

Soil health post fire and drought

There's no doubt about it, both fire and drought can kill a good soil. In the case of a hot fire it can happen very quickly, but the same things can happen to land slowly baked in dry times. The good news is that when we have some understanding of living soils we can manage our activities to help them thrive.

What are living soils?

Living soils are the product of an interaction between microbes (bacteria, fungi, protozoa) and roots of photosynthesising plants. The process of soil formation can be assisted by other critters such as invertebrates (e.g. nematodes, earthworms), burrowing animals (from frogs to wombats), scratching animals (fabulous composters such as lyrebirds, brush turkeys and bandicoots), grazing (fertilising!) animals (native or introduced, from cows to koalas), and us.

Healthy, living soils have many wonderful properties, including, but not limited to:

- Good fertility thanks to microbes making minerals plant-available, and producing humic compounds with which to store them
- Good water holding capacity (1 part humus can hold 4 parts water)
- Good water infiltration, meaning less erosive surface-flowing water, and longer-term base flow for streams
- Stable soil structure fungi are the principle producers of glomalin, a substance which simultaneously holds soil open, and holds it together. Think soil as sponge.
- Capturing and storing carbon
- Low risk/ incidence of pest and disease outbreaks

The impact of fire and drought

There are different degrees that fire and drought can impact a soil:

- Incineration/ oxidisation of organic material on the surface increases in both percentage of matter affected and depth into the ground the hotter and more protracted the event is. This can result in loss of soil structure and water holding capacity.
- There is loss of beneficial soil microbes, particularly fungi and free-living nitrogen cyclers. This breaks the structure of the soil, makes it harder for desirable plants to establish, and makes it harder for plants to access proper nutrition from the soil and stay healthy, impacting production. Soils become bacterially dominated and conditions are right for earlysuccession weeds.
- Alteration of soil chemistry. Some nutrients can be lost or locked up immediately, while others such as nitrogen, phosphorus, sulphur and boron can show post-fire spikes but longer-term drop offs. Also, water-repellent waxy coatings form rapidly on bare soil, making it hard for your soil to rehydrate when it eventually rains, and making you vulnerable to erosion.
- Soil compaction can become a significant issue, especially if soil remains bare for an extended period.

Regaining soil health post fire and drought

It would be fair to say that most agricultural soils in our region (and across Australia) were not enjoying a state of thriving health prior to the impacts of drought and fire, and this will have a bearing on how easily your soils recover. However; with some TLC all soils can be bought into health! It is as simple as promoting the processes which create living soil: photosynthesising plants, and diverse soil microbes.

Observing nature, we see that the first rains after drought or fire bring a proliferation of early coloniser plants, usually fast growing annuals and short-lived perennials. These have an important role as nursery species to the slower growing plants; but they are also incredibly important in soil repair. These plants are breaking up compacted soils to let in air and water, adding shelter and organic matter for soil-building critters, and exuding sugars through their roots to feed soil microbes, which are starting to rebuild humus to regain soil function. Plants have a different relationship with microbes across their life cycle (and different plants have different relationships). As a rule of thumb, these early colonisers will do well with bacterial soils, and they will start to feed fungi as they mature to seed and then death. Our higher value pastures and crops prefer a balanced bacteria to fungi soil, or fungally-dominated, and won't do well post-fire or drought. They need the early colonisers to set the scene for them.

Managing the early colonisers:

You can enhance this natural process to your benefit with the following ideas:

- Unless weeds are noxious, let them be.
- Seed with your own 'early colonisers' to form a productive multi-species cover crop. There are an enormous variety of species to choose from. Research has shown that you will get maximum benefit if you can get at least 8 species in your mix from at least 4 plant families. The more diversity you can get, in all its forms, the better. Inoculate the seed before planting with a living biological for great results.
- Manage grazing carefully grazing animals can be used as a recovery tool but you must monitor closely. Again, aim to promote diversity in all its forms number of plant species (take animals off before the favourite one gets eaten twice, alternatively use them to knock down monocultures to make space for germinating seeds); age and size of plants (take animals off well before you get the 'mown grass' look), and habitat for a multitude of other creatures. Ample resting time between grazings will be your friend, as will dung beetles.
- Promote the health of the existing and establishing plants with biostimulants (e.g. worm liquids, compost teas, seaweed extracts, humates etc.)
- Avoid nitrogen-based fertilisers, fungicides, and anti-microbial herbicides like glyphosate; as these inhibit the formation of healthy living soils.

Sometimes, especially if land was already degraded, or if you are aiming of a quick return to high productivity, you can use inputs. The following fire recovery formula was created by agroecologist Nicole Masters, with a view to fostering the return of all-important soil fungi in a balanced way. It can be applied as a foliar or a seed dressing.

Ingredient	L/ha
Fish hydrolysate	7
Molasses	1
Liquid lime (DIY with superfine lime	10
+ apple cider vinegar)	
Humic acid	1
Fungally dominant worm cast	5
extract/ high quality compost tea	

Links:

Nicole Masters fire recovery webinar and summary: <u>https://www.biocast.com.au/post-fire-soil-recovery/</u>

How to do a biological seed inoculation (it's really easy): <u>https://www.biocast.com.au/seed-inoculation-with-biocast/</u>

Walter Jehne talks fire & fungi: <u>https://vimeo.com/391991020</u>

There are many stories from Australia and across the world of people bringing soils back to life. You might enjoy books such as 'Call of the Reed Warbler' by Charles Massey, or 'For the Love of Soil' by Nicole Masters; and Facebook groups such as the' Regenerative Agriculture Group'.

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