WPEF student research grant awarded for 2018

A call for proposals for the annual WPEF student research grant was released in the Spring/Summer issue of Nutcracker Notes, and online. The proposals were reviewed by former board members Bryan Donner and Edie Dooley, Nutcracker Notes *editor and interim associate director Bob Keane, and interim director Cyndi Smith.* ***MICHAEL HOWE****, a PhD student in the Department of Entomology at University of Wisconsin-Madison, was chosen as the grant recipient for 2018. His supervisor is Dr. Kenneth Raffa. Following is a description of Michael's project:*

Is whitebark pine more amenable to mountain pine beetle attack behavior than historical hosts?

Whitebark pine faces numerous biotic and abiotic threats including blister rust, *Cronartium ribicola* (Tomback & Achuff 2010), mountain pine beetle (*Dendroctonus ponderosae*: MPB) (Logan et al. 2010), and warming temperatures that exacerbate MPB outbreaks (Raffa et al. 2008, Bentz et al. 2010). Warming temperatures increase beetle overwintering survival, hasten development, and increase transpiration stress, thus reducing tree defenses (Raffa et al. 2015). By the end of this century, almost all whitebark pine habitat in the Greater Yellowstone Ecosystem will be thermally suitable for MPB during most years (Buotte et al. 2016).

Mountain pine beetle is an eruptive insect that causes landscape scale mortality events that are increasing in severity and frequency (Hicke et al. 2006). Beetles engage in pheromone mediated mass attacks (Blomquist et al. 2010) that exhaust tree defenses (Raffa et al. 2014). During outbreaks, beetles can overcome the defenses of most trees, but at the lower population densities at which beetles usually occur, tree defenses are an important constraint on beetle colonization and development (Raffa et al. 2008, Boone et al. 2011, Burke & Carroll 2017). Conifers defend themselves against beetle attacks with integrated constitutive and induced defenses that exert both chemical and physical barriers.

Differences in defense chemistry between lodgepole (*Pinus contorta*) and whitebark pines have recently revealed important clues into the relative susceptibility of historically exposed versus less exposed trees (Raffa et al. 2013, Bentz et al. 2015, Raffa et al. 2017). These differences in tree chemistry are manifested by varying MPB behaviors. For example, MPB attacks lodgepole pine at higher rates, but the percent of attacks that succeed is higher in whitebark pine (Bentz et al. 2015). In cut bolts, MPB successfully attacks lodgepole pine at higher rates, but gallery density is higher in whitebark pine (Esch et al. 2016). Predators of MPB are equally likely to land on unattacked whitebark and lodgepole pines, but are more attracted to lodgepole pines undergoing attack (Raffa et al. 2013). Similarly, populations of predators are relatively higher in lodgepole than whitebark pine habitat (Krause et al 2017).

Objectives

We will examine whether whitebark and lodgepole pines differ in the ease with which low-density mountain pine beetle populations can successfully elicit aggregation. Specifically: 1) What signals indicative of MPB attack do trees use to induce anti-aggregants, precursors, and synergists, and in what tissues? 2) Does the number of pioneer beetles needed to elicit arrival by flying beetles differ between lodgepole and whitebark pines? 3) Do properties associated with tree defenses such as resin flow, resin canals, and phloem chemistry differ between lodgepole and whitebark pines?

Methods

Obj. 1: We will induce defenses of lodgepole pine and whitebark pine by simulated attack, using a cork borer, fungal (using MPB's primary associate *Grossmania clavigera*) inoculation, or simulated attack and addition of trans-verbenol and exo-brevicomin packets. Phloem and foliage tissues will be sampled before application of treatment attack and 21 days post treatment (Mason et al. 2017) using an arch punch and pole pruners. Composition and concentration of defensive compounds will be analyzed using gas chromatography (Keefover-Ring et al. 2016, Howe et al., accepted). Additionally, 30 trees will be induced with methyl jasmonate and fungi to compare local defensive response to a general tree defense signal and MPB specific signal (Burke et al. 2017).

Obj. 2: We will attach 5 different doses of trans-verbenol/exo-brecomin packets to trees to simulate initial number of beetles attacking a tree and record attack density (and possibly cage trees to measure beetle emergence).

Obj. 3: Fifty trees of each species will be cored to compare resin ducts and resin will be collected to record rate of resin flow (Karsky et al. 2004). The constitutive phloem defenses of a small subsample of these trees will be analyzed using gas chromatography to examine relationships between resinous defenses and constitutive phloem defenses.

Site location and collaborators: This work will be conducted in two locations, near Bend, OR, and Kootenai, BC. Both regions have large populations of whitebark pine, which are reproductively separated from previous work in the Greater Yellowstone Ecosystem, and have not been previously studied. Field work will be performed in collaboration with Robbie Flowers of USDA FS in OR, and Dr. Allan Carroll, University of British Columbia.

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