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Assessing genotypic variation in heat tolerance using portable heat chambers in canola

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Background:

Elevated temperatures during reproductive development result in significant yield loss in canola. Recent climate change predictions emphasize that the frequency of extreme climatic events is expected to increase and pose serious concerns to crop productivity. It is important to breed varieties that adapt to future warming climates and for the expansion of canola industry to hotter regions.

Objective:

This presentation will report on a novel field-based phenotyping technique to simulate heat wave in canola to assess genotypic variation in heat tolerance traits. Elite genotypes from multi-location field trials and controlled environment experiments were selected and tested under portable heat chambers.

Methods:

A series of experiments were conducted from 2018-2022 using portable heat chambers to investigate heat wave effect on canola yield and quality, the most sensitive reproductive stage, and genotypic interaction with heat stress to assess heat tolerance. Portable heat chambers (2.5m L ×1.8m W) were used to impose a temperature of 35°C for 5h for eight-day period to simulate heat stress in canola plots. Heat tolerance was assessed as mean productivity (MP) and percentage change (PC) under heat stress vs control.

Results:

The impact of heat stress was confirmed through a statistically significant reduction in plot grain yield which was associated with a reduction in total pods, fertile pods, and seed number. Heat stress at advanced reproductive developmental stages resulted in grain yield reduction ranging from 39.9% at mid- flowering to 56.2% at the end of flowering compared to the control. Genotype and genotype × heat stress interaction was significant for yield and yield components, MP, and PC. Some genotypes demonstrated high MP and low PC in grain yield under heat stress. These genotypes could be candidates for heat tolerance without compromising mean productivity.

Conclusions:

Field based portable heat chambers enable researchers to simulate heat stress in natural environments. This phenotyping technique enhances the reliability of the pre-breeding programs for commercial adoption of heat tolerant varieties. While the system and methodology developed is successful in canola heat tolerance breeding programs, there is potential that this methodology is scalable and can be extended to other crop plants.