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Tuart decline
RESEARCH FINDINGS

Eucalyptus gomphocephala

Tuart Bulletin No.8 A series outlining key research findings associated with tuart health in south-west Western Australia

8 Beneficial fungi and the health of tuart

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The tuart forest and woodlands contain a rich diversity of higher fungi. Because of the known benefit of symbiotic fungi that form associations with roots (known as mycorrhizas), this component of the Tuart Project is focussing on fungi in this group. Examination of the roots of tuart seedlings grown in pots of soil collected from under healthy tuart in the field showed that the most abundant type of mycorrhizas are those formed with higher fungi such as the toadstools, puffballs and truffle-like fungi.

Fungal mats

Fungal mats formed by ectomycorrhizal fungi are frequently observed in the litter under healthy tuart (1, 2, 3). Work is in progress to document whether there is a change in mat abundance and composition of the fungal flora with decline in the canopy of host trees.

Ectomycorrhizal fungal diversity

So far, most effort has been placed on documenting the fungi associated with tuart (4) and building up a data base that can be used to investigate fungal distribution in the field in relation to site characteristics, site history and tuart health. In addition, where possible, mycelium cultures and spore samples have been taken to enable inoculation studies to take place over the next two years. These studies will explore fungal attributes that facilitate the growth of tuart seedlings in disturbed habitats as well as in soils with particular physical and chemical constraints.

Part of this work was undertaken by Andrew Legault during his Honours research in 2004 and has been supplemented by collections in 2005 and 2006. So far, 46 genera of ectomycorrhizal fungi in 21 families have been collected. Examples of fungal diversity are shown below (5-11).

1. The fine feeder roots of tuart form symbiotic associations with a wide range of fungi. In this image, white fungal mats and ectomycorrhizas are visible beneath the litter near the base of the tree. These mats are the vegetative body of the fungus and are present all year but are most active in the wet season. The mats vary in size and colour depending on fungal species. The mats that are most obvious are white, grey, yellow or brown in colour. Some fungal mats are hydrophobic and even in the middle of winter remain dry to the touch.
A single tuart tree may have mats of many fungal species. In addition to fungal hyphae, the mats also contain the symbiotic structures, known as ectomycorrhizas. Many of the ectomycorrhizal fungi associated with tuart do not form obvious mats like those shown above. The hyphae may ramify in the litter when it is moist or fan out into the soil.

We have yet to study the function of the mats and ectomycorrhizas of tuart in detail. However, studies on other species of eucalypts indicate that these fungi help the host tree to gain access to a range of inorganic and some organic nutrients, and in return receive a carbon supply from the tree. Indirectly, the carbon flow contributes to maintaining soil microbial diversity and soil health.

2. Removal of the upper layer of tuart litter exposes the small fruiting bodies of Dermocybe globuliformis *and the extensive yellow hyphae associated with the decomposing litter and fine roots. High intensity fires are likely to impact greatly on these and other ectomycorrhizal fungi that inhabit the litter layer.*

In winter 2006, more ectomycorrhizal species were recorded under tuart at Yalgorup compared to at Ludlow. Also, there were more fungi fruiting in healthy tuart sites compared to declining sites at Yalgorup. This work needs to be repeated over a number of years and at more sites to definitively establish patterns in the landscape.

Ongoing research objectives

- To determine whether a reduction in the diversity of ectomycorrhizal fungi is a factor in tuart decline.
- To identify suitable ectomycorrhizal fungi for the regeneration of tuart.
- To examine the impact of fire on tuart ectomycorrhizal fungi.
- To produce an atlas of higher fungi associated with tuart.
- To document the functional diversity of bacteria associated with tuart ectomycorrhizas and associated hyphal mats.

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*3. The dynamics of the near surface feeder root system of tuart is evident in this microcosm where the roots of tuart are completely ensheathed in white fungal hyphae and other hyphae are feeding on organic matter and soil. Because the photo was taken in winter, small fruiting bodies of the fungus (*Hysterangium *sp.) are present.*

4. After autumn rains, fruiting bodies (the sexual stage of the fungal life cycle) may also appear above ground where spore dispersal takes place. This image shows a collection of Cortinarius *sp., bearing gills beneath the cap, being prepared for drying and then storage in the fungal herbarium at Murdoch University. Descriptions and photographs are taken to record information on living specimens, DNA samples are collected to facilitate future taxonomy of undescribed species and to identify types of mycorrhizal fungi associated with roots in healthy and unhealthy tuart. Spore prints are taken and microscope slides are made of the spores. Finally, the specimens are dried and curated within the herbarium. Prior to the commencement of the Tuart Project, there was very little information on the ectomycorrhizal fungi associated with tuart in the Yalgorup region.*

5. Many species of ectomycorrhizal fungi just break through the surface in sandy soils under tuart as shown here for a sulfur bolete in Yalgorup National Park. In this type of mushroom, the spores are produced in tubes that run vertically under the cap.

6. A mature Scleroderma fruiting body with the dry spore mass exposed ready for rain and wind dispersal. This puffball is common in disturbed tuart habitats.

7. Protubera *sp. a litter-inhabiting ectomycorrhizal fungus with an unusual jelly-like fruiting body that appears under tuart after rain in autumn.*

8. Piloderma sp. nov. is an ectomycorrhizal fungus, often overlooked because of its cryptic fruiting habit concealed under burnt logs, and less frequently in litter.

9. Mesophellia *sp. is an example of an underground fruiting body that is ectomycorrhizal with tuart. This fungus is an important source of food for a number of mycophagous marsupials Australia wide. Both the quenda and the brush tailed possum consume this fungus. They also consume a wide range of other mycorrhizal fungi. The relationship between the marsupial, the fungus and the host tree, such as tuart, is considered to be of great benefit to ecosystems. Here you can see small woody roots of tuart entering fruiting bodies where they form a casing of ectomycorrhizas in the outer wall of the fungus. The bulk of the central, light coloured tissue is a mass of powdery spores but also has tissue that is attractive to mammals. These fruiting bodies occur at depths of 10-20 cm, or more, in the soil, often in dense patches.*

*10. An example of a truffle-like fungal fruiting body (*Dingleya *sp. nov.) that has the external appearance of a lateritic pebble with internal, elongated tubular cavities where the spores are produced.*

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