Buzi-B Flower Farm

At Buzi-B Flower Farm, we do not use poisons or synthetic fertilisers. Instead, we work with nature, drawing on its natural systems to improve the environment and support sustainable farming practices.

We are constantly learning and enjoying the experience. Through both successes and failures, we are embracing the journey and continuing to grow alongside the land.

We have found that the soils in our region are dominated by kaolinite clay. This came as a bit of a shock to us, as we were complete novices when we first looked at buying a farm for flower growing. However, it has also become a fun and rewarding challenge, and one we have chosen to embrace.

Transforming our soils, together with nature.

To get in touch, visit our website – www.buzibflowers.co.nz

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Our BioChar Methods

Often small-scale production of BioChar is done using some of the methods below:

- Cone kilns (such as flame-cap kilns)
- Retort kilns, which burn gases released from the biomass to improve efficiency and reduce smoke
- Sealed metal drum kilns
- TLUD - A top-lit updraft gasifier (also known as a TLUD) is a micro-kiln used to produce charcoal, especially biochar, and heat for cooking. A TLUD pyrolyzes organic material, including wood or manure, and uses a reburner to eliminate volatile byproducts of pyrolysis. The process leaves mostly carbon as a residue, which can be incorporated into soil to create terra preta soil.

Our Research to Date

Every season teaches us something new. As we learn to grow flowers and vegetables in our unique environment, we're documenting what works, what doesn't, and the lessons we uncover along the way. This section shares our observations and experiences to date.

For **clay soil**, the best biochar particle size is usually **small to medium granules (about 1–10 mm)**, with many growers aiming for **2–5 mm** as a good compromise.

Why this particle size works well in clay soils

- **Improves soil structure:** Small-to-medium particles help create pore spaces within dense clay, improving aeration and drainage.
- **Retains moisture without waterlogging:** Biochar's porous structure helps hold water while reducing compaction.
- **Provides habitat for microbes:** A larger surface area supports beneficial soil biology.
- **Mixes more uniformly:** Very large chunks can create uneven soil conditions.

Particle sizes to avoid

- **Fine powder (<1 mm):**
    - Can become dusty and difficult to handle.
    - May temporarily tie up nutrients if not properly charged.
    - Can clog soil pores when used excessively in heavy clay.
- **Large chunks (>10–20 mm):**
    - Break down and integrate more slowly.
    - Provide less contact with the surrounding clay.
    - Can create uneven soil texture.

Some devices that can help break biochar into smaller pieces

Finding the right method for breaking down chunks of biochar can take some trial and error. People use a range of practical methods:

including placing biochar in strong bags and driving over it with a vehicle, jumping or stamping on it, crushing it with a large hammer in a bucket, or pushing it through a sieve with a shovel.

For larger quantities, or when consistent particle size is important, the easier and more reliable methods below are likely to work better.

On Buzi-b Flower Farm, we use a drum to break down the large chunks of BioChar down to smaller pieces that will pass through the Insinkerator. To assist with reducing dust we first soak the BioChar in worm tea.

Particle size makes a difference

Depending on the soil type the size of your BioChar particles is believed to have a different effect on the soil. There are several ways that you can achieve the Biochar size. Some of these are listed below:

- **garbage disposal (Insinkerator)** – Will achieve a particle size of approximately 1 to 2 mm. One consideration here is that the speed of the Insinkerator does cause it to smash the biochar in powder much of the time. This challenge can be reduced by soaking the Biochar pieces in water so that it reduces this. Well soaked Biochar may end up looking like mud which is fine if you do not have issues with that.
- **manual grain/corn mill** - Will achieve a particle size of approximately 1 to 2 mm but could have the same challenge as the Insinkerator.
- **Fruit Grinder –** Will achieve a particle size of approximately 1cm.

How temperatures affect the Biochar process

Based on our research and experience, temperatures between **500 °C and 600 °C** are generally considered optimal for producing high-quality biochar for agricultural use. This range typically produces biochar with high porosity and surface area, helping to improve nutrient retention, water-holding capacity, and microbial habitat in the soil.

The ideal temperature ranges

- **450 °C - 500 °C:** Generally sufficient to remove most volatile compounds, producing a stable, porous carbon structure suitable for many agricultural applications.
- **500 °C - 600 °C (Optimal):** Often considered the "sweet spot" for agricultural and horticultural use, producing biochar with high porosity and surface area while retaining good cation exchange capacity (CEC).
- **Above 750 °C:** Generally not recommended for most soil applications. While it produces very stable carbon, the higher temperatures can reduce surface functional groups and may decrease the biochar's ability to retain nutrients, depending on the feedstock and production method.

Key production factors

- **Oxygen Depletion:** Pyrolysis requires a low- or no-oxygen environment. If too much air is allowed into your kiln, pit, or barrel, the biomass will simply turn into white ash.
- **Post-Production "Charging":** Fresh biochar is basically an empty sponge; it must be "charged" (inoculated) with nutrients so it doesn't strip existing fertility from your soil. Soak the cooled biochar in liquid fertilizer, manure tea, or compost tea for 1–2 weeks before applying it.

Our Experience in Making BioChar

TLUD - *The top-lit updraft gasifier (TLUD) used for creating biochar is designed to pyrolyze organic material and produce biochar while eliminating volatile byproducts*. This process allows for a cleaner combustion, resulting in a more efficient biochar *production system*. The TLUD operates by introducing air from the bottom to support controlled pyrolysis, while secondary air is injected above the fuel bed to reduce emissions and improve combustion efficiency.

We started off with 200 L steel drum made locally with a steel pot placed inside the drum upside down, which held the Biochar material. This works well and is a very low-cost option for if making small amounts of BioChar. Our pyrolysis chamber was a 20 L pot. The lid of the pot had a small hole where the handle was originally placed which allowed the gases to escape, allowing the pyrolysis process to work. This is placed upside down in the TLUD so that the hole is at the bottom which ensures that the material does not get too much oxygen.

The TLUD in the picture on the left is our latest unit that we use to make our BioChar. This unit has a capacity of 260 L, and we use a drum made locally in Waitoki which hold around 60 L of raw material.

We understand that if the process is successful, it can reduce the weight of the material in the chamber by as much as 80%. To achieve this, we needed to achieve a temperature of around 500 °C around the chamber. We have conducted some testing of the biochar made and found upward of 69% loss in the weight of the material.

One of our challenges to date is how do we accurately test the temperature in our TLUD/Kiln. Currently we have been using a Stanley Laser temperature thermometer. However, this tests the outer skin of the unit which tends to vary depending on the outside factors such as cold winds.

We are currently looking at how we can insert a thermocouple probe that will not easily be damaged when loading the fuel and Biochar container *(the container holding the Biochar material)*.

How we break down the Biochar

Breaking down the BioChar and getting it to the right size was an interesting challenge. We had seen a farmer in South Africa who had been using an Insinkerator. He had said that this was the easiest way he had found to break it down without all the dust challenges. So, we have been doing this ourselves and found it to be quite effective. One concern, however, was whether it was giving us the right particle size. So, we are in the process of testing it.

The first step is to break the larger pieces of biochar into smaller chunks so they can easily fit through the opening of the InSinkErator. The biochar is then placed into containers and soaked with worm tea produced on our farm (*Wriggly World* 🪱). Allowing the biochar to absorb the worm tea helps eliminate dust, making it much easier to process through the InSinkErator.

How we inoculate our Biochar

Once our biochar has been produced, we begin the process of preparing and inoculating it before it is applied to the soil. This process is done in a large tank with a mixture of BioChar, Molasses, Worm Tea, Seaweed amendments and water.

We use a ratio of:

- 1L Molasses
- 20 L Worm Tea *(Leachate)* with crushed BioChar slurry
- 200 L water
- 1L Soil Bacteria additive *(Seaweed we created ourselves)*

(This is not necessarily a hard rule and you can change it to suit yourself.)

The mixture is then aerated using a fish tank air pump for approximately 48 hours. During this time, beneficial microorganisms multiply and colonise the biochar, effectively charging it with microbial life.

The next step is critical. Once the 48-hour charging period is complete, the inoculated biochar should be applied to the soil as soon as possible. Based on our research and observations, we believe the populations of beneficial bacteria begin to decline if the mixture is left for more than another 48 hours.

To apply the biochar, we pump the mixture into a tank mounted on our utility buggy and transport it to the flower beds. Using a long 18 mm hose, we pour the inoculated biochar evenly over the beds, where it is ready to become part of the soil ecosystem.

Tips for applying Biochar to clay soils

Based on the research we have done so far, the following are some commonly recommended practices for using biochar in clay soils:

- Always apply biochar after it has been properly charged (inoculated). Compost tea, worm tea, manure tea, liquid fertiliser, or compost are all commonly used for this purpose.
- Incorporate the biochar into the top 10–20 cm (4–8 inches) of soil where most plant roots develop.
- Combine biochar with compost for the best results. A commonly recommended amendment mix is approximately 70–90% compost and 10–30% biochar by volume.
- Apply biochar gradually over time rather than adding very large quantities in a single application.

While these recommendations are widely supported, we have not always followed these exact ratios. Instead, we have worked with the materials available at the time we prepared each growing area. Our focus has been on creating healthy, living soil using a practical combination of compost, biochar, and other natural amendments.

We also incorporated crushed pumice stone into our flower beds when establishing them on our heavy clay soils. Our research has led us to believe that:

- Pumice acts like a large sponge with vast micro-cavities across the rock which would allow beneficial bacteria to anchor securely.
- The pores allow oxygen-rich water to pass through freely, keeping the bacteria alive and active.
- Being a natural rock-based material, it is safe for both biological filtration and plant growth.

How We Prepare Our Flower Beds

At Buzi-B Flower Farm, we prepare our flower beds using a blend of compost, BioChar, crushed pumice, and gypsum. Our goal is to improve the structure of our clay soils, increasing drainage, aeration, and permeability more quickly than relying on natural processes alone.

Once these soil amendments have been incorporated, we allow the plants, soil microbes, earthworms, and ongoing additions of organic matter to continue building healthy, living soil over time.

Our understanding is that pumice is an excellent natural material for supporting beneficial soil microorganisms. Its highly porous volcanic structure provides an extensive surface area where bacteria and fungi can colonise and thrive. Combined with nutrient-rich compost and biologically active BioChar, these ingredients work together to create a healthier soil ecosystem that supports strong root growth and resilient plants.

Our worm farm called Wriggly World

We have been doing worm farms for many years prior to moving the farm. What we have is a few old baths which we empty all our food scraps into along with other scraps we sometimes get from the greengrocer. A bucket is placed at the plug hole which then collects all the fluids which run through the bath plug. This fluid (Worm Tea) is then used for our BioChar.

The worm casting is where the real stuff happens. We take the castings and place them into a muslin bag and hang it in a container filled with water, molasses and some

seaweed tea, then place an aerator into the container and allow it to stew for around 48 hours. Afterwards, we strain the tea into our sprayer and then spray the plant foliage. We have found this successful.

Our compost bins

To try to achieve the quantity required so that we can amend our soil has been a huge challenge. So, what we decided to do was improve the ability for us to easily turn the compost allowing air to be added to the mix and hopefully improving the decomposition time. The faster we can get the compost to break down the organic material, the faster we can get it onto the soil and create more compost.

The ability to turn the organic material using the tractor bucket makes it quicker and easier to continuously aerate the compost and thus improving the quality and decomposition time. We have been able to reach temperatures of 65 °C which kills off most of the bad bacteria without harming the good bacteria.

This adds organic matter, attracts beneficial microbes and worms, and improves water retention and aeration which in turn provides a slow-release source of nutrients, promoting stronger, healthier plant growth. By doing this we not only reduce our methane emissions from organic waste in landfills but it also supports sustainable farming practices.