Photoprotective metabolites in asexual life cycle stages of the Antarctic moss *Ceratodon purpureus* in response to UV radiation

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Although ice-free areas in Antarctica are exposed to harsh conditions, such as extreme cold, aridity, intense light, and strong ultraviolet (UV) radiation; more than one hundred species of mosses live there. In the Antarctic terrestrial environment, mosses have two ecological roles. The first role is as a primary producer (Ino, 1983), and the second is a habitat for small invertebrates and microbes (Yin et al., 2023; Lindo and Gonzalez, 2010). Therefore, revealing the mechanisms that allow mosses to survive and thrive in Antarctica is crucial to understanding the Antarctic terrestrial environment.

In Antarctica, mosses reproduce asexually because environmental stressors limit sexual reproduction (Convey and Smith, 1993; Ayukawa, 2003). The lifecycle of asexual reproduction is composed of four stages (Kofuji and Hasebe, 2008; Fig.1). The first stage is a mature "gametophyte". The second is the "fragment of gametophyte" stage when a leaf or tip of the mature gametophyte shoot fragments off and lands on a substrate. Cells from this fragment dedifferentiates and forms the "protonemata" third stage. From this protonemata, a "leafy bud" forms when cells differentiate resulting in a new gametophyte clone. To successfully reproduce asexually in Antarctica, all lifecycle stages of mosses should be tolerant to environmental stressors. Because the shape and role of each stage are different, we hypothesized that each stage has different tolerance mechanisms to environmental stressors.

Previous physiological studies have revealed that the accumulation of flavonoids and carotenoids, which act as sunscreen and radical oxygen species scavengers, are important mechanisms for the survival of mature gametophytes in the harsh Antarctic climate (Robinson, 2006; Waterman et al., 2018), especially for *Ceratodon purpureus*, a cosmopolitan species abundant in Antarctica. However, few studies have focused on the other lifecycle stages.

Therefore, we aim to treat cultured gametophytes, fragments, protonemata and leafy buds to UV and measure their accumulation of protective metabolites. We have already succeeded in culturing the Antarctic moss *C. purpureus*, which was collected at Langhovde in 2018 and kept frozen until 2022. Results will allow us to compare the difference in the quality and quantity of accumulating compounds at each lifecycle stage exposed to UV. As this is our first report, we discuss preliminary findings for gametophyte and protonema stages. Results from this study contribute to our understanding of some of the tolerance mechanisms mosses use to proliferate in ice-free regions in Antarctica.

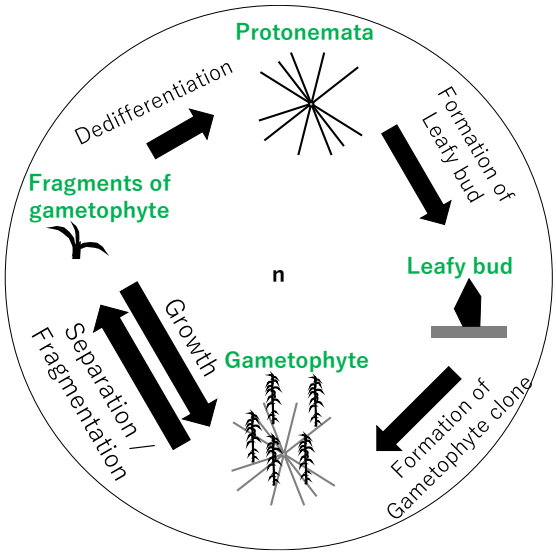

Fig.1 The lifecycle of asexual reproduction