# Evaluation of Crown Membrane Health and Gas Accumulation in Response to Ice Stress and Management Practices of Creeping Bentgrass and Poa Annua

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Start date: 2015
Project duration 2 years
Total funding: $20,000

**Objectives:**
1. *Investigate whether crown membrane fatty acid ratios and composition may correlate to toxic gas accumulation and are they differentially accumulated between creeping bentgrass and poa annua under ice cover stress*
2. *Evaluate how lipid profiles and FFA change over a time course of ice cover*
3. *Use a simulated ice cover experiment to determine whether membrane health changes due to incubation of turf with specific ice cover associated gases*
4. *Evaluate whether chemical treatments commonly used in the turf industry reduce turf loss due to ice cover, particularly related to membrane disruption or FFA accumulation*

Creeping bentgrass and annual bluegrass are two important putting green species that are sensitive to ice cover damage. Creeping bentgrass is typically more tolerant to ice stress than annual bluegrass. A major cause of damage under prolonged ice cover is the accumulation of toxic gases and damage to grass crown tissue. Several management practices have been reported to improve turf survival of winter, but have not been investigated in controlled studies. This project aimed to determine whether commonly used plant growth regulators (PGRs) and an oil based product, Civitas, have an effect on turf survival of ice cover and is that survival related to membrane or crown health.

Separate creeping bentgrass and annual bluegrass fields were maintained at the Hancock Turfgrass Research Center at Michigan State University. Plots of both species were treated in late summer through fall of 2014 every two weeks with: Civitas, mefluidide, propiconazole, or trinexapac ethyl at label recommended rates. Turfgrass plots underwent natural acclimation to cold conditions in fall 2014. Turfgrass plugs were then taken on 11 Nov 2014 from each plot, planted in 4 inch plastic pots in native soil, and then transferred to an environmentally controlled low temperature growth chamber (-4$^{o}$C) where they underwent 1) no ice or 2) ice cover (0.5" thick) treatments. Turfgrass plugs were taken out of the low temperature growth chamber at 0, 20, 40, 60, and 100 days after temperature treatments. Plants were then destructively sampled by cutting the plants in half. Half of the plant went to gas chromatography mass spectroscopy (GC/MS) for analysis of free fatty acids while the other half went towards a percent regrowth assay in a greenhouse.

Ice covered plugs treated with mefluidide, propiconazol, and civitas all had significantly more regrowth than trinexapac-ethyl and untreated control plugs after 20, 40, and 60 days in the

low temperature growth chamber. Exposure of plants to the low temperature chamber conditions and the regrowth assay results should not be directly correlated with number of days of survival in the field. The chamber conditions completely freeze the soil profile, which would not likely occur under field conditions. We are currently installing heating ribbons in the growth chamber in order to keep soil temperatures warmer and more closely aligned with field conditions for future projects.

At 20 days under ice cover, the majority of the fatty acids detected within annual bluegrass were linolenic acid, linoleic acid, oleic acid, stearic acid, palmitoleic acid, and palmitic acid. Plants that were treated with mefluidide, propiconazole, and Civitas have a greater percentage of polyunsaturated fatty acids, with linoleic acid being the most increased due to these chemical treatments, compared with trinexapac-ethyl and untreated samples (Table 1). The unsaturated fatty acid linoleic acid is a precursor to the plant hormone jasmonic acid, a hormone involved in stress responses and the induced systemic resistance pathway. Fatty acids greater than 18 carbons were detected in trace amounts primarily in Civitas treated samples. Further evaluation of these profiles is needed and is being performed.

Currently, field plots are being treated in the same manner as in 2014 in order for collection of turf plugs. Analysis on creeping bentgrass plants and the other objectives listed above are also on-going.

Summary Points

- Annual bluegrass regrowth after simulated ice cover in a growth chamber was significantly affected by plant growth regulator or civitas treatments.
- Enhanced survival of annual bluegrass after treatment with plant growth regulators or civitas could be related to shifts in fatty acid accumulation.
- More work is on-going to thoroughly investigate fatty acids and gas accumulation in both creeping bentgrass and annual bluegrass responses to chemical management practices and ice cover.

Figure 1 – Annual bluegrass plants treated with Civitas, mefluidide, propiconazole, trinexapac ethyl, or untreated under ice (0.5” thick) in a low temperature growth chamber (-4°C)

Figure 2 – Regrowth (%) of annual bluegrass plugs maintained under ice cover in a low temperature growth chamber (-4 °C) that were treated with different plant growth regulating compounds. Different letters indicate statistically significant differences within a sampling day ($P \leq 0.05$).

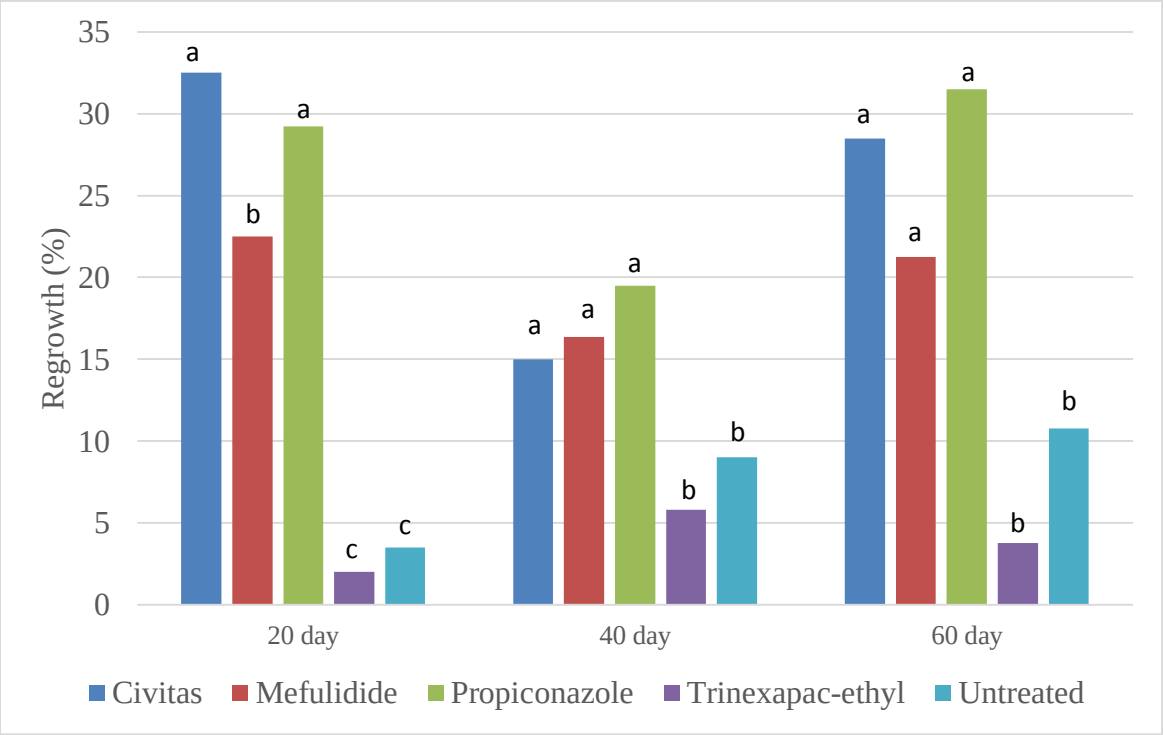

Table 1. List of free fatty acids found in annual bluegrass crown tissue exposed to different chemical treatments after 20 days of ice cover. The fatty acid designation ratios are (C, number of carbon atoms)/(D, number of double bonds). Different letters indicate statistically significant differences within each column ($P \leq 0.05$).

| | **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 | 30.5 bc | 29.1 b | 6.6 ab | 6.7a | 13.5 b | 12.9 ab | 0.08 | 0.06 |
| Propiconazole | 26.9 c | 26.2 b | 4.7 c | 5.3a | 21.6 a | 15.3 a | N/A | N/A |
| Mefluidide | 29.3 c | 26.2 b | 6.3 ab | 7.1a | 19.0 a | 11.7 ab | N/A | N/A |
| Trinexapac-ethyl | 33.4 ab | 35.4 a | 7.2 a | 5.8a | 9.0 bc | 9.3 b | N/A | N/A |
| Untreated | 35.0 a | 37.0 a | 5.5 bc | 5.6a | 8.0 c | 8.1 b | N/A | N/A |
| LSD | 3.83 | 1.33 | 4.73 | 2.22 | 4.83 | 5.73 | | |