Freeze Duration Effects on Winter Canola Survival at Different Growth Stages

E. Gantz, S.J. Dooley, and M. Stamm
Department of Agronomy
Kansas State University

Introduction

Canola producers are concerned about the effects of early, hard freezes on canola at different growth stages. Freezing temperatures may be fairly short duration, but plants can still be lost to the cold. When the cold acclimation (winter hardening) period is brief before temperatures drop below freezing (-5 to -4^{0}C), plants do not attain the appropriate level of winter hardening. The question becomes whether or not more growth would improve plant vigor and survival.

Objectives

Short damage freeze events were simulated in the growth chamber. Variety, growth stage, and freeze duration were evaluated.

The long term goal of this project is to develop a controlled environment test to evaluate freezing tolerance in breeding materials and commercial products.

Materials and Methods

- Three varieties: Wichita, DKW46-15, and Sitro
- Three replications in a randomized complete block design: one rep = six plants
- Growth stages: cotyledon, 1-leaf, 3-leaf, 6-leaf
- Temperature treatments: control, (-2^{0}C), (-4^{0}C), (-6^{0}C), (-8 ^{0}C)
- Plants were placed in the growth chamber to acclimate for 48 hours at 4^{0}C
- Temperature was dropped at a rate of 2^{0}C/hr to (-2^{0}C), then held for one hour to begin the treatments.
- Temperature steps decreased by 2^{0}C/hr then held for one hour before decreasing again.
- Plants were removed after each one hour holding period.
- Plants were allowed to acclimate in a second chamber at 4^{0}C before returning to the greenhouse.
- Observations were taken after three weeks to determine whether plants survived then rated as dead or alive.
- Data were analyzed using PROC GLM in SAS

Figure 1. Testing three-leaf growth stage in Percival

Figure 2. Testing cotyledon growth stage in Percival

Results

- Table 1. Canola response to freezing temperatures at different growth stages

	Growth Stage			
Temperature	Cotyledon	One-leaf	Three-leaf	Six-leaf
Control	100a	100a	100a	100a
-2	100a	100a	100a	100a
-4	92.6a	70.4b	100a	96.3a
-6	0b	7.4c	27.8b	59.3b
-8	0b	0c	0c	11.11c
R^2	0.97	0.94	0.97	0.94
p-value	0.0001	0.0001	0.0001	0.0001
LSD	9.6	13.2	9.7	11

Conclusions

- Temperatures below (-4^{0}C) are detrimental to canola surviving an early fall freeze
- Larger plants are more likely to survive an early freeze
- This project is the basis for screening varieties for breeding purposes

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If you have any questions please contact Emma Gantz at egantz@ksu.edu