

Introduction

The Sugarbeet Root Maggot (SBRM) is a freeze tolerant insect.



45%¹

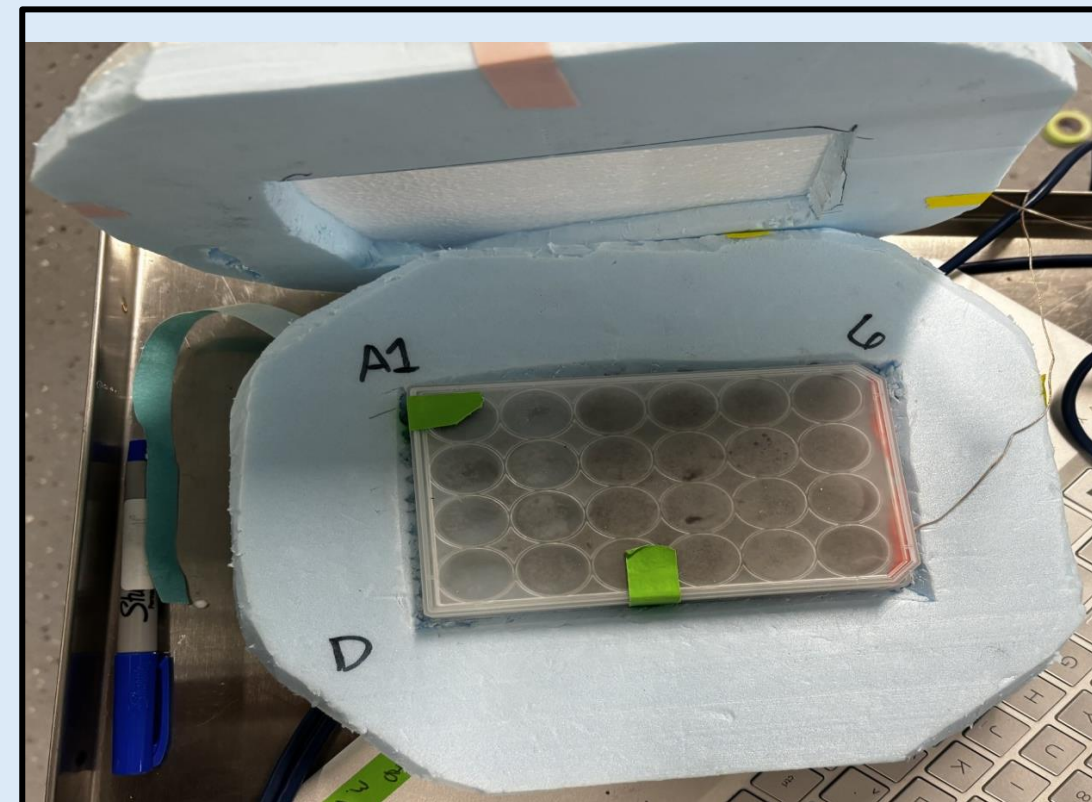
We aim to understand the mechanisms of the SBRM's ability to survive freezing by discovering their lower lethal limit and hemolymph characteristics.

In previous studies, the Malpighian tubules have been shown to have ice-nucleating capabilities².

Methods



n=15 (x6)



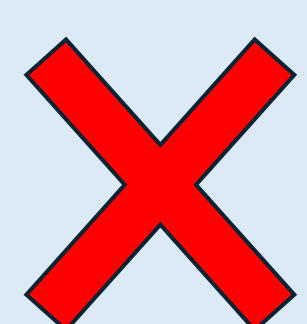
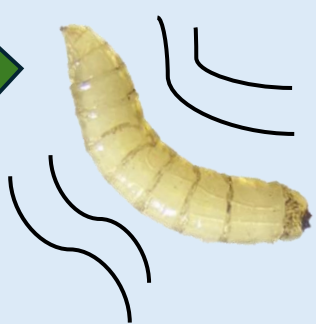
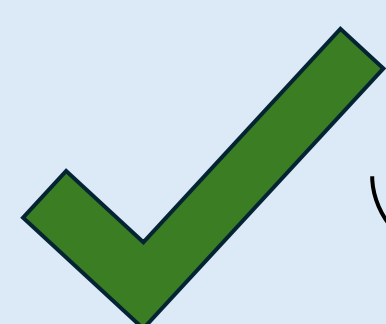
7 Days @

- Set 1: 0°C
- Set 2: -10°C
- Set 3: -20°C
- Set 4: -30°C
- Set 5: -40°C
- Set 6: -50°C

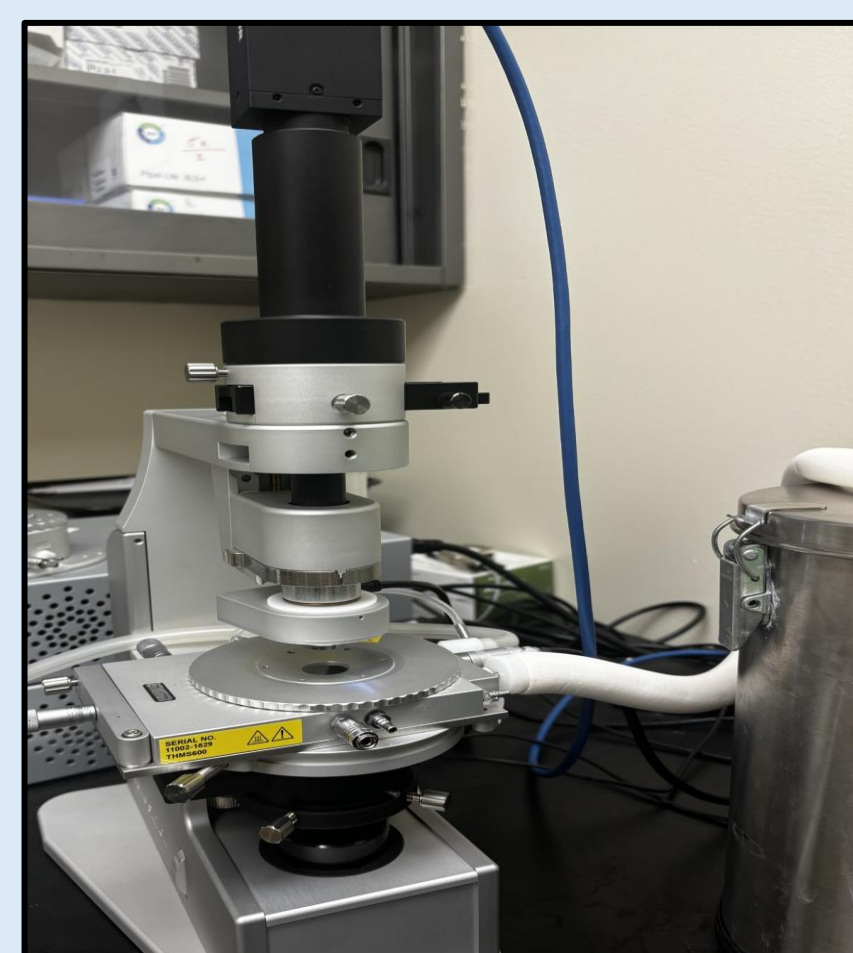


Maggots were weighed before and after treatment, and survival was monitored over one-week post-treatment.

- Day 1
- Day 3
- Day 7

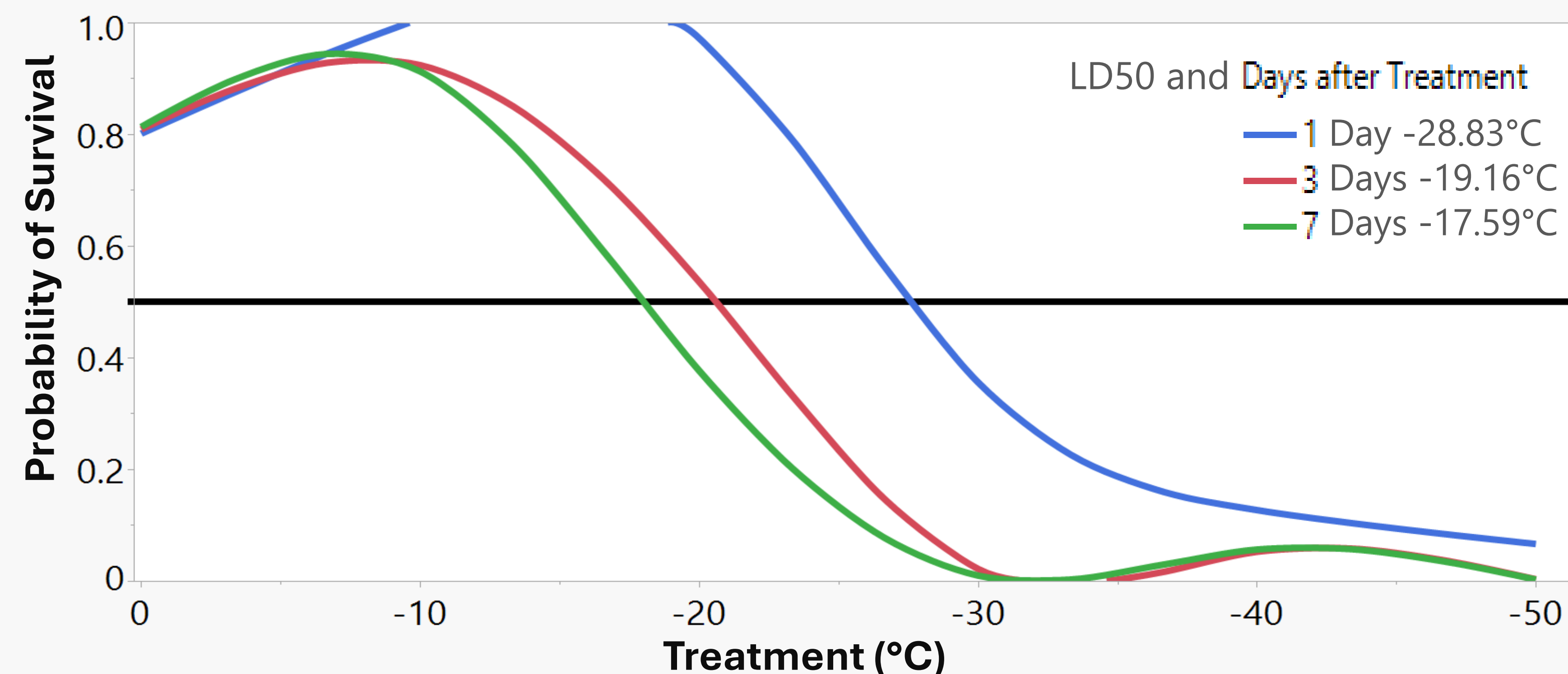


Hemolymph supercooling points were determined with and without Malpighian tubules using a cryoscope.

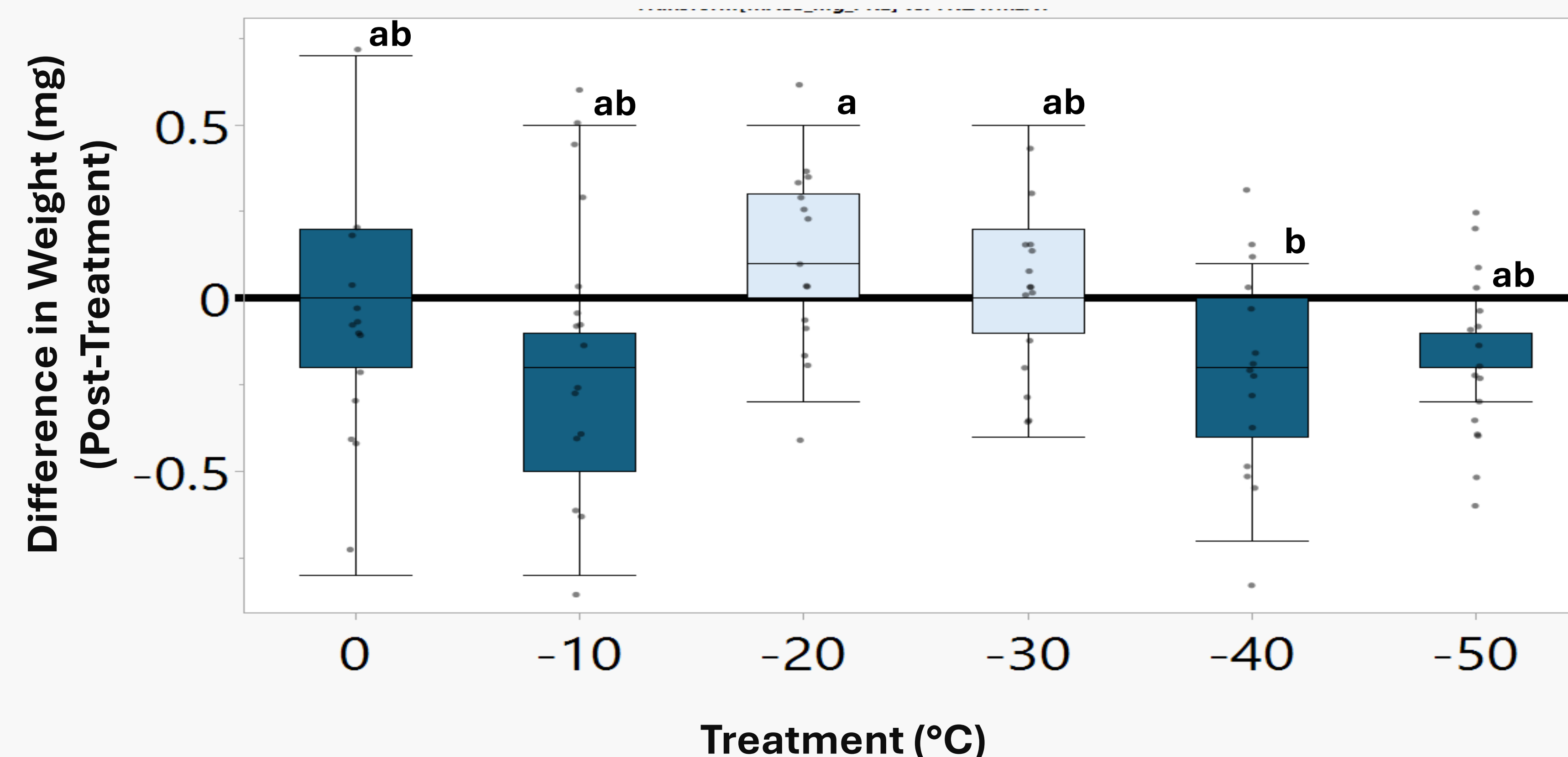


Results

Survival Decreased with Time $p=0.0196$ and Temperature $p=0.0001$

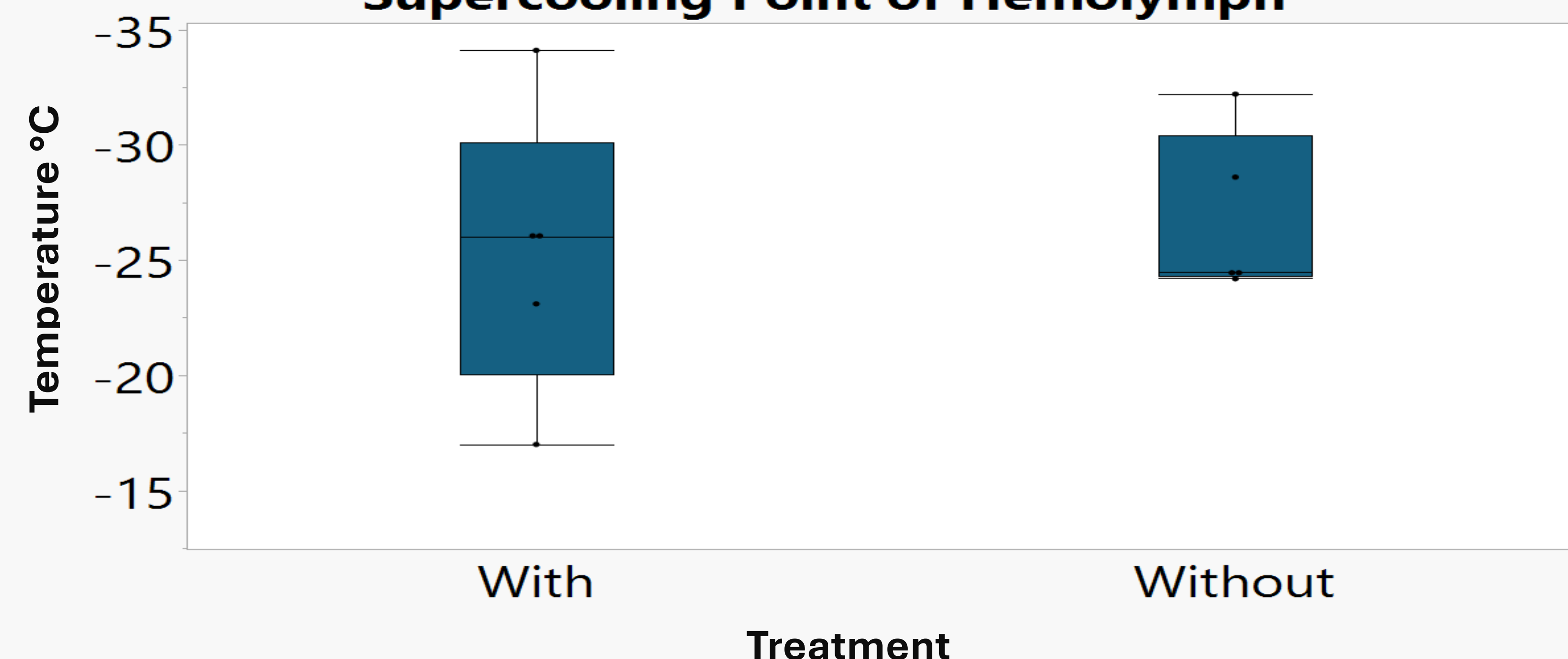


Loss of mass was observed in the temperature range of the SCP of Hemolymph. There was a significant difference between the -20°C and -40°C treatment groups $p=0.0108$



There was no difference in the supercooling point of hemolymph with or without the Malpighian tubule. $p=0.6456$

Supercooling Point of Hemolymph

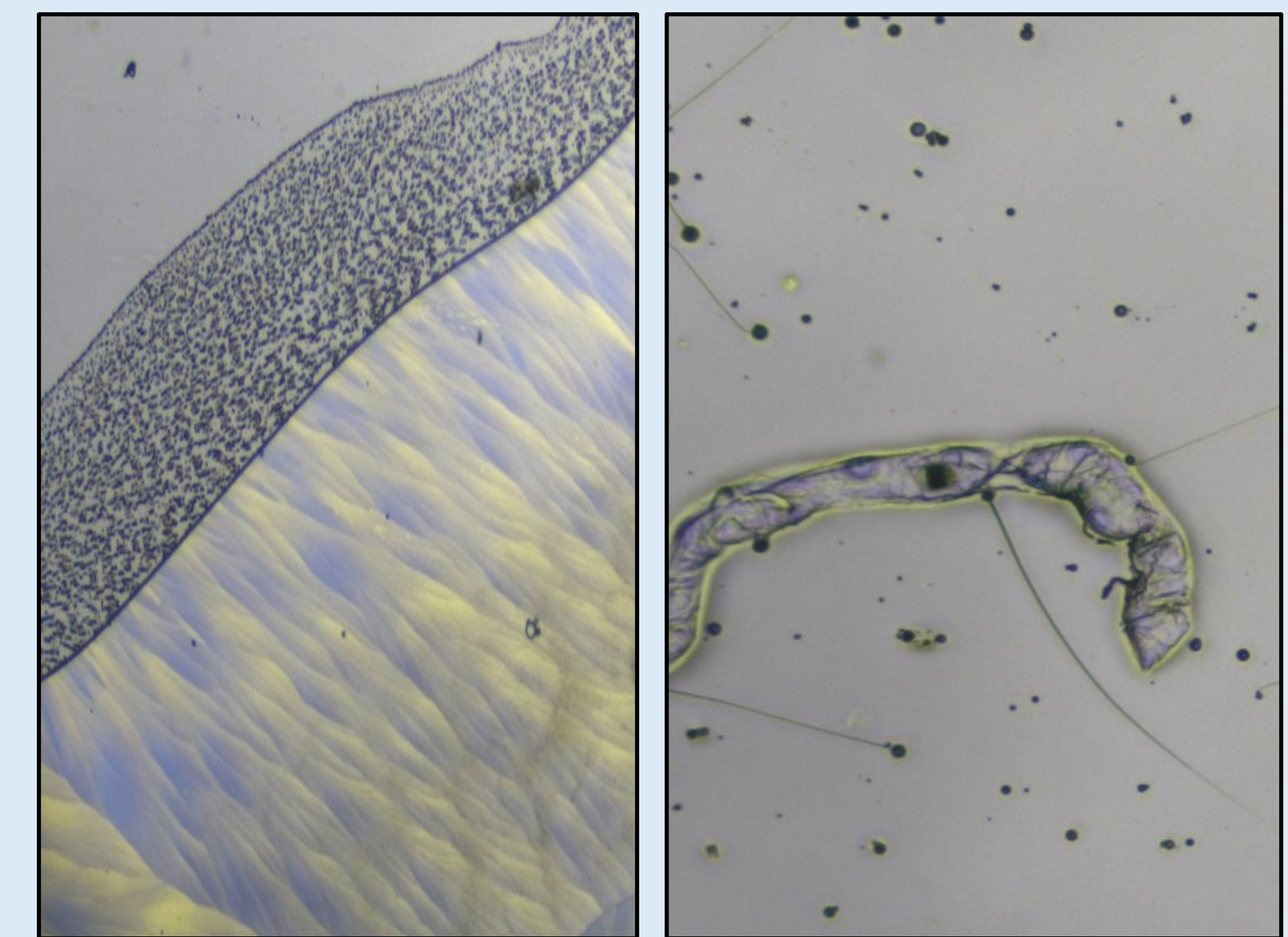


Discussion

Results show that lethal temperatures are below normal field temperatures that the SBRM experience.

Results showed that the presence of the Malpighian tubule in hemolymph did not affect supercooling point, which indicates a lack of ice-nucleators in the Malpighian.

During the cryoscope testing, one possible instance of vitrification was observed.



Vitrification potentially counteracts loss of mass, which could explain the discrepancies in mass across treatments.

Future Directions

Determination of LD50 can be done with SBRM that have not undergone long periods in cold-storage.



Protein analyses of hemolymph to identify potential ice nucleator or cryoprotectant proteins may provide new areas of study.

Future experiments can explore the SBRM's possible vitrification capabilities.

References and Acknowledgements

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References:

¹https://www.ndsu.edu/vpag/newsletter/ndsu_helping_control_sugarbeet_root_maggot/. (2024)

²Mugnano. etal. (1996) *Eur. J. Entomol.*