Variations in Leaf Characteristics Among Different Genetic Lines of Canola Plants

Jaime Smith, Saima Liza, Fernando Guerrero-Zurita, Karanjot Gil, Salvador Lopez, Rebecca Enesi, Linda Gorim

Department of Agriculture, Food, and Nutritional Sciences, University of Alberta, Agriculture/Forestry Centre

Introduction

- Alberta is the primary exporter of canola, producing approximately 3.2 million tonnes annually.
- Canola is mainly used in oil, baking, bio-fuels, bio-plastics, and cosmetics.
- A lot of breeding efforts have been put into canola to increase yields, such as cross-breeding, mutation, and genomic selection.
- For my study, I will be focusing on examining the anatomical structure of four superior canola genetic lines that have surpassed the two original checks that are on the market at the moment.
- In my examination, I will be comparing amounts of these microstructures in different lines in terms of their photosynthetic efficiency.

Objective

- Examine and analyze the difference in microstructures to identify the better-performing germplasm.

Methodology

- The field trial had 170 different Canola lines in an alpha lattice design.
- 6 lines were chosen and leaves were taken from these canola plants and imprinted onto slides.
- The leaves were examined under a Zeiss Primo Star light microscope at 10x magnification, to hand count the stomata and epidermal cells on the leaves.

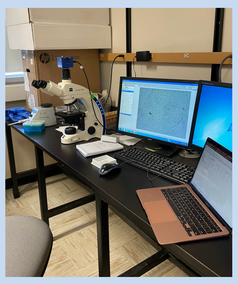

Figure 1: Zeiss Primo Star Microscope setup

Results

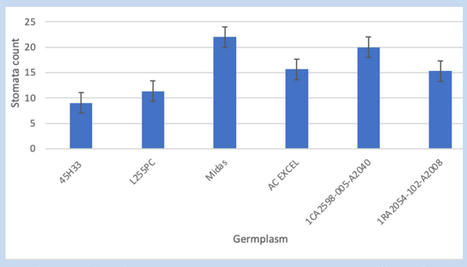

Figure 2: The average stomata count for the adaxial (front) side of leaves for each germplasm

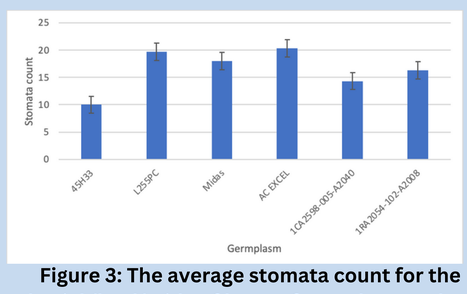

Figure 3: The average stomata count for the abaxial (back) side of leaves for each germplasm

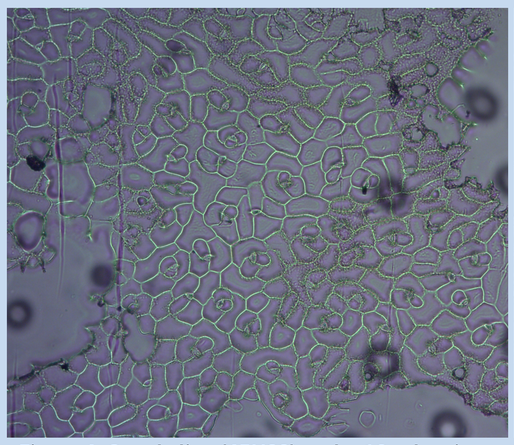

Figure 4: Canola line (45H33) under 10x showing front epidermal and stomata cells

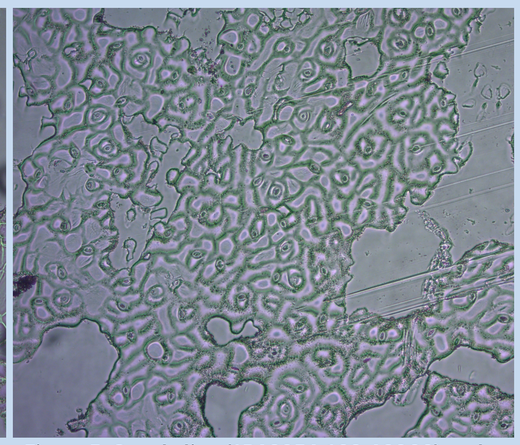

Figure 5: Canola line (1RA2054-102-A2008) under 10x showing back epidermal and stomata cells

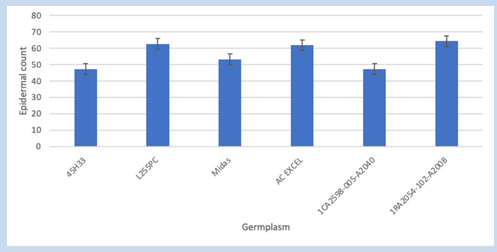

Figure 6: The average Epidermal cell count of the canola lines on the front of leaves

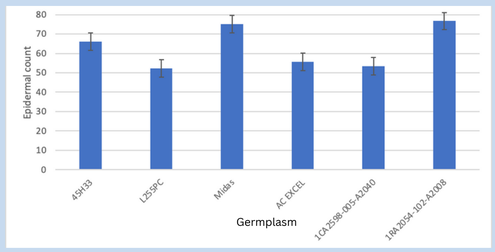

Figure 7: The average Epidermal cell count of the canola lines on the back of leaves

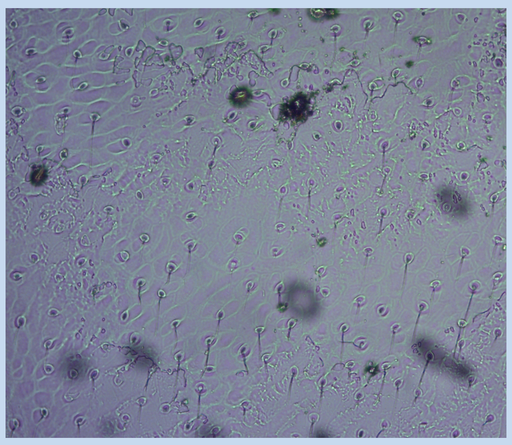

Figure 8: Canola line (1CA2598-005-A2040) with trichome's present

- There was observed to be higher stomata count on the Midas and 1CA2598-005-A2040 lines compared to the other germplasms on the front side of the leaves.
- A higher stomata count with L255PC, Midas, and AC EXCEL than other germplasm lines on the back.
- A higher epidermal count was observed with L255PC, AC EXCEL, and 1RA2054-102-A2008 than other germplasm lines on the front.
- Higher epidermal count with 45H33, Midas, and 1RA2054-102-A2008 than other germplasm lines on the back side of the leaves.
- Very few canola lines were observed to have trichomes, on L255PC they were present in small patches on the back side and they were consistent on 1CA2598-005-A2040.

Discussions

- Because these germplasm lines have both a high stomata and epidermal cell count they will have enhanced photosynthetic capability due to the increased stomata, this will allow for more gas exchange.
- As well as the high epidermal cell count which will aid in cell protection and water retention, these factors together increase photosynthetic efficiency resulting in enhanced canola biomass production and crop yields.
- Furthermore, the few lines with trichomes present may be better prepared for possible harsh future conditions such as droughts, as trichomes help with water retention as well as disease and pest protection.
- With a climate crisis on the horizon germplasm lines with trichome present may adapt and function better.

Conclusions

- The germplasm lines exhibit variations in the studied leaf anatomical structures.
- This information aids scientists and crop producers in identifying superior and more efficient lines that are compatible with the environment, thus optimizing crop productivity.
- Canola growers now possess a range of options that can more effectively suit their individual requirements.

Acknowledgments

This project was inspired by the ongoing canola research being conducted by the Agriculture department, and I'd like to thank WISEST, Dr.Gorim, the whole of the cropping systems unit, as well as the Grads, undergrads and lab technicians and WISEST for making my project and this summer possible for me.

Citations

I.Patel, L.Gorim, K. Tanino, A.vanderberg Diversity in Surface Microstructures of Trichomes, Epidermal Cells, and Stomata in Lentil Germplasm

S.P.Driscoll, A.Prins, E.Olmos, K.J. unert, C.H.Foyer.(2006) Specification of adaxial and abaxial stomata, epidermal structure and photosynthesis to CO2 enrichment in maize leaves

G.Karabourniotis, G.LiakopoulosmnP. Bresta D.Nikolopoulos The optical Properties of Leaf Structural Elements and Their Contribution to Photosynthesis Performance and Photoprotection