CHARTON & BANG

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Composting

Compost Recipe

The target carbon:nitrogen ratio for composting is around 30:1. The mix below should produce this ratio:

45% Pomace

45% Chipped grove prunings /woodchip or cereal straw

10% Animal Manure (Cow, sheep, pig or chicken)

Plus 1 tonne water / tonne of dry compost mix

The materials need to be combined and then mixed thoroughly by turning the pile over 4-5 times. This should be done in one big cone pile.

After mixing add water until saturated and then let it drain and mix again.

Check water content using the squeeze test. Collect a handful of mixed compost and squeeze with firm handshake pressure. If more than a drip or two comes out the mix is too wet and needs to drain longer.

Hold the handful up to your ear and squeeze again. If you hear squelching, the mix is likely just right. If there is no squelching noise the mix is too dry.

After the water content is right, lay the material out in a windrow 1.5-2m high. It will likely drop in height considerably over the next week, this is fine.

Over a 12 week period, the windrow should be mixed by picking it up and dropping it in to a new windrow next to the original. This process should be done 4- 6 times. Care should be taken to try and mix the dry material on the outside of the pile into the middle of the pile.

The material is ready when there's no rotting smell in the middle of the pile, it smells earthy, it's dark brown/black, soft and moulds like plasticine when moist. This is known as mature compost.

Compost Application Rates

Minimum application rates are around 5 cubic metres (m^3) per hectare. $100m^3$/ha is at the upper end of application rates, and $20m^3$/ha is a good balance. For a traditionally spaced 6m X 8m (208 trees/ha) this equates to around 100 litres/tree, or around 1 wheelbarrow/tree.

Compost can be applied every 1-4 years. Sometimes you can go even longer if you combine it with good all round management. If you are a purely conventional grower, with little ground cover and lots of chemical fertiliser, it would be a good idea to apply compost every year to help repair the soil from the year's wear and tear. If you're right into regenerative farming and have living plant cover all year round and organic sources of nutrients, then after a first application of good quality compost it might not be necessary to reapply for many years afterwards.

Soil Water

Water is critical to all life. You need water to drink. Your trees need water to drink. The life in the soil also needs water to do its jobs. Nearly all of Australia is a water limited environment, so we need to actively manage water in order to have a productive farming system, even when it isn't irrigated. In order to get the most out of the resource we have, we need to manage 3 aspects of soil water:

- Collecting more water
- Holding more water
- Giving more water back

Collecting more water

To collect more water to need to ensure that as little as possible runs off the surface or evaporates. This requires that the surface of the soil allows water in rapidly, and that surface water isn't allowed to run rapidly away. A compacted and bare soil will not allow water in, and the bare surface allows water to easily run away. A healthy soil with flourishing soil biology and plenty of soil carbon will fluff up and allow water into it easily. If the soil is also covered with mulch or living plants there are barriers to the water easily running away. This gives more time for water from heavy rainfall to soak in and prevents soil erosion.

Holding more water

Once water has entered the soil, it needs to be stored in a way that prevents it easily being evaporated back out, or running straight through the topsoil and away from roots. Good levels of high quality soil carbon are critical to acting as a sponge directly, and stimulating soil biology to create a soil structure that holds water in place. The more water that can be successfully stored in the topsoil, the longer that your trees can last between rainfall events or irrigation.

Giving more water back

Water that is stored in the soil is of no use to your trees if they can't get access to it. If the water is bound too tightly it becomes impossible for plants to generate enough suctions to recover the water, and the water is effectively lost. If the root networks of the trees are limited, then they will not explore the full soil volume available, and a water resource is wasted. A soil with plenty of soil carbon will stimulate both the growth of tree roots and mycorrhizal fungi. These fungi make associations with tree roots, and can then explore thousands of times more soil volume for water and nutrients in exchange for sugars from the plant.

Soil Carbon

As shown above, more soil carbon almost always improves soil health and function. If there is a single soil parameter that you could concentrate on to get positive results in nearly every aspect of growing plants, it's the levels and types of soil carbon. For the purposes of conversation there are 3 main categories of soil carbon:

- Living
- Simple
- Complex

Living carbon

This is carbon contained in living organisms in the soil. Excluding water, up to 50% of the elements in a living body are carbon molecules. This is very active carbon moving around the soil rearranging the furniture and eating other living carbon. It is in bacteria, fungi, insects, worms, plant roots, and anything else alive in the soil. Building this type of carbon increases the activity in the soil which can lead to better soil structure, better nutrient cycling and more carbon moving into the other two fractions.

Simple Carbon

Simple carbon is living carbon that has recently died and broken down. It is nutrient rich and very available to microbes to use for food. It is made up of various types of short chain carbon molecules that are easy to break down and relatively short lived. It also includes sugars (also small carbon molecules) that plants exude from their root tips to feed soil biology and encourage all of the positive effects that soil biology can bring about for plants.

Living carbon drives the activity of the living carbon as an energy source. Carbon molecules need to be reacted with oxygen (or some substitutes) to create the energy for life. This produces carbon dioxide that then returns to the atmosphere as a gas. Processing simple carbon for energy leads to larger and more stable carbon molecules that go on to become complex carbon.

Complex carbon

Complex carbon is made up of the same components as living and simple carbon, but has molecules that are hundreds to thousand of times larger. These molecules come from carbon being processed by multiple groups of soil microbes until the end products are gigantic molecules. Only a very small proportion of the carbon (less than 1%) of the carbon that enters the soils from plant roots and dying organisms becomes complex carbon. It takes a long time to form, but also can last for thousands of years in the right conditions.

Most of the positive soil health parameters in the soil are closely linked to the presence of complex carbon. Complex carbon fosters soil structure, stores soil water, stimulates healthy and diverse soil biology, stimulates increase root growth, stores fertiliser nutrients in a slow release form, reduces soil and plant diseases and generally saves the world.

How we lose soil carbon

Unfortunately many modern agricultural practices destroy complex carbon. Ploughing, excess herbicides/pesticides and excess fertiliser can all break down the long living large carbon molecules. When complex carbon is lost not only are many of the best functions of soils compared, but the soil also suffers a reduction in its ability to make complex carbon.

Nitrogen is normally a limiting factor in both plant and microbial growth and populations. Under natural conditions soil microbes are using nitrogen for building bodies and carbon for energy. They source these resources from simple carbon primarily. Complex carbon is much more difficult to break down and generally not worth it. When there is a new source of nitrogen in the soil, particularly from readily soluble nitrogen fertiliser, it disrupts the normal balance. Microbes now have a wealth of nitrogen to use to grow bodies, but they don't have enough carbon to go with it. In this circumstance it becomes worth the effort to break down complex carbon to extract carbon for energy. The complex carbon that took decades to build up can be lost in a few weeks.

How we can build soil carbon

The primary source of carbon into the soil is from sugars emitted from plant roots (exudates). The simplest and cheapest way to bring large amounts of carbon into the soil is to grow as many roots as you can. More roots = more carbon. In an olive orchard, the best way to grow more roots is to have active living plants between rows. More living plants means more leaf area extracting carbon dioxide from the atmosphere and transferring a percentage into the soil. Living plants reduce evaporation from the soil, slow down water flowing on the surface and help open up the soil to allow water in.

While living plants can introduce tons of carbon per hectare each year into the soil, it still takes time to rebuild complex carbon levels. An effective way to shortcut this process is to apply mature compost. Composting is effectively a way of optimise the natural complex carbon building process under controlled conditions. Decades worth of complex carbon building can happen within 3 months of composting. You can then use this compost to instantly replace a portion of the complex carbon that has been lost from the soil.

How to keep soil carbon

The first action to take is to space out nitrogen fertilisers into as many small applications as possible spread over time. One large application with strongly disrupt the soil and lose complex carbon. Multiple smaller applications can still apply the same total amount of nitrogen over a season, but will have a lower concentration of nitrogen in the soil at any one time. The ideal is to deliver nitrogen at the same rate that plants and microbes will take it up so that there is only a small amount of soluble nitrogen present at any one time. This can also be achieved by building soil fertility in total, so that nutrient cycling from soil microbes can produce a steady small stream of soluble nitrogen.

Avoid cultivation where possible. Sometimes there are compelling reasons to cultivate soil, but when it is used it creates a similar soil conditions to excess nitrogen applications. Complex carbon can also be degraded through exposure to sunlight and dry air.

Cover the soil with growing plants. This both builds soil carbon and protects the ability of the soil to hold simple carbon while it converts to complex carbon. It takes some water and nutrients to grow and maintain the plants, but the net position for your olive trees is nearly always better.

If the soil can't be covered with growing plants, dead plants over summer or mulching at any time of year is almost as good. These situations don't add much soil carbon, but they do protect the soil, helping it maintain moisture and avoiding overheating or frosting that can kill soil biology.

Managed intensive grazing for short periods followed by good rest periods has been shown to rapidly increase soil carbon. This is possible to do in olive orchards using electric fencing. Low pressure longer period grazing won't achieve the same results, and can even reduce soil carbon if the grazing pressure is too high for too long.

Measuring soil carbon

Conventional soil tests measure soil carbon. This is a useful measure for an indication of if your soil carbon is building or falling. However, this test measures all types of soil carbon as one and doesn't tell you what proportion is living, simple or complex carbon. The living and simple portions of soil carbon make up 80-99% of soil carbon. They can change rapidly according to temperature, rainfall, disturbance and season. Identical management in the same paddock between a cool wet and warm dry year can result in different soil carbon readings. To attempt to measure your soil carbon using conventional soil tests it is best to take the samples at the same place at the same time of year and compare them over multiple years. This will give a picture of how the soil carbon levels are moving on average.

There are specialty tests available that can measure soil carbon types separately. They are more expensive and harder to find, but give a more accurate picture of how soil carbon is progressing. Levels of complex carbon (that could be called humus, humates, humic acids or fulvic acids) should be more stable and building in total.