QuickNotes

Science summaries from fRI Research

Introducing: Improving monitoring tools to detect mountain pine beetle at low densities in novel habitats: incorporating host-tree stress and fungal volatiles in beetle attraction

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Mountain pine beetle (MPB) has two distinctive population density-driven host colonization behaviors. At high densities, beetles colonize large and healthy trees and cause mortality at the landscape level. In contrast, at low densities, beetles depend on host trees with compromised (weaker) defenses and thus beetle colonization is limited to trees downed (i.e., wind thrown) or stressed by a number of biotic and abiotic factors. Currently few tools are available for detecting MPB at low densities. Typically traps or trap-trees baited with baits are used to monitor MPB activities in low density beetle areas. However, success of this approach solely depends on the efficacy of the baits used for detecting MPB.

Trees under stress release 'stressed volatile chemicals' (SVCs) that are not released otherwise. Major tree stress factors include insects and pathogen attacks, fire, drought, etc. SVCs can be released from foliage, shoots, and stems of trees and composition and concentrations of SVCs are usually different from those volatiles released from healthy trees. Stressed or downed trees tend to be rare in nature but can be highly abundant in stands following wildfires or insect outbreaks. Stressed trees play two critical roles in host colonization by MPB at low densities. At low densities MPB colonize trees with weakened defenses and thus trees with compromised defenses provide opportunities for MPB to locate and colonize trees. In addition, SVCs provide

Federal-Provincial MPB Research Partnership

Mountain Pine Beetle remains a severe threat to Alberta's pine forests despite the province making positive progress in controlling its spread within the province and reducing the risk to the rest of Canada.

Natural Resources Canada and Alberta Agriculture and Forestry have provided funding to a suite of projects with the goals of limiting the spread of Mountain Pine Beetle and mitigating damages where it has already invaded.

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the necessary chemical cues for MPB locating the most suitable (i.e., less defended) hosts. Due to their critical importance in MPB at low densities, the role of SVCs in attraction of MPB warrants further investigations.

We will also incorporate the volatile compounds emitted from fungal associates of MPB in beetle attraction. The potential contribution of fungal volatiles to the MPB attraction is largely unexplored. In nature, we typically find trees infected by the fungal associates of MPB after unsuccessful beetle host colonization (i.e., strip attacks); however due to unusual climate patterns, numbers and availability of such trees have dramatically increased in recent years. For instance, in the winter of 2019, we witnessed cold snaps throughout western Alberta which killed a sizeable overwintering MPB population and yet a large number of trees remained infected with MPB fungal associates. These trees will likely be targeted by low density MPB and thus fungal volatiles released from such trees will be likely improve host location by MPB.

Objectives

We hypothesize that MPB at low densities depend on stress and fungal volatiles to locate suitable (less defended) hos trees. Our objective is to determine the feasibility of using SVCs and fungal volatiles to improve the efficacy of MPB attractants at low density populations. We will (1) identify major volatile chemicals emitted from different types of stressed trees; (2) identify and quantify major volatiles emitted from trees colonized by the fungal associates of MPB; (3) determine attractiveness of SVCs and fungal volatiles to the MPB in field; (4) develop a new bait to improve the efficacy of MPB attractant at low densities.

Expected Outcomes

This will be the first investigation incorporating stressed and fungal volatiles in improving the efficacy of MPB attractants in North America and therefore we are confident that we will find novel chemicals that can be used to improve the efficacy of MPB attractants at low densities. Considering the low population densities of MPB on the eastern and northern edge of beetle expansion into Alberta, improved detection of MPB can be significant tool to slow the spread of beetles in Albert as well into the eastern boreal forest.

Implications for Land Management

Overall, it is relatively difficult to manage bark beetles at higher than lower densities and thus management efforts should focus on beetles at the lower densities. Since endemic bark beetle populations are vulnerable to local extinction, the use of attractants at low densities can prevent and reduce number of MPB from the ecosystem. Such reduction will lower the probability of MPB population buildup and outbreaks in Alberta and eastern pine forests. Thus, development of a high-accuracy monitoring bait to detect MPB at low densities will impact MPB management. This type of bait can be used to: (1) monitor MPB activities at low densities; (2) delay population buildup from endemic to epidemic by removing adult beetles captured in traps from the population; (3) attract beetles to trap-trees (which emulate stressed trees) and removal of trap-trees can further deplete beetle populations.

Social, Economic, and Ecological Value

Our study aligns with three key outcomes (Limit the spread of MPB into the eastern boreal forest; Limit the spread of MPB along the eastern slopes of Alberta; Generate knowledge and innovative management techniques through research on MPB). Preventing or delaying beetle population build-up can have cascading socio-economic impact forest resources across province.

Expected Completion Date

September 30, 2023

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