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UNUSUAL BASIDIAL DEVELOPMENT AND NUCLEAR BEHAVIOUR IN THE MICROCYCLIC RUST FUNGUS PUCCINIA BORONIAE

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INTRODUCTION
Rust fungi exhibit a large diversity in their basidial development (2). The typical cycle represented in many textbooks is a haploid binucleate teliospore undergoing karyogamy and meiosis to germinate and produce four haploid basidiospores on a four celled metabasidium. This behaviour is most often seen in the macro- and demicyclic rust species. However, great variation from this ‘norm’ is often present in microcyclic rust species (2).

Puccinia boroniae is a microcyclic rust species endemic to Australia. The objectives of this study were to examine basidial development over time, and the nuclear behaviour during teliospore germination.

MATERIALS AND METHODS
Basidial development over time. Telia of P. boroniae were briefly soaked (10 min) in sterile distilled water. Whole telia were placed upright on a 2 % DWA plate. Moist filter paper was attached to the lid of the Petri dish (to ensure high humidity) and incubated at 15 ± 1 °C (optimal temperature) in the dark. Telia were monitored initially every 30 min for 3 h, then at hourly intervals for 8 h, and then at 24 h.

Nuclear behaviour. Germinating teliospores and basidiospores were gently removed from the telium, stained with the fluorescent stain DAPI and examined under a fluorescent microscope.

RESULTS
Basidial development. Teliospore germination began within 1–1.5 h after exposure to moisture. Metabasidia were apparent, extruding through the germ pore of either the apical or basal teliospore cell. Within 2 h, the entire teliospore cellular contents had migrated into the elongated metabasidium. At this stage, metabasidia were observed to curve, with a septum laid down at the proximal end either prior to or after curvature of the metabasidium had occurred (Fig 1A). Within 2–3 h, a single sterigma was observed, with a basidiospore initial attached (Fig 1B). After 3 h, the first fully mature basidiospores were apparent, either attached to the sterigma (Fig 1C) or cast onto the DWA plate. Mature basidiospores were continually formed over the next 4–24 h.

Figure 1 Basidial development in P. boroniae. A. Septate (arrow) curved metabasidium; B. Basidiospore initial (arrow) on sterigma (St); C. Mature basidiospore (Bs) attached to sterigma. Bar (all) = 20 μm.

Nuclear behaviour. Immature teliospores were initially binucleate undergoing karyogamy to form a single large (presumably diploid) nucleus (Fig 2A). The nucleus migrated into the developing metabasidium (Fig 2B), dividing to form two nuclei (Fig 2C). Both bi- and tetranucleate metabasidia (Fig 2D) were observed in approximately equal occurrences. The point at which the second division occurred was not captured. Migration of the nuclei from the metabasidium into the basidiospore was not observed in the experiment. Mature uni-, bi- and tetranucleate basidiospores were observed (Fig 2E, F).

Figure 2 DAPI stained nuclei of P. boroniae during teliospore germination. Bar (all) = 10 μm.

DISCUSSION
The relatively rapid (and sequential) formation of basidiospores of P. boroniae is similar to other microcyclic rust species and suggests that under optimal field conditions, a rapid build-up in inoculum would result. Consistent and reproducible formation of a single basidiospore indicated this to be the normal behaviour of P. boroniae. Though this development is unusual, it has been reported for P. rutainsulara and Uromyces alyxiae (1).

The nuclear behaviour of P. boroniae could not be definitively concluded in this study. The behaviour seen was similar to that reported for several microcyclic rust species endemic to Hawaii (1). Two theories are suggested: (i) meiosis occurs in the metabasidium with 1–4 nuclei migrating into the basidiospore, and (ii) one or two successive mitotic divisions occur in the metabasidium, with one (diploid) nucleus migrating into the basidiospore, dividing by meiosis into 4 haploid nuclei. Further investigations are underway.

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REFERENCES