Restoration of Australia's native fungi

For improved commercial environmental forestry, farm revegetation and sustainability in the Australian wheatbelt region

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There is currently much effort being put into methods of harnessing Australia's plant biodiversity for profitable farming systems with multiple environmental benefits. However, less attention has been given to significant components of natural ecosystems other than plants.

One such component is Australia's diverse and unique native fungi, and the range of largely ignored, out of sight, ecosystem functions provided by fungi. Though poorly recognised to date, management and restoration of Australia's native fungi and other soil organisms in tandem with animals and plants are likely to be key parts of an overall strategy to achieve environmentally sustainable and economically profitable agricultural landscapes for the long term.

Commercial and environmental forestry in farming systems

Eucalypt woodlands and mallee communities once widespread throughout temperate Australia, including mediterranean climatic zones, have been heavily cleared for grazing and cropping[1]. Remaining fragments of this natural vegetation represent a treasure trove of diverse, uniquely Australian biota long exploited for wood products and other industries.

In recent years continued loss of biodiversity has coincided with an increasing urgency to utilise and conserve Australia's precious genetic resources. The same processes that threaten productivity of agriculture threaten the continued existence of Australia's natural vegetation. In low to medium rainfall regions, large scale threats such as rising water tables and accompanying salinity have been intensified by catchment-scale removal of biodiverse, deep-rooted natural vegetation and replacement with grasses and annual crop monocultures.

Native trees and shrubs are widely planted on farmland in Australia to help combat the deleterious biophysical, financial and sociological consequences of landscape degradation. Many regions in Australia are now addressing the multiple environmental benefits in farming landscapes along with profitable farming systems. Forest tree crops on farms planted for commercial products such as wood, oil and bioenergy can be integrated with restoration and conservation of biodiverse native vegetation. Commercial and environment plantings can be strategically placed in farm landscapes to provide positive environmental benefits for farms. These include reducing run-off and secondary salinisation, windbreaks for soil conservation and stock shelter, biodiversity for pest control, and increased nature conservation. There is also increasing recognition of the need to retain remnants of the original native vegetation and integrate it into farming landscapes in ways to protect the diversity of the remnant vegetation community and its functioning[2].

Farming systems including tree crops with integrated components of native vegetation, biodiverse environmental plantings and conserved natural remnants may be positioned well for future carbon, biodiversity, water/salinisation or other environmental accreditation, enabling competitive advantages for premium marketing of farm produce.

Native fungi and restoration in farming landscapes

Australia's natural vegetation communities have a highly evolved level of fungal diversity and the presence of many fungi

Figure 1. Native fungi such as this species of *Laccaria* from eucalypt mallee vegetation in the Western Australian wheatbelt can be harnessed from local natural vegetation and restored into revegetation on farmland.

is a healthy sign that a robust, sustainable soil nutrient cycling system is operating. Like many other parts of Australia, soils of woodlands are mostly nutrient-poor. In such soils, fungi have accentuated roles to capture, store, release and recycle essential nutrients.

The fungi drive major nutrient cycling processes in woodlands in two major ways. Firstly by decomposing dead plant and animal material, supplying nutrients to ensure the healthy growth of plants, and providing food for insects, small mammals and soil microbes [3]. Secondly by symbiotic associations [3].

Fine roots of woody plants are sparse in the soil of Australia's woodlands [4]. However, the soil has abundant fungal mycelium, much of it traceable to mycorrhizal fungi which form symbiotic partnerships essential to the existence of many native plants including eucalypts, and nitrogen fixing trees and shrubs such as sheoaks, acacias and native peas.

The diversity of fungi in relatively undisturbed natural woodlands rivals that of wetter eucalypt forests in Australia [4]. Fungal diversity is also high in shrubland communities in the Australian wheatbelt region. Several hundred fungi species can occur within relatively undisturbed small patches (a few hectares) of remnant woodland. Fungi are present in all woodland patches, some potentially rare and endangered, but the abundance and diversity of fungi varies depending on extent of disturbance. Underground-fruiting fungi (truffle-like fungi) also occur in woodlands. These fungi are largely dependant on small mammals for spore dispersal.

Although a diverse array of native fungi exists in woodland remnants, these fungi can take a very long time, if they ever do, to self-establish in conventional revegetation sites. A major reason why native fungi do not self-establish in revegetation on farmland is because fertilised farmed soil is very different to soil under natural vegetation. Without fungi, decomposition and nutrient cycling processes would most likely run down, and the health of plants dependant on symbiotic mycorrhizal fungi may deteriorate. The fungi need to be assisted back in order to help re-establish the natural processes that have contributed to sustainability of natural vegetation in the past.

Techniques for restoring native fungi into revegetation on Australian farms in low to medium rainfall regions at minimal cost and without need to modify current nursery and planting practices have been developed recently [5, 6]. The techniques are effective for new plantings, existing revegetation, or highly degraded remnant natural woodlands.

Figure 2. Seedlings of native plants provided with native fungi can be planted into revegetation zones on farmland. Strategically placed native vegetation including biodiverse environmental plantings with fungi, commercial farm forestry and conserved natural remnants can contribute to environmentally sustainable and economically profitable agricultural landscapes.

Dwindling reservoirs of native fungi

Over time in successful revegetation, there will be a gradual shift from a soil environment that is alien to one that is attractive to native fungi and associated biodiversity. This will accompany restoration of healthy soil functions. Following assisted re-introduction of some fungi, self-colonisation of native fungi from neighbouring woodlands will be more likely to occur and be further enhanced by the return of vectors such as animals.

However, Australia's natural reservoirs of native fungi are rapidly depleting as remnant natural woodlands diminish in number, size and quality. Australia has a pressing need to rapidly conserve and maximise use of the remaining native fungal resources with minimal disturbance of remnant natural vegetation.

References

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