The nutrient requirements of tuart

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Tuart decline

RESEARCH FINDINGS

Eucalyptus gomphocephala

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The nutrient requirements of tuart

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Over the last 10 years, tuart trees in the Yalgorup region of south-western Australia have been undergoing an alarming period of decline and dieback. Research into the cause of the decline indicates the possible involvement of a complex disease syndrome involving a number of unknown factors contributing to the overall reduction in health. Factors affecting nutrient supply and availability have been suggested as playing a role in the decline. Tuart belongs to the largest *Eucalyptus* subgenus Symphyomyrtus but is taxonomically distinct, having no close relatives and thus forming a monospecific section (Ruthrof *et al.* 2002). The Symphyomyrtus species has a greater demand for calcium, magnesium, and probably potassium whereas Monocalyptus has a greater demand for magnesium. Such differences must have a physiological basis but as yet no explanation has been offered (Judd *et al.* 1996). The nutrient status of tuart has been largely unknown, creating a gap in our knowledge in the role of nutrient supply to healthy tuart trees. Therefore, there has been an obvious need to investigate the current nutrient status of both healthy and declining tuart in native plant communities along the Swan Coastal Plain and further determine the role of particular macro and/or micronutrients in the decline.

Nutrient status of a healthy tuart

Very little is known about the nutrient status of a healthy tuart, in contrast to other eucalypts, such as *E. globulus* and *E. grandis*. When compared to these species and their known nutrient deficiency ranges in plantations, six nutrients in tuart were found to be in the deficient range, namely copper (Cu), nitrogen (N), phosphorus (P), potassium (K), sulphur (S) and zinc (Zn) (Moore 2004). Symptoms of deficiency or toxicity in eucalypts can often be expressed as discolouration of the foliage (Dell 1996, Dell *et al.* 2001). A compilation of such symptoms is being compiled for tuart (Fig. 1.).

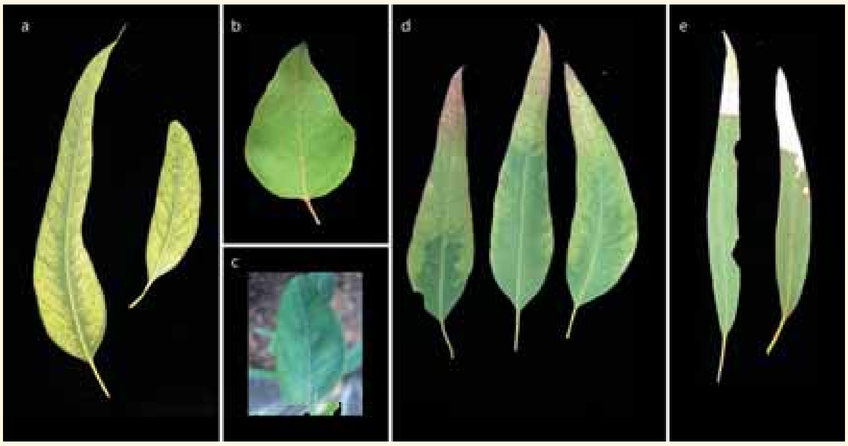

Figure 1: Putative symptoms of various nutrient deficiencies and toxicities in tuart foliage are manganese deficiency (a), iron deficiency (b), zinc deficiency (c), boron deficiency (d) and phosphorus toxicity (e).

Generally, symptoms of nutrient disorders are rare in eucalypts in the field except when severely stressed or growing in disturbed environments. Low foliar concentrations of nutrients are indicative of trees being unable to modulate growth with change in nutrient delivery in the tree. Some of the factors that can influence nutrient delivery include changes in nutrient supply of the soil e.g. after perturbations such as fire and feral animals, reduced uptake due to destruction of feeder roots by pests or disease, and reduced transpiration by the canopy. Research is progressing to determine whether the foliar symptoms in tuart are a consequence or precursor to tree decline.

The role of zinc in the decline

Further research has been conducted to confirm an existence of low Zn levels in declining areas, and to establish their extent. Possible links between canopy decline and low foliar Zn levels have also been explored, as well as identifying other potentially limiting nutrients. Foliar sampling conducted at twenty sites in the area between Mandurah and Bunbury, which included the Yalgorup National Park and sites established previously by other researchers, confirms low levels of Zn in the Yalgorup area (Fig. 2). A link between these low levels and canopy health is yet to be proven. Comparison of the foliar nutrient concentrations observed with

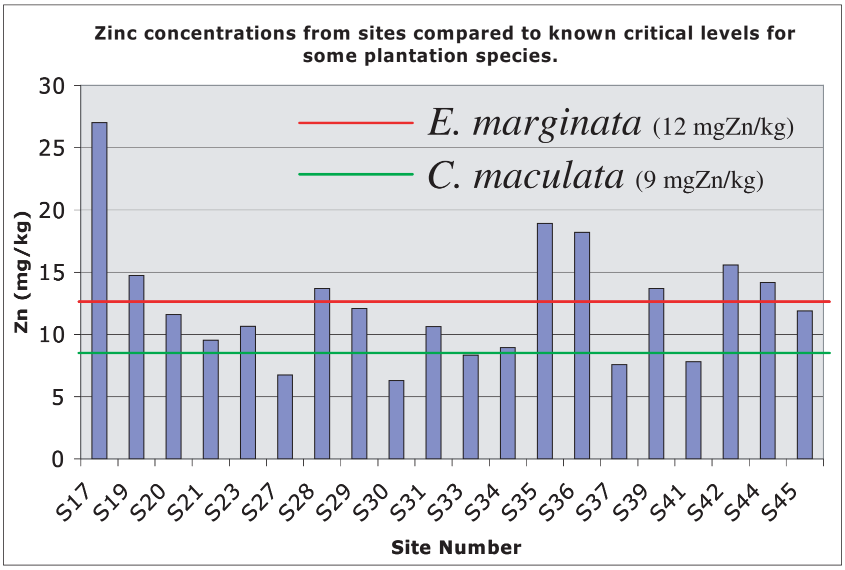

Figure 3: Zinc concentrations (mg/kg DW) of tuart from 20 sites within and outside Yalgorup National Park. Levels are compared to those known to be in the critical range for jarrah and spotted gum

concentrations published for other eucalypts, shows levels of Zn and N are particularly low in tuart and these low levels tend to be more common in trees in the Yalgorup region, where canopy decline is severe (Fig. 3). Glasshouse trials have shown that tuart seedlings are mildly Zn-deficient when concentrations in the youngest fully expanded leaf are 9 – 15 mg Zn/kg DW. This range is similar to that in Jarrah seedlings (Wallace, Dell & Loneragan 1986) but lower than in *E. urophylla* (Dell & Xu 1995) .

Stem injections show response to particular nutrients

In order to determine if Zn or another nutrient deficiency was limiting growth of mature, declining trees in the field, trees were supplied with nutrients in the form of a stem implant as part of an ongoing injection trial. The application of a Zinc treatment or a Complete Nutrient treatment (containing N, P, K, Zn, Mn, Fe) stimulates canopy recovery, suggesting that Zn and other unidentified nutrients are limiting the growth of these trees (Fig. 4.). Trees injected with Fe alone and control trees slightly declined in health over a 12 month period and trees injected with Zn or a Complete Nutrient in combination with low rates of Potassium phosphonate (25g/L & 50g/L) also showed a good response (Fig. 4). Given the low levels of N observed in declining trees, it was hypothesised that N, in addition to Zn, may be largely responsible for the improvement in canopy condition. It is concluded that Zn and perhaps N may limit the growth of declining trees. However, it is not known whether low nutrient availability is a factor contributing to the decline or whether is a response to it.

Future work

Detailed studies during the onset of decline may help to determine whether low nutrient availability is a contributing factor or a response. So far, studies into the nutrition of declining tuart have only been conducted during the winter months and early spring, and as effects of season on foliar nutrient values may give different results at different times of year, this should be investigated further. Given the large east west variation in soil types, it is possible that soil is a dominant factor influencing the change in canopy nutrient status, but this requires further study.

Acknowledgments

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