

RAINFED SPRING CANOLA YIELD RESPONSE TO CHANGING HEAT AND WATER STRESS IN THE CANADIAN PRAIRIE REGION

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RESEARCH OBJECTIVES

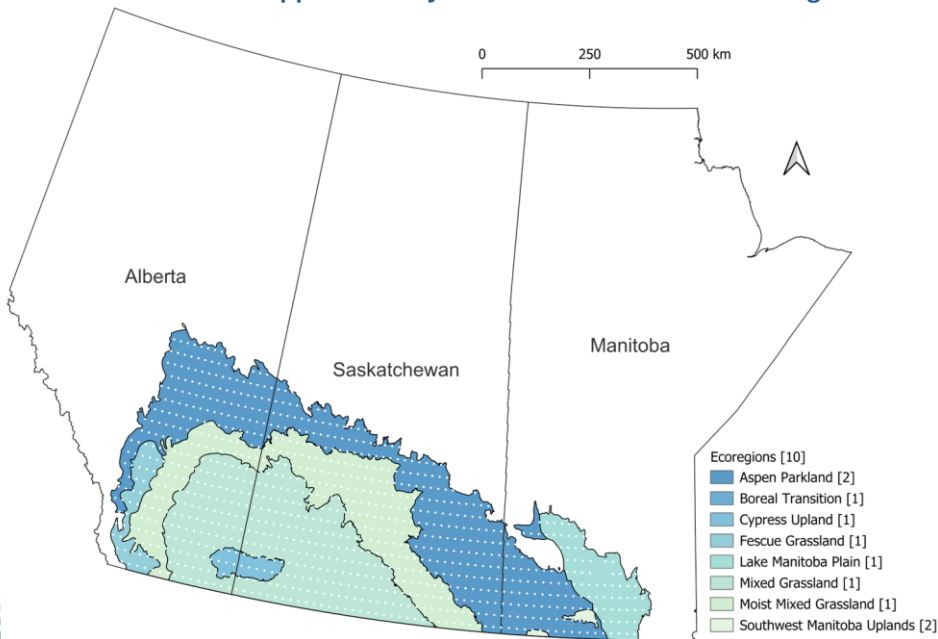
- Analyze water and temperature stress interactions
- Offer insights into potentially detrimental conditions for rainfed canola production
- Support producer decision-making

METHODS: OVERVIEW



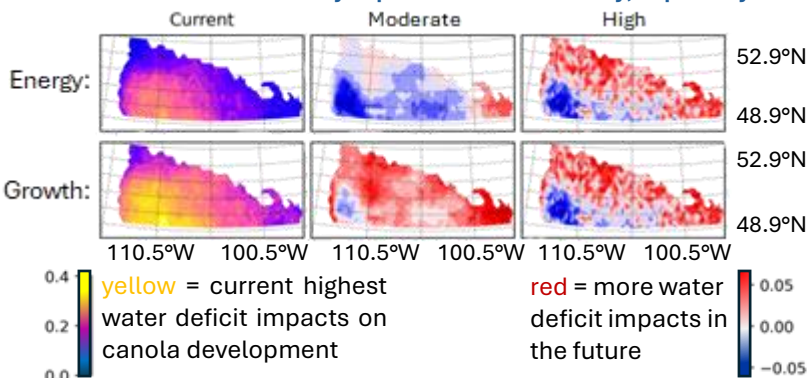
STUDY AREA

Gridded area of approximately 27 km x 27 km in the Prairie Region.



FUTURE WATER STRESS

Water deficit stress mainly expected in June and July, especially in the Cypress Upland and Mixed Grassland ecoregions.

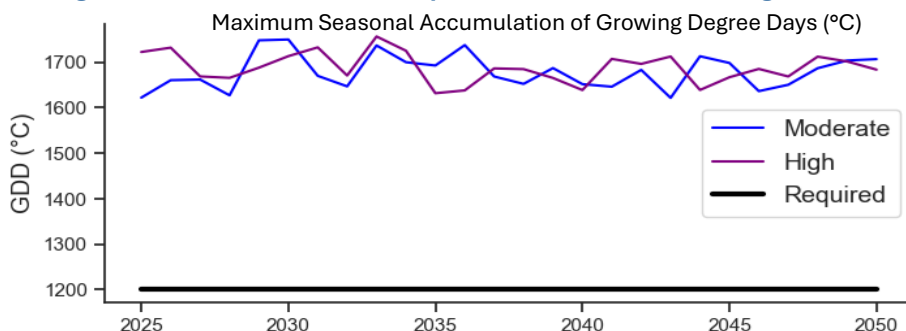


Water deficit expected to affect canola energy production and growth expansion in the future. Moderate Scenario: more negative impacts are expected in growth development, affecting leaf expansion. High Scenario: similar impacts to energy production and growth expansion, but over a wider area, showing lower deficit in southern Alberta.

FUTURE ACCUMULATED GROWING DEGREE DAYS

Air temperatures projections were higher than ideal! Faster development = less time to fill the grains

Under current conditions an average 625.5°C accumulates during the early flowering stage and 859.5°C during pod growth and seed development. Under climate projections, Cypress Uplands and Mixed Grassland in SK will average at least 732°C during the early flowering stage and 1011°C during pod growth and seed development.



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JOINT EFFECTS OF SOIL WATER CONTENT AND AIR TEMPERATURE ON CANOLA YIELD

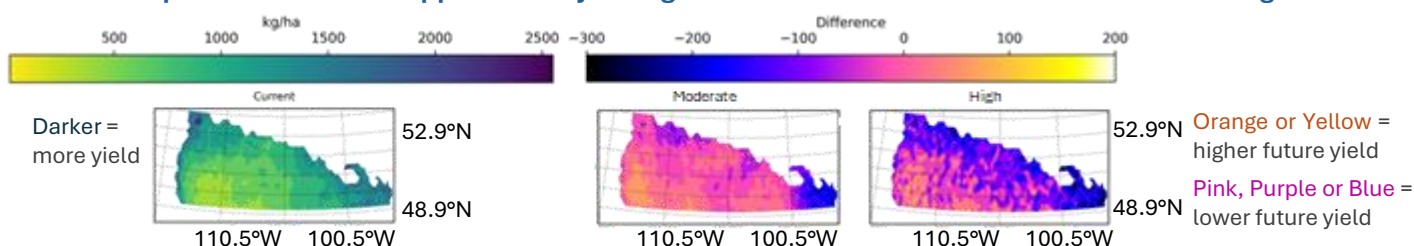
Soil Water Content (60 cm depth, $\text{cm}^3 \text{cm}^{-3}$)	Air Temperature (mean, $^{\circ}\text{C}$)	Yield (kg ha^{-1})	Climate Scenario
≤ 0.20	≥ 25	< 500	Low Warming
≤ 0.17	≥ 24	< 800	High Warming
$0.16 \geq 0.19$	$21 \geq 24$	> 2000	Average

Projected FUTURE YIELD per growing season by 2050

Expected **reduction** of $203 \pm 4.3 \text{ kg ha}^{-1}$ in Lake Manitoba Plain (MB) under High Warming

Expected **reduction** of $121 \pm 13.6 \text{ kg ha}^{-1}$ in Aspen Parkland (SK) under High Warming

Expected **increase** of approximately 100 kg ha^{-1} in southern AB under Moderate Warming



RECOMMENDED ADAPTATION STRATEGY

Seeds with high tolerance to weather

Early planting date

Conservation tillage, subsoiling or no tillage

Biochar application

Implementing irrigation

RECOMMENDED MITIGATION STRATEGY

Renewable energy - diversified energy sources and reduced fossil fuel usage to enable environmental conservation and reduce greenhouse gas emissions

Dedicate canola as feedstock for biofuel production besides oil for human consumption

CONCLUSIONS

The main areas where canola is grown in the Aspen Parkland are expected to get hotter with drier soils

If temperatures rise by about 1.5°C and crops face more water stress, seasonal canola yields could drop by around $203 \pm 4.3 \text{ kg}$ per hectare in the Lake Manitoba Plain and about $121 \pm 13.6 \text{ kg}$ per hectare in the Aspen Parkland (especially in Saskatchewan) and rise $\pm 100 \text{ kg}$ per hectare in southern Alberta

Water shortages are likely to become more serious in Manitoba, especially under moderate warming conditions

By 2050, heat stress is also expected to increase. When combined with less water, it could reduce canola yields by up to 20% compared to today.

To prevent major drops in crop production, farmers will need to use adaptation strategies, such as better water management or more resilient crop varieties

Even with these challenges, the highest canola yields are still expected in well-known productive regions like the Aspen Parkland, Lake Manitoba Plain, and Southwest Manitoba Uplands