

Evaluation of a field detector for identifying ambrosia beetle susceptible trees



Karla Adesso¹, Anju Poudel¹, Jason Oliver¹, Chris Ranger²
¹Tennessee State University, Otis L. Floyd Nursery Research Center, McMinnville, TN
²USDA-ARS, Wooster, OH

ABSTRACT

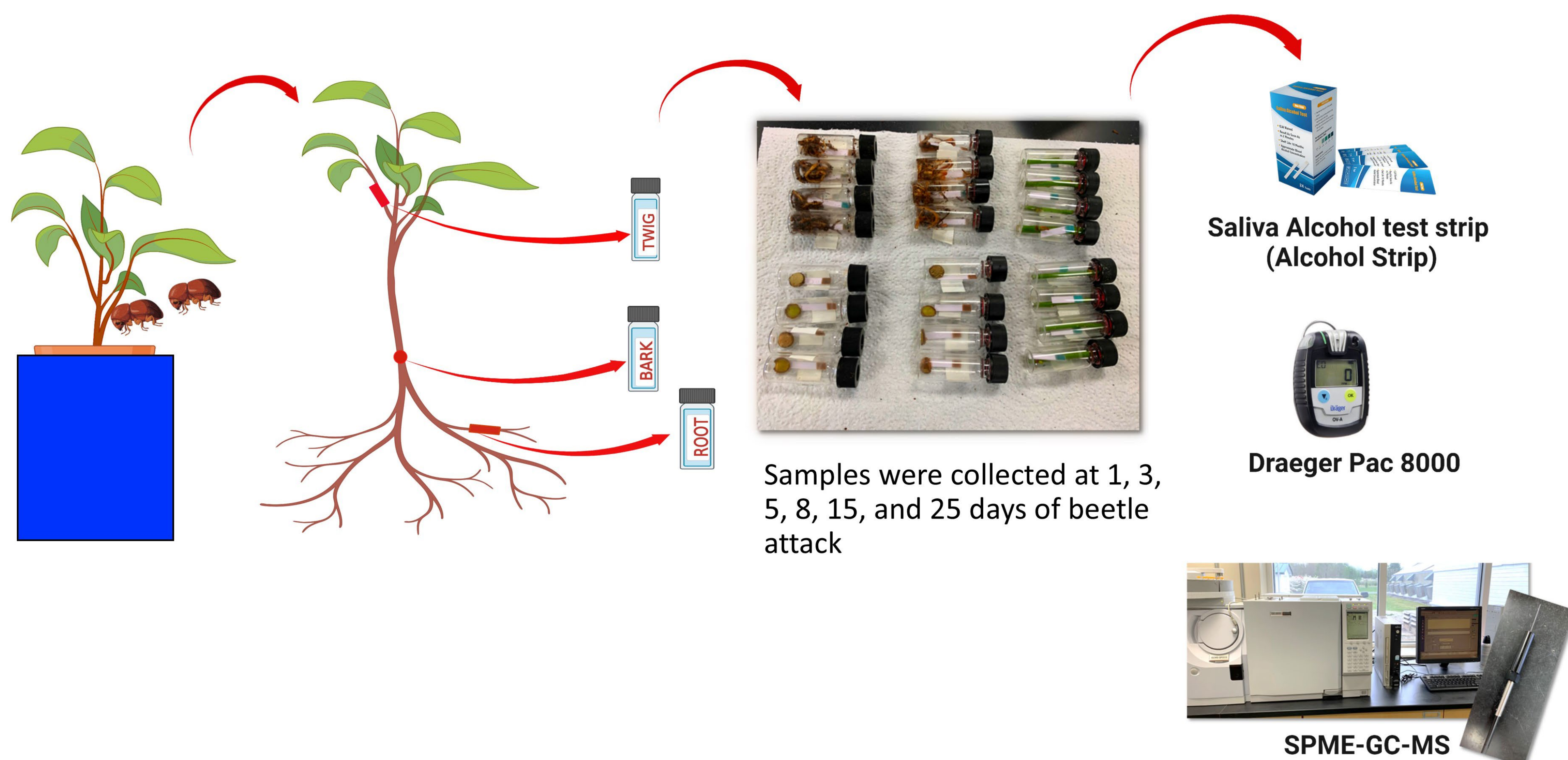
Ambrosia beetles (Coleoptera: Curculionidae: Scolytinae) are small fungus-farming beetles that damage stressed nursery trees. Stressed trees emit ethanol, which is the primary cue for ambrosia beetles to locate suitable hosts. This study evaluated the efficacy of low-cost ethanol detectors, which could offer a viable solution for the early detection of flood-stressed trees susceptible to ambrosia beetle infestation. Experiments were conducted using 48 native dogwoods (*Cornus florida* L.), subjecting half to flooded or non-flooded conditions. The presence of ambrosia beetles was significantly higher in flooded trees, indicating a clear preference and validating the use of flood stress as a reliable method for susceptibility assessment. Ethanol emission from these trees was measured using low-cost alcohol saliva test strips and Dräger Pac® 8000 gas detectors alongside a solid phase microextraction-gas chromatography-mass spectrometry (SPME-GC-MS) method for validation. Both low-cost methods detected ethanol production in plant material, correlating positively with SPME-GC-MS results. These detectors could offer a rapid, cost-effective method for identifying trees at risk of ambrosia beetle attack. More work is needed to optimize these tools for use by nursery growers, consultants, and researchers as an early-warning system and aid in ambrosia beetle management decision-making.

INTRODUCTION

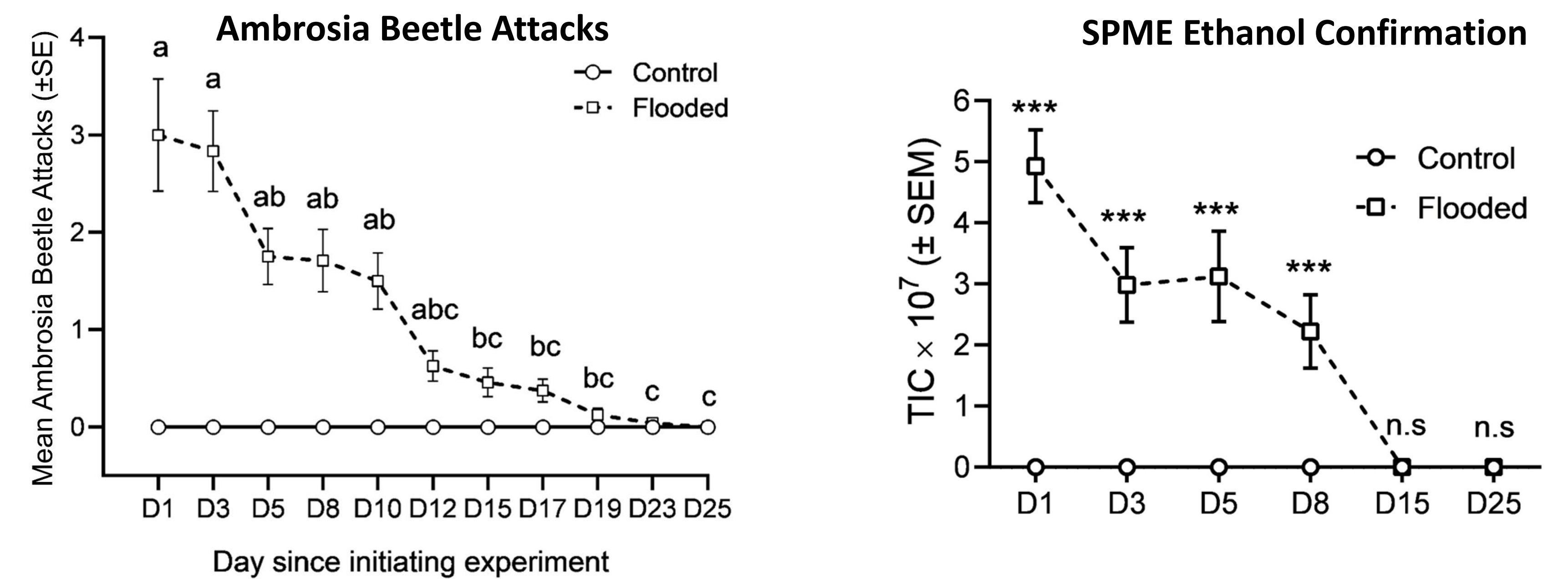
- Ambrosia beetles, known as fungus-farming beetles, are small wood-boring pests. Their broad host range, cryptic habitat, haplodiploid reproduction, and sib-mating favor their dispersal and establishment in new regions.
- Ambrosia beetles are attracted to stressed trees in nursery production. Stressed trees emit ethanol, which is the primary ambrosia beetle attractant.
- Chemical methods exist to detect ethanol emission in trees, but these methods have historically been expensive and highly technical.
- Practical field methods for detecting ethanol in trees could improve scouting and decision-making in nursery production fields by identifying stressed fields prior to ambrosia beetle activity in spring.

MATERIALS & METHODS

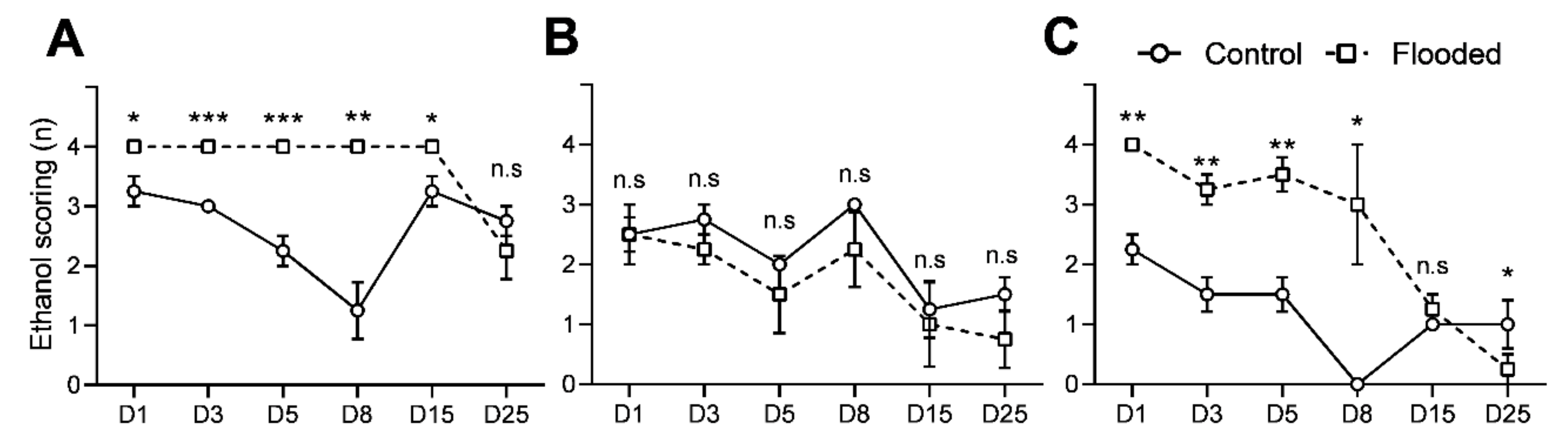
- Dogwood trees in 3-gallon containers were submerged in water to induce a flood-stressed state. Trees were monitored daily until ambrosia beetle attacks began, which was considered day 1 (D1) of the experiment.
- On the same days as ambrosia beetle counts were made, tissue samples were collected from 4 unflooded control and 4 flooded tree replicates. The tissue was analyzed for ethanol using an Alcohol Strip saliva test, a Dräger Pac 8000 personal detector.
- Ethanol emission from each plant was confirmed using SPME-GC-MS of stem tissue.



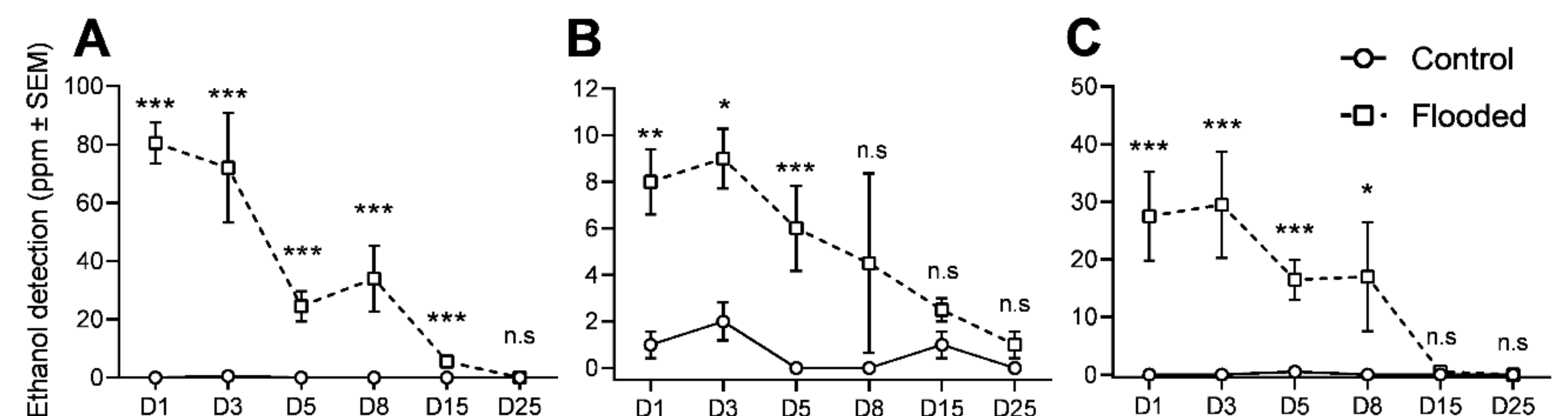
RESULTS



Ethanol Detection Using Saliva Alcohol Strip for (A) Stem, (B) Root, and (C) Twig Tissue



Ethanol Detection Using Dräger PAC 8000 for (A) Stem, (B) Root, and (C) Twig Tissue



- The average wet weight of the stem tissue cores, twigs, and root samples used in the 4 ml vial experiments were 0.04 ± 0.00 g, 0.43 ± 0.01 g, and 0.23 ± 0.04 g, respectively.

CONCLUSIONS

- While both detectors did react to ethanol in the sample vials, the Dräger detector was easier to use and provided quantitative measures in the 0-200 ppm range relevant to the sample tissue.
- Within trees, stem tissue plugs with exposed vascular tissue had the highest ethanol ratings, followed by twig and root tissue. Detection of ethanol in root tissue was unreliable.
- We recommend future research focus on optimizing sampling methodology for the Dräger detector. Specifically, processing of twig tissue samples may allow for a sampling method that would not require damaging the main trunk of the tree.
- The Dräger detector gave low false-positive readings when exposed to some aromatic plants. Evaluations of other cross-reactive plants as well as investigations into whether the detector is sensitive enough to provide effective attack predictions in the field are ongoing.

ACKNOWLEDGEMENTS

- SCRI-USDA-NIFA for providing grant funding.
- Garrett Roper and Asmita Gautam for help with fieldwork.

