

**Evaluation of turfgrass crown membrane health
in response to ice stress and management
practices of *Poa annua* putting green species.**

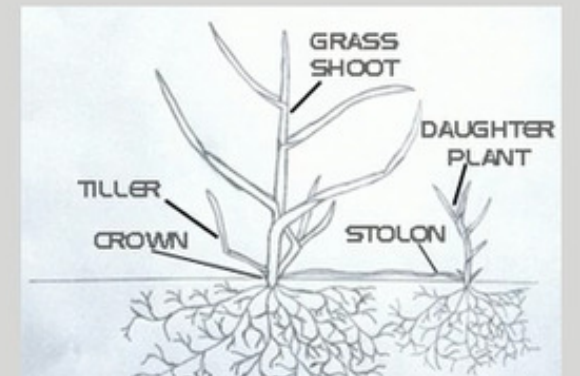
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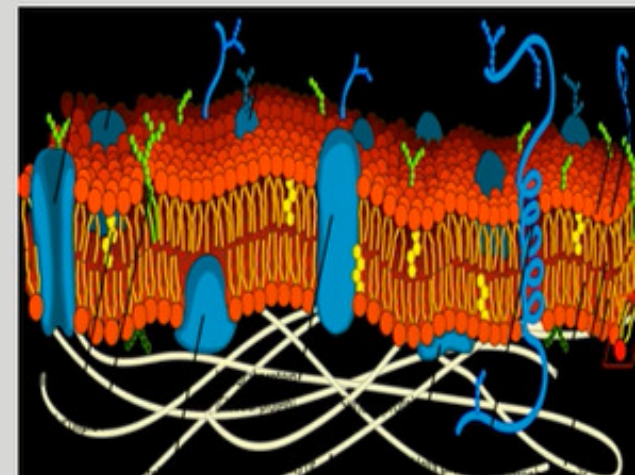
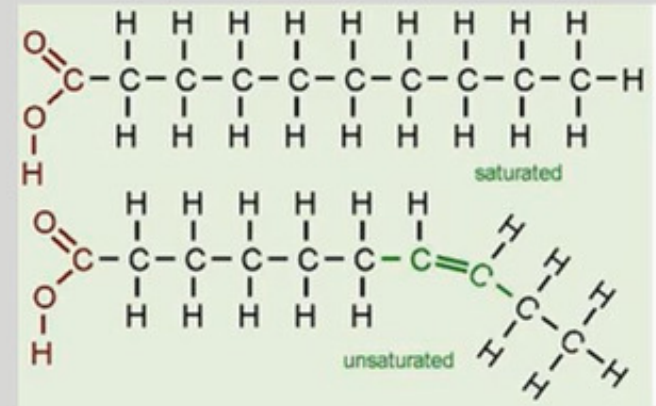
Turf Survival of Ice Cover

- Acclimation
 - Altering growth habit
 - Shift in fatty acid profiles (unsaturated and saturated)
- Crown tissue
 - Major energy storage
 - Susceptible to ice/freeze damage



Fatty Acids

- High component in membranes
- Saturated
- Unsaturated



Materials and methods

- Chemical treatments

Chemical Name	Trade name	Rate
– 1. Mineral Oil	Civitas One	406 ml / 100 m ²
– 2. Mefluidide	Embark T&O	15.9 ml / 100 m ²
– 3. Propiconazol	Banner Maxx	63.6 ml / 100 m ²
– 4. Trinexapac Ethyl	Primo Maxx	3.97 ml / 100 m ²
– 5. Untreated		

- Application dates 2014: 7-31 to 10-9



Creeping bentgrass

Civitas One

Untreated

Propiconazol



Materials and methods

- Transfer to low temperature growth chamber
 - -4°C
 - 10 hour light 14 hour dark photoperiod
 - $200 \mu\text{mol m}^{-2} \text{s}^{-1}$
 - Sampling occurred at 20, 40, 60, 100 days
 - Samples split
 - 21 day recovery period
 - 4 replicates



Completely randomized design.

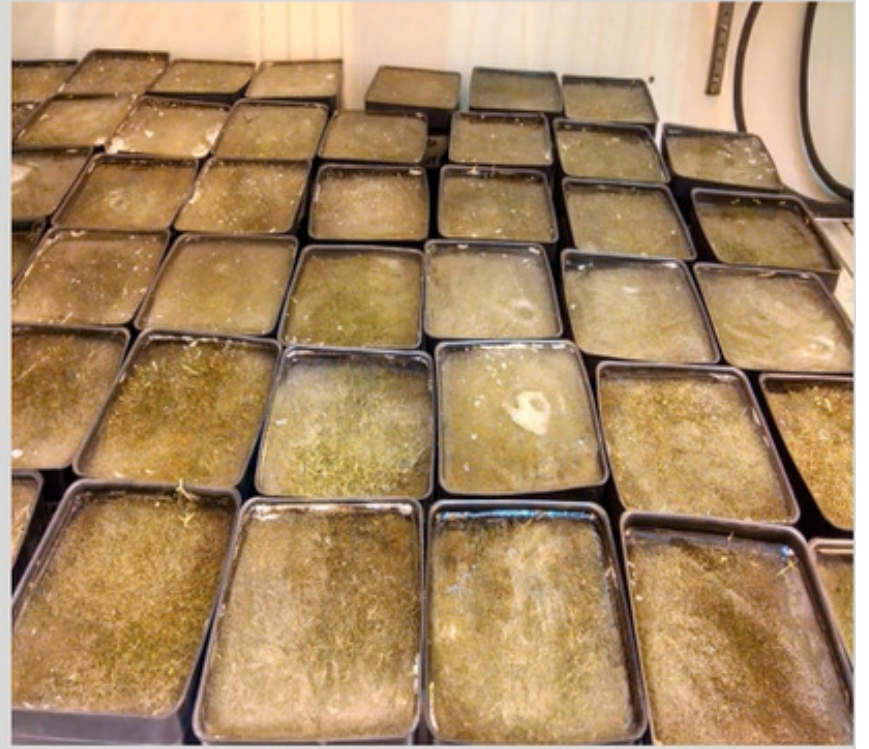
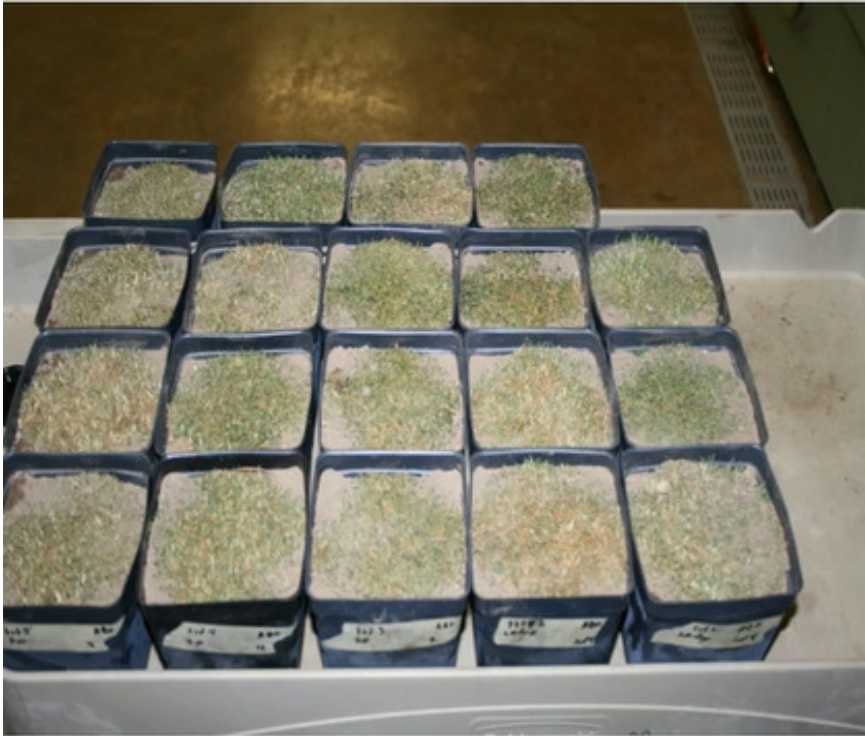
The Fisher's protected least significant difference (LSD) test at the 0.05 P level was used to detect the difference between treatment

Measurements

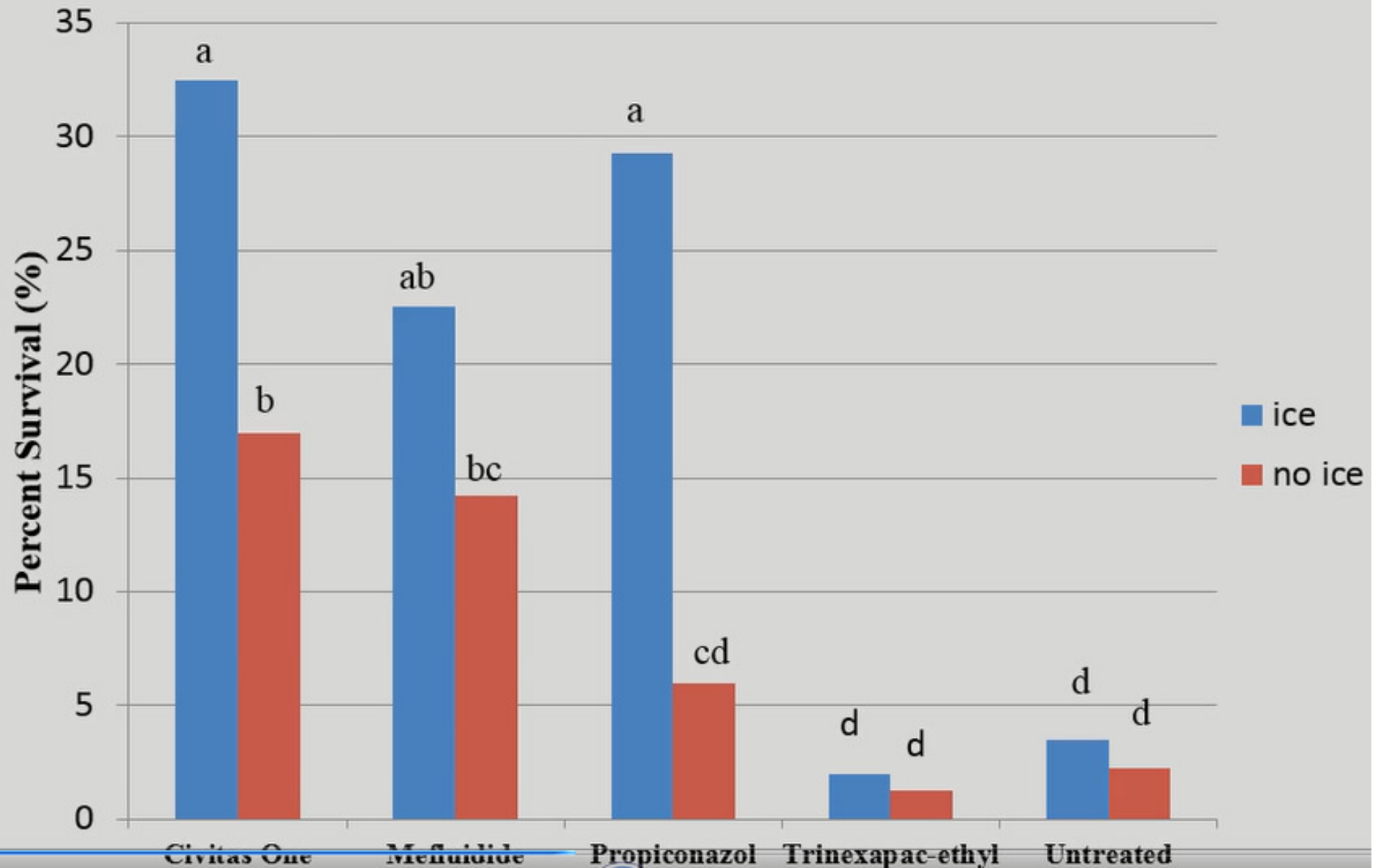
- Fatty acid ratios
 - Gas Chromatography Mass Spectroscopy
- Percent regrowth
- Field plot ratings



Results



ABG 20 day



20 days Ice cover ABG

	Fatty Acids							
	Molar percentage (mol %)							
	saturated		unsaturated				Trace	
	16:0 Palmitic acid	18:0 Stearic acid	16:1 Palmitoleic acid	18:1 Oleic acid	18:2 Linoleic acid	18:3 Linolenic acid	24:0 Lignoceric acid	26:0 Cerotic acid
Civitas One	30.5 bc	29.1 b	6.6 ab	6.7a	13.5 b	12.9 ab	0.08	0.06
Mefluidide	29.3 c	26.2 b	6.3 c	7.1a	19.0 a	11.7 a	ND	ND
Propiconazole	26.9 c	26.2 b	4.7 ab	5.3a	21.6 a	15.3 ab	ND	ND
Trinexapac-ethyl	33.4 ab	35.4 a	7.2 a	5.8a	9.0 bc	9.3 b	ND	ND
Untreated	35.0 a	37.0 a	5.5 bc	5.6a	8.0 c	8.1 b	ND	ND
LSD	3.83	1.33	4.73	2.22	4.83	5.73		

20 day under ice

Civitas One



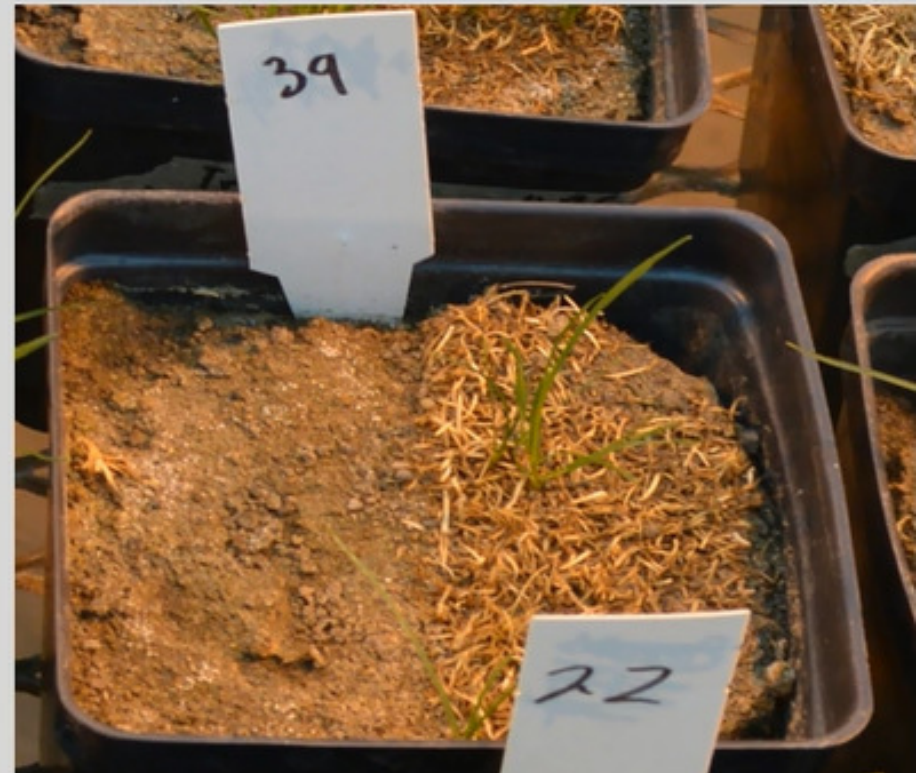
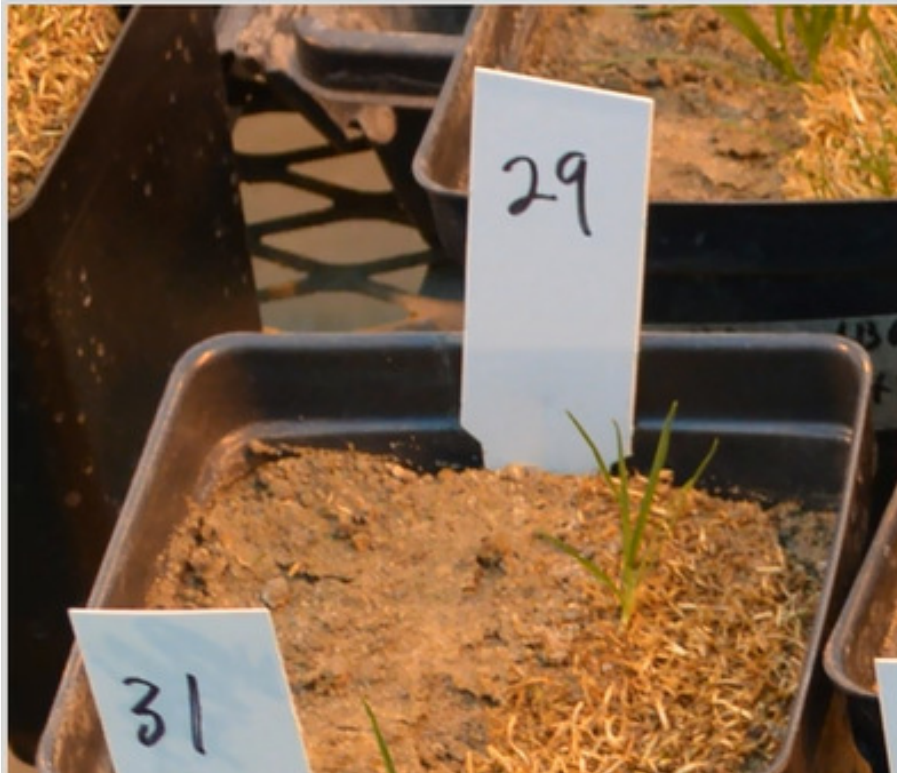
Untreated



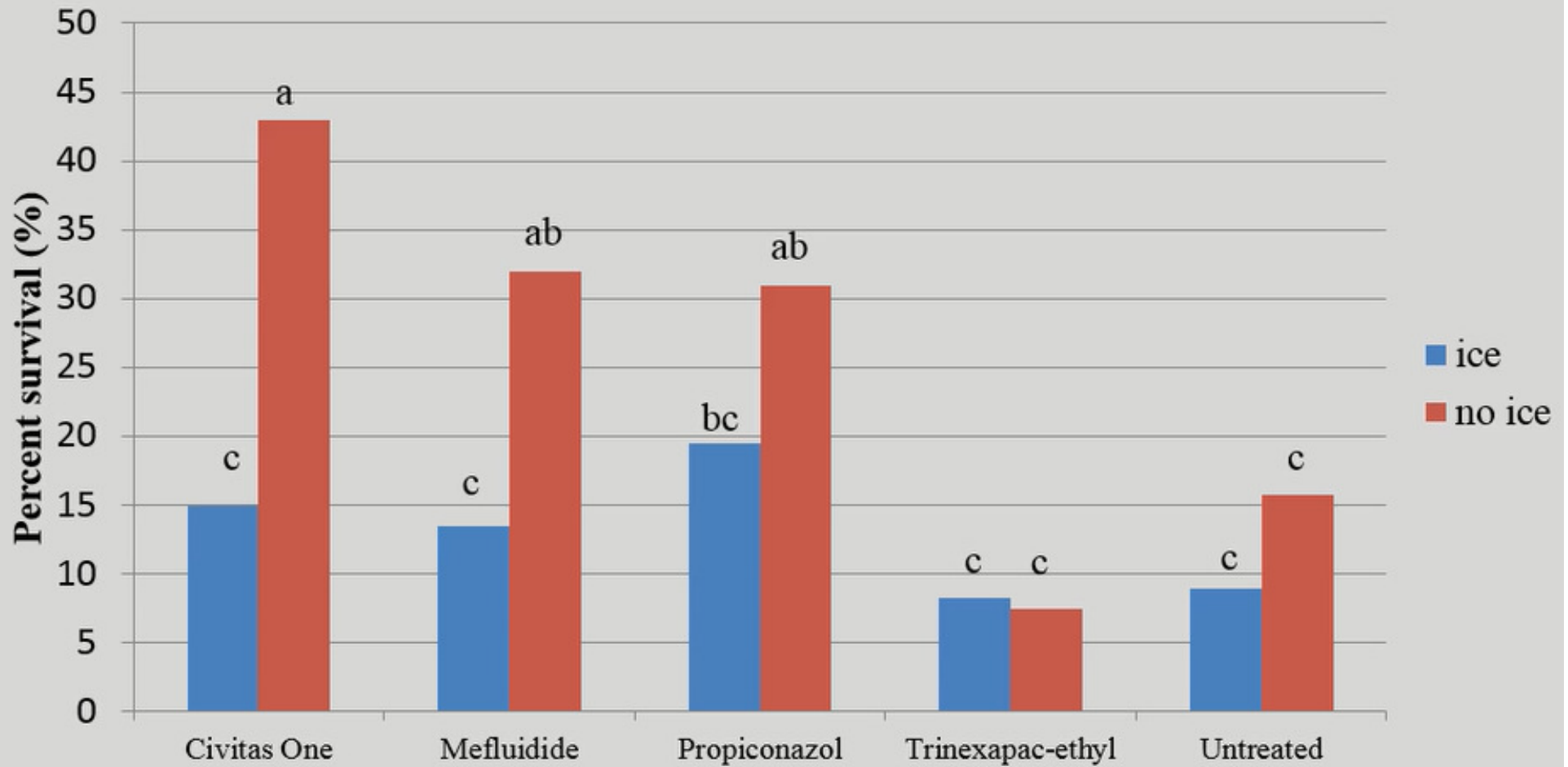
20 days under ice

Trinexapac-Ethyl

Untreated



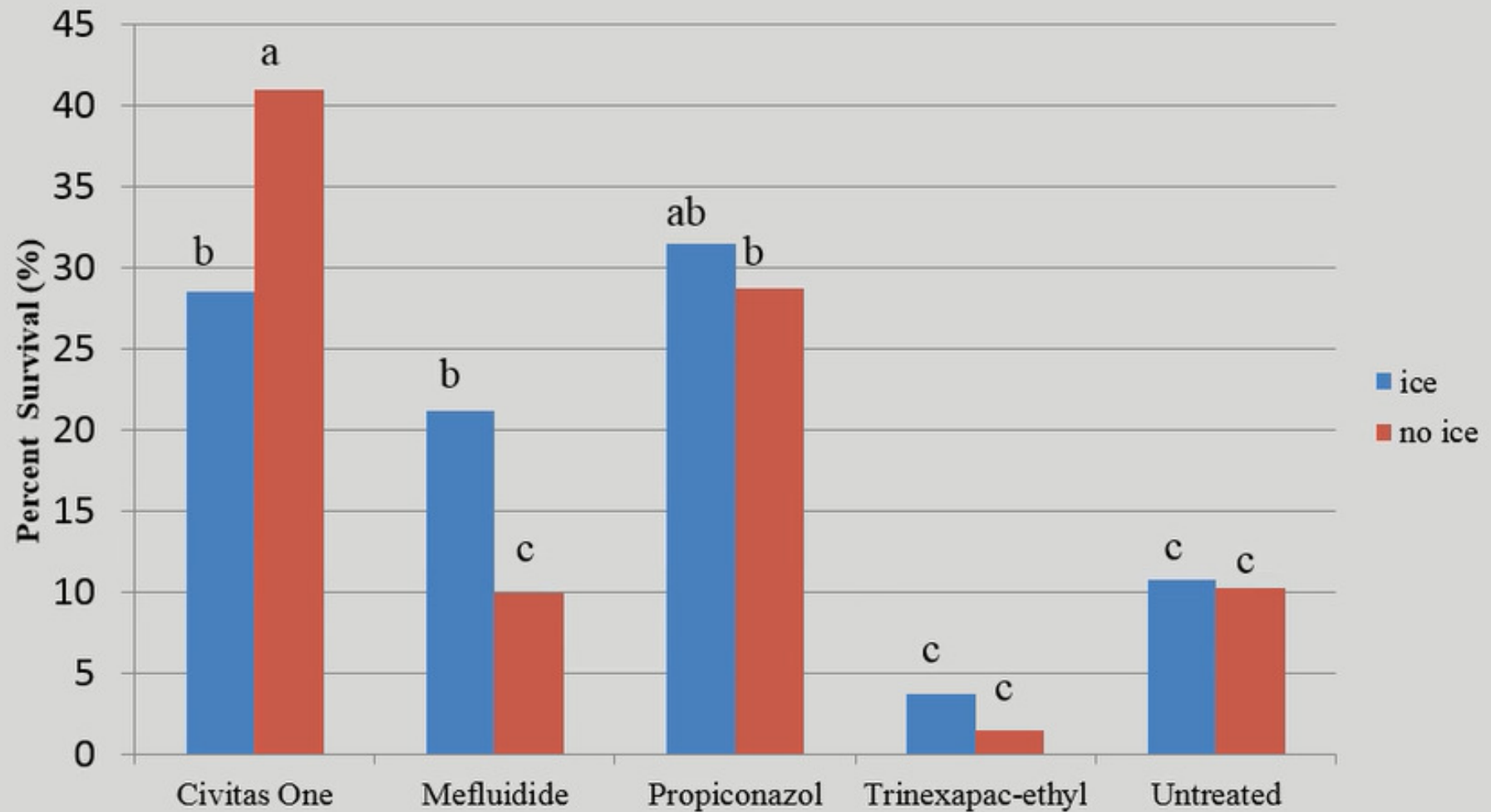
40 day ABG



40 days Ice Cover ABG

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	Molar percentage (mol %)							
	saturated		unsaturated				Trace	
	16:0	18:0	16:1	18:1	18:2	18:3	24:0	26:0
Palmitic acid	Stearic acid	Palmitoleic acid	Oleic acid	Linoleic acid	Linolenic acid	Lignoceric acid	Cerotic acid	
Civitas One	29.25 bc	28.83 b	6.28 a	7.08 a	12.93 bc	13.43 ab	ND	ND
Mefluidide	27.38 bc	25.9 b	6.65 a	6.33 a	19.30 a	10.33 ab	ND	ND
Propiconazole	24.25 c	26.18 b	4.15 b	5.35 a	22.03 a	15.93 a	ND	ND
Trinexapac-ethyl	31.98 ab	36.43 a	7.05 a	6.08 a	9.33 bc	9.65 b	ND	ND
Untreated	34.88 a	36.90 a	4.78 b	5.73 a	7.63 c	8.15 b	ND	ND
LSD	5.53	1.14	4.43	NS	4.79	6.00		

60 day ABG



- Mefluidide decreased in percent survival in relation to 40 and 20 days

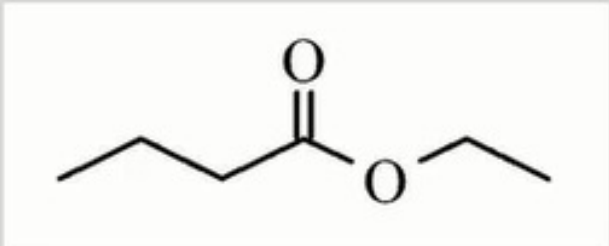
60 days Ice cover

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Civitas One	26.95 c	29.03 b	6.08 a	6.93 a	13.53 bc	13.38 a	ND	ND
Mefluidide	26.95 c	26.25 b	4.00 b	4.40 b	17.25 ab	10.60 ab	ND	ND
Propiconazole	29.58 bc	25.88 b	6.60 a	6.60 ab	22.00 a	10.25 ab	ND	ND
Trinexapac-ethyl	34.18 a	35.43 a	6.33 a	5.90 ab	9.73 cd	9.18 b	ND	ND
Untreated	32.63 ab	36.38 a	4.33 b	5.73 ab	7.13 d	7.08 b	ND	ND
LSD	4.22	1.26	5.28	2.25	5.79	3.90		

Conclusions

- Civitas One allowed for the greatest regrowth after recovery period
- Trinexapac Ethyl treated pots were not significantly different than untreated controls
- Unsaturated fatty acids contents were greater when treated with mefulidide, propiconazol, and mineral oil.

Future Research

- Gas accumulation under anoxic conditions
 - Ethyl butyrate
- 

The image shows the skeletal structure of ethyl butyrate, a chemical compound. It consists of a four-carbon chain (butyrate) attached to an oxygen atom, which is further attached to another two-carbon chain (ethyl). The structure is drawn in a zig-zag pattern with a double bond to the oxygen atom above the carbonyl group.

CCCC(=O)OCC
- Other gas accumulations
 - Oxygen
 - CO₂
- Identify total non-structural carbohydrate contents



Acknowledgements

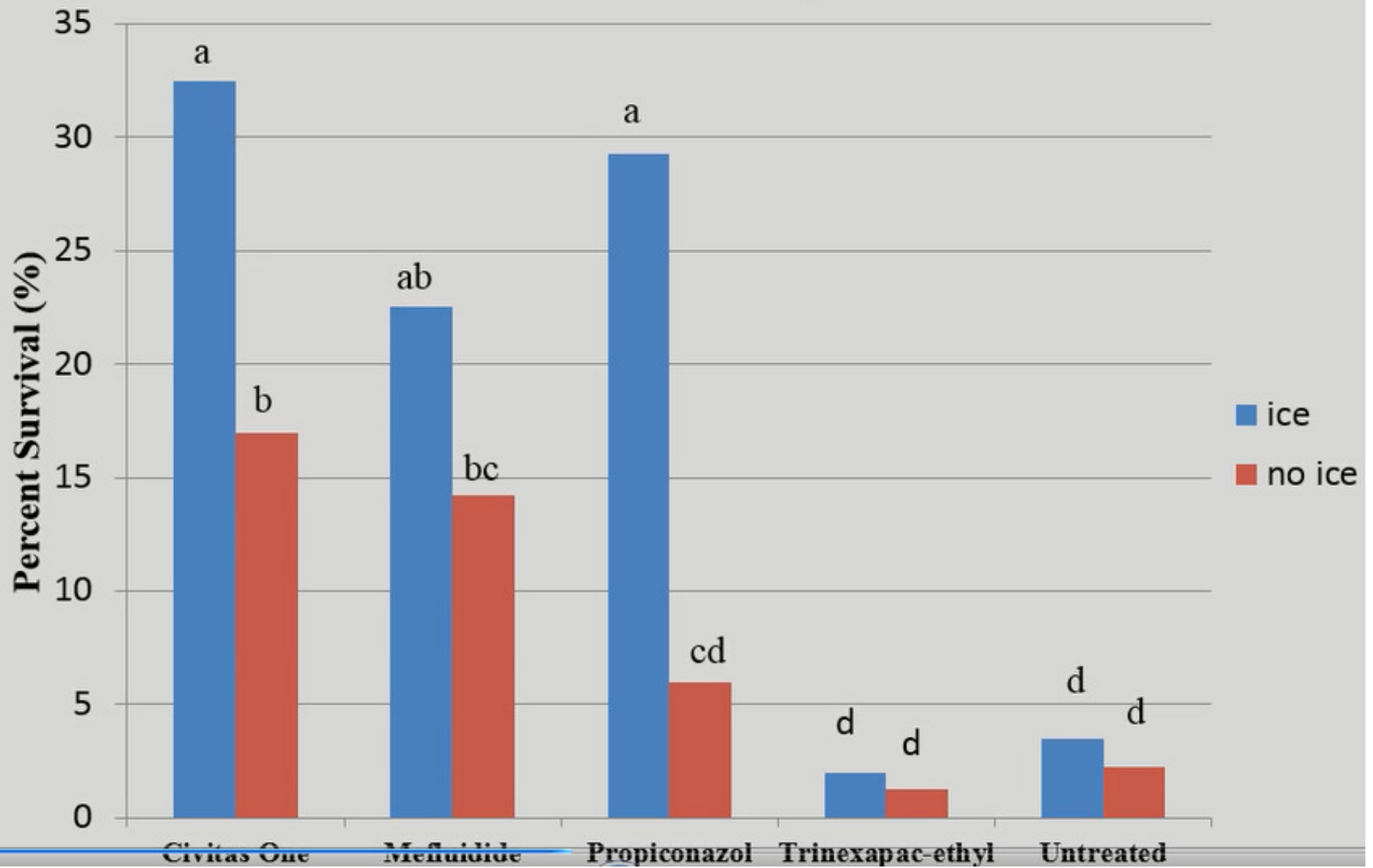


- United States Golf Association
- Project GREEN
- Dr. Emily Merewitz
- Dr. Kevin Frank
- Dr. Sanal Krishnan

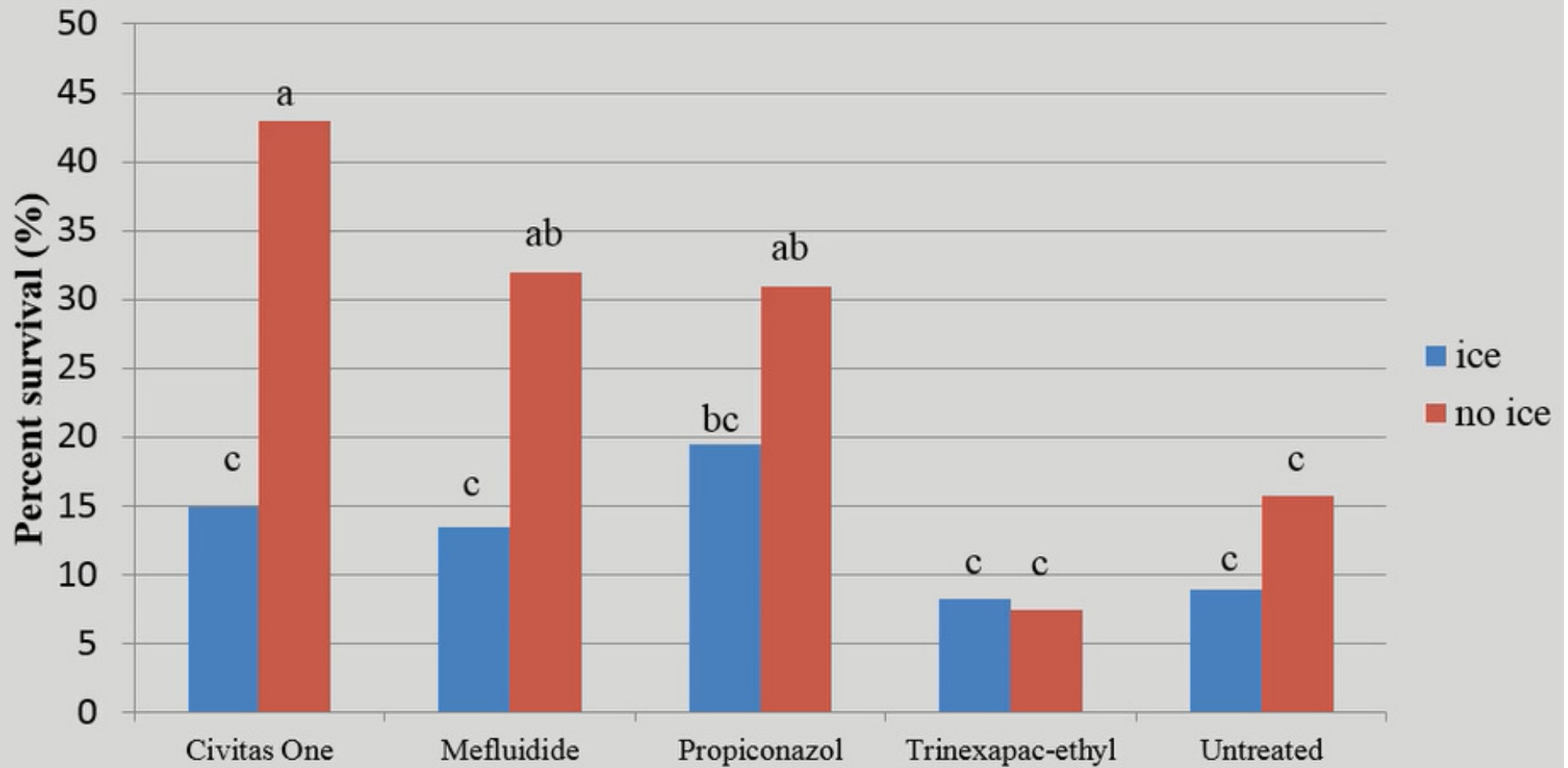


Data Slides

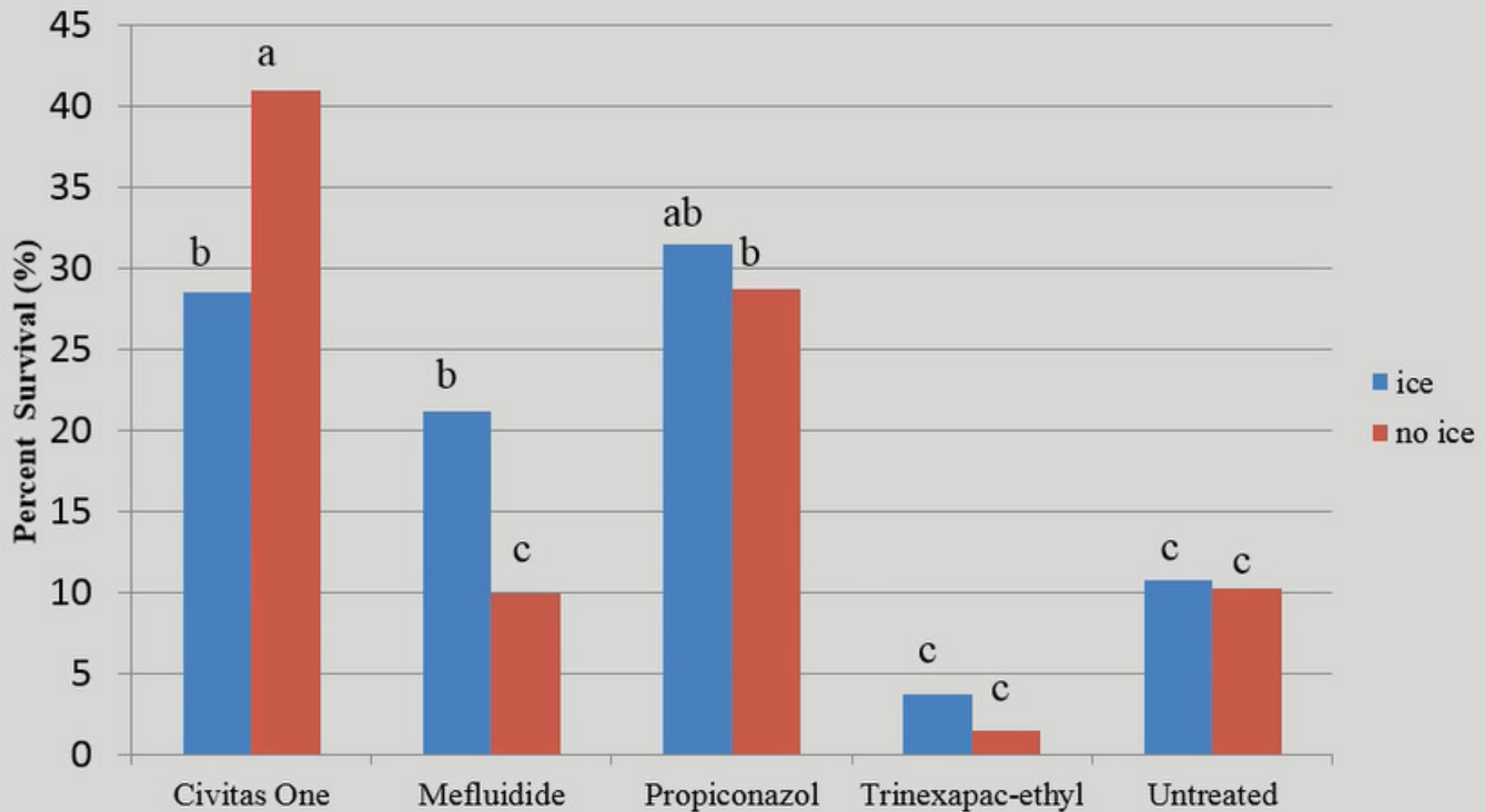
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