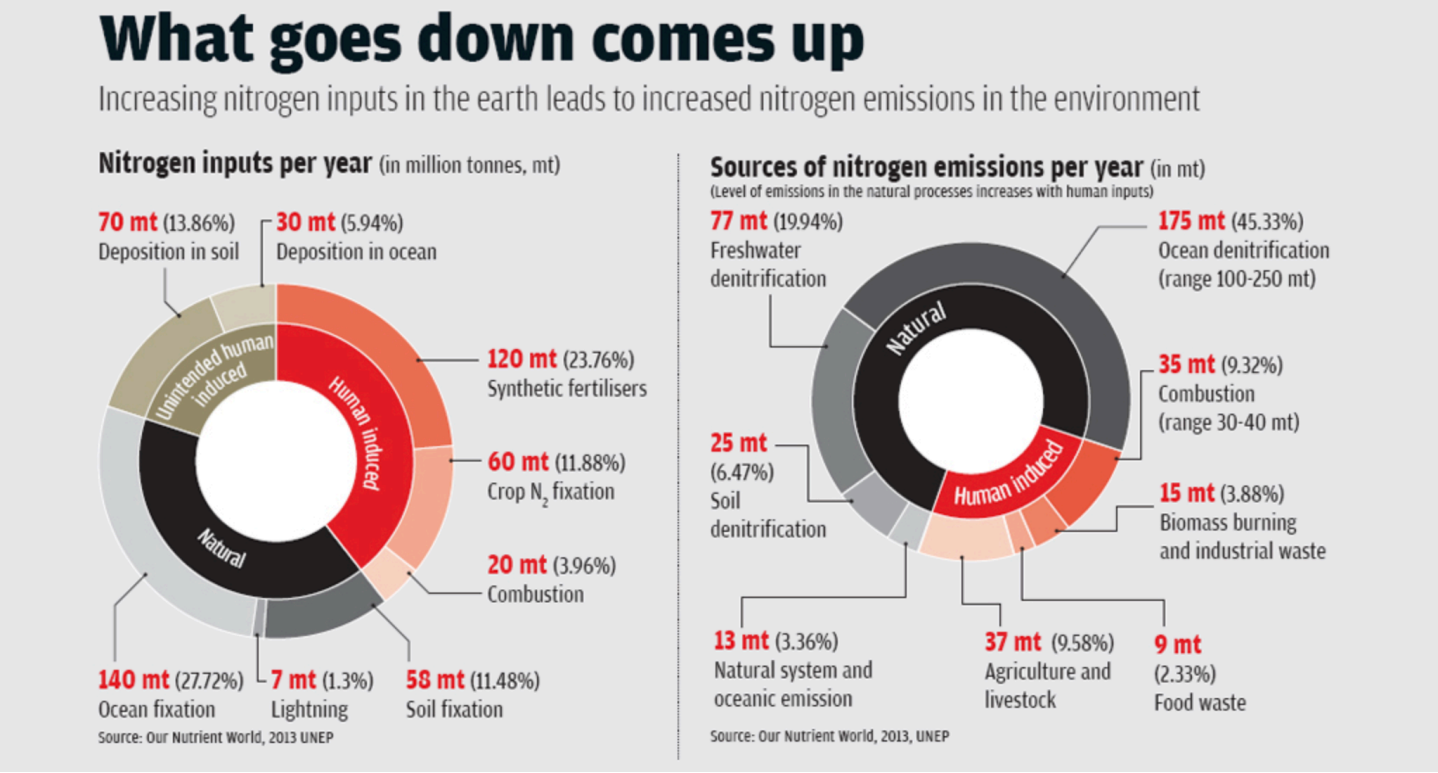
materials as the microbes drawn down nitrogen to break down woody compost.

Q. Building soil nitrogen and nitrogen fixation

A. Nitrogen applications are an essential part of good olive grove nutrition (based on soil and leaf assessments), but certain bacteria will convert atmospheric nitrogen from a nitrite form and convert it into a nitrate that can be taken up by the plant.

The earth's atmosphere is made up of 78% nitrogen with soil fixation and crop fixation making up the same level of nitrogen in the soil as synthetic fertilisers do.

Agriculture and livestock account for almost 10% of the total global nitrogen emissions which is the highest single human induced emissions per annum



Nefarious nitrogen is becoming a major problem globally. Nitrous oxide (N2O), another oxide of nitrogen, is a greenhouse gas that is 300 times more reactive than carbon dioxide and has a lifespan of 120 years in the atmosphere. An American study in 2012 found that over a period of 100 years, the heating effects of N2O far outweighed any short-term cooling impact that reactive nitrogen might have. Further, N2O has a potential of

ozone depletion in the stratosphere—this ozone protects us from the harmful ultraviolet rays of the sun—that is comparable to the potential of hydrochlorofluorocarbons which were phased out in the 1990s as a highly ozone-depleting substance.

POLLUTANTS AND EFFECTS

Pollutant	Health impact	Environmental impact
Nitrogen oxide in air	Chronic respiratory diseases, respiratory tract inflammation, asthma and cough	Smog and acid rains
PM2.5 & PM10	Cardiovascular diseases, respiratory diseases, asthma, reduced lung function, overall mortality	Reduces visibility and smog
Nitrates in water	Blue-baby disease, reproductive problems, bladder and ovarian cancers	Eutrophication, biodiversity loss, aquatic oxygen depletion
Nitrous oxide in air	Skin cancer due to breakdown of stratospheric ozone	Contributes to GHG, breaks down stratospheric ozone
Ozone	Respiratory ailments, decreased lung function	Detrimental to plant growth, reduces crop productivity

Source: Our Nutrient World, 2013, UNEP

"Our Nutrient World" estimated that the global cost of damage from nitrogen could go up to US $2,000 billion.

Precision farming practices can lower the nitrogen usage in agriculture through regular soil and leaf testing, bioremediating your soil and only feeding the trees nitrogen when they require it, coupled with a strong biological soil structure that is drawing 'free' nitrogen from the atmosphere.

Particular Bacillus bacteria and other genus convert that nitrogen. During the day, atmospheric nitrogen is well mixed whereas at night, it becomes denser than the layers below it and falls to the ground, percolating into the pores of the soil. By having your biological workforce at the ready to consume that nitrite and convert it to nitrate, the plant is able to benefit with free nitrogen given to them by the microbes.

This makes up part of your plants overall nitrogen requirements and not only is a cost saving, it can also assist your plants ongoing nitrogen requirements and you can do your part to grow sustainably….for free!

Q. The use of soil amendments to correct sodic and acidic soils

A. Alkaline sodic soils cover about 60% of all Australian agriculture and account for around $1.4 billion in crop losses.
In Australia, soils are considered sodic if they have Na+ ions above 6%

One remediation method outside of the traditional use of gypsum, is bioremediation using halophilic bacteria (Bacillus falls into this category).

These bacteria, once added to the soil and stimulated to grow using bio-stimulants such as Bactivate BioBoost Enhance, produce acid and increase the soil pH while releasing calcium, which helps prevent soil dispersion.

In sodic soils, the use of specific additions of biology to correct this will only be effective if high grade biostimulants are used to ensure they have the correct food source to be able to grow and multiply in these conditions.

When choosing biostimulants, it is important to understand the source of the carbon and humics being used and whether they have been derived from coal or plant materials

Soil microbes can’t identify carbons from coal-based materials at the same level that they identify and consume plant-based carbon, as their main food source is derived from plant exudates (the carbon rich excretions the plant sends out of its root structures)

Lime is the most commonly used method to the raise pH in acidic soils

Studies have shown that using electrokinetic bioremediation (EK-Bio) with bacillus species (including Bacillus subtilis), along with high grade, plant based biostimulants, can increase acidic soils pH.

One study conducted showed an increase in pH from 2.95 to 4.66 using Bacillus subtilis along with studies conducted by Mitta Valley Landcare Group between 2015-2020 using the Bactivate Program concluded that the there was a lift in pH over that time to the equivalent of 1 ton of lime per acre per annum