An Ace in the Hole

Explosive Seed Discharge may be Facilitated by Declining Stomatal Density

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INTRODUCTION

- Dwarf mistletoes parasitize conifers by invading the host's vasculature, stealing water and nutrients[1]
- *Arceuthobium americanum* uses explosive discharge of the seed from the fruit as a dispersal mechanism[2]
- *A. americanum* infection causes timber losses estimated at 3.8 million m^3 in western Canada and 11.3 million m^3 in the western United States[3]
- Stomata are small pores in the plant epidermis involved in gas exchange and water movement
  - Integral to understanding the accumulation of hydrostatic pressure prior to discharge
- **Objective:** To determine if stomatal density changes as the fruit matures

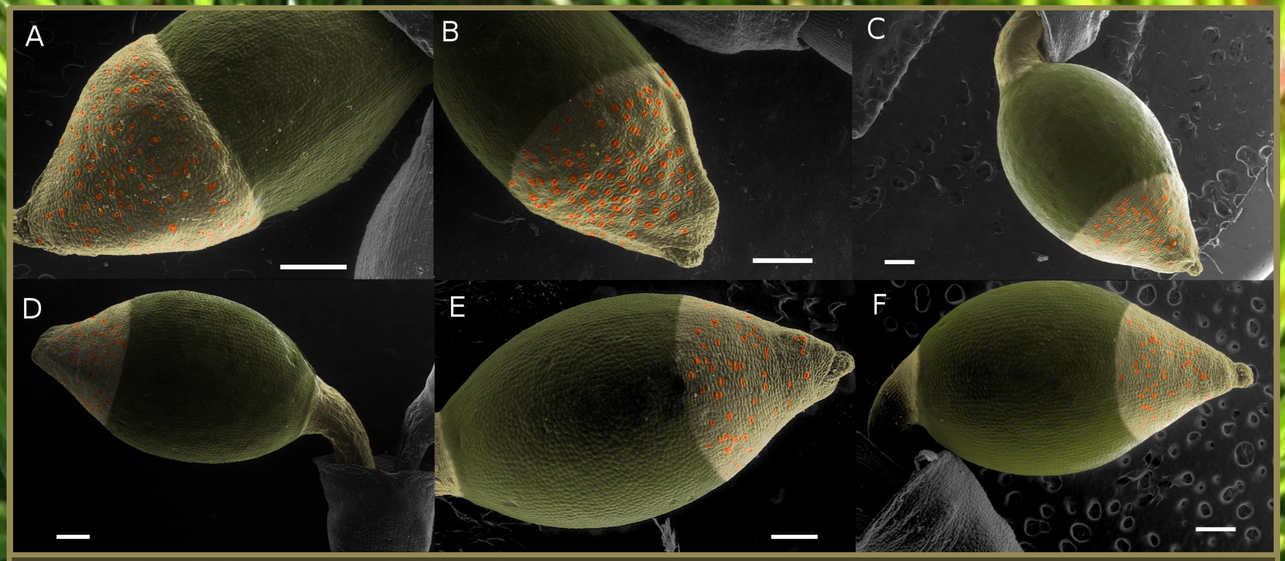

Figure 1. Second year DM fruit SEM micrographs taken in A) April B) May C) June D) July E) August and F) September. Scale bars represent 400 µm in each micrograph. Images taken at 56 Pa of extended pressure by Zeiss LS Evo Scanning Electron Microscope. Micrographs have been artificially colourized, showing the fruit in green, the tepal whorl in beige, and highlighting the stomata in orange.

RESULTS

- Floral structures (the tepals and stigma) persist through second year of maturation (Figure 1)
- Fruit recurves downwards as it approaches discharge in September
- *A. americanum* possesses transverse stomata
- Stomata only observed on the stems, bracts, pedicels, and tepals of the plant; stomata were never observed on the fruit
- Fruit length and diameter was found to increase over the growing season in all five trees sampled
- Tepal whorl surface area increased in all trees
- Stomatal density declined in all trees (Figure 2)

METHODS

Collect *A. americanum* fruits from Stake Lake (once per week) from five randomly selected trees from April-September

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Examine fruits under Environmental Scanning Electron Microscope at a partial pressure of 56 Pa

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Image the whole fruit and tepal whorl, take measurements of the fruit length, diameter and stomatal density using the image analysis software, ImageJ

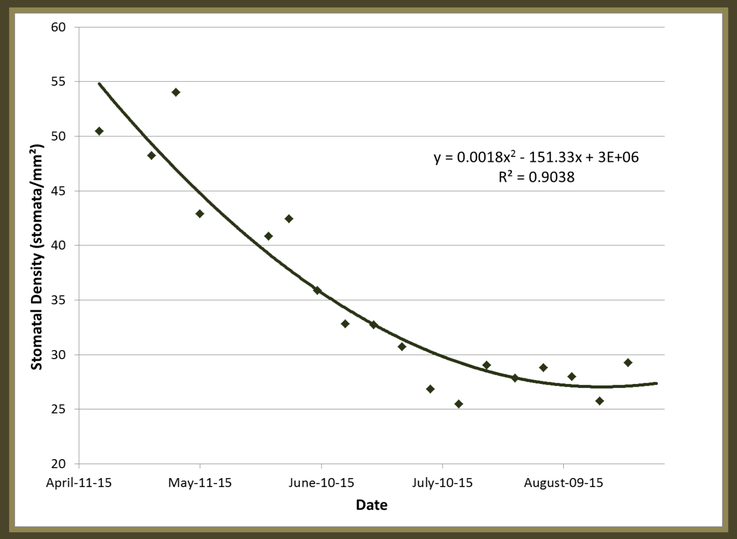

Figure 2. Stomatal density (stomata/mm^2) change over the growing season. Curve generated by averaging all 5 trees sampled. Measurements taken using ImageJ.

DISCUSSION

- Floral organs may provide necessary transpiration
- Fruit diameter increases leading up to discharge; presumably due to water accumulation in the fruit
- Cuticle development likely functions in water retention
- The observed decline in stomatal density any of the following three non-exclusive mechanisms:

1. Stomata number remains constant, surface area increases due to growth, consequently reducing stomatal density
2. Stomatal density decline may be a mechanism of water retention. A reduction in stomata reduces transpiration rate; allows the fruit to accumulate water pressure
3. A reduction in transpiration heats the plant up. Given the plant relies on thermogenesis to explode, this could be an additional mechanism to trigger the process[2]

- **Future research:** Investigate transpiration rates in the fruit and explore the otherwise undocumented genome

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