Optimising cultivation conditions for *Asparagopsis taxiformis* gametophytes

There is growing interest in how to optimise the cultivation conditions for *Asparagopsis* spp., which are crucial for its commercial production and economic viability. However, its complex life cycle, especially the gametophyte stage, has made this challenging. Improving our understanding of cultivation conditions will enable better insights into aquaculture site selection, seasonal variation in growth and health, and optimal harvest timing for maximal bromoform concentration.

This fact sheet, developed as part of the project *Developing Asparagopsis cultivation at scale for rapid industry growth*, summarises the outcomes of research into how light intensity, light spectrum and temperature influence the growth rate and bromoform concentration of *Aspragopsis taxiformis* gametophytes in controlled conditions. Each variable has the potential to influence growth rate and bromoform concentration, but not always in the same way. Offshore seaweed producers may wish to consider these variables and their influence on growth and bromoform concentration before deciding on an aquaculture site or when they plant and harvest.

Figure 1. *Asparagopsis taxiformis* gametophyte fragments.

About cultivation

Numerous studies have focused on the tetrasporophyte life stage due to its ease of cultivation in onshore research trials and production systems. The research has shown that *Asparagopsis* growth is influenced by factors such as temperature, light intensity, stocking density and nutrients, with greater light intensity and lower temperatures promoting faster growth. Bromoform concentration in tetrasporophytes also appears to be negatively related to conditions that promote growth. Bromoform levels in *Asparagopsis* can vary based on factors such as temperature, light and nutrient availability. Gametophytes, by contrast, are more suitable for offshore cultivation given their affinity for attaching to various substrate via creeping stolons.

Cultivation methods

The research aimed to identify the optimal temperature and light conditions that promote growth and enhance bromoform concentration of *A. taxiformis* gametophytes in laboratory cultures. We then tested these optimal conditions to establish gametophyte (Figure 1) cultures on substrate in an outdoor flow-through tank system to simulate offshore, oceanic conditions.

The research explored which conditions yield the highest growth rate, which conditions lead to the highest bromoform concentration, whether there is a relationship between growth rate and bromoform concentration in *A. taxiformis* gametophytes, and whether we can cultivate *A. taxiformis* in ambient conditions that reflect our controlled conditions. Ultimately, the study sought to determine whether gametophytes can be sustained under optimal conditions for successful cultivation.

Findings from the work include:

- The growth rate of gametophytes increases with increasing light intensity, but bromoform concentration falls below the industry minimum (6.5 mg/g dry weight) with sustained light intensity beyond 5-10% of full sunlight (Figure 2).
- Low light levels up to 10% of full sunlight appear to provide the best combination of growth and bromoform concentration. Under reduced-light conditions, a growth rate of 4-6% per day and a bromoform concentration of 10-16 mg/g dry weight was achieved.
- Conditions where full light spectrum (white light) is available and that are below 23 °C will ensure high growth rates and increased bromoform concentrations (Figure 3).
- Under conditions where blue light dominates (e.g. deeper water), bromoform concentration is expected to be severely reduced (Figure 3).
- Cultivating *A. taxiformis* gametophyte fragments in outdoor, ambient conditions exposed to <10% of full sunlight and 22 °C seawater resulted in positive growth of gametophytes on rope substrate (Figure 4), with a bromoform concentration of >8 mg/g dry weight.

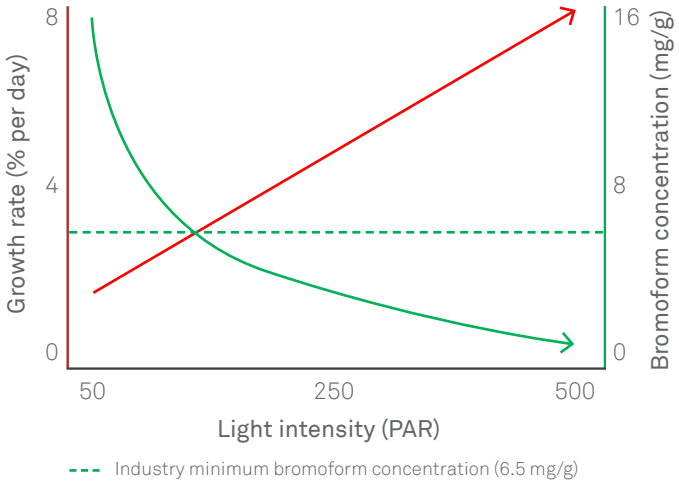

Figure 2. Growth rate and bromoform concentration of *Asparagopsis taxiformis* gametophytes as a function of increasing light intensity and constant temperature.

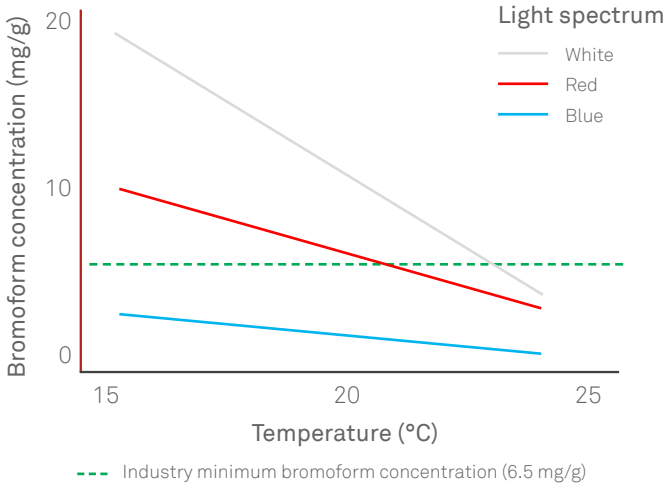

Figure 3. Bromoform concentration of *Asparagopsis taxiformis* gametophytes as a function of increasing temperature with white, red and blue light spectrum.

Figure 4. *Asparagopsis taxiformis* gametophyte fragments (20 mm) after attachment to an eight-strand mooring line and propagated in a flow-through tank system for four weeks.