

Cold temperatures inhibit infection (soft tunic syndrome) of sea pineapple *Halocynthia roretzi* by the kinetoplastid parasite *Azumiobodo hoyamushi*

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Abstract

Soft tunic syndrome (STS) is caused by the kinetoplastid parasite *Azumiobodo hoyamushi* and is a major cause of death in cultivated sea pineapples (*Halocynthia roretzi*) of Korea and Japan. Our previous study showed that water temperatures <10°C or >20°C impairs *A. hoyamushi* growth *in vitro*. The present study investigated the possibility of controlling soft tunic syndrome in sea pineapples through regulating water temperature. We divided sea pineapples into an “induced STS” group (artificially infected with *A. hoyamushi*) and a “basal STS” group (no experimental infection). Sea pineapples were subjected to either a high (24°C), low (4°C), or control (15°C) water temperatures; STS incidence and development were then measured, as well as sea pineapple mortality. Sea pineapples raised at high or low water temperatures exhibited notably lower STS incidence and no additional STS development compared with control (optimal for *A. hoyamushi* growth). Sea pineapple fatality rate at 24°C reached 75%, but no fatality was observed in either the basal or the induced STS groups at lower temperatures. Water temperature strongly influenced *A. hoyamushi*-induced STS in sea pineapples. Specifically, hot and cold water significantly suppressed STS incidence through inhibiting *A. hoyamushi* growth. Low water temperatures are particularly effective at suppressing STS without increasing sea pineapple mortality. These characteristics of STS pathogenesis in sea pineapples could be used to select suitable cultivation locations and to develop farming techniques that reduce STS-associated damage.

Introduction

Sea pineapples (*Halocynthia roretzi*) are a critical species for the Korean fisheries industry, which cultivates them underwater on the eastern and southern coasts of the country. However, mortality rates in sea pineapples have been high since the 1980s due to soft tunic syndrome (STS), a tunic-weakening disease caused by the kinetoplastid parasite *Azumiobodo hoyamushi*

(Kim et al., 2014) both in South Korea and in northeast Japan (Kumagai et al., 2011) (Figure 1). The resultant yield loss negatively affects sea-pineapple farmers.

Azumiobodo hoyamushi infiltrates sea pineapples via the branchial siphon if the tunic cuticle of that organ’s inner wall is damaged (Hirose et

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