First Record of *Amanita muscaria* in Western Australia

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Abstract

Amanita muscaria is a Northern Hemisphere mycorrhizal fungus that has become well established in eastern Australia; associated with amenity plantings of exotic conifers and hardwoods and also pine plantations. In regions of Tasmania and Victoria, *A. muscaria* has also been recorded in temperate rainforest dominated by *Nothofagus cunninghamii*. However, *A. muscaria* has not previously been reported from Western Australia; this paper confirms the first record. Records of its association with eucalypts in eastern Australia and other regions of the world are briefly reviewed and discussed with respect to the possibility of it spreading to eucalypt forests in the south-west.

Key words: Ectomycorrhiza, *Amanita muscaria,* Western Australia, plant host associations.

Introduction

Amanita muscaria occurs naturally in the Northern Hemisphere as a mycorrhizal fungus associated with various conifers and hardwoods including pine, chestnut and birch. Following the establishment of the *Pinus radiata* plantation industry in Australia, *A. muscaria* has also become common in pine plantations and under exotic plantings of both conifer and hardwood trees in eastern Australia (see Grey & Grey 2005). In the early 1990s, *A. muscaria*, along with the northern hemisphere bolete *Chalciporus piperatus,* was found to be invading myrtle (*Nothofagus cunninghamii*) forest in northwestern Tasmania (Fuhrer & Robinson 1992). It has since been collected in temperate rainforest at several locations in Victoria (B. Fuhrer pers. comm.; T. May pers. comm.; Dunk 2002), and in mixed wet sclerophyll forest in southern Tasmania (D. Ratkowsky pers. comm.) and there is concern that it may become established and compete with or replace native mycorrhizal fungi associated with *N. cunninghamii* trees.

A. muscaria has also become established in New Zealand. It has a wide distribution within pine and Douglas-fir plantations and under ornamental plantings of *Nothofagus* spp., *Betula pendula, Fagus silvatica* and *Quercus robur* trees in both the North and South Islands (Ridley 1991). In the early 1960s it was reported fruiting in natural *Nothofagus* forest in the Nelson district of the South Island (Stevenson 1962) and more recently it was shown to have a much broader range within *Nothofagus* forests; being reported throughout the northern half of the South Island and within the central region of the North Island (Johnson & Buchannan 1998).

Fig. 1 Sporophores of *Amanita muscaria* from Manjimup Western Australia.

Conversely, in other regions of the world, including New Zealand, Spain and Portugal, *A. muscaria* has been found associated with exotic plantings of eucalypts (Ridley 1991: Castro 1998 and others cited in May & Wood 1997).

Despite being common in eastern Australia *A. muscaria* has not previously been recorded in Western Australia (WA). Trial plantings of *Pinus radiata* began in the late 1890s in WA and the plantation industry became well established during the 1950s (Forests Department 1969). The most common mycorrhizal species associated with *P. radiata* trees in WA include *Rhizopogon luteus, R, roseus, Suillus luteus* and *S. granulosus* (Kessell 1927; Bougher & Syme 1998, Dunstan *et al.* 1998). In June 2009, six sporophores of *A. muscaria* were found in a rural garden in the southwestern town of Manjimup, under a birch (*B. pendula*) tree.

Materials and methods

Sporophores were photographed *in situ,* and a collection consisting of four specimens was brought back to the laboratory for formal identification. Morphological details of the fresh specimens were compared with descriptions published for both Australian (Grgurinovic 1997) and New Zealand (Ridley 1991) collections of *A. muscaria.* The sporophores were then air dried at 35° C and processed for lodging at the Western Australian Herbarium (PERTH). Microscopic examination of dried material was undertaken using bright field microscopy.

Results

Macroscopic and microscopic details of the Manjimup collection of *A. muscaria* agree with descriptions by Grgrinovic (1997) for South Australian collections held in the State Herbarium in Adelaide (AD) and Ridley (1991) for New Zealand collections held at Auckland (PDD). The cap is 55–95 mm diameter, orange-red, fading to yellow at the margin with creamy-white wart-like universal veil fragments on the surface, the gills are creamy-white, and the stipe is white with a torn membranous veil and a bulbous tapering base (Fig. 1). The spores are short ellipsoid, inamyloid, hylaine, 8–10.5 × 7–9.5 µm; basidia are 4-spored, clavate, 46–55 × 10–12 µm and there are occasional clamp connections (Fig. 2). All macrosopic and microscopic characters are typical for *A. muscaria*.

Collection details. ***Western Australia***: Manjimup. Under *Betula pendula*, 3 June 2009, *B. & J. Markotis* (RR1104WA, PERTH 06672345)

Discussion

A. muscaria is a well known conspicuous fungus. Although it is a Fungimap target species (Grey & Grey 2005) and WA has an active community-based fungal studies group this is the first record of *A. muscaria* in WA. Pine plantations in WA were established using seed and in the 1920s *P. radiata* seedlings were actively inoculated with *R. luteolus* using spores and soil from established nurseries (Kessell 1927; Kessell & Stoat 1938). It is not clear how *R. luteolus* became established in nurseries, but possibly through the introduction of spores with seed (Kessell 1927). *A. muscaria* has not been actively used to inoculate trees in WA, unlike plantations in eastern Australia (Sawyer 2001).

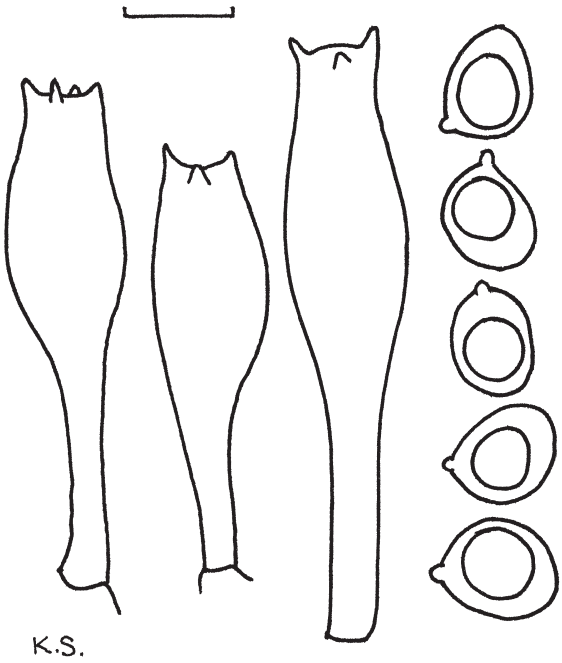

Fig. 2 Basidia (left) and spores (right) from the Manjimup collection of *Amanita muscaria.* Scale bar = 10 µm (drawn by K. Syme).

The garden in which the sporophores were found was established about 1996 and is isolated within cleared farm land surrounded by lawn and a gravel driveway. There are three ornamental trees in the garden; a birch (*B. pendula*), a crab apple (*Malus* sp.) and a golden ash (*Fraxinus excelsior* 'Aurea'). The trees were purchased in Balingup, a town approximately 60 km northwest of Manjimup. The birch tree is the most likely host. The owners of the property first noticed a single sporophore in 2008, and in June 2009 about 12 sporophores developed over a 2–3 week period (B. Markotis pers. comm.).

Although the garden is isolated, future occurrence of sporophores will need to be monitored and the risk of spread into *P. radiata* plantations, neighbouring ornamental plantings or native forest will need to be assessed. In southeastern Australia, *N. cunninghamii* appears to be the main native species at risk to hosting *A. muscaria.* Dunk (2002) confirmed from

morphological and molecular observations that *A. muscaria* ectomycorrhizas were present on roots of *N. cunninghamii* in Victoria. Many species of native ectomycorrhizal fungi are known to associate with *N. cunninghamii* (Dunk 2002; Tedersoo *et al.* 2009). It is likely that the presence of the exotic *Amanita* reduces the diversity of native ectomycorrhizal fungi on *N. cunninghamii*s roots (Dunk 2002).

Nothofagus does not occur in WA but in glasshouse experiments *A. muscaria* was shown to be capable of forming ectomycorrhiza on several eucalypts, including *Eucalyptus* diversicolor, *E. marginata* and *Corymbia calophylla*, which are endemic to the south west of WA, and on the eastern Australian *E. regnans* (Malajczuk *et al.* 1982, 1984). The inoculation of these eucalypts with *A. muscaria* took place under sterile conditions in the laboratory. The proportion of short roots colonised for the western species was relatively low at 0–29%. In contrast 70–100% of the short roots of *E. regnans* seedlings were colonized by *A. muscaria* (Malajczuk *et al.* 1982). It is yet to be confirmed if mycorrhizal formation would occur naturally on these species in native eucalypt forest.

In Australia, whenever *Amanita muscaria* is found under *Eucalyptus*, there are almost always exotic hosts in the vicinity. In Tasmania *A. muscaria* has been recorded from both wet and dry sclerophyll forest (Ratkowsky & Gates 2002, 2005) but it was always associated with *P. radiata* wildings or within mixed forest with rainforest elements (D. Ratkowsky pers. comm.). However, several recent reports submitted to Fungimap are of *A. muscaria* fruiting in *Eucalyptus* plantations with no exotic hosts nearby (T. May pers. comm.). Occurrence of *Amanita muscaria* on planted eucalypts in field conditions needs to be confirmed by examination of ectomycorrhizas. In New Zealand *A. muscaria* is found associated with ornamental plantings of *E. ficifolia* and *E. pauciflora* (Ridley 1991). *E. ficifolia* is also endemic to the south-west of WA and is widely planted throughout southern Australian cities and towns.

Birch is a common ornamental tree in the Manjimup region, *Paxillus involutus*, and an unidentified *Scleroderma,* which fruit abundantly in early- to mid-autumn, appear to be the most common fungal associates (pers. obs.). The present situation requires a range of surveys to be undertaken to confirm that *A. muscaria* is not established elsewhere within the south-west. Meanwhile, to reduce the potential of spread, the owners of the property have been advised to destroy any sporophores that may develop in the future, before they reach maturity. It is also recommended that the horticulture and nursery industry be alerted to the potential spread of this fungus in Western Australia.

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